NEAR FIELD RECEIVING WATER MONITORING OF TRACE METALS IN CLAMS (*MACOMA BALTHICA*) AND SEDIMENTS NEAR THE PALO ALTO AND SAN JOSE/SUNNYVALE WATER QUALITY CONTROL PLANTS IN SOUTH SAN FRANCISCO BAY: JUNE 1993 THROUGH OCTOBER 1994

U. S. GEOLOGICAL SURVEY

OPEN FILE REPORT 95-299

Prepared in cooperation with

CITIES OF PALO ALTO, SAN JOSE, AND SUNNYVALE, CALIFORNIA

NEAR FIELD RECEIVING WATER MONITORING OF TRACE METALS IN CLAMS (*MACOMA BALTHICA*) AND SEDIMENTS NEAR THE PALO ALTO AND SAN JOSE/SUNNYVALE WATER QUALITY CONTROL PLANTS IN SOUTH SAN FRANCISCO BAY: JUNE, 1993 THROUGH OCTOBER 1994.

By Samuel N. Luoma, Daniel J. Cain, Cynthia Brown, Michelle Hornberger and Robin Bouse Schaenemann

---

U. S. GEOLOGICAL SURVEY

OPEN FILE REPORT 95-299

Prepared in cooperation with

CITIES OF PALO ALTO, SAN JOSE, AND SUNNYVALE CALIFORNIA

Menlo Park, California

1995

U. S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U. S. GEOLOGICAL SURVEY

Gordon P. Eaton, Director

For additional information
write to:

Samuel N. Luoma, MS 465
U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 94025

Copies of this report may be
purchased from:

U. S. Geological Survey
Earth Sciences Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, CO 80225

CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION FACTORS

Multiply	*By*	*To obtain*
Micrometer	2.54×10^{-6}	Inch
Millimeter	2.54×10^{-3}	Inch
Centimeter	2.54×10^{-2}	Inch
Kilometer	1.609	Mile
Microgram	2.83×10^{-5}	Ounce
Milligram	2.83×10^{-2}	Ounce
Gram	28.3	Ounce

NEAR FIELD RECEIVING WATER MONITORING OF TRACE METALS IN CLAMS (*MACOMA BALTHICA*) AND SEDIMENTS NEAR THE PALO ALTO AND SAN JOSE/SUNNYVALE WATER QUALITY CONTROL PLANTS IN SOUTH SAN FRANCISCO BAY: JUNE, 1993 THROUGH OCTOBER 1994.

By Samuel N. Luoma, Daniel J. Cain, Cynthia Brown, Michelle Hornberger and Robin Bouse Schaenemann

ABSTRACT

This report presents trace element concentrations analyzed on samples of fine-grained sediments and clams (*Macoma balthica*) collected from two mudflats. The first is one kilometer south of the discharge of the Palo Alto sewage treatment works and the second lies between the locations where the San Jose and Sunnyvale sewage discharges enter San Francisco Bay. Samples from Palo Alto were collected on thirteen occasions between June 1993 and October 1994. Samples from San Jose were collected on four occasions in 1994. Concentrations of metals are compared with monthly collections at Palo Alto between 1977 and 1992 as well as selected data from other stations in San Francisco Bay. Concentrations of metals that are representative of reference values and effects levels are presented from the literature to provide context.

INTRODUCTION

Sediments and benthic organisms are commonly employed to determine spatial distributions and temporal trends of trace metal contamination in estuarine waters. Sediments bind metals strongly, removing them from solution. The result is that sediments may retain the metals released to an environment. Thus concentrations of metals in sediments may be indicative of anthropogenic releases, with at least some integration over time.

Metals in sediments are also indicative of the exposure of animals in contact with benthic and suspended particulate materials. However, it is not well known what proportion of sediment-bound metal is passed on to living organisms. In order to better estimate bioavailable metal exposures, the tissues of the organisms themselves may be analyzed for trace metals. Biological species concentrate most metals to levels higher than occur in solution, and may even be more sensitive indicators of anthropogenic metal inputs than are sediments. Different species concentrate metals to different degrees. If one species is analyzed consistently the results can be successfully employed to indicate trace element exposures to the food web of the organism. For example, Ag, Cu and Se contamination originally observed in clams (*Macoma balthica*) at a Palo Alto mudflat was later also found in diving ducks, snails, and mussels from that area.

Because of the proven value of the above approaches for monitoring near field receiving waters, the California Regional Water Quality Control Board (RWQCB) has described a Self Monitoring Program with its reissuance of NPDES permits for South San Francisco Bay

dischargers that includes specific receiving water monitoring requirements. One of the requirements is for inshore monitoring of metals and other specified parameters using the clam *Macoma balthica* and fine-grained sediments. The protocols should also be compatible with or complement the Board's Regional Monitoring Program. Monitoring efforts are to be coordinated with the U. S. Geological Survey's (USGS) 18 years of previous data collected from the site south of the Palo Alto discharge site.

PURPOSE

The purpose of this study is to present trace metal concentrations observed in sediments and clams at two inshore locations in South San Francisco Bay. The Palo Alto site is located one kilometer south of the intertidal discharge point of the Palo Alto publically-owned treatment works (POTW) (fig. 1). The San Jose site is located in the mouth of Coyote Creek, between the mouths of Alviso and Guadalupe sloughs. The receiving waters in the latter location should reflect the discharges of the San Jose and Sunnyvale POTW's. The Palo Alto data reported here are from samples collected on thirteen dates between June 1993 and October 1994. The San Jose data are only from 1994. These data and data collected from earlier studies will be used to approach the following objectives:

- Provide data to assess seasonal and year-to-year trends in trace element concentrations in sediments and clams in receiving waters near the POTW's as designated in the RWQCB's Self-Monitoring Program guidelines.

- Present the data within the context of historical changes inshore in South Bay and within the context of other locations in San Francisco Bay in the international literature.

- Coordinate inshore receiving water monitoring programs for Palo Alto and San Jose/Sunnyvale, and provide data compatible with relevant aspects of the Regional Monitoring Program. The near field data will augment the Regional Monitoring Program as suggested by the RWQCB.

- Provide data which could support other South Bay issues or programs such as development of sediment quality standards.

STUDY SITES

The data from this study were collected from sites near the discharges of the Palo Alto POTW and between the San Jose and Sunnyvale POTWs (fig. 1).

Palo Alto

The Palo Alto site is site 3 of the transect conducted by Thomson and others (1984) along the Palo Alto shoreline (also reported by Luoma and others, 1991; 1992; 1993). The influence of the Palo Alto POTW on metal concentrations at site 3 was demonstrated by Thomson and others (1984) and by Cain and Luoma (1990). Spatial and temporal trends in clams and sediments indicated that the source of metal contamination in this area was the POTW. As more efficient treatment processes and source control have been incorporated at the treatment works, metal (especially copper and silver) concentrations in sediments and clams have declined

substantially. Another important conclusion from Cain and Luoma (1990) and Luoma and others (1985) was that concentrations of metals fluctuated on nearly monthly time scales in the Palo Alto mudflat environment. Thus frequent sampling within a year was necessary to characterize contamination for that year. The goal of this report is to continue to characterize long term trends in the environment affected by the POTW and to use short term temporal variability for 1993 and 1994 to better understand those trends.

San Jose

The San Jose site is located in a zone of brackish water where Coyote Creek confluences with San Francisco Bay. The site is midway between the mouth of Alviso Slough and the mouth of Guadalupe Slough (fig. 1). The San Jose POTW discharges into Artesian Slough which flows into Coyote Creek. The Sunnyvale POTW discharges into Guadalupe Slough. Hydrodynamic models (Ed Gross, Stanford University, unpublished) suggest that the San Jose site should be influenced by discharges from both POTW's. The tidal height of the collection site was similar to that of Palo Alto.

METHODS

The Palo Alto samples were collected from the exposed mudflat at low tide, with hand and shovel. The San Jose samples were collected by floating a shallow bottom boat (a whaler) onto the edge of the marsh at high tide, because of poor landward access. The samples were then collected by van Veen grab. Sediment samples were scraped from the surface oxidized layers (1 -2 cm) of mud. Thus, these samples represent recently deposited sediments, or sediments affected by recent chemical reaction with the water column. Sediments were immediately returned to the laboratory in Menlo Park after collection. There they were sieved through 100 micrometer polyethylene mesh with distilled water to remove large grains that might bias interpretation of concentrations. The mesh size was chosen by the largest grains typically found in the digestive tract of *Macoma balthica*. Previous studies have shown little difference between sieved and unsieved sediments when silt-clay type sediment is dominant at this station. Seasonally the sediments at both sites become more sandy. In such samples, sieving reduces the likelihood that differences in metal concentration are the result of sampling sediments of different character.

The mass of sediments that did not pass through the sieve was weighed and the percentage of the bulk sample was determined to assess percent sand in the sediment. The sediment that passed through the sieve was dried at room temperature, weighed, then 0.250 to 0.500 gram aliquots were collected in replicate for analysis. The subsamples were further dried at 60° celsius before re-weighing and extraction. The replicate subsamples were digested for "total" metal analysis by refluxing in 10 milliliters of concentrated nitric acid until the digest was clear. This method is comparable with the recommended procedures of US Environmental Protection Agency and with the procedures employed in the Regional Monitoring Program. It also provides data comparable to the historical data available on San Francisco Bay sediments. Data comparing complete decomposition and near total decomposition are available on request (M. Hornberger, USGS, unpublished data). After decomposition, samples were evaporated to dryness and reconstituted in dilute (5 percent) hydrochloric acid for analysis. The hydrochloric acid matrix was specifically chosen because it mobilizes Ag into solution through creation of

Ag-chloro complexes. Another set of replicate samples was subjected to a partial weak acid extraction in 0.5N Hydrochloric acid (HCl), as a crude chemical estimate of bioavailable metal. These subsamples were extracted for 2 hours with 10 mL of acid at room temperature. The extract was pressure filtered through a 0.45 micrometer membrane filter before analysis. Total organic carbon was determined by difference between total carbon and carbonate determined using a total combustion carbon analyzer. Salinity was determined from the mantle water of clams at the time of collection using a refractometer; and from open pools on the mudflat.

The deposit feeding clam *Macoma balthica* was collected simultaneously with the sediment samples. More than 40 individuals were collected at each sampling, and the range of sizes (shell length) was maximized by intensive field sampling. Animals were returned to the laboratory and held for 48 hours in ocean water diluted to the ambient salinity at the time of sampling. This was done to depurate undigested material from their digestive tracts. After depuration the individual clams were separated into size classes (determined by differences of one millimeter shell length). Each size class was composited for a single sample, and soft tissues were removed for analysis. Samples for each date thus were composed of eight to sixteen replicate composites, with each composite consisting of animals of a similar shell length. Animal tissue samples were dried, weighed and refluxed in concentrated nitric acid until the digest was clear. Digests were then dried and reconstituted in dilute (5 percent) hydrochloric acid for analysis.

Metal analyses were conducted by Inductively Coupled Argon Plasma Emission Spectroscopy (ICAPES). Cadmium and silver in sediments were analyzed by Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS) with Zeeman background correction, because of their low concentrations. The standard additions technique was employed for the GFAAS analyses. Mercury and selenium were determined in both sediment and clam tissues by Hydride Atomic Absorption Spectrophotometry. A separate subsample was decomposed for mercury as well as one for selenium. Mercury subsamples were digested at 100° C in aqua regia, re-digested in 10 percent nitric acid plus potassium dichromate and then reduced at the time of the hydride analysis. Selenium subsamples were digested in concentrated nitric and perchloric acids at 200°C and reconstituted in hydrochloric acid.

All glassware and field collection apparatus were acid washed, thoroughly rinsed in ultra-clean deionized water, dried in a dust-free positive pressure environment, sealed and stored in a dust free cabinet. Quality control was maintained by frequent analysis of blanks, analysis of National Institute of Standards and Technology standard reference materials (tissues and sediments) with each analytical run, and internal comparisons with prepared quality control standards. A full QA/QC plan is available upon request. Analyses of National Institute of Technical Standards (NITS) reference materials (oyster tissue, San Joaquin soils) were within an acceptable range of certified values reported by NITS or were consistent where the nitric acid digest did not completely decompose the sediment samples (table 1 and 2).

RESULTS AND DISCUSSION

Palo Alto

Table 3 illustrates sediment characteristics and salinities on the dates that these data were collected at Palo Alto between June 1993 and October 1994. Aluminum concentrations

characterize particle size within the 100 micrometer fraction of the sediment. Iron, manganese and organic carbon are fractions of the sediment that bind metal. Percent sand is shown to indicate particle size distributions before sediments were sieved. Coarser sediments commonly occur in the Fall at Palo Alto (Thompson-Becker and others, 1985), so the high proportion of sand in October and November, 1993, as well as, in September, 1994, was expected. The high proportion of sand in January and February, 1994, was unusual, especially since it was accompanied by high concentrations of Fe in January.

Metal concentrations in the sediments at Palo Alto are shown in table 4. Table 5 shows metal concentrations in *Macoma balthica* on the 11 dates. Changes in annual mean concentrations of copper and silver since 1977 are shown in tables 6 and 7 because trends in these two metals at Palo Alto have been of special interest. Trends in silver concentrations in *M. balthica* since 1989 (fig. 2; trends calculated on the basis of calendar year) show that the lowest mean annual concentration occurred in 1991. Mean annual concentrations have increased since then. Similar trends are observed for copper (table 5). Seasonal fluctuations in copper and silver concentrations in 1990-91 are contrasted for the last three years in figure 3 and 4. The figure is to illustrate that concentrations have increased after an episode of metal input reflected in the sediments in March 1992 and returned to a seasonal peak of ~80 µg/g in 1993. Concentrations may be declining again into late 1994.

Appendix 1 shows the details of ICAPES analyses of metals in sediments, and Appendix 3 lists the details of metal analyses of clam tissues for the June 1993 through October 1994 samples. It should be noted that silver and cadmium were also analyzed by Graphite Furnace Atomic Absorption Spectrometry (GFAAS), a method better suited for the low concentrations of these elements. The GFAAS results are the most accurate and are reported in the summary tables described above. Analytical data and detection limits also are given for each sample to aid in verification of peaks. Statistical data indicates size influences on tissue concentrations, and content calculations are reported with summary statistics in Appendix 3. Details on selenium and mercury are not included in these appendices because these elements were analyzed by Hydride Atomic Absorption Spectrometry.

San Jose

Sediment characteristics and salinity are shown for San Jose between February and September 1994 in table 8. Salinities were lower in February than in the other months, reflecting the increased inputs of runoff. Sediments in February also contained a higher proportion of sand. Trace element concentrations in sediments are shown in table 9 and concentrations in *Macoma balthica* are shown in table 10. Figure 5 illustrates concentrations in *Macoma balthica* of three metals that do not fluctuate greatly with time: nickel, vanadium, and chromium. The lowest concentrations are observed in June. Figure 6 shows substantial temporal fluctuation in concentrations of copper, selenium and silver in *M. balthica.* Concentrations of all three elements are significantly greater in February than in April. Concentrations of copper and silver remain low in April, June and September. By September, selenium concentrations returned to the level observed in February. Obviously, frequent sampling is essential for characterizing ambient metal concentrations in the environments in the vicinity of the outfalls. Several causes of the higher concentrations in February are possible. Lower salinities could cause increased metal bioavailability. However, cadmium should be the metal most affected by this process, and no change in cadmium concentrations was observed. Biological factors also could contribute. The

high February concentrations occurred before *M. balthica* began to grow rapidly in this area (that is, prior to any growth dilution of metal concentrations in the tissues). However, biological factors should affect a variety of metals similarly. That was not the case. Increased input from a waste treatment facility(s) is possible. This is supported by the large increase in silver concentrations. Silver is often a contaminant associated with municipal waste, especially in South Bay. The high tissue metal concentrations in February also coincided with increased runoff (indicated by the reduced salinity), higher rainfall, and a possible runoff event that moved sand onto the mudflats at both San Jose and Palo Alto. Further monitoring will aid in determining if this strong seasonality is typical at the San Jose site, and may help delineate the cause of the changes.

Appendix 2 shows the details of ICAPES analyses of metals in sediments at San Jose. Appendix 4 lists the details of metal analyses of clam tissues for the June 1993 through October 1994 samples. It should be noted that silver and cadmium in sediments were also analyzed by Graphite Furnace Atomic Absorption Spectrometry (GFAAS), a method better suited for the low concentrations of these elements. The GFAAS results are the most accurate and are reported in the summary tables described above. Analytical data and detection limits also are given for each sample to aid in verification of peaks. Statistical data indicates size influences on tissue concentrations, and content calculations are reported with summary statistics in Appendix 3. Details on selenium and mercury are not included in these appendices because these elements were analyzed by Hydride Atomic Absorption Spectrometry.

Site Comparisons

The annual mean concentrations of metal in sediments at Palo Alto and San Jose are compared in table 11. Annual mean concentrations of most elements are similar at the two sites, with the exception of silver, which is higher in concentration at Palo Alto. Figure 7 shows near-monthly determinations of copper in sediments at Palo Alto between January 1993 and October 1994. The four determinations of copper at San Jose in 1994 are shown on the same plot. These results also illustrate the general similarity in copper concentrations at the two locations, at least in three of these four collections. Further study will be necessary to determine if the annual cycle in concentration typical of Palo Alto is also seen at San Jose. To provide some perspective on the degree of contamination the sediment data are contrasted with the National Status and Trends "Effects Levels" (Long and others, 1995). It should be remembered that "effects levels" are derived from bioassay studies and may not be literally accurate estimates of sediments that are toxic. Approaches for determining sediment toxicity are poorly developed, however. Estimates of "background" concentrations are also shown in table 11. These concentrations are taken from concentrations in sediments deposited before 1850 (unpublished data from sediment cores; M. Hornberger, USGS). The background concentrations and the coarse estimates of effects levels are used as a comparative context for the sediment data. Comparisons to effects levels also are available in the Regional Monitoring Program Annual Reports.

Concentrations of cadmium, lead, and zinc in sediments at the two stations are slightly higher than background and below effects levels. These appear to be the metals of least concern in these sediments. Concentrations of Cr, Hg and Cu fall between the lowest level at which effects are seen in bioassays (ER-L) and the median level (ER-M). Unpublished results from

sediment cores in San Francisco Bay (M. Hornberger, USGS) indicate that high Cr concentrations of geologic origin occur throughout San Francisco Bay, and make it difficult to interpret anthopogenic Cr inputs to sediments or effects of Cr in such sediments. In at least some types of sediments, the concentrations of Cu and Hg at Palo Alto and San Jose could be associated with adverse biological effects. Nickel concentrations exceed even ER-M concentrations. However, studies of sediment cores show that very high nickel concentrations are of geologic origin in San Francisco Bay, probably originating from mobile nickel deposits in ultramafic rocks in the region. Like Cr, separation of anthropogenic and geologic contributions to nickel concentrations are difficult because of the high natural concentrations. Concentrations of silver are below the ER-L concentrations. However, earlier studies have shown that small increases in Ag concentrations in San Francisco Bay sediments result in substantial bioaccumulation and, at least, some sublethal changes in individual bivalves (Luoma and Bryan, 1995).

Trace element concentrations in *Macoma balthica* from Palo Alto and San Jose are compared in table 12. Shown for perspective are the highest and lowest concentrations of metals in this species observed in extensive surveys of uncontaminated and contaminated environments in other estuaries (mostly from the United Kingdom, (Bryan and others 1995)). These probably represent close to the full range of values that might be expected in this species from pristine to highly contaminated environments. Nickel, silver, and copper are three metals of regulatory concern in South Bay. Concentrations of these metals in *Macoma balthica* at Palo Alto and San Jose are compared to selected sites elsewhere in San Francisco Bay in figures 8, 9, and 10, respectively. Stations with low and high concentrations typical of the bay were chosen for this comparison.

The tables and figures illustrate that the concentrations of Cu and Ag observed in clam tissues at San Jose and Palo Alto in February are high compared to elsewhere in the bay and to the full range of values that might be expected. Concentrations of nickel in *M. balthica* are high everywhere in San Francisco Bay, compared to the global perspective. Nickel is not especially elevated at either San Jose or Palo Alto compared to the three other sites in the Bay that have been studied. Mercury and selenium in the clam tissues are typical of moderate contamination.

Figure 11 shows the condition index for clams during 1988 through 1994. Condition index (CI) is a measure of physiological "fatness", the tissue weight of a clam of a given length. It is an index of the clams' well-being and indicative of the seasonal reproductive cycle. Seasonally, a clam of a given shell length will add glycogen and weight as it prepares for reproduction. That glycogen is metabolized and weight is lost during and after reproduction. Stress caused by pollutant exposure, salinity stress or lack of food, can consume energy, affect net glycogen accumulation, and reduce condition index. Condition index data are available from Palo Alto since 1977. The years 1988 through 1994 were chosen in figure 12 to demonstrate the seasonal and interannual variation in CI. The index remained high throughout the year in 1991, the year of lowest silver and copper concentrations. Peak condition index was reduced after the 1992 episode of contaminant input and again in 1994, compared to other years. *M. balthica* collected at San Jose were very small, in both shell length and weight, in February, 1994. In April the weight of the clams per unit shell length had grown to a level very comparable to Palo Alto, where they remained for the remainder of the year. The poor condition observed in February coincided with the high pollutant concentrations and other conditions that could have induced stress. More study will be necessary to determine if and how the various factors are related.

REFERENCES CITED

Bryan, G. W., Langston, W. J., Hummerstone, L. G., and Burt, G. R., 1985, A Guide to Assessment of Heavy-Metal Contamination in Estuaries Using Biological Indicators: Marine Biological Association of the United Kingdom Occassional Publication No. 4. Plymouth, UK. 92pp.

Cain, D. J. and Luoma, S. N., 1990, Influence of seasonal growth, age and environmental exposure on Cu and Ag in a bivalve indicator, *Macoma balthica* in San Francisco Bay: Marine Ecology Progress Series, v. 60, p. 45 - 55.

Long, E. R., MacDonald, D. D., Smith, S. L., and Calder, F. D., 1995, Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments: Environmental Management, v. 19, p. 81 - 97.

Luoma, S. N., Cain, D. J., Brown, C. and Axtmann, E. V., 1991, Trace Metals in Clams (*Macoma balthica*) and sediments at the Palo Alto Mudflat in South San Francisco Bay: April, 1990 - April, 1991. U. S. Geological Survey Open File Report 91-460. Menlo Park, California. 47pp.

Luoma, S. N., Cain, D. J., Brown, C. and Hornberger, M., 1992, Trace Metals in Clams (*Macoma balthica*) and sediments at the Palo Alto Mudflat in South San Francisco Bay: May 1991 - May 1992. U. S. Geological Survey Open File Report 92-456. Menlo Park, California. 51pp.

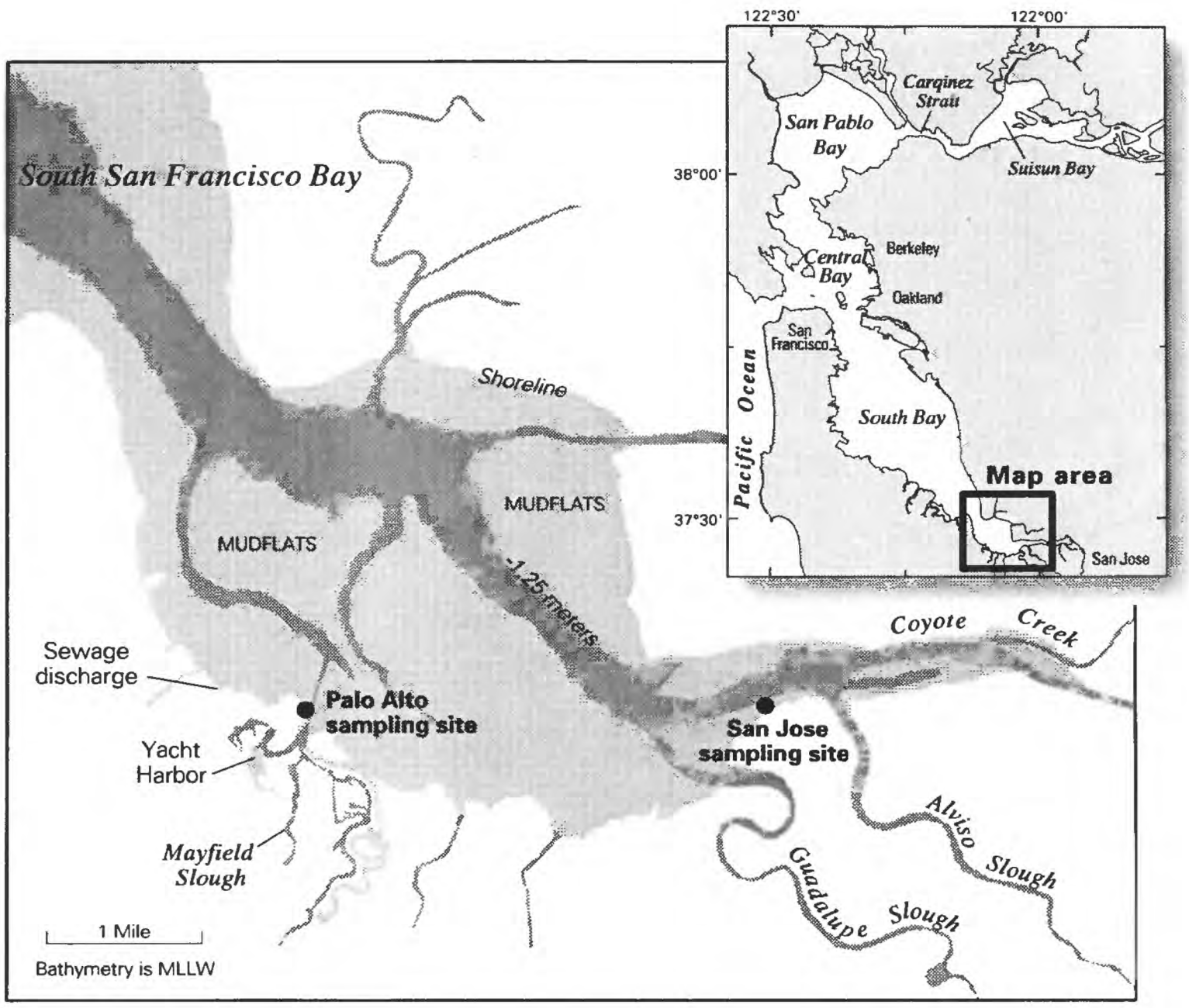
Luoma, S. N., Cain, D. J., Brown, C. and Hornberger, M., 1993, Trace Metals in Clams (*Macoma balthica*) and sediments at the Palo Alto Mudflat in South San Francisco Bay: June 1992 - June 1993. U. S. Geological Survey Open File Report 93-500. Menlo Park, California. 52pp.

Luoma, S. N, Cain, D. J. and Johansson, C. E., 1985, Temporal fluctuations of silver, copper and zinc in the bivalve *Macoma balthica* at five stations in South San Francisco Bay: Hydrobiologia, v. 129, p. 109 - 120.

Luoma, S. N., Ho, Y.B, and Bryan, G. W., 1995, Fate, bioavailability and toxicity of silver in estuarine environments. Mar. Pollution Bulletin.

Thomson, E. A., Luoma, S. N., Johansson, C. E., and Cain, D. J., 1984, Comparison of sediments and organisms in identifying sources of biologically available trace metal contamination: Water Research, v. 18, p. 755 - 765.

ILLUSTRATIONS


South San Francisco Bay
Shoreline
MUDFLATS
MUDFLATS
-1.25 meters
Sewage discharge
Palo Alto sampling site
Yacht Harbor
Mayfield Slough
1 Mile
Bathymetry is MLLW
122°30'
122°00'
38°00'
37°30'
Carqinez Strait
San Pablo Bay
Suisun Bay
Central Bay
Berkeley
Oakland
San Francisco
Pacific Ocean
South Bay
Map area
San Jose
Coyote Creek
San Jose sampling site
Alviso Slough
Guadalupe Slough

Palo Alto

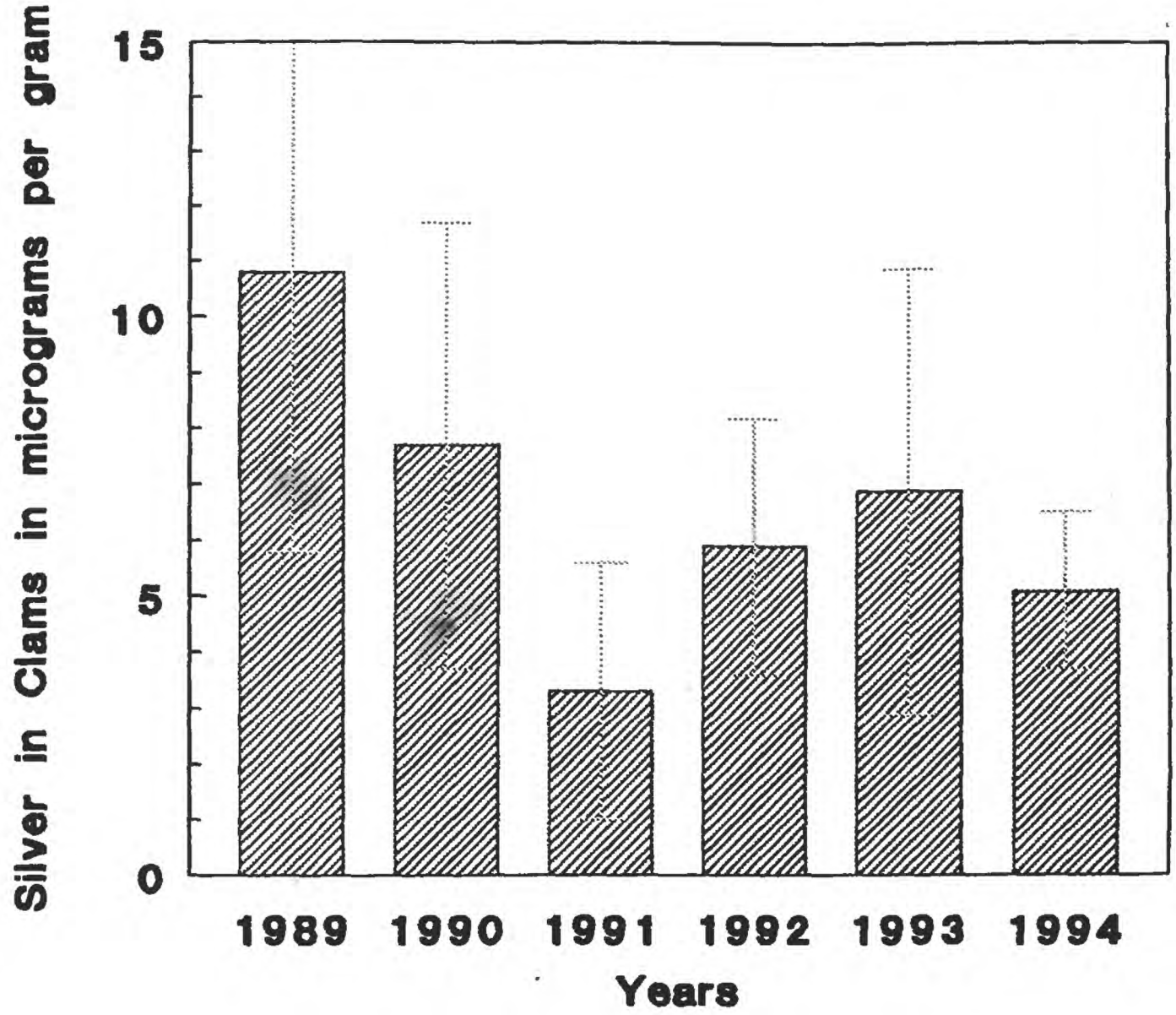


Figure 2. Annual mean concentrations of silver in clams at Palo alto from 1989 through 1994.

Each annual mean is derived from seven to eleven collections at near-monthly intervals in each calendar year. Vertical bars represent ± one standard error of the mean from all the composite samples collected during the year. Values are in micrograms per gram dry weight of soft tissue.

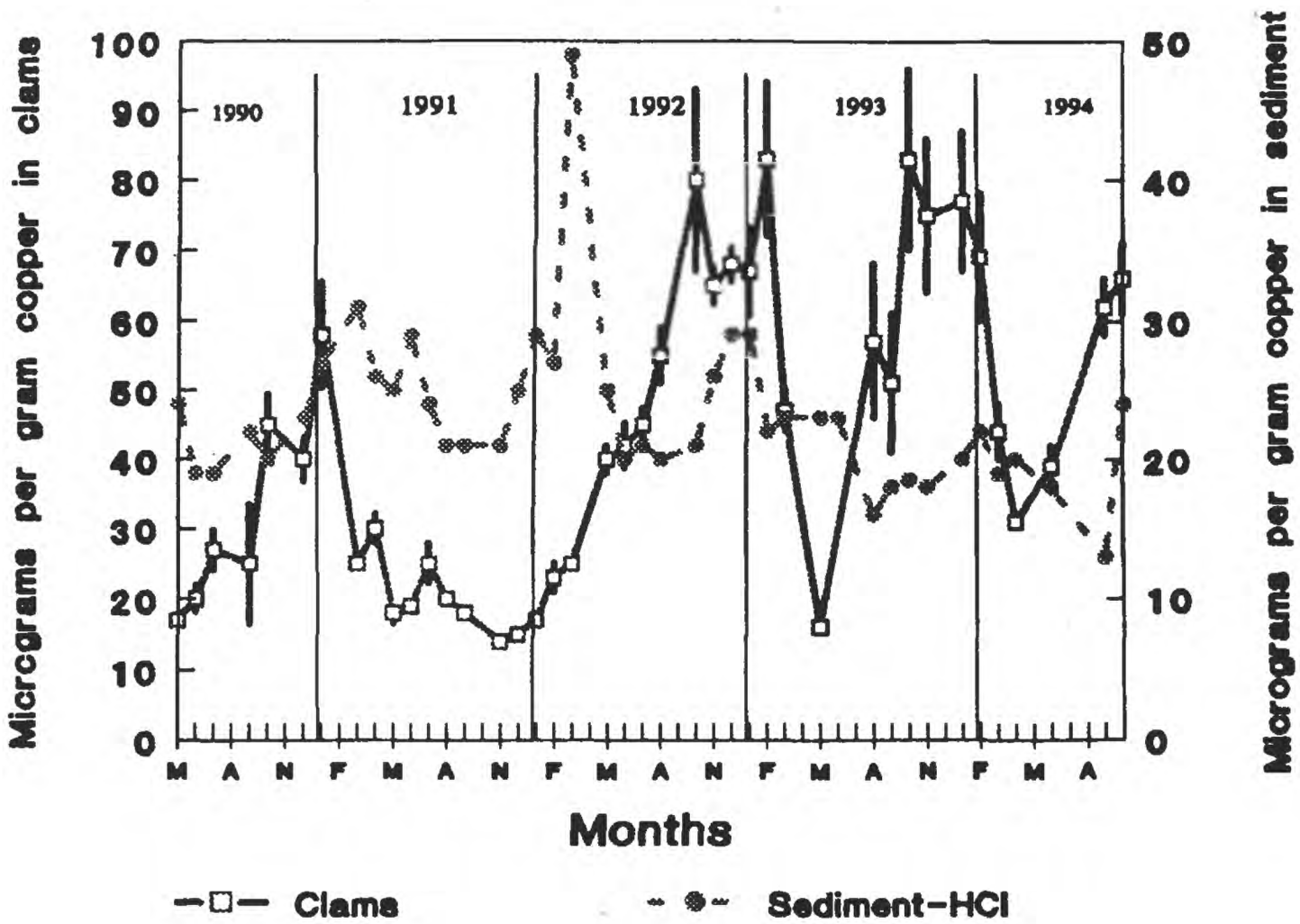


Figure 3. Copper concentrations in sediments and the clam *Macoma balthica* as observed at near-monthly intervals between May 1990 and October 1994 at Palo Alto.

The right Y axis also shows the scale for copper concentrations in sediments and the left axis for the clams. Vertical bars represent ± one standard deviation from replicate composite clam samples. Replicate values are shown in Appendix 1. Values are in micrograms per gram dry weight of soft tissues.

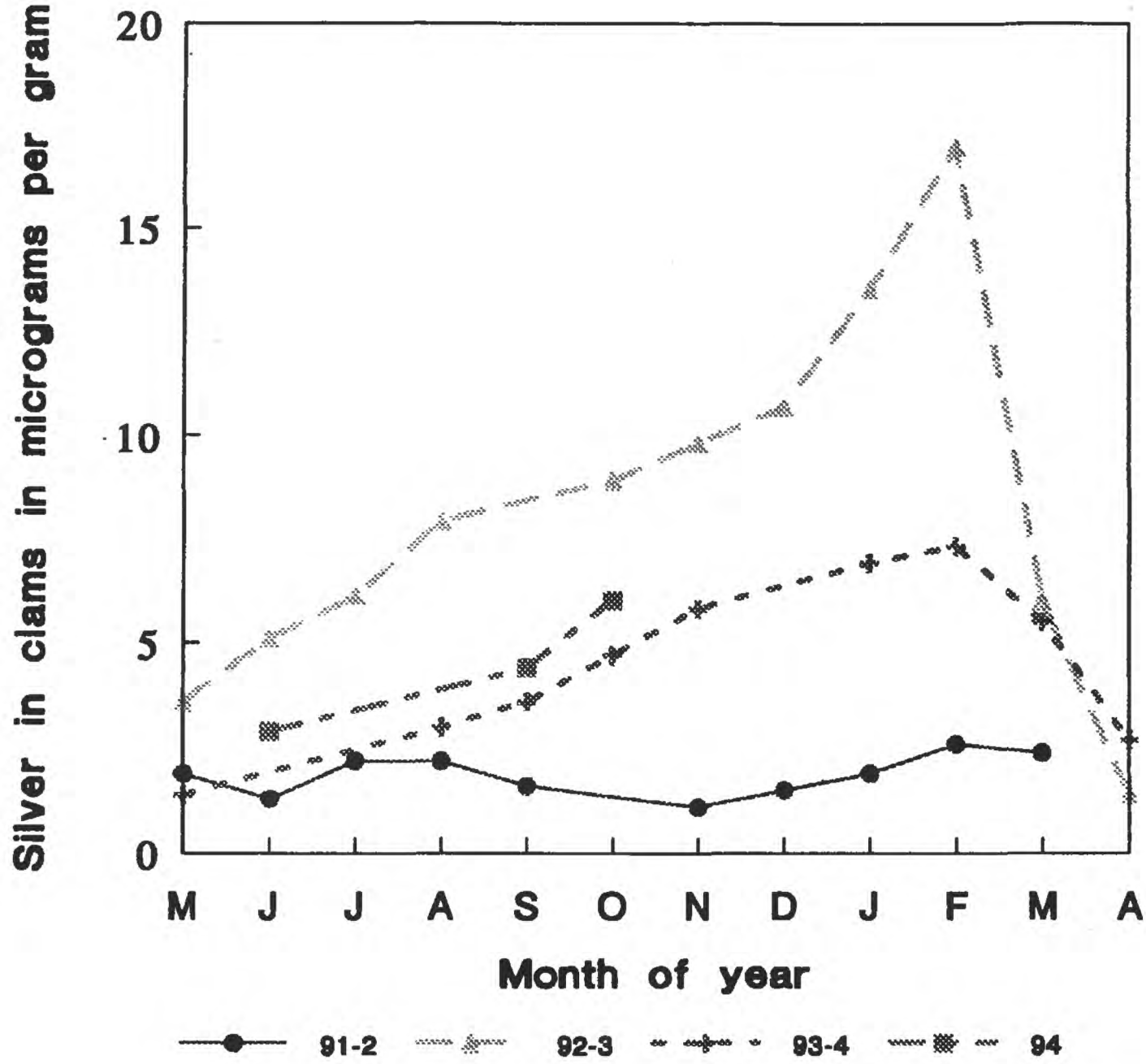


Figure 4. Silver concentrations in the clam *Macoma balthica* as observed at near-monthly intervals between May 1991 and October 1994 at Palo Alto.

Values are in micrograms per gram dry weight of soft tissues.

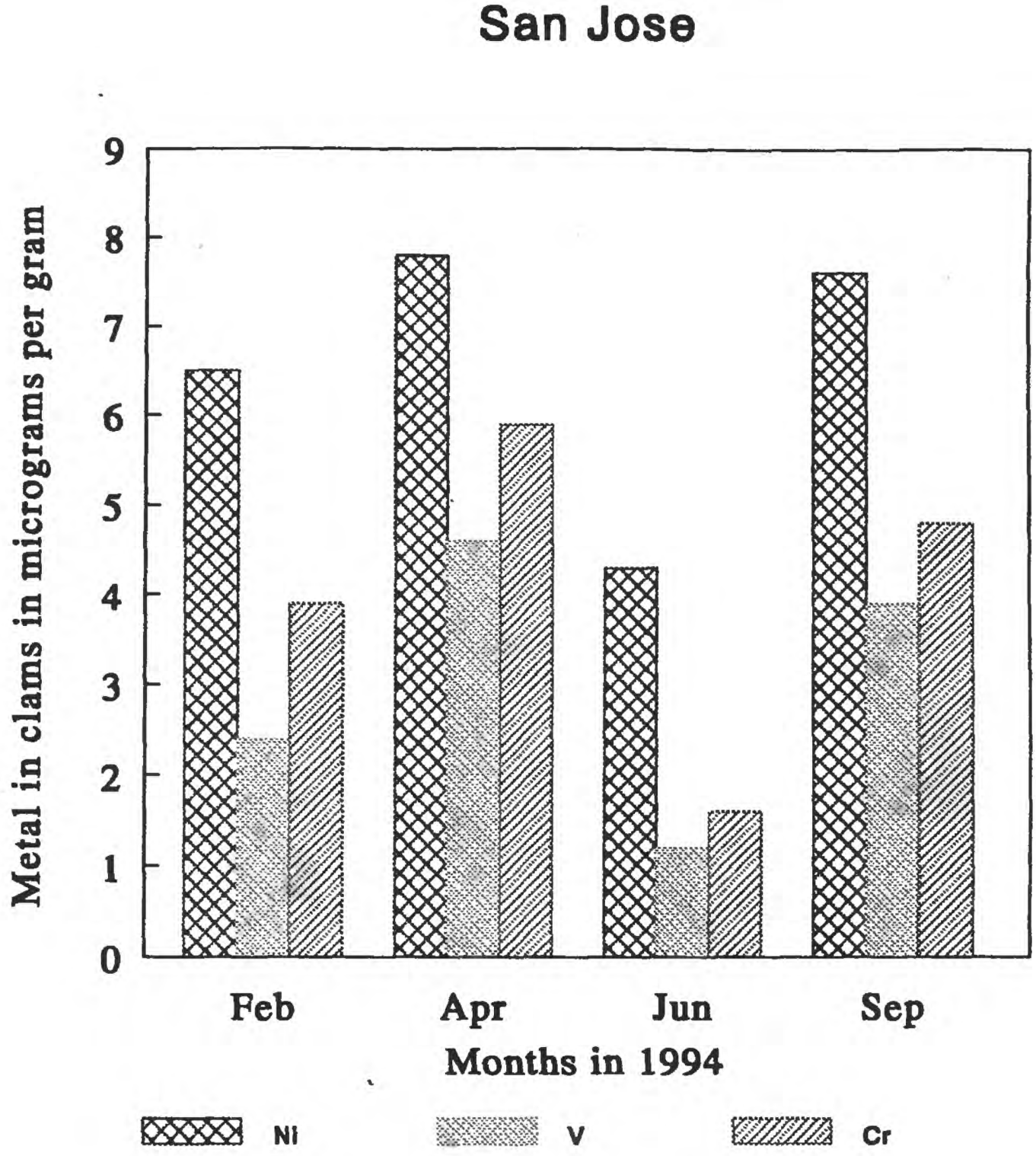


Figure 5. Mean concentrations of nickel, vanadium and chromium observed in the clam *Macoma balthica* at San Jose in February, April, June and September, 1994.

Values are in micrograms per gram dry weight of soft tissue.

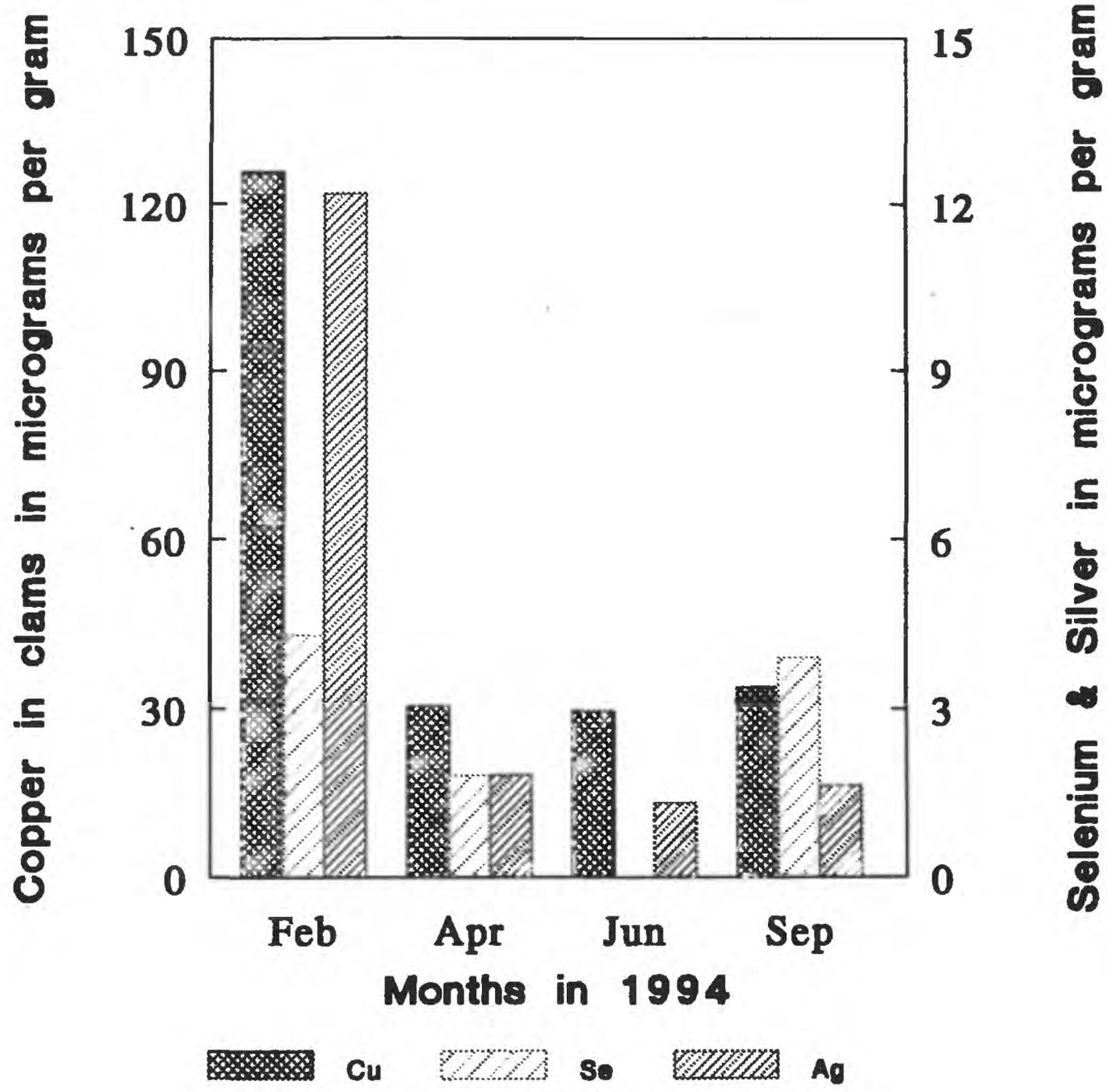


Figure 6. Mean concentrations of copper, selenium and silver observed in the clam *Macoma balthica* at San Jose in February, April, June and September, 1994.

Selenium and silver concentrations are shown on the right y-axis and copper is shown on the left axis. Values are in micrograms per gram dry weight of soft tissue.

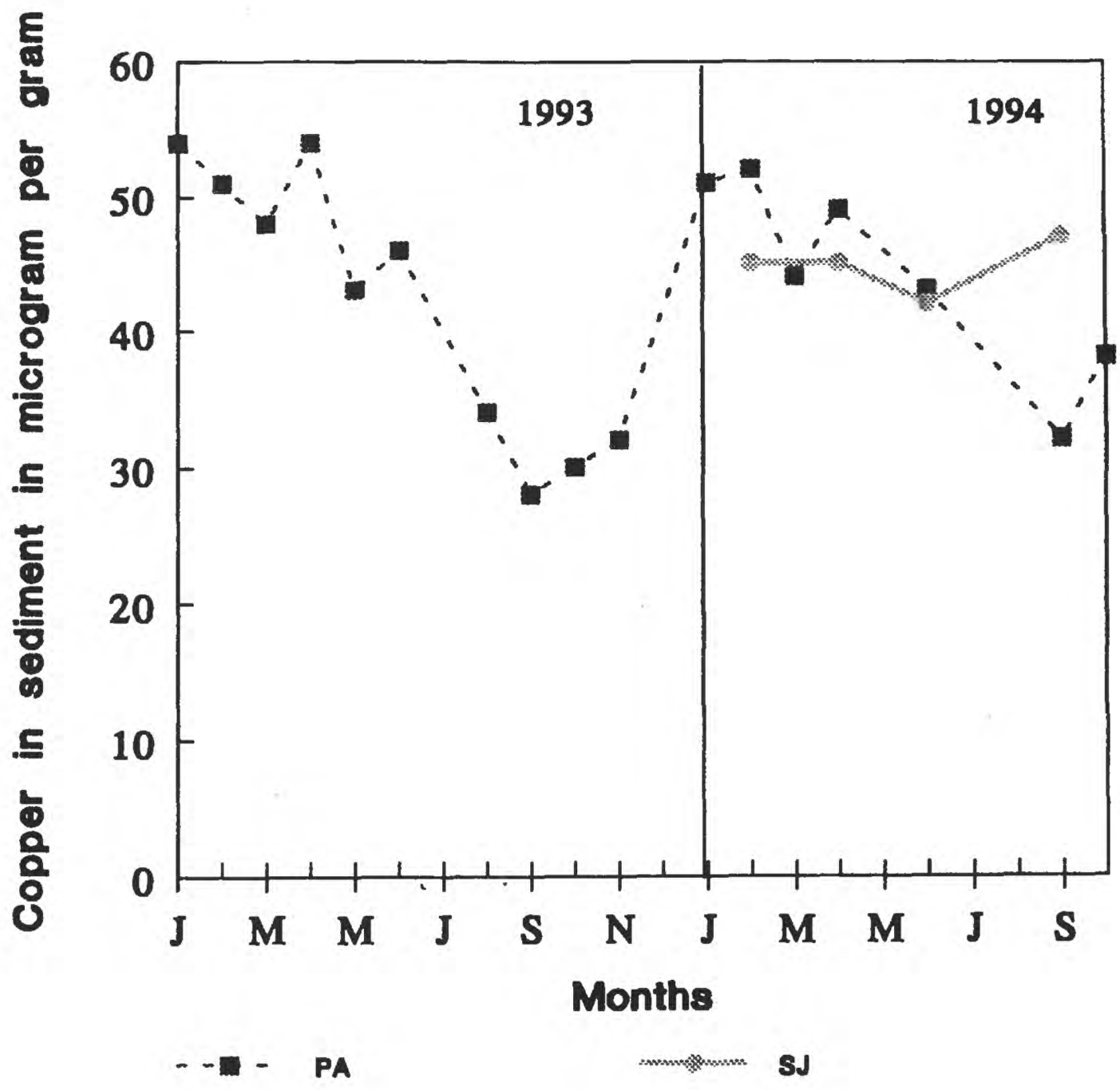


Figure 7. Copper concentrations in sediments at Palo Alto between January 1993 and September 1994, and at San Jose between February and September 1994.

Sediments were decomposed by concentrated nitric acid reflux. Values are in micrograms per gram dry weight.

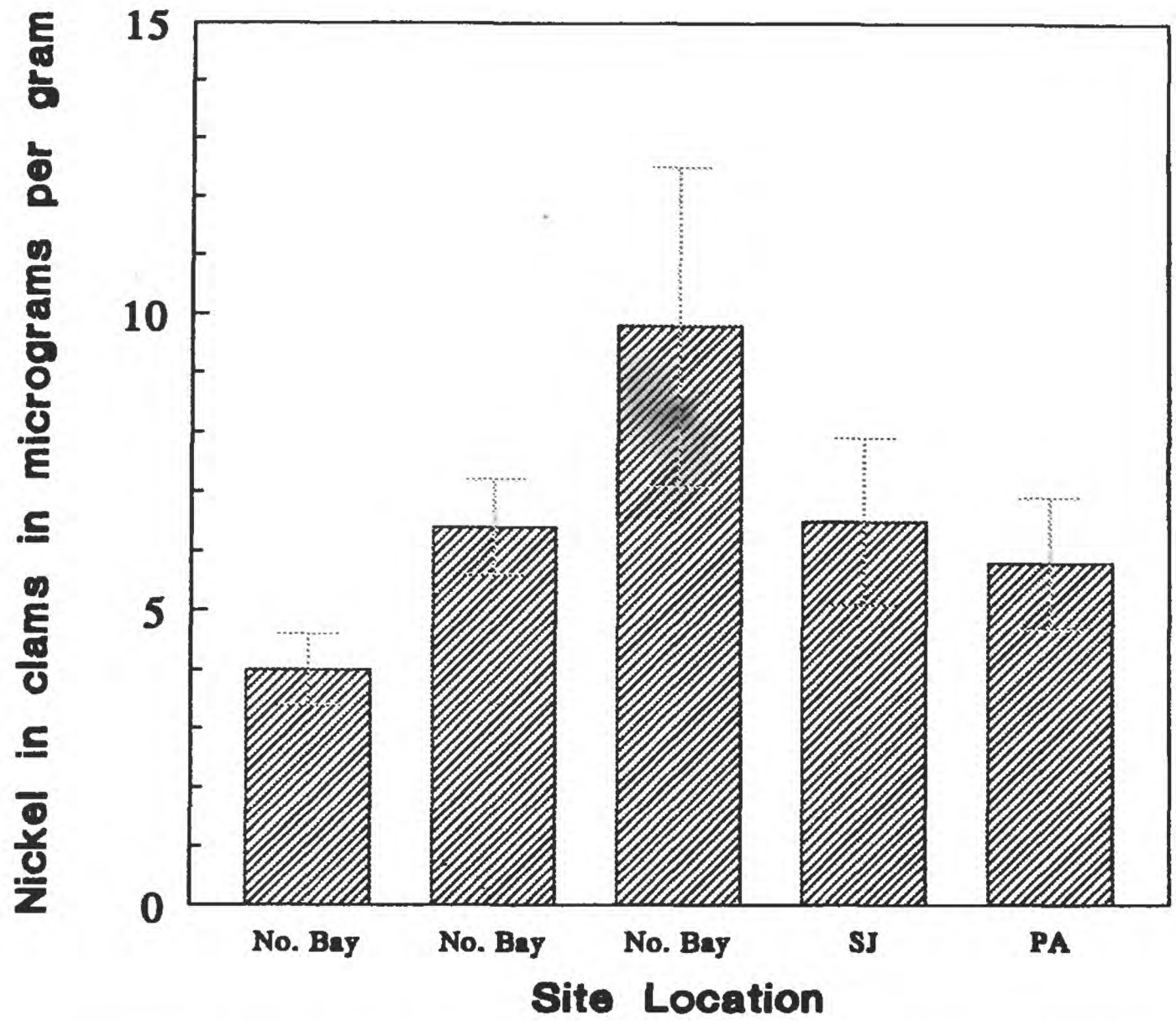


Figure 8. Comparison of nickel concentrations in clams *Macoma balthica* from stations in San Francisco Bay.

Concentrations for Palo Alto (PA) were taken from mean of all collections during the 1993 - 94 sampling period. SJ is mean nickel during the 1994 sampling period at San Jose. The North Bay samples were collected at the Martinez marsh mudflat on the west shore of Carquinez Strait in February 1991(highest value) and July 1991, as well as on the east shore of Carquinez Strait (Southampton Bay) in July 1991. Vertical bars represent $\pm$ one standard deviation from replicate composite clam samples. Values are in micrograms per gram dry weight of soft tissue.

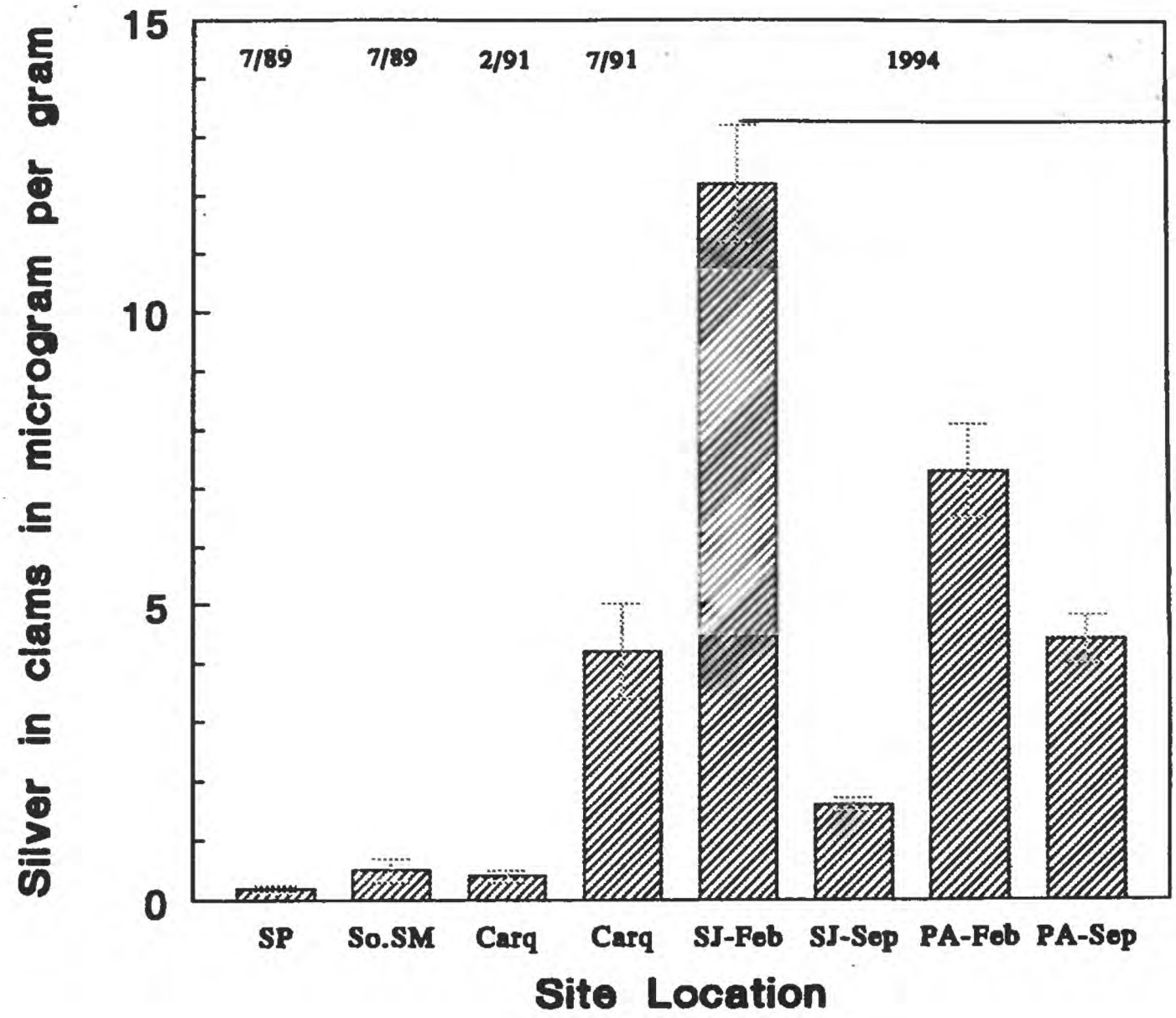


Figure 9. Comparison of silver concentrations in clams *Macoma balthica* from stations in San Francisco Bay.

Mean silver concentrations are reported at Palo Alto and San Jose for February 1994 and September 1994 . Carq samples were collected in July 1987 and February 1991 at the Martinez marsh mudflat on the west shore of Carquinez Strait. So.SM is a sample from the eastern shore of South Bay near the San Mateo Bridge and SP is from the west shore of San Pablo Bay (East of Pinole Point). The latter two samples were collected in July 1989 and are the same as reported in Luoma and others (1991). Vertical bars represent $\pm$ one standard deviation from replicate composite clam samples. Values are in micrograms per gram dry weight of soft tissue.

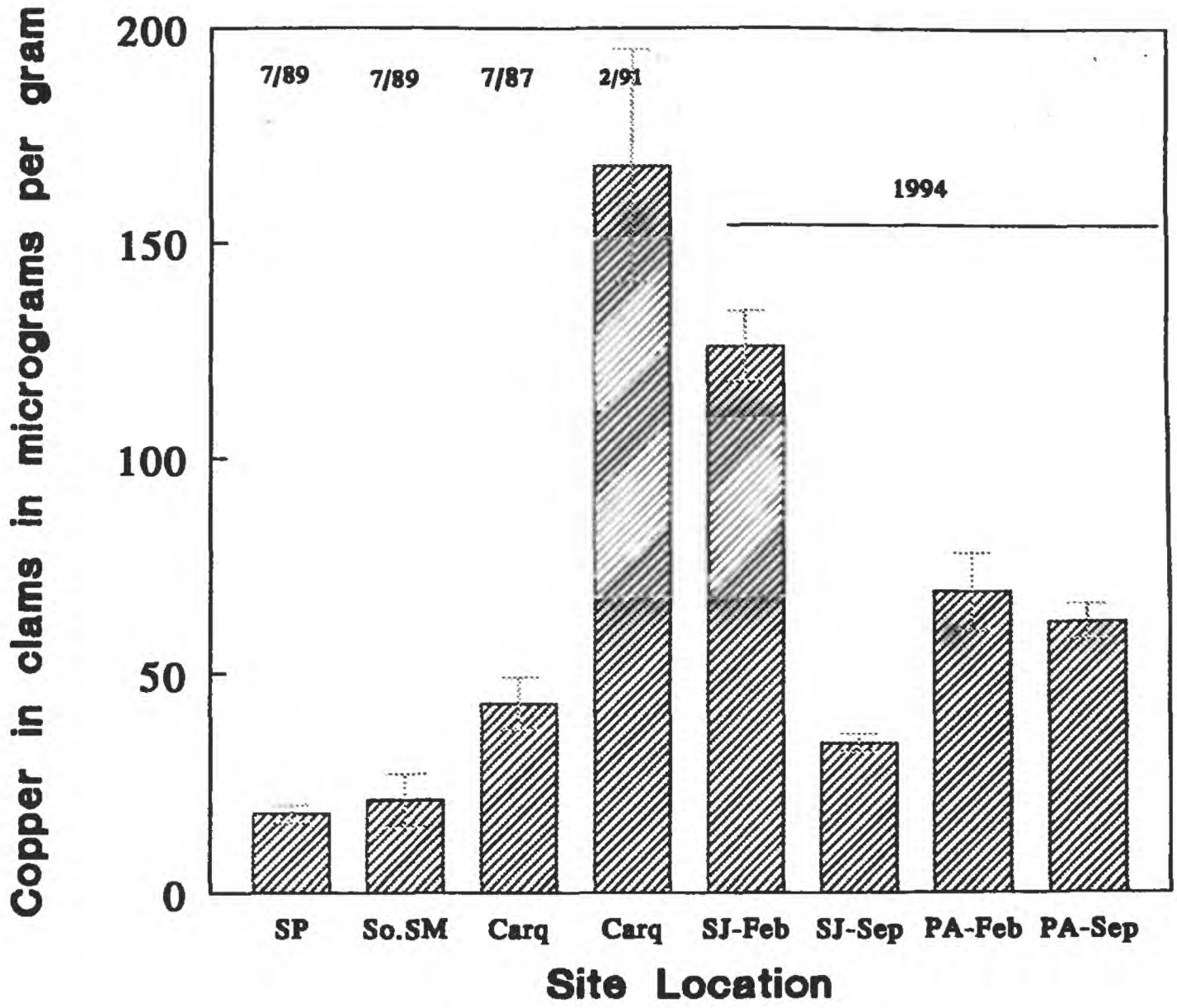


Figure 10. Comparison of copper concentrations in clams *Macoma balthica* from stations in San Francisco Bay.

Mean copper concentrations are reported at Palo Alto and San Jose for February 1994 and September 1994 . Carq samples were collected in July 1987 and February 1991 at the Martinez marsh mudflat on the west shore of Carquinez Strait. So.SM is a sample from the eastern shore of South Bay near the San Mateo Bridge and SP is from the west shore of San Pablo Bay (East of Pinole Point). The latter two samples were collected in July 1989 and are the same as reported in Luoma and others (1991). Vertical bars represent $\pm$ one standard deviation from replicate composite clam samples. Values are in micrograms per gram dry weight of soft tissue.

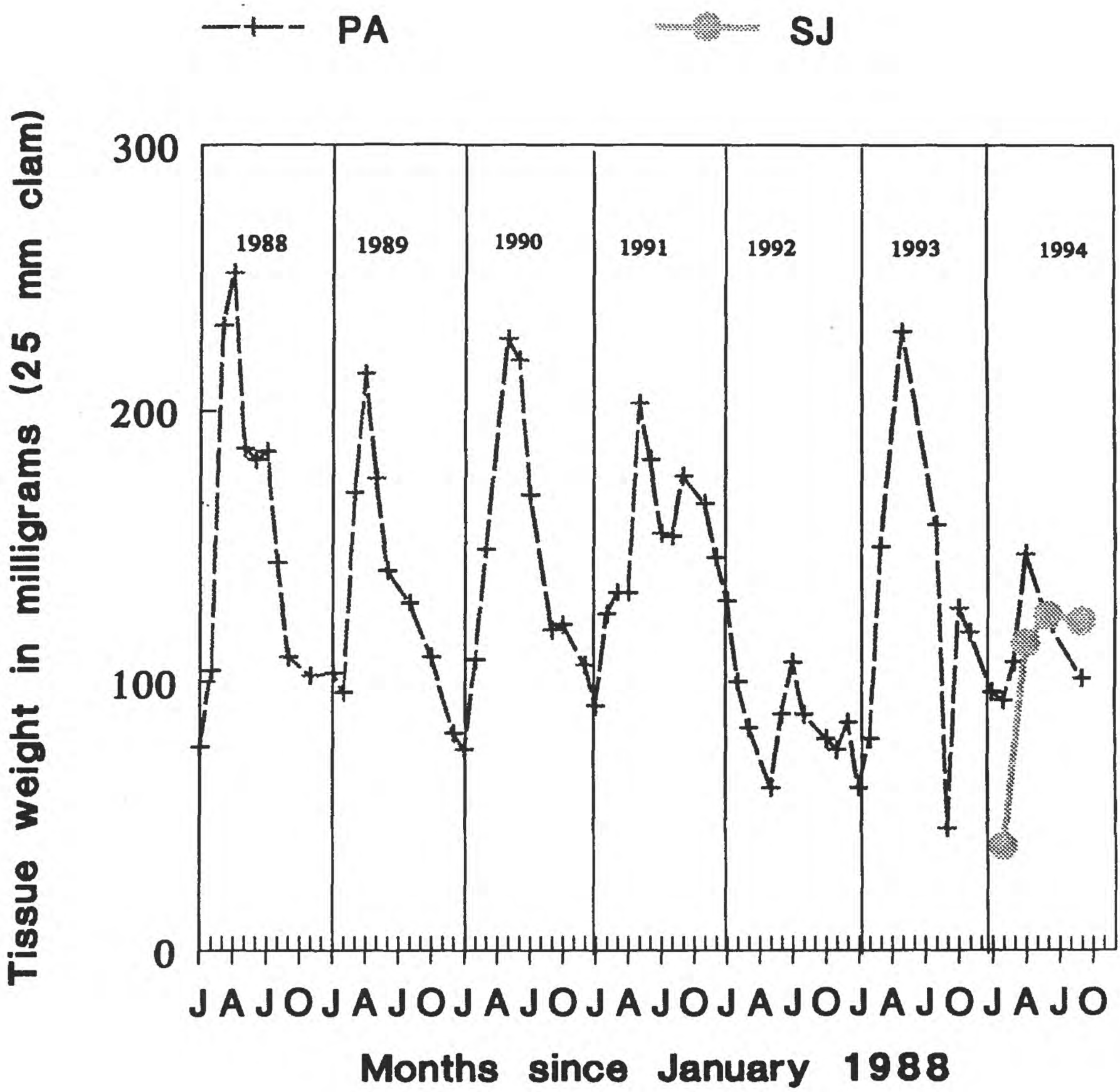


Figure 11. Weight of *Macoma balthica* of 25 millimeter shell length between January 1988 and October 1994 at Palo Alto, and between February and September 1994 at San Jose.

Weights interpolated from a regression calculated at each collection date. The regression related mean dry tissue weight per individual to mean shell length per individual for each composite collected at that date. Data used for the regressions are shown in Appendices 2 and 4.

TABLES

Table 1. Metal concentrations analyzed in National Institute of Standards Standard Reference Material 2709 (San Joaquin soil) after concentrated nitric acid reflux and analysis by Inductively Coupled Plasma Atomic Emission Spectroscopy, as compared to certified values for that material.

[All values in micrograms per gram dry weight.]

DATE	REP #	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
11/93	1	34088	0.396	82	27.9	30050	482	76	23.8	79	93
	2	32053	0.554	75	25.6	27292	437	68	22.6	75	86
2/94	1	33449	0.354	80	29	30306	507	76	20	77	99
	2	30726		75	27.8	29348	491	74	18.4	71	95
3/94	1	32327	0.342	77	28	29290	490	73	19.3	74	95
	2	30436		74	27.5	29072	486	73	18.2	70	94
4/94	1	29125	0.028	73	27.3	27477	471	72	18.3	65	89
	2	35062	0.08	80	28.9	28674	473	73	18	77	91
5/94	1	36712	0.209	81	30.0	27984	538	70	19.4	83	89
	2	37750	0.116	82	30.0	28634	465	71	17.5	85	90
	3	37653	0.078	81	29.0	27981	454	70	17.5	84	88
7/94	1	39111	1.03	84	29.1	30551	469	77	20.4	82	95
	2	38669	0.618	84	27.4	30542	497	77	21.5	83	96
	3	38473	0.415	83	28.2	30254	489	76	19.5	81	94
8/94	1	38713	0.314	81	29.68	28395	456	72	16.3	83	90
	2	42062	0.468	90	32.07	31570	510	79	18.2	92	100
	3	40687	0.604	87		29815	508	77	16.9	87	97
10/94	1	36162	0.846	81	25.12	30684	493	77	17.8	80	95
	2	37146	0.459	83	25.66	30867	497	78	19	83	96
	3	34409	0.555	77	23.14	29215	470	74	17.8	75	91

ELEMENT	% Recovery (n=20)
Al	48
Cd	109
Cr	62
Cu	88
Fe	84
Mn	90
Ni	84
Pb	101
V	71
Zn	88

n=20

	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
AVG	35741	0.415	80.5	28.0	29400	484	74.2	19	79.3	93.2
STD	3583	0.267	4.35	2.06	1208	23.2	3.05	1.89	6.39	3.76

	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
Certified Values:	75000	0.38	130	34.6	35000	538	88	18.9	112	106
Range:	600	0.01	4	0.7	1100	17	5	0.5	5	3

Table 2. Metal concentrations analyzed in National Institute of Standards Standard Reference Material 1566A (oyster tissue), as compared to certified values for that material.

[All values in micrograms per gram dry weight.]

Date	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Feb94	1.57	3.67	0.9	62	1.6	0.5	3.8	675
Mar94	1.70	3.90	1.38	66	1.7	0.5	4.4	741
Apr94	1.43	3.70	1.06	65	2.0	0.4	4.3	698
Jun94	1.33	3.73	1.12	64	1.6	0.4	4.1	699
Sep94	1.42	4.21	1.50	65	2.4	0.5	4.4	795
Oct94	1.52	4.11	1.26	67	2.3	0.4	4.4	826
Mean	**1.50**	**3.89**	**1.20**	**64**	**1.9**	**0.4**	**4.2**	**739**
Stdev	*0.13*	*0.23*	*0.22*	*2*	*0.4*	*0.1*	*0.2*	*60*
Cert. Max	*1.69*	*4.53*	*1.89*	*71*	*2.7*	*0.4*	*4.8*	*887*
Cert. Min	*1.67*	*3.77*	*0.97*	*62*	*1.8*	*0.4*	*4.5*	*773*

Table 3. Concentrations, standard deviations, and annual means describing sediment and environmental characteristics at 13 dates between June 1993 and October 1994 at the Palo Alto site.

[Sediment values for each individual date are means of two replicate sediment samples. Manganese units are microgram per gram dry weight; salinity units (o/o) are parts per thousand. Sediments were sieved through 100 micrometer mesh before analysis and only the fine fraction was analyzed. Sediments were decomposed by concentrated nitric acid reflux.]

Date		Aluminum	Iron	Manganese	Organic Carbon	Sand	Salinity
		percent	percent		percent	percent	o/oo
1993							
June 7	*MEAN*	4.23	3.95	1397		9	22
	STD	0.59	0.08	9			
July 8	*MEAN*					8	
	STD	0.13	0.11	5			
Aug 17	*MEAN*	3.92	3.78	991		11	25
	STD	0.24	0.19	76			
Sept 15	*MEAN*	3.56	3.93	738		19	24
	STD	0.71	0.09	10			
Oct 12	*MEAN*	3.76	3.80	792		25	25
	STD	0.57	0.13	10			
Nov 10	*MEAN*	3.89	3.79	795		25	24
	STD	0.16	0.00	9			
Annual Mean: 1993		**3.23**	**3.21**	**786**		**16**	**20**
Annual STD: 1993		**1.46**	**1.44**	**415**		**7**	**9**
1994							
Jan 10	*MEAN*	4.76	7.51	1053		39	25
	STD	0.77	0.21	7			
Feb 8	*MEAN*	4.45	4.77	1202	1.39	52	25
	STD	0.27	0.08	20			
Mar 23	*MEAN*	4.00	5.27	1012		12	25
	STD	0.02	1.70	28			
Apr 20	*MEAN*	4.58	5.37	715	1.46	18	25
	STD	0.40	0.20	18			
Jun 13	*MEAN*	4.64	4.17	797		10	26
	STD	0.19	0.08	9			
Sept 20	*MEAN*	3.12	3.38	863	0.98	40	27
	STD	0.00	0.00	4			
Oct 17	*MEAN*	4.56	3.84	1154		17	28
	STD	0.08	0.03	7			
Annual Mean:1994		**4.30**	**4.90**	**971**	**1.28**	**27**	**26**
Annual STD:1994		**0.53**	**1.26**	**170**	**0.21**	**15**	**1**

Table 4. Concentrations, standard deviations (std), and annual means of trace elements in sediments in calendar years 1993 and 1994 at Palo Alto.

[Units are microgram per gram dry weight unless otherwise noted. Values for each individual date are means of analyses of two replicate sediment samples. Sediments were sieved through 100 micrometer mesh before analysis and only the fine fraction was analyzed. Sediments were decomposed by concentrated nitric acid reflux. Blanks in table indicate analysis was not conducted. bd means below detection limit of 0.3 µg/g.]

DATE		Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc	Silver HCl
1993												
Jan 19	MEAN	bd	130	54	49		101			115	157	0.47
	STD		*4*	*1*	*1*		*1*			*5*	*2*	*0.02*
Feb 9	MEAN	bd	109	51	35		91			93	143	0.39
	STD		*12*	*6*	*7*		*1*			*18*	*7*	*0.11*
Mar 16	MEAN	bd	118	48	35		94			100	135	0.32
	STD		*1*	*6*	*4*		*1*			*1*	*19*	*0.01*
Apr 8	MEAN	bd	103	54	40		97			76	150	0.29
	STD		*4*	*9*	*1*		*1*			*6*	*1*	*0.01*
May 10	MEAN	bd	*88*	43	*38*		*86*			67	126	0.11
	STD		*6*	*3*	*1*		*4*			*6*	*11*	*0.06*
June 7	MEAN	0.22	102	46	39		95		1.02	79	138	0.29
	STD	*0.02*	*8*	*4*	*0*		*1*		*0.04*	*10*	*1*	*0.02*
July 6	MEAN	0.22	127	51	38		102		0.70	101	136	0.44
	STD	*0.03*	*13*	*3*	*1*		*3*		*0.08*	*13*	*3*	*0.02*
Aug 17	MEAN	0.17	103	34	38		85		0.65	82	115	0.47
	STD	*0.02*	*1*	*5*	*5*		*6*		*0.01*	*6*	*11*	
Sept 15	MEAN	0.20	103	28	39		90		0.96	80	116	
	STD	*0.01*	*11*	*1*	*1*		*0*		*0.01*	*16*	*2*	
Oct 12	MEAN	0.37	104	*30*	*38*		*86*		1.67	81	117	
	STD	*0.02*	*10*	*3*	*3*		*1*		*1.04*	*14*	*2*	
Nov 10	MEAN	0.31	104	32	38		85		0.82	82	119	
	STD	*0.03*	*1*	*1*	*1*		*2*		*0.04*	*3*	*1*	
Annual Mean: 1993		**0.25**	**108**	**43**	**39**		**92**		**0.53**	**87**	**132**	**0.35**
Annual STD: 1993		**0.07**	**12**	**10**	**4**		**6**		**0.54**	**13**	**14**	**0.18**
1994												
Jan 10	*MEAN*	0.21	116	51	41		97		0.75	96	148	0.52
	STD	*0.03*	*10*	*3*	*1*		*1*		*0.02*	*18*	*2*	
Feb 8	*MEAN*	0.19	120	52	49	0.34	107	0.30	1.00	95	156	0.55
	STD	*0.03*	*4*	*1*	*2*		*2*		*0.13*	*5*	*3*	*0.03*
Mar 23	*MEAN*	0.23	102	44	37		90		0.81	80	137	0.59
	STD	*0.00*	*1*	*1*	*5*		*2*		*0.01*	*1*	*6*	
Apr 20	*MEAN*	0.17	111	49	37	0.23	92	0.35	0.82	89	134	0.47
	STD	*0.01*	*7*	*1*	*3*	*0.03*	*3*	*0.01*	*0.12*	*7*	*1*	
Jun 13	*MEAN*	0.23	109	43	40		94		0.83	88	136	0.47
	STD	*0.01*	*4*	*1*	*2*		*1*		*0.01*	*3*	*1*	*0.06*
Sept 20	*MEAN*	0.24	85	*33*	31	*0.33*	*78*	0.23	0.67	66	106	0.38
	STD	*0.01*	*1*	*1*	*1*	*0.04*	*1*	*0.01*	*0.01*	*1*	*1*	*0.08*
Oct 17	*MEAN*		112	36	36		85		0.53	93	126	0.34
	STD		*1*	*1*	*1*		*1*		*0.02*	*2*	*1*	*0.02*
Annual Mean		**0.18**	**108**	**44**	**39**	**0.13**	**92**	**0.13**	**0.77**	**87**	**135**	**0.47**
Annual STD		**0.08**	**11**	**6**	**5**	**0.15**	**8**	**0.15**	**0.14**	**10**	**15**	**0.08**

Table 5. Concentrations, standard error of means, annual means of trace elements in the soft tissues of the clam *Macoma balthica* for calendar years 1993 and 1994 at Palo Alto.

[Wt. 25mm is the weight of a clam of 25 mm shell length, a measure of condition index. It is determined by interpolation from the correlation between shell length and tissue weight at each date. Detailed data are in appendices. Metal values are concentrations in micrograms per gram dry weight and represent the mean and standard error of from nine to sixteen replicate analyses of composite samples. Animal size range, individual replicate analyses, number of individual clams per composite and analytical details are shown in appendices. Blanks in the table are variables that were not analyzed.]

Date	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc	Wt. 25mm
Jan93	0.39	3.8	67	2.6		7.5		13.5	3.1	347	61
SEM	*0.1*	*0.6*	*6.3*	*0.2*		*0.6*		*1.4*	*0.5*	*42.0*	
Feb93	0.41	5.3	83	2.9		10.1		17.0	4.8	459	79
SEM	*0.04*	*0.5*	*11*	*0.2*		*0.4*		*3.8*	*0.5*	*80*	
Mar93	0.34	3.8	47	1.7		6.8		6.0	2.9	329	120
SEM	*0.01*	*0.3*	*3*	*0.2*		*0.3*		*0.4*	*0.3*	*17*	
May93	0.24	3.3	16	2.2		4.7		1.4	2.5	184	230
SEM	*0.02*	*0.6*	*1*	*0.3*		*0.6*		*0.2*	*0.4*	*10*	
Aug93	0.24	2.6	57	2.6		6.0		3.0	1.9	207	158
SEM	*0.0*	*0.5*	*11.0*	*0.6*		*0.7*		*0.3*	*0.4*	*14.0*	
Sep93	0.28	1.7	51	2.4		4.4		3.6	1.2	192	46
SEM	*0.04*	*0.2*	*10*	*0.5*		*0.6*		*0.4*	*0.1*	*16*	
Oct93	0.31	2.0	83	3.3		5.4		4.7	1.3	229	126
SEM	*0.04*	*0.2*	*13*	*0.5*		*0.4*		*0.5*	*0.1*	*19*	
Nov93	0.32	3.4	75	3.6		6.5		5.8	2.3	229	118
SEM	*0.06*	*0.3*	*11*	*0.4*		*0.5*		*0.6*	*0.2*	*12*	
Annual Mean:1993	**0.32**	**3.24**	**59.88**	**2.66**	**0.00**	**6.43**	**0.00**	**6.87**	**2.50**	**272.00**	**117.25**
Annual STD 1993	*0.12*	*1.51*	*25.38*	*1.05*	*0.00*	*2.71*	*0.00*	*5.32*	*1.36*	*126.45*	*48.20*
Jan94	0.17	5.5	77	4.1		7.6		6.9	4.0	327	96
SEM	*0.02*	*0.4*	*10*	*0.3*		*0.4*		*0.8*	*0.3*	*27*	
Feb94	0.13	3.4	69	3.1	0.33	6.1	3.2	7.3	2.3	296	124
SEM	*0.06*	*0.4*	*9*	*0.4*	*0.04*	*0.3*	*0.1*	*0.6*	*0.3*	*18*	
Mar94	0.20	2.1	44	2.1		4.9		5.5	1.7	308	107
SEM	*0.01*	*0.2*	*4*	*0.2*		*0.2*		*0.7*	*0.2*	*28*	
Apr94	0.20	6.6	31	4.3	0.23	7.5	1.9	2.7	5.2	276	147
SEM	*0.01*	*0.5*	*1*	*0.3*	*0.03*	*0.4*	*0.3*	*0.2*	*0.4*	*19*	
Jun94	0.60	1.8	39	2.2		4.5		2.9	1.4	260	122
SEM	*0.50*	*0.2*	*3*	*0.1*		*0.2*		*0.3*	*0.1*	*22*	
Sep94	0.30	2.2	62	2.6	0.53	5.8	3.9	4.4	1.9	252	101
SEM	*0.01*	*0.1*	*4*	*0.1*	*0.08*	*0.3*	*0.4*	*0.4*	*0.1*	*28*	
Oct94	0.30	2.1	66	2.3		5.7		6.0	1.7	280	93
SEM	*0.01*	*0.2*	*5*	*0.1*		*0.3*		*0.5*	*0.2*		
Annual Mean:1994	**0.27**	**3.38**	**55.47**	**2.96**	**0.36**	**6.02**	**2.99**	**5.10**	**2.60**	**285.57**	**112.86**
Annual STD:1994	*0.15*	*1.77*	*15.98*	*0.84*	*0.12*	*1.10*	*1.58*	*1.70*	*1.33*	*24.59*	*17.84*

Table 6. Annual mean copper concentrations in clams and sediments at Palo Alto: May 1977 through June 1994.

[Values are annual means from 7 to 12 collections per year and standard deviations. Means are calculated between May and April of each respective year. Units are microgram per gram dry weight of soft tissue for clams (*Macoma balthica*) and microgram per gram dry weight for sediment. Sediments were seived through 100 µm mesh prior to analysis.]

Year (May to April)	Copper in sediment (micrograms per gram)		Copper in clams (micrograms per gram)
	HCl	Total	
1977 to 1978	38 ± 16	56 ± 20	151± 24
1978 to 1979	51 ± 20	70 ± 19	378 ± 104
1979 to 1980	50 ± 8	84 ± 25	255 ± 124
1980 to 1981	46 ± 9	63 ± 11	267 ± 107
1981 to 1982	43 ± 8	71 ± 11	173 ± 63
1982 to 1983	31 ± 7	64 ± 11	158 ± 62
1983 to 1984	29 ± 7	58 ± 8	156 ± 62
1984 to 1985	32 ± 11	52 ± 8	141 ± 81
1985 to 1986	26 ± 4	51 ± 12	160 ± 81
1986 to 1987	22 ± 4	48 ± 9	78 ± 28
1987 to 1988	23 ± 7	48 ± 10	88 ± 48
1988 to 1989	27 ± 5	54 ± 6	46 ± 22
1989 to 1990	24 ± 3	47 ± 12	42 ± 19
1990 to 1991	23 ± 4	53 ± 7	31 ± 13
1991 to 1992	27 ± 8	51 ± 7	21 ± 7
1992 to 1993	23 ± 4	50 ± 5	57 ± 20
1993 to 1994	20 ± 2	40 ± 9	56 ± 21

Table 7. Annual mean silver concentrations in clams (*Macoma balthica*) and sediments from Palo Alto mudflat: May 1977 through June 1994 at Palo Alto.

[Silver in sediment is from the hydrochloric acid extract, the most bioavailable form. Values are annual means from 7 to 12 collections per year and standard deviations. Sediments were seived through 100 µm mesh prior to analysis. Means are calculated between May and April of each respective year (in contrast to the calendar year used in Figure 2). Units are microgram per gram dry weight of soft tissue for clams (*Macoma balthica*) and microgram per gram dry weight for sediment. ND means not determined. Silver concentrations were not analyzed on sediments between 1987 and early 1990.]

Year (May to April)	Silver in sediment (micrograms per gram)	Silver in clams (micrograms per gram)
1977 to 1978	1.44 ± 0.92	102 ± 47
1978 to 1979	1.44 ± 0.51	125 ± 49
1979 to 1980	1.58 ± 0.30	75 ± 51
1980 to 1981	1.27 ± 0.21	90 ± 41
1981 to 1982	1.29 ± 0.36	45 ± 24
1982 to 1983	0.82 + 0.14	42 + 26
1983 to 1984	0.73 ± 0.22	54 ± 26
1984 to 1985	0.75 ± 0.13	53 ± 24
1985 to 1986	0.71 ± 0.24	77 ± 44
1986 to 1987	0.62 ± 0.21	32 ± 18
1987 to 1988	ND	51 ± 36
1988 to 1989	ND	15 ± 9
1989 to 1990	ND	10.5 ± 6
1990 to 1991	0.38 ± 0.12	5.3 ± 3.3
1991 to 1992	<0.5	2.0 ± 0.6
1992 to 1993	0.36 ± 0.11	8.6 ± 4.4
1993 to 1994	0.51 ± 0.05	4.6 ± 2.0

Table 8. Concentrations, standard deviations, and annual means describing sediment and environmental characteristics at four dates between February 1994 and September 1994 at the San Jose site.

[Sediment values for each individual date are means of two replicate sediment samples. Manganese units are microgram per gram dry weight; salinity units (o/o) are parts per thousand. Sediments were sieved through 100 micrometer mesh before analysis and only the fine fraction was analyzed. Sediments were decomposed by concentrated nitric acid reflux.]

Date		Aluminum percent	Iron percent	Manganese	Organic Carbon percent	Sand percent	Salinity o/oo
Feb. 10	MEAN	3.82	3.90	1229	1.24	41	15
	STD	*0.12*	*0.02*	*1*			
April 21	MEAN	4.14	6.50	1115	1.50	3	20
	STD	*0.12*	*1.80*	*20*			
June 17	MEAN	4.89	4.30	1274		4	25
	STD	*0.26*	*0.05*	*2*			
Sep.13	MEAN	4.51	4.40	542	1.33	10	30
	STD	*0.24*	*0.05*	*5*			
Annual Mean		**4.34**	**4.78**	**1040**	**1.36**	**15**	**23**
Standard Deviation		**0.40**	**1.01**	**293**	***0.11***	***16***	***6***

Table 9. Concentrations, standard deviations (std), and annual means of trace elements in sediments at four dates between February 1994 and September 1994 at the San Jose site.

[Units are microgram per gram dry weight unless otherwise noted. Values for each individual date are means of analyses of two replicate sediment samples. Sediments were sieved through 100 micrometer mesh before analysis and only the fine fraction was analyzed. Sediments were decomposed by concentrated nitric acid reflux.]

		Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc	Silver HCL
Feb. 10	MEAN	0.20	101	45	38	0.37	92	0.30	0.51	78	136	0.37
	STD	0.03	3	3	0		1			3	1	
Apr. 21	MEAN	0.14	106	45	36	0.30	96	0.40	0.54	81	135	0.34
	STD	0.00	2	1	1		1			2	2	
Jun. 17	MEAN	0.18	116	42	42		97		0.54	92	137	0.39
	STD	0.01	4	1	1		1			8	1	
Sep. 13	MEAN	0.26	112	47	39	0.41	104	0.30	0.58	86	140	0.30
	STD	0.00	5	1	0	0.00	1	0.00		5	2	
ANNUAL	**MEAN**	**0.20**	**109**	**45**	**39**	**0.36**	**97**	**0.33**	**0.54**	**84**	**137**	**0.35**
ANNUAL	**STD**	**0.04**	**6**	**2**	**2**	**0.05**	**4**	**0.05**	**0.02**	**5**	**2**	**0.03**

Table 10. Concentrations, standard error of means, annual means of trace elements in the soft tissues of the clam *Macoma balthica* at four dates between February1994 and September 1994 at the San Jose site.

[Wt. 25mm is a measure of condition index or weight of a clam of shell length 25 millimeters, as determined by interpolation from the correlation between shell length and tissue weight at each date. Detailed data are in appendices. Values are concentrations in micrograms per gram dry weight and represent the mean and standard error of from six to nine replicate analyses of composite samples. Animal size range, individual replicate analyses, number of individual clams per composite and analytical details are shown in appendices.]

Date	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc	Wt. 25mm
Feb. 10	<0.5	3.9	126	4.8	0.34	6.5	4.2	12.2	2.4	423	39
SEM		*0.5*	*8*	*0.5*		*0.6*	*0.2*	*1.0*	*0.3*	*35*	
Apr. 21	0.10	5.9	31	4.1	0.20	7.8	1.8	1.8	4.6	231	114
SEM		*0.8*	*2*	*0.4*	*0.01*	*0.8*	*0.2*	*0.1*	*0.6*	*9*	
Jun. 17	0.30	1.6	30	1.7		4.3		1.3	1.2	229	124
SEM	*0.10*	*0.2*	*4*	*0.2*		*0.4*		*0.2*	*0.2*	*9*	
Sep. 13	0.30	4.8	34	4.4	0.43	7.6	3.9	1.6	3.9	163	122
SEM		*0.5*	*2*	*0.3*	*0.05*	*0.5*	*0.1*	*0.1*	*0.4*	*8*	
Mean	**0.18**	**4.1**	**55**	**3.8**	**0.32**	**6.6**	**3.3**	**4.2**	**3.0**	**262**	**100**
SEM	***0.13***	***1.6***	***41***	***1.2***	***0.12***	***1.4***	***1.3***	***4.6***	***1.3***	***97***	***35***

Table 11. Mean metal concentrations and (standard error) in fine-grained sediments at San Jose/Sunnyvale and Palo Alto "near-field" sites in 1994, compared to "effects range-low" (ER-L) and "effects range-medium" (ER-M) defined by national status and trends program (Long and others, 1995).

Site	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Se	V
Bck-grnd	0.1	108	35 - 45	6 - 16	0.1	70-200	0.1	60-80	0.1	75-110
San Jose	*0.2 (.04)*	*109 (6)*	*45 (2)*	*39 (2)*	*0.35 (.05)*	*97 (4)*	*0.5 (.02)*	*137 (2)*	*.35*	*84 (5)*
Palo Alto	*0.2 (.06)*	*105 (8)*	*40 (9)*	*39 (4)*	*0.36 (0.1)*	*91 (7)*	*0.9 (0.3)*	*129 (15*	*.35*	*84 (8)*
ER-L	1.2	81	34	47	0.15	21	1	150	NA	NA
ER-M	9.6	370	270	218	0.71	52	3.7	410	NA	NA

Table 12.Mean metal concentrations and (standard error) in clams *(Macoma balthica)* at San Jose/Sunnyvale and Palo Alto "near-field" sites in February 1994, and in April through September, 1994, compared to the highest (max) and lowest (min) concentrations found in M. balthica tissues in extensive surveys in the United Kingdom (UK) (Bryan and others, 1985).

[SJ is San Jose. PA is Palo Alto. Numbers in parentheses are standard deviation.]

Site	Silver	Copper	Mercury	Selenium	Nickel
SJ 2/94	12.2 (1)	126 (8)	0.34	4.2 (0.2)	6.5 (0.6)
SJ 4-9/94	1.6 (0.2)	32 (2)	0.23 (0.06)	1.8 (0.2)	6.6 (2.0)
PA 2/94	7.3 (0.8)	57 (11)	0.33 (0.04)	3.2 (0.07)	6.0 (0.7)
PA 4-9/94	4.0 (1.5)	50 (17)	0.23 (0.03)	1.87 (0.02)	5.9 (1.2)
UK Min	0.3	32	0.1	1.0*	0.3
UK Max	122.0	224	1.0	8.0*	12.7

*Johns and others, 1988 surveyed Se in a control site and San Francisco Bay.

APPENDIX 1. Metal concentrations determined by ICAPES in sediments collected at the Palo Alto mudflat. Each monthly collection is reported on a separate page. Concentrations observed in the reconstituted samples or extracts (in micrograms per milliliter or ug/ml) are reported at the top of each page, along with the sediment weight and dilution factor. The latter are employed to determine concentrations in sediments (reported as microgram per gram dry sediment or µg/g). Replicate subsamples were analyzed from each collection. Mean and standard deviation for the replicate samples are reported for the total and hydrochloric acid extracts. bd means below the limit of detection. Silver (Ag) and cadmium (Cd) were generally below the limits of quantitation and were re-run by graphite furnace Atomic Absorption Spectrophotometry (GFAAS). The GFAAS values are reported in the summary tables.

PALO ALTO STUDY SITE 6-7-93

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.4527	10.00	TOT 2:8	ug/ml		420.45574	0.0023	0.97251	0.4423	362.16549	12.58599	0.8698	0.34877	0.77792	1.26034
0.4694	10.00				358.16201	0.00191	0.90654	0.408	365.47784	13.17195	0.8893	0.36543	0.67167	1.28749
			ug/g	0.850	46438.672	bd	107.41	48.85	40000.6	1390.1	96.06	38.52	85.92	139.20
				1.520	38151.045	bd	96.56	43.46	38930.3	1403.1	94.73	38.93	71.55	137.14
			Mean	1.185	42294.859	<.3	101.988	46.152	39465.5	1396.583	95.397	38.723	78.733	138.172
			Stdv	0.474	5860.238		7.67	3.81	756.8	9.2	0.94	0.29	10.16	1.46

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.4718	10.00	HCL	ug/ml	0.01433	130.82725	0.00766	0.32146	1.1337	288.56451	56.85136	0.4632	1.4169	0.62379	2.785
0.5463	10.00			0.01496	145.24523	0.00958	0.35911	1.2509	317.59432	62.90207	0.5144	1.61268	0.69035	3.08951
			ug/g	0.304	2772.939	0.162	6.81	24.03	6116.2	1205.0	9.82	30.03	13.22	59.03
				0.274	2658.708	0.175	6.57	22.90	5813.6	1151.4	9.42	29.52	12.64	56.55
			Mean	0.289	2715.823	0.169	6.693	23.463	5964.9	1178.204	9.617	29.776	12.929	57.791
			Stdv	0.021	80.773	0.009	0.17	0.80	214.0	37.9	0.28	0.36	0.41	1.75

PALO ALTO STUDY SITE 7-6-93

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.56[illegible]	10.00	HCL	ug/ml	0.02561	141.9[illegible]077	0.01407	0.3[illegible]03	1.3656	315[illegible]408	42.62607	[illegible]068	1.70428	0.[illegible]2108	3.11643
0.6184	10.00			0.02611	155.09666	0.01555	0.35652	1.4986	336.01571	45.76591	0.558	1.83952	0.77355	3.37461
			ug/g	0.453	2513.379	0.249	5.88	24.17	5576.9	754.6	8.97	30.17	12.76	55.17
				0.422	2508.031	0.251	5.77	24.23	5433.6	740.1	9.02	29.75	12.51	54.57
			Mean	0.438	2510.705	0.250	5.821	24.203	5505.3	747.323	8.997	29.958	12.637	54.869
			Stdv	0.022	3.781	0.002	0.08	0.04	101.3	10.3	0.04	0.30	0.18	0.42

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5275	10.00	TOT 2:8	ug/ml	0.01141	597.729	0.00421	1.43549	0.5579	861.00219	11.55609	1.09237	0.40249	1.15369	1.45917
0.5805	10.00			0.00956	546.58551	0.00534	1.36282	0.5714	860.73297	12.33652	1.1595	0.4473	1.0638	1.55511
			ug/g	1.082	56656.777	0.399	136.07	52.88	81611.6	1095.4	103.54	38.15	109.35	138.31
				0.823	47078.855	0.460	117.38	49.22	74137.2	1062.6	99.87	38.53	91.63	133.95
			Mean	0.952	51867.816	0.430	126.724	51.050	77874.4	1078.971	101.706	38.339	100.491	136.128
			Stdv	0.182	6772.614	0.043	13.21	2.59	5285.2	23.2	2.60	0.27	12.53	3.09

PALO ALTO STUDY SITE 8-17-93

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5463	10.00	TOT 2:8	ug/ml		409.91067	0.00331	1.12093	0.413	428.18704	11.41549	0.97813	0.44684	0.84886	1.34294
0.5778	10.00				472.75994	0.0003	1.20235	0.3522	421.53549	10.82948	0.94128	0.3958	1.00123	1.2388
			ug/g	0.630	37516.993	bd	102.59	37.80	39189.7	1044.8	89.52	40.90	77.69	122.91
				1.220	40910.344	bd	104.05	30.48	36477.6	937.1	81.45	34.25	86.64	107.20
			Mean	0.925	39213.669	<.3	103.319	34.141	37833.68	990.965	85.488	37.574	82.167	115.056
			Stdv	0.417	2399.462		1.03	5.18	1917.7	76.1	5.71	4.70	6.33	11.11

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.6311	10.00	HCL	ug/ml		108.32823	0.00737	0.2424	1.0457	231.80223	45.92595	0.34999	1.6523	0.58403	2.23875
0.5933	10.00				104.41756	0.00707	0.2368	0.9493	227.22169	43.30819	0.34922	1.55394	0.55597	2.16201
			ug/g	0.470	1716.499	0.117	3.84	16.57	3673.0	727.7	5.55	26.18	9.25	35.47
					1759.945	0.119	3.99	16.00	3829.8	730.0	5.89	26.19	9.37	36.44
			Mean	0.470	1738.222	0.118	3.916	16.285	3751.39	728.834	5.716	26.186	9.312	35.957
			Stdv		30.721	0.002	0.11	0.40	110.9	1.6	0.24	0.01	0.08	0.68

PALO ALTO STUDY SITE 9-15-93

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.3507	10.00	TOT 2:8	ug/ml		285.13385	0.0000	0.7785	0.1909	279.89697	5.12871	0.63411	0.27859	0.64296	0.80156
0.4237	10.00				259.694	-0.0003	0.8044	0.24	327.44113	6.31474	0.76079	0.33025	0.58055	0.99306
			ug/g	0.950	40652.103	bd	110.99	27.22	39905.5	731.2	90.41	39.72	91.67	114.28
				0.960	30645.976	bd	94.93	28.32	38640.7	745.2	89.78	38.97	68.51	117.19
			Mean	0.955	35649.039	<.3	102.959	27.769	39273.1	738.200	90.093	39.346	80.089	115.735
			Stdv	0.007	7075.400		11.36	0.78	894.3	9.9	0.44	0.53	16.38	2.06

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.384	10.00	HCL	ug/ml		75.16458	0.00491	0.17418	0.6851	168.18336	17.37565	0.29304	1.04756	0.39697	1.63868
0.3944	10.00				76.2138	0.0083	0.17786	0.6957	169.64976	17.69295	0.29175	1.05596	0.40272	1.66553
			ug/g	0.000	1957.411	0.128	4.54	17.84	4379.8	452.5	7.63	27.28	10.34	42.67
				0.000	1932.399	0.210	4.51	17.64	4301.5	448.6	7.40	26.77	10.21	42.23
			Mean	0.000	1944.905	0.169	4.523	17.741	4340.6	450.548	7.514	27.027	10.274	42.452
			Stdv	0.000	17.686	0.058	0.02	0.14	55.4	2.7	0.17	0.36	0.09	0.31

PALO ALTO STUDY SITE 10-12-93

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5415	10.00	TOT 2:8	ug/ml		451.38125	0.0009	1.20313	0.3492	421.59124	8.65987	0.93222	0.43321	0.98763	1.2792
0.5943	10.00				399.12179	0.00241	1.14685	0.3398	440.1285	9.3343	1.01409	0.42544	0.84188	1.37967
			ug/g	1.600	41678.786	bd	111.09	32.24	38928.1	799.6	86.08	40.00	91.19	118.12
				2.640	33579.151	bd	96.49	28.59	37029.2	785.3	85.32	35.79	70.83	116.08
			Mean	2.120	37628.968	<.3	103.790	30.416	37978.622	792.469	85.698	37.897	81.012	117.096
			Stdv	0.735	5727.307		10.33	2.58	1342.8	10.1	0.54	2.98	14.40	1.44

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5876	10.00	HCL	ug/ml		110.6379	0.01076	0.25237	1.0976	276.16555	31.00029	0.41728	1.53431	0.6006	2.53422
0.5715	10.00				107.78589	0.01106	0.25103	1.0468	270.71154	29.81501	0.41092	1.47972	0.58212	2.47315
			ug/g	0.000	1882.878	0.183	4.29	18.68	4699.9	527.6	7.10	26.11	10.22	43.13
				0.000	1886.017	0.194	4.39	18.32	4736.9	521.7	7.19	25.89	10.19	43.27
			Mean	0.000	1884.448	0.188	4.344	18.498	4718.375	524.636	7.146	26.002	10.204	43.202
			Stdv	0.000	2.220	0.007	0.07	0.26	26.1	4.2	0.06	0.16	0.03	0.10

PALO ALTO STUDY SITE 11-10-93

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.6507	10.00	TOT 2:8	ug/ml		521.026	0.0012	1.36911	0.4292	492.15762	10.2693	1.09801	0.49175	1.10078	1.54239
0.5935	10.00				447.73767	0.0015	1.22458	0.3725	450.04147	9.51483	1.02738	0.46071	0.94597	1.41368
			ug/g	0.960	40035.808	bd	105.20	32.98	37817.6	789.1	84.37	37.79	84.58	118.52
				2.570	37720.107	bd	103.17	31.38	37914.2	801.6	86.55	38.81	79.69	119.10
			Mean	1.765	38877.957	<.3	104.184	32.178	37865.9	795.341	85.462	38.300	82.139	118.807
			Stdv	1.138	1637.448		1.44	1.13	68.3	8.8	1.54	0.73	3.46	0.41

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.6054	10.00	HCL	ug/ml		113.9551	0.00983	0.25873	1.1104	260.64318	32.53506	0.39628	1.60777	0.6067	2.52197
0.6159	10.00				113.53664	0.01106	0.25894	1.0767	265.46511	33.04675	0.4072	1.60243	0.60652	2.45928
			ug/g	0.000	1882.311	0.162	4.27	18.34	4305.3	537.4	6.55	26.56	10.02	41.66
				0.000	1843.427	0.180	4.20	17.48	4310.2	536.6	6.61	26.02	9.85	39.93
			Mean	0.000	1862.869	0.171	4.239	17.911	4307.8	536.987	6.579	26.287	9.935	40.794
			Stdv	0.000	27.495	0.012	0.05	0.61	3.5	0.6	0.05	0.38	0.12	1.22

PALO ALTO STUDY SITE 1-10-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5397	10.00	TOT 2:8	ug/ml		454.80264	0.00224	1.17716	0.5292	827.50775	11.43271	1.05266	0.43472	0.90755	1.5782
0.5618	10.00				595.50665	0.00192	1.38704	0.5986	826.8717	11.78315	1.08906	0.47469	1.22297	1.67319
			ug/g	1.260	42134.764	bd	109.06	49.02	76663.7	1059.2	97.52	40.27	84.08	146.21
				1.780	52999.880	bd	123.45	53.27	73591.3	1048.7	96.93	42.25	108.84	148.91
			Mean	1.520	47567.322	<.3	116.251	51.147	75127.5	1053.934	97.224	41.261	96.462	147.562
			Stdv	0.368	7682.797		10.17	3.00	2172.5	7.4	0.42	1.40	17.51	1.91

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.59	10.00	HCL	ug/ml		138.16632	0.00865	0.34941	1.1915	325.43017	43.23624	0.48033	1.77887	0.80367	2.85143
0.5384	10.00				125.25373	0.00626	0.31381	1.092	294.62683	39.21032	0.4339	1.63762	0.73034	2.59295
			ug/g	0.520	2341.802	0.147	5.92	20.19	5515.8	732.8	8.14	30.15	13.62	48.33
					2326.407	0.116	5.83	20.28	5472.3	728.3	8.06	30.42	13.57	48.16
			Mean	0.520	2334.104	0.131	5.875	20.238	5494.0	730.546	8.100	30.283	13.593	48.245
			Stdv		10.886	0.021	0.07	0.06	30.8	3.2	0.06	0.19	0.04	0.12

PALO ALTO STUDY SITE 2-8-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.2204	10.00	TOT 2:8	ug/ml		187.55142	0.00098	0.5154	0.2325	208.36898	5.24075	0.46387	0.21124	0.40669	0.68009
0.2398	10.00				222.3244	0.00032	0.5903	0.2504	230.89144	5.83484	0.51907	0.24052	0.47335	0.75801
			ug/g	0.910	42547.963	bd	116.92	52.75	47270.6	1188.9	105.23	47.92	92.26	154.29
				1.100	46356.214	bd	123.08	52.22	48142.5	1216.6	108.23	50.15	98.70	158.05
			Mean	1.005	44452.088	<.7	120.003	52.482	47706.6	1202.762	106.732	49.036	95.479	156.168
			Stdv	0.134	2692.840		4.35	0.38	616.5	19.6	2.12	1.58	4.55	2.66

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.2340	10.00	HCL	ug/ml		61.00029	0.00327	0.15117	0.5246	152.27369	20.49378	0.20442	0.80282	0.34951	1.251
0.2538	10.00				63.46635	0.00393	0.15672	0.5511	158.71421	21.96127	0.21486	0.8601	0.36904	1.32174
			ug/g	0.530	2606.850	0.140	6.46	22.42	6507.4	875.8	8.74	34.31	14.94	53.46
				0.580	2500.644	0.155	6.17	21.72	6253.5	865.3	8.47	33.89	14.54	52.08
			Mean	0.555	2553.747	0.147	6.318	22.067	6380.5	870.550	8.601	34.099	14.738	52.770
			Stdv	0.035	75.099	0.011	0.20	0.50	179.5	7.4	0.19	0.30	0.28	0.98

PALO ALTO STUDY SITE 3-23-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5319	10.00	TOT 2:8	ug/ml		424.0065	0.00032	1.0906	0.4695	434.32238	10.98414	0.96796	0.42371	0.85759	1.49836
0.6010	10.00				481.8193	0.00163	1.21038	0.5197	775.75616	11.93401	1.06161	0.39945	0.95205	1.59492
			ug/g	0.870	39857.727	bd	102.52	44.13	40827.4	1032.5	90.99	39.83	80.62	140.85
				1.280	40084.800	bd	100.70	43.24	64538.8	992.8	88.32	33.23	79.21	132.69
			Mean	1.075	39971.264	<.3	101.608	43.683	52683.1	1012.692	89.656	36.531	79.911	136.769
			Stdv	0.290	160.565		1.29	0.63	16766.4	28.1	1.89	4.67	1.00	5.77

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5963	10.00	HCL	ug/ml		115.67297	0.00786	0.25328	1.0999	270.95489	42.75203	0.41754	1.64009	0.64499	2.6773
0.5546	10.00				113.85072	0.00688	0.25457	1.0523	270.36752	40.35081	0.41038	1.54229	0.62277	2.61558
			ug/g		1939.845	0.132	4.25	18.45	4543.9	717.0	7.00	27.50	10.82	44.90
				0.590	2052.844	0.124	4.59	18.97	4875.0	727.6	7.40	27.81	11.23	47.16
			Mean	0.590	1996.345	0.128	4.419	18.710	4709.5	722.261	7.201	27.657	11.023	46.030
			Stdv		79.902	0.005	0.24	0.37	234.1	7.5	0.28	0.22	0.29	1.60

PALO ALTO STUDY SITE 4-20-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5393	10.00	TOT 2:8	ug/ml		524.33026	-0.0022	1.24664	0.5273	729.31463	7.8411	1.01167	0.37389	1.01064	1.45144
0.5435	10.00				466.5039	0.00063	1.15119	0.5235	432.26095	7.63134	0.97501	0.42176	0.91187	1.44074
			ug/g	0.750	48612.114	bd	115.58	48.88	67616.8	727.0	93.79	34.66	93.70	134.57
				1.180	42916.642	bd	105.91	48.16	39766.4	702.1	89.70	38.80	83.89	132.54
			Mean	0.965	45764.378	<.3	110.742	48.519	53691.600	714.513	91.746	36.732	88.794	133.555
			Stdv	0.304	4027.307		6.84	0.51	19693.2	17.6	2.90	2.92	6.94	1.43

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5458	10.00	HCL	ug/ml		117.18688	-0.0092	0.27765	1.1179	291.06216	24.70545	0.43132	1.53348	0.64813	2.74592
0.5416	10.00				119.5489	-0.0048	0.29615	1.108	298.12615	24.32199	0.44809	1.55432	0.6621	2.82437
			ug/g	0.470	2147.066	bd	5.09	20.48	5332.8	452.6	7.90	28.10	11.87	50.31
					2207.328	bd	5.47	20.46	5504.5	449.1	8.27	28.70	12.22	52.15
			Mean	0.470	2177.197	<.3	5.278	20.470	5418.654	450.862	8.088	28.397	12.050	51.229
			Stdv		42.612		0.27	0.02	121.5	2.5	0.26	0.43	0.25	1.30

PALO ALTO STUDY SITE 6-13-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5305	10.00	TOT 2:8	ug/ml		505.859	0.00343	1.18508	0.4571	448.60101	8.52202	1.00296	0.40762	0.9552	1.43408
0.5494	10.00				494.73529	0.00156	1.16994	0.4801	452.82	8.68357	1.03118	0.45879	0.93818	1.50763
			ug/g	0.000	47677.568	bd	111.69	43.08	42281.0	803.2	94.53	38.42	90.03	135.16
				0.000	45025.054	bd	106.47	43.69	41210.4	790.3	93.85	41.75	85.38	137.21
			Mean	0.000	46351.311	<.3	109.084	43.386	41745.7	796.742	94.188	40.086	87.705	136.185
			Stdv	0.000	1875.611		3.69	0.43	757.0	9.1	0.48	2.36	3.29	1.45

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5303	10.00	HCL	ug/ml		99.63495	0.00517	0.22341	0.9469	236.04817	26.48021	0.37765	1.47328	0.54508	2.37165
0.541	10.00				107.21835	0.00485	0.24421	1.0047	257.27749	28.00378	0.40676	1.526	0.58365	2.537
			ug/g	0.000	1878.841	0.097	4.21	17.86	4451.2	499.3	7.12	27.78	10.28	44.72
				0.000	1981.855	0.090	4.51	18.57	4755.6	517.6	7.52	28.21	10.79	46.89
			Mean	0.000	1930.348	0.094	4.363	18.214	4603.4	508.487	7.320	27.995	10.534	45.809
			Stdv	0.000	72.842	0.006	0.21	0.51	215.2	12.9	0.28	0.30	0.36	1.54

PALO ALTO STUDY SITE 9-20-94

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5053	10.00	TOT 2:8	ug/ml		315.82473	0.0024	0.85684	0.3357	342.32562	8.74888	0.79076	0.31463	0.6675	1.06462
0.5263	10.00				327.85546	0.00343	0.88809	0.3355	355.40527	9.06071	0.82008	0.32711	0.69093	1.11514
			ug/g	0.000	31251.210	bd	84.79	33.22	33873.5	865.7	78.25	31.13	66.05	105.35
				0.000	31147.203	bd	84.37	31.87	33764.5	860.8	77.91	31.08	65.64	105.94
			Mean	0.000	31199.207	<.3	84.578	32.545	33819.0	863.252	78.078	31.105	65.845	105.643
			Stdv	0.000	73.544		0.29	0.95	77.1	3.5	0.24	0.04	0.29	0.42

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5185	10.00	HCL	ug/ml		56.05919	0.00509	0.08479	0.574	140.71952	22.3463	0.19713	0.65019	0.29283	1.21747
0.497	10.00				76.2742	0.00679	0.16034	0.7771	193.54521	30.33303	0.26339	1.12356	0.39539	1.71153
			ug/g	0.000	1081.180	0.098	1.64	11.07	2714.0	431.0	3.80	12.54	5.65	23.48
				0.000	1534.692	0.137	3.23	15.63	3894.3	610.3	5.30	22.61	7.96	34.44
			Mean	0.000	1307.936	0.117	2.431	13.353	3304.1	520.651	4.551	17.573	6.802	28.959
			Stdv	0.000	320.681	0.027	1.12	3.23	834.6	126.8	1.06	7.12	1.63	7.75

PALO ALTO STUDY SITE 10-17-94

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5049	10.00	TOT . .3	ug/ml		466.55023	0.00257	1.14141	0.3904	389.48086	11.71056	0.8645[illegible]	0.36295	0.95461	1.2755
0.4986	10.00				448.824	-0.0006	1.11506	0.3778	380.63165	11.46725	0.84591	0.35095	0.91758	1.24641
			ug/g	0.000	46202.241	bd	113.03	38.66	38570.1	1159.7	85.62	35.94	94.53	126.31
				0.000	45008.424	bd	111.82	37.88	38170.0	1149.9	84.83	35.19	92.02	124.99
			Mean	0.000	45605.332	<.3	112.426	38.273	38370.1	1154.818	85.224	35.568	93.275	125.652
			Stdv	0.000	844.156		0.86	0.55	282.9	6.9	0.56	0.53	1.78	0.93

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5954	10.00	HCL	ug/ml	0.01078	85.94952	0.01307	0.17233	0.9021	203.47334	51.11938	0.28701	1.32111	0.43765	2.04827
0.5968	10.00			0.01194	87.13676	0.01032	0.18023	0.9013	207.49046	51.65366	0.29436	1.35675	0.44278	2.07675
			ug/g	0.181	1443.559	0.220	2.89	15.15	3417.4	858.6	4.82	22.19	7.35	34.40
				0.200	1460.066	0.173	3.02	15.10	3476.7	865.5	4.93	22.73	7.42	34.80
			Mean	0.191	1451.813	0.196	2.957	15.127	3447.1	862.041	4.876	22.461	7.385	34.600
			Stdv	0.013	11.672	0.033	0.09	0.03	41.9	4.9	0.08	0.39	0.05	0.28

gsh

APPENDIX 2. Metal concentrations determined by ICAPES in sediments collected at the San Jose mudflat. Each monthly collection is reported on a separate page. Concentrations observed in the reconstituted samples or extracts (in micrograms per milliliter or ug/ml) are reported at the top of each page, along with the sediment weight and dilution factor. The latter are employed to determine concentrations in sediments (reported as microgram per gram dry sediment or µg/g). Replicate subsamples were analyzed from each collection. Mean and standard deviation for the replicate samples are reported for the total and hydrochloric acid extracts. bd means below the limit of detection. Silver (Ag) and cadmium (Cd) were generally below the limits of quantitation and were re-run by graphite furnace Atomic Absorption Spectrophotometry (GFAAS). The GFAAS values are reported in the summary tables.

SAN JOSE STUDY SITE 2-10-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5202	10.00	TOT 2:8	ug/ml		389.08648	0.00065	1.03292	0.4434	406.27822	12.79777	0.94956	0.3901	0.78933	1.40676
0.5303	10.00				415.51263	0.00032	1.10124	0.4936	416.90249	13.03619	0.97585	0.40366	0.85634	1.4498
			ug/g	0.485	37397.778	bd	99.28	42.62	39050.2	1230.1	91.27	37.50	75.87	135.21
				0.506	39177.129	bd	103.83	46.54	39308.2	1229.1	92.01	38.06	80.74	136.70
			Mean	0.496	38287.453	<.3	101.556	44.578	39179.18	1229.608	91.639	37.777	78.305	135.955
			Stdv	0.015	1258.191		3.22	2.77	182.4	0.7	0.52	0.40	3.45	1.05

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5192	10.00	HCL	ug/ml		98.26822	0.00556	0.23528	0.8887	240.54162	47.65737	0.35765	1.39747	0.57663	2.25881
0.5562	10.00				77.03821	0.00294	0.17492	0.6902	186.38984	36.26266	0.27602	0.95106	0.45053	1.72105
			ug/g	0.370	1892.685	0.107	4.53	17.12	4632.9	917.9	6.89	26.92	11.11	43.51
					1385.081	0.053	3.14	12.41	3351.1	652.0	4.96	17.10	8.10	30.94
			Mean	0.370	1638.883	0.080	3.838	14.763	3992.03	784.936	5.926	22.008	9.603	37.224
			Stdv		358.930	0.038	0.98	3.33	906.4	188.0	1.36	6.94	2.13	8.88

SAN JOSE STUDY SITE 4-21-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5533	10.00	TOT 2:8	ug/ml		468.29168	0.00127	1.19347	0.5044	866.16772	12.49458	1.07079	0.38931	0.9117	1.50953
0.5594	10.00				455.01202	-0.0006	1.16764	0.5017	594.33154	12.32186	1.06043	0.41456	0.88331	1.49468
			ug/g	0.503	42318.063	bd	107.85	45.58	78272.9	1129.1	96.76	35.18	82.39	136.41
				0.556	40669.648	bd	104.37	44.84	53122.2	1101.3	94.78	37.05	78.95	133.60
			Mean	0.530	41493.855	<.3	106.108	45.212	65697.6	1115.221	95.773	36.117	80.670	135.004
			Stdv	0.037	1165.605		2.46	0.52	17784.2	19.6	1.40	1.32	2.43	1.99

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5152	10.00	HCL	ug/ml		116.78518	-0.0038	0.28433	1.0194	298.98059	44.59686	0.41727	1.4412	0.67313	2.60079
0.5153	10.00				117.98891	-0.0121	0.29168	1.0115	302.71124	44.13051	0.42509	1.46953	0.67486	2.63543
			ug/g	0.360	2266.793	bd	5.52	19.79	5803.2	865.6	8.10	27.97	13.07	50.48
				0.320	2289.713	bd	5.66	19.63	5874.5	856.4	8.25	28.52	13.10	51.14
			Mean	0.340	2278.253	<.06	5.590	19.707	5838.8	861.013	8.174	28.246	13.081	50.812
			Stdv	0.028	16.207		0.10	0.11	50.4	6.5	0.11	0.38	0.02	0.47

SAN JOSE STUDY SITE 6-17-94

TOT

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5169	10.00	TOT 2:8	ug/ml		524.14892	-0.0006	1.22352	0.4465	446.40509	13.19561	1.01226	0.43372	1.0077	1.42344
0.5094	10.00				478.97238	0.00062	1.15273	0.4245	433.29382	12.97256	0.98825	0.41893	0.88422	1.38263
			ug/g	0.000	50701.192	bd	118.35	43.19	43181.0	1276.4	97.92	41.95	97.48	137.69
				0.000	47013.386	bd	113.15	41.67	42529.8	1273.3	97.00	41.12	86.79	135.71
			Mean	0.000	48857.289	<.3	115.749	42.427	42855.406	1274.868	97.459	41.537	92.133	136.701
			Stdv	0.000	2607.672		3.68	1.07	460.4	2.2	0.65	0.59	7.56	1.40

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5239	10.00	HCL	ug/ml		101.92841	0.00388	0.23604	0.8761	245.74662	52.01974	0.3766	1.42339	0.56631	2.30655
0.5092	10.00				101.66001	0.00226	0.23755	0.871	246.40791	50.61655	0.38556	1.3984	0.56177	2.31816
			ug/g	0.000	1945.570	0.074	4.51	16.72	4690.7	992.9	7.19	27.17	10.81	44.03
				0.000	1996.465	0.044	4.67	17.10	4839.1	994.0	7.57	27.46	11.03	45.53
			Mean	0.000	1971.018	0.059	4.585	16.913	4764.917	993.487	7.380	27.316	10.921	44.776
			Stdv	0.000	35.988	0.021	0.11	0.27	104.9	0.8	0.27	0.21	0.16	1.06

SAN JOSE STUDY SITE 9-13-94

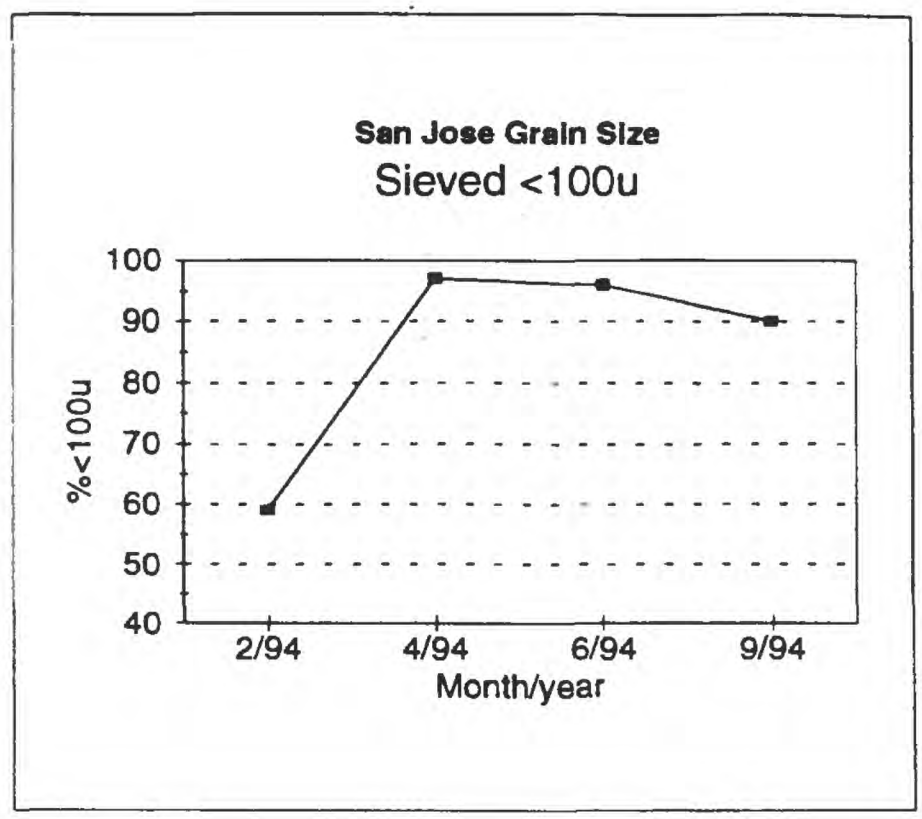
Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5178	10.00	TOT 2:8	ug/ml		449.31936	0.00274	1.13043	0.475	448.56756	5.58124	1.06969	0.40477	0.85341	1.43152
0.505	10.00				471.81423	0.00377	1.16878	0.48	445.11264	5.51909	1.05462	0.39724	0.90386	1.42514
			ug/g	0.000	43387.346	bd	109.16	45.87	43314.8	538.9	103.29	39.09	82.41	138.23
				0.000	46714.280	bd	115.72	47.52	44070.6	546.4	104.42	39.33	89.49	141.10
			Mean	0.000	45050.813	<.3	112.439	46.695	43692.7	542.691	103.855	39.208	85.949	139.667
			Stdv	0.000	2352.497		4.64	1.17	534.4	5.3	0.80	0.17	5.01	2.03

HCL

Sed Wt (g)	Dilution(ml)	Extractant		Ag	Al	Cd	Cr	Cu	Fe	Mn	Ni	Pb	V	Zn
0.5077	10.00	HCL	ug/ml		105.30747	0.00713	0.22918	1.062	238.99264	11.95825	0.36166	1.53152	0.61083	2.24783
0.5001	10.00				110.03216	0.00883	0.24777	1.0699	252.76004	12.17903	0.38118	1.54128	0.63564	2.33175
			ug/g	0.000	2074.207	0.140	4.51	20.92	4707.4	235.5	7.12	30.17	12.03	44.27
				0.000	2200.203	0.177	4.95	21.39	5054.2	243.5	7.62	30.82	12.71	46.63
			Mean	0.000	2137.205	0.159	4.734	21.156	4880.8	239.535	7.373	30.493	12.371	45.450
			Stdv	0.000	89.093	0.026	0.31	0.34	245.2	5.7	0.35	0.46	0.48	1.66

SAN JOSE GRAIN SIZE DATA: <100u

MONTH/YEAR	%<100u
2/94	59
4/94	97
6/94	96
9/94	90



APPENDIX 3. Metal concentrations in the clam *Macoma balthica* collected at the Palo Alto Mudflat. Each monthly collection is reported on two pages. The first page contains summary statistics:

Mean concentrations in microgram per gram dry tissue weight (ug/g).

STD is the standard deviation of the mean.

SEM is the standard error of the mean.

CV percent is the coefficient of variation.

r wt x [] is the correlation coefficient for the concentration versus weight correlation for each element.

X 100mg is the concentration interpolated from the above regression for a 100 mg animal.

r l x [] is the correlation coefficient for the concentration versus shell length regression.

X 20 mm and X 25 mm are concentrations interpolated from the regression for 20mm and 25 mm animals.

Content (a measure of metal bioaccumulation that is independent of mass) is also shown for 20 and 25 mm animals, as is the weight determined for animals of 15 mm and 20 mm shell length.

The second page for each month shows each analysis of each composite sample, the number of animals composited in each, concentration as calculated from sample dry weight and the dilution factor and the metal content for each sample.

Macoma balthica: Palo Alto 8/17/93

-	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	3.029	0.2356	2.591	56.63	5.999	2.581	1.855	207.5
STD	1.075	0.05942	1.817	37.06	2.199	1.826	1.303	47.8
SEM	0.324	0.021	0.548	11.17	0.663	0.551	0.393	14.4
CV%	35.5	25.2	70.1	65.4	36.7	70.8	70.2	23.0
r wt x [ ]	0.243	0.000	0.515	0.689	0.488	0.600	0.456	0.162
X 100mg	3.022	0.000	2.565	55.905	5.969	2.550	1.838	207.681
r l x [ ]	0.497	0.000	0.738	0.865	0.720	0.799	0.687	0.072
X 20mm	3.002	0.000	2.523	54.999	5.919	2.506	1.809	207.288
X 25mm	2.576	0.000	1.453	29.427	4.654	1.342	1.095	204.550

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.58		0.4101	9.0	1.13	0.4095	0.2932	42.0
25mm	0.77		0.4470	9.4	1.42	0.4331	0.3288	59.9

Estimated weight for 15mm clam

0.025 gm
25 mg

Estimated weight for 20mm clam

0.071 gm
71 mg

Estimated weight for 25mm clam

0.158 gm
158 mg

Macoma balthica: Palo Alto 8/17/93

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.1	0.0722	0.00722	5	0.077	0.005	0.085	1.67	0.144	0.083	0.06	3.765
mb2	12	0.1242	0.01129	5	0.114	0.009	0.145	2.89	0.243	0.156	0.104	6.27
mb3	13.6	0.0649	0.01623	5	0.039	0.005	0.053	1.364	0.103	0.045	0.039	2.448
mb4	16.3	0.1757	0.02928	5	0.071	0.008	0.064	2.174	0.19	0.084	0.04	7.251
mb5	17.8	0.0968	0.0484	5	0.047	0.004	0.024	0.67	0.081	0.029	0.013	3.389
mb6	19.8	0.2031	0.0677	5	0.072	0.011	0.048	1.185	0.155	0.05	0.034	6.124
mb7	22.2	0.2927	0.09757	5	0.171	0.009	0.095	1.728	0.261	0.094	0.068	11.05
mb8	23.4	0.3787	0.12623	5	0.186	0.017	0.075	2.775	0.393	0.097	0.061	13.72
mb9	25.4	0.3611	0.18055	5	0.214	0.013	0.138	2.443	0.331	0.119	0.105	10.3
mb10	27.6	0.4521	0.226	5	0.223	0.021	0.199	2.495	0.449	0.154	0.149	26.03
mb11	28.3	0.2615	0.2615	5	0.178	0.014	0.088	1.705	0.298	0.077	0.071	12.96
				Detection Lim	.003	.004	.005	.002	.01	.025	.001	.005

Concentration (ug/g) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	5.3303		5.8885	115.64	9.9398	5.7819	4.1240	260.7
mb2	4.5882	0.3551	5.8535	116.34	9.7935	6.2830	4.1779	252.4
mb3	3.0039		4.0817	105.06	7.9576	3.4938	3.0354	188.6
mb4	2.0139	0.2177	1.8293	61.88	5.3961	2.3981	1.1508	206.3
mb5	2.4163		1.2583	34.62	4.1865	1.5134	0.6457	175.1
mb6	1.7605	0.2607	1.1844	29.16	3.8129	1.2235	0.8358	150.8
mb7	2.9148	0.1607	1.6285	29.53	4.4534	1.6011	1.1655	188.8
mb8	2.4567	0.2252	0.9885	36.64	5.1858	1.2802	0.8027	181.2
mb9	2.9626	0.1792	1.9103	33.83	4.5892	1.6483	1.4561	142.6
mb10	2.4654	0.2277	2.2046	27.60	4.9701	1.6987	1.6506	287.8
mb11	3.4069	0.2587	1.6750	32.60	5.7059	1.4641	1.3549	247.8

Content (ug) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	0.3849		0.4252	8.3492	0.7177	0.4174	0.2978	18.8239
mb2	0.5699	0.0441	0.7270	14.4492	1.2164	0.7803	0.5189	31.3518
mb3	0.1950		0.2649	6.8182	0.5165	0.2268	0.1970	12.2405
mb4	0.3539	0.0383	0.3214	10.8725	0.9481	0.4214	0.2022	36.2549
mb5	0.2339		0.1218	3.3511	0.4052	0.1465	0.0625	16.9463
mb6	0.3576	0.0530	0.2406	5.9230	0.7744	0.2485	0.1698	30.6176
mb7	0.8532	0.0471	0.4767	8.6421	1.3035	0.4687	0.3412	55.2712
mb8	0.9304	0.0853	0.3744	13.8770	1.9639	0.4848	0.3040	68.6054
mb9	1.0698	0.0647	0.6898	12.2164	1.6572	0.5952	0.5258	51.4842
mb10	1.1146	0.1030	0.9967	12.4770	2.2470	0.7680	0.7463	130.13
mb11	0.8909	0.0677	0.4380	8.5237	1.4921	0.3829	0.3543	64.7919

Macoma balthica: Palo Alto 9/15/93

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.9	0.3295	0.0412	5	0.153	0.017	0.16	3.104	0.318	0.133	0.118	6.9
mb2	12.5	0.4964	0.1241	5	0.258	0.022	0.097	2.834	0.298	0.132	0.076	18.29
mb3	17.1	0.5487	0.1372	5	0.42	0.024	0.124	3.205	0.37	0.157	0.099	25.23
mb4	19.7	0.4689	0.1172	5	0.316	0.022	0.088	2.624	0.329	0.119	0.07	23.48
mb5	22.4	0.4342	0.1086	5	0.402	0.019	0.133	2.947	0.299	0.154	0.107	11.46
mb6	23.4	0.2293	0.0573	5	0.101	0.01	0.072	1.723	0.164	0.102	0.057	8.079
mb7	24.6	0.1373	0.0343	5	0.077	0.008	0.055	1.382	0.099	0.065	0.039	5.38
mb8	25.8	0.0469	0.0156	5	0.055	0.004	0.02	0.961	0.074	0.047	0.012	2.238
mb9	26.8	0.0634	0.0317	5	0.066	0.007	0.032	1.291	0.087	0.056	0.022	2.77
				Detection Lim	.003	.004	.005	.002	.01	.025	.001	.005

Concentration (ug/g) ==>

Sample #								
mb1	2.3223	0.2589	2.4300	47.1021	4.8223	2.0115	1.7830	104.700
mb2	2.6035	0.2252	0.9818	28.5455	3.0035	1.3342	0.7621	184.191
mb3	3.8301	0.2198	1.1333	29.2079	3.3732	1.4272	0.9017	229.909
mb4	3.3683	0.2384	0.9387	27.9810	3.5097	1.2641	0.7467	250.425
mb5	4.6305	0.2168	1.5359	33.9412	3.4469	1.7712	1.2328	131.913
mb6	2.2037	0.2181	1.5730	37.5805	3.5698	2.2202	1.2486	176.166
mb7	2.8092	0.2786	2.0175	50.3405	3.6071	2.3667	1.4341	195.909
mb8	5.8774		2.1844	102.5	7.9318	4.9861	1.3273	238.549
mb9	5.1743	0.5568	2.4961	101.8	6.8352	4.4487	1.7185	218.442

Content (ug) ==>

Sample #								
mb1	0.0957	0.0107	0.1001	1.9401	0.1986	0.0829	0.0734	4.3126
mb2	0.3231	0.0280	0.1218	3.5425	0.3727	0.1656	0.0946	22.8581
mb3	0.5255	0.0302	0.1555	4.0073	0.4628	0.1958	0.1237	31.5435
mb4	0.3948	0.0279	0.1100	3.2794	0.4113	0.1482	0.0875	29.3498
mb5	0.5029	0.0235	0.1668	3.6860	0.3743	0.1924	0.1339	14.3257
mb6	0.1263	0.0125	0.0901	2.1534	0.2045	0.1272	0.0715	10.0943
mb7	0.0964	0.0096	0.0692	1.7267	0.1237	0.0812	0.0492	6.7197
mb8	0.0919		0.0341	1.6017	0.1240	0.0779	0.0207	3.7285
mb9	0.1640	0.0177	0.0791	3.2265	0.2167	0.1410	0.0545	6.9246

Macoma balthica: Palo Alto 9/15/93

–	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	3.647	0.2766	1.699	50.9950	4.455	2.426	1.239	192.2
STD	1.324	0.11535	0.608	30.0501	1.753	1.362	0.380	49.1
SEM	0.441	0.041	0.203	10.017	0.584	0.454	0.127	16.4
CV%	36.3	41.7	35.8	58.9	39.3	56.1	30.7	25.5
r wt x [ ]	0.226	0.000	0.903	0.784	0.734	0.793	0.824	0.086
X 100mg	3.482	0.000	1.397	38.043	3.748	1.832	1.067	194.565
r l x [ ]	0.597	0.000	0.338	0.599	0.471	0.658	0.254	0.440
X 20mm	3.598	0.000	1.686	49.883	4.404	2.370	1.233	190.909
X 25mm	4.284	0.000	1.865	65.523	5.122	3.149	1.317	209.689

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2014	1.0000	0.0927	2.6345	0.2446	0.1269	0.0686	10.8179
25mm	0.1854	1.0000	0.0800	2.5182	0.2138	0.1244	0.0578	9.5917

Estimated weight for 15mm clam

0.077 gm
76.816 mg

Estimated weight for 20mm clam

0.058 gm
57.567 mg

Estimated weight for 25mm clam

0.046 gm
46.026 mg

Macoma balthica: Palo Alto 10/12/93

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	4.652	0.3142	1.961	83.06	5.405	3.318	1.268	228.7
STD	1.665	0.1365	0.695	43.39	1.500	1.568	0.388	66.1
SEM	0.481	0.0411	0.201	12.53	0.433	0.453	0.112	19.1
CV%	35.8	43.4	35.5	52.2	27.7	47.3	30.6	28.9
r wt x [ ]	0.453	0.661	0.816	0.661	0.737	0.801	0.709	0.210
X 100mg	4.376	0.288	1.753	72.555	5.000	2.858	1.167	223.601
r l x [ ]	0.501	0.756	0.809	0.830	0.856	0.897	0.731	0.315
X 20mm	4.439	0.294	1.817	73.872	5.078	2.959	1.196	223.362
X 25mm	3.820	0.221	1.399	47.117	4.124	1.914	0.985	207.887

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2252	0.0146	0.0902	3.2507	0.2619	0.1363	0.0614	11.8516
25mm	0.4533	0.0273	0.1694	5.4574	0.5102	0.2317	0.1206	25.4167

Estimated weight for 15mm clam

0.019 gm
19.322 mg

Estimated weight for 20mm clam

0.056 gm
55.761 mg

Estimated weight for 25mm clam

0.127 gm
126.868 mg

Macoma balthica: Palo Alto 10/12/93

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.1	0.0411	0.0051	5	0.063	0.005	0.021	1.243	0.07	0.055	0.016	2.475
mb2	11.4	0.0657	0.0082	5	0.072	0.005	0.037	1.698	0.085	0.063	0.02	3.226
mb3	12.3	0.0836	0.0093	5	0.072	0.005	0.03	1.973	0.112	0.062	0.021	4.136
mb4	13.4	0.1016	0.0127	5	0.089	0.007	0.042	2.557	0.128	0.078	0.03	3.938
mb5	14.3	0.0839	0.0140	5	0.081	0.008	0.036	1.69	0.097	0.075	0.021	3.334
mb6	15.5	0.0525	0.0175	5	0.079	0.004	0.031	1.129	0.061	0.037	0.012	4.109
mb7	17.0	0.1338	0.0268	5	0.102	0.007	0.072	1.511	0.142	0.098	0.052	4.432
mb8	19.2	0.2275	0.0455	5	0.132	0.01	0.08	1.712	0.196	0.111	0.052	7.847
mb9	22.9	0.2397	0.1198	5	0.115	0.01	0.062	1.326	0.172	0.086	0.041	8.312
mb10	25.7	0.2666	0.1333	5	0.28	0.013	0.062	1.759	0.203	0.1	0.049	11.46
mb11	28.2	0.2367	0.2367	5	0.135	0.009	0.049	2.778	0.165	0.061	0.034	12.28
mb12	29.4	0.4114	0.2057	5	0.367	0.017	0.1	4.18	0.391	0.144	0.087	14.84
				Detection Lim	.003	.004	.005	.002	.01	.025	.001	.005

Concentration (ug/g) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	7.6326	0.6265	2.6077	151.2	8.4988	6.6679	1.9161	301.122
mb2	5.4726	0.3919	2.7941	129.2	6.4703	4.7983	1.5266	245.510
mb3	4.2763	0.2733	1.7814	118.0	6.7243	3.7183	1.2518	247.398
mb4	4.3917	0.3376	2.0780	125.8	6.3012	3.8563	1.4843	193.803
mb5	4.8337	0.4774	2.1207	100.7	5.7831	4.4696	1.2795	198.677
mb6	7.5229		2.9843	107.5	5.8400	3.4819	1.1410	391.294
mb7	3.8274	0.2780	2.6986	56.4791	5.3053	3.6573	1.9391	165.612
mb8	2.9092	0.2264	1.7612	37.6301	4.3075	2.4488	1.1321	172.461
mb9	2.3894	0.2149	1.2880	27.6552	3.5916	1.7993	0.8527	173.382
mb10	5.2536	0.2468	1.1687	32.9801	3.8106	1.8742	0.9190	214.965
mb11	2.8530	0.1812	1.0265	58.6793	3.4852	1.2890	0.7203	259.494
mb12	4.4609	0.2016	1.2181	50.8041	4.7464	1.7528	1.0569	180.386

Content (ug) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	0.0389	0.0032	0.0133	0.7709	0.0433	0.0340	0.0098	1.5357
mb2	0.0449	0.0032	0.0229	1.0596	0.0531	0.0393	0.0125	2.0132
mb3	0.0398	0.0025	0.0166	1.0976	0.0625	0.0346	0.0116	2.3008
mb4	0.0558	0.0043	0.0264	1.5981	0.0800	0.0490	0.0189	2.4613
mb5	0.0676	0.0067	0.0296	1.4082	0.0808	0.0625	0.0179	2.7775
mb6	0.1317		0.0522	1.8812	0.1022	0.0609	0.0200	6.8477
mb7	0.1026	0.0075	0.0723	1.5136	0.1422	0.0980	0.0520	4.4384
mb8	0.1324	0.0103	0.0801	1.7122	0.1960	0.1114	0.0515	7.8470
mb9	0.2863	0.0257	0.1543	3.3131	0.4303	0.2156	0.1022	20.7712
mb10	0.7003	0.0329	0.1558	4.3963	0.5080	0.2498	0.1225	28.6548
mb11	0.6753	0.0429	0.2430	13.8894	0.8250	0.3051	0.1705	61.4222
mb12	0.9176	0.0415	0.2506	10.4504	0.9763	0.3606	0.2174	37.1055

Macoma balthica: Palo Alto 11/10/93

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	5.810	0.319	3.424	74.566	6.539	3.661	2.309	229.967
STD	2.288	0.149	1.194	44.290	1.962	1.449	0.907	46.533
SEM	0.572	0.056	0.298	11.072	0.491	0.362	0.227	11.633
CV%	39.4	46.7	34.9	59.4	30.0	39.6	39.3	20.2
n	16	7	16	16	16	16	16	16
r wt x [ ]	0.538	0.000	0.389	0.712	0.635	0.665	0.179	0.311
X 100mg	5.249	0.000	3.212	60.194	5.971	3.222	2.235	223.365
r l x [ ]	0.676	0.000	0.398	0.854	0.663	0.753	0.133	0.372
X 20mm	5.602	0.000	3.360	69.492	6.364	3.514	2.293	227.643
X 25mm	4.371	0.000	2.982	39.427	5.329	2.646	2.197	213.872

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2605	1.0000	0.1585	2.8331	0.3040	0.1620	0.1089	11.5221
25mm	0.4850	1.0000	0.3145	4.4549	0.5842	0.2944	0.2291	24.5115

Estimated weight for 15mm clam

0.018 gm
18 mg

Estimated weight for 20mm clam

0.052 gm
52 mg

Estimated weight for 25mm clam

0.118 gm
118 mg

Macoma balthica: Palo Alto 11/10/99

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.2	0.0440	0.0049	5	0.095	0.005	0.036	1.516	0.077	0.064	0.02	2.545
mb2	11.6	0.0993	0.0076	5	0.146	0.008	0.09	2.34	0.157	0.097	0.053	4.761
mb3	12.5	0.0791	0.0099	5	0.144	0.005	0.046	1.957	0.116	0.073	0.027	4.475
mb4	13.4	0.0996	0.0124	5	0.123	0.006	0.097	2.154	0.169	0.074	0.058	4.599
mb5	14.6	0.0688	0.0172	5	0.097	0.00064	0.048	1.683	0.109	0.054	0.029	2.631
mb6	15.3	0.0485	0.0162	5	0.074	0.00129	0.034	0.945	0.079	0.04	0.021	2.798
mb7	16.1	0.0395	0.0198	5	0.083	0.00324	0.062	1.096	0.104	0.063	0.049	2.598
mb8	17.5	0.1383	0.0346	5	0.093	0.00454	0.073	1.255	0.159	0.081	0.045	6.652
mb9	18.4	0.1042	0.0347	5	0.1	0.00389	0.084	0.973	0.132	0.073	0.064	4.193
mb10	20.4	0.1083	0.0542	5	0.085	0.00324	0.069	1.032	0.129	0.078	0.051	4.171
mb11	22.9	0.0918	0.0918	5	0.053	0.00319	0.069	0.559	0.093	0.059	0.049	2.843
mb12	23.2	0.1862	0.0931	5	0.182	0.00519	0.065	1.546	0.192	0.082	0.049	12.14
mb13	25.3	0.1447	0.1447	5	0.13	0.00064	0.04	0.927	0.087	0.044	0.028	5.006
mb14	26.7	0.1583	0.1583	5	0.1	0.00389	0.055	0.83	0.114	0.054	0.041	6.892
mb15	28.3	0.1987	0.1987	5	0.145	0.00389	0.105	1.647	0.153	0.099	0.068	8.852
mb16	30.1	0.195	0.195	5	0.264	0.00680	0.197	1.868	0.333	0.139	0.155	8.205
				LOD	0.0031	0.0045	0.0027	0.0038	0.0084	0.0166	0.0026	0.0037
				LOQ	0.0102	0.0139	0.0089	0.0110	0.0245	0.0553	0.0088	0.0124

Concentration (ug/g) ==>

Sample #							
mb1	10.791	0.5898	4.043	172.32	8.727	7.318	2.313	289.2
mb2	7.336	0.3922	4.511	117.83	7.918	4.876	2.671	239.7
mb3	9.131	0.3281	2.932	123.70	7.357	4.630	1.698	282.9
mb4	6.187	0.3258	4.853	108.15	8.489	3.711	2.901	230.9
mb5	7.019		3.523	122.28	7.895	3.955	2.132	191.2
mb6	7.608		3.552	97.42	8.157	4.113	2.139	288.4
mb7	6.945		5.197	92.08	8.761	5.284	4.123	218.3
mb8	3.371		2.627	45.38	5.764	2.931	1.624	240.5
mb9	4.801		4.051	46.68	6.352	3.515	3.073	201.2
mb10	3.921		3.198	47.63	5.956	3.587	2.347	192.6
mb11	2.905	0.2827	3.764	30.47	5.089	3.188	2.666	154.9
mb12	4.886	0.1394	1.734	41.52	5.150	2.197	1.307	325.9
mb13	4.490		1.369	32.05	3.019	1.508	0.962	173.0
mb14	3.149		1.735	26.22	3.611	1.697	1.304	217.7
mb15	3.651		2.648	41.44	3.843	2.499	1.715	222.8
mb16	6.764	0.1744	5.044	47.88	8.532	3.599	3.974	210.4

Content (ng) ==>

Sample #							
mb1	0.0529	0.0029	0.0190	0.8444	0.0428	0.0359	0.0113	1.4171
mb2	0.0558	0.0030	0.0343	0.8955	0.0602	0.0371	0.0203	1.8220
mb3	0.0904	0.0032	0.0290	1.2247	0.0728	0.0458	0.0168	2.8004
mb4	0.0767	0.0040	0.0602	1.3411	0.1053	0.0460	0.0360	2.8626
mb5	0.1207		0.0606	2.1033	0.1358	0.0680	0.0367	3.2887
mb6	0.1230		0.0574	1.5753	0.1319	0.0665	0.0346	4.6641
mb7	0.1375		0.1029	1.8231	0.1735	0.1046	0.0816	4.3223
mb8	0.1166		0.0908	1.5691	0.1993	0.1014	0.0562	8.3163
mb9	0.1666		0.1406	1.6198	0.2204	0.1220	0.1066	6.9819
mb10	0.2123		0.1732	2.5794	0.3225	0.1942	0.1271	10.4278
mb11	0.2667	0.0260	0.3456	2.7968	0.4672	0.2927	0.2448	14.2162
mb12	0.4549	0.0130	0.1615	3.8651	0.4795	0.2046	0.1217	30.3431
mb13	0.6497		0.1981	4.6375	0.4369	0.2182	0.1392	25.0299
mb14	0.4983		0.2746	4.1503	0.5716	0.2687	0.2064	34.4592
mb15	0.7256		0.5261	8.2334	0.7637	0.4965	0.3408	44.2625
mb16	1.3190	0.0340	0.9836	9.3375	1.6637	0.6940	0.7750	41.0250

Macoma balthica: Palo Alto 1/10/94

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	6.918	0.1732	5.482	76.82	7.639	4.101	3.976	327.6
STD	2.784	0.0546	1.275	33.84	1.444	1.072	1.025	93.6
SEM	0.804	0.0244	0.368	9.77	0.417	0.310	0.296	27.0
CV%	40.2	31.5	23.3	44.1	18.9	26.1	25.8	28.6
n	12	5	12	12	12	12	12	12
r wt x [ ]	0.724	0.000	0.567	0.761	0.800	0.830	0.332	0.339
X 100mg	4.848	0.000	4.739	50.366	6.452	3.186	3.627	294.962
r l x [ ]	0.829	0.000	0.452	0.877	0.745	0.811	0.178	0.342
X 20mm	6.407	0.000	5.354	70.248	7.401	3.908	3.936	320.467
X 25mm	4.569	0.000	4.896	46.645	6.544	3.217	3.791	294.958

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2606	1.0000	0.2386	2.8130	0.3304	0.1701	0.1769	14.0382
25mm	0.4316	1.0000	0.4624	4.5268	0.6255	0.3075	0.3586	26.9746

Estimated weight for 15mm clam

0.018 gm
18 mg

Estimated weight for 20mm clam

0.046 gm
46 mg

Estimated weight for 25mm clam

0.096 gm
96 mg

Macoma balthica: Palo Alto 1/10/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mb1	10.3	0.0390	0.0056	5	0.085	-0.0006	0.041	0.961	0.065	0.035	0.026	3.439
Mb2	11.6	0.0512	0.0073	5	0.105	0.0032	0.051	1.234	0.086	0.055	0.031	3.314
Mb3	12.3	0.0668	0.0095	5	0.132	0.0019	0.085	1.348	0.119	0.055	0.061	5.359
Mb4	13.3	0.0348	0.0116	5	0.061	0.0019	0.045	0.872	0.064	0.041	0.032	2.115
Mb5	14.5	0.0767	0.0153	5	0.141	0.0013	0.098	1.314	0.134	0.079	0.069	4.793
Mb6	17.0	0.1241	0.0310	5	0.133	0.0039	0.141	2.053	0.173	0.107	0.107	7.878
Mb7	20.4	0.0980	0.0490	5	0.089	0.0052	0.108	0.793	0.146	0.066	0.081	6.891
Mb8	21.8	0.1865	0.0622	5	0.141	0.0052	0.175	1.745	0.256	0.129	0.134	7.727
Mb9	22.1	0.1317	0.0659	5	0.116	0.0039	0.216	1.03	0.254	0.125	0.168	7.302
Mb10	24.6	0.2684	0.0895	5	0.409	0.0097	0.26	3.113	0.341	0.175	0.205	28.5
Mb11	26.7	0.4805	0.1201	5	0.333	0.0143	0.36	4.862	0.571	0.239	0.283	22.8
Mb12	28.7	0.2948	0.1474	5	0.285	0.0078	0.212	2.859	0.293	0.155	0.153	13.4
				LOD	0.0031	0.0045	0.0027	0.0038	0.0084	0.0166	0.0026	0.0037
				LOQ	0.0102	0.0139	0.0089	0.0110	0.0245	0.0553	0.0088	0.0124

Concentration (ug/g) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mb1	10.888		5.294	123.26	8.331	4.529	3.273	440.9
Mb2	10.231		4.983	120.54	8.360	5.336	2.992	323.6
Mb3	9.897		6.332	100.88	8.897	4.094	4.567	401.1
Mb4	8.784		6.536	125.28	9.151	5.836	4.562	303.9
Mb5	9.200		6.369	85.68	8.741	5.134	4.528	312.5
Mb6	5.375		5.695	82.73	6.955	4.325	4.304	317.4
Mb7	4.559	0.2648	5.498	40.46	7.472	3.391	4.151	351.6
Mb8	3.772	0.1391	4.703	46.80	6.851	3.455	3.588	207.2
Mb9	4.393		8.189	39.12	9.653	4.737	6.389	277.2
Mb10	7.616	0.1814	4.847	58.00	6.357	3.257	3.823	531.0
Mb11	3.462	0.1486	3.749	50.59	5.937	2.488	2.943	237.2
Mb12	4.840	0.1321	3.588	48.49	4.964	2.627	2.597	227.2

Content (ug) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mb1	0.0610		0.0296	0.6902	0.0467	0.0254	0.0183	2.4692
Mb2	0.0747		0.0364	0.8800	0.0610	0.0390	0.0218	2.3625
Mb3	0.0940		0.0602	0.9584	0.0845	0.0389	0.0434	3.8104
Mb4	0.1019		0.0758	1.4532	0.1062	0.0677	0.0529	3.5254
Mb5	0.1408		0.0974	1.3109	0.1337	0.0785	0.0693	4.7805
Mb6	0.1666		0.1765	2.5645	0.2156	0.1341	0.1334	9.8401
Mb7	0.2234	0.0130	0.2694	1.9824	0.3662	0.1662	0.2034	17.2271
Mb8	0.2346	0.0087	0.2925	2.9107	0.4261	0.2149	0.2232	12.8849
Mb9	0.2895		0.5397	2.5779	0.6361	0.3122	0.4210	18.2681
Mb10	0.6817	0.0162	0.4338	5.1911	0.5690	0.2915	0.3422	47.5245
Mb11	0.4158	0.0178	0.4502	6.0758	0.7130	0.2989	0.3535	28.4894
Mb12	0.7135	0.0195	0.5288	7.1480	0.7317	0.3873	0.3828	33.4915

Macoma balthica: Palo Alto 2/8/94

–	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	7.31	0.13	3.37	69.02	6.14	3.05	2.29	296.4
STD	2.49	0.11	1.16	28.82	1.11	1.12	1.02	59.5
SEM	0.75	0.06	0.35	8.69	0.33	0.37	0.31	17.9
CV%	34.0	81.5	34.5	41.7	18.1	36.7	44.7	20.1
n	11	3	11	11	11	9	11	11
r wt x [ ]	0.747	0.000	0.116	0.752	0.486	0.400	0.218	0.361
X 100mg	4.353	0.000	3.588	34.546	5.279	2.436	2.642	262.273
r l x [ ]	0.852	0.000	0.284	0.813	0.411	0.391	0.403	0.556
X 20mm	6.182	0.000	3.548	56.540	5.894	2.923	2.507	278.835
X 25mm	4.282	0.000	3.844	35.545	5.485	2.485	2.877	249.215

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.26		0.16	2.31	0.26	0.13	0.11	12
25mm	0.43		0.33	3.67	0.50	0.24	0.25	23

Estimated weight for 15mm clam

0.018 gm
18 mg

Estimated weight for 20mm clam

0.046 gm
46 mg

Estimated weight for 25mm clam

0.093 gm
93 mg

Macoma balthica: Palo Alto 2/8/94

Sample #	Average Length (mm)	Total Dry Wt (g)	Average Dry Wt (g)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	9.6	0.0262	0.0052	5	0.057	0.004	0.017	0.527	0.04	0.02	0.009	2.197
mb2	11.1	0.0377	0.0075	5	0.062	0.001	0.018	0.5	0.047	0.008	0.011	2.119
mb3	12.5	0.039	0.0098	5	0.084	-0.00	0.025	0.905	0.045	0.042	0.014	2.514
mb4	13.6	0.1154	0.0128	5	0.236	0.006	0.072	2.485	0.149	0.063	0.052	8.398
mb5	14.5	0.0586	0.0147	5	0.096	0.004	0.038	0.97	0.074	0.032	0.025	3.594
mb6	15.3	0.0654	0.0164	5	0.089	0.001	0.035	0.878	0.081	0.035	0.023	3.983
mb7	18	0.1339	0.0335	5	0.133	0.003	0.088	1.227	0.141	0.064	0.061	5.837
mb8	19.6	0.1815	0.0454	5	0.188	0.003	0.124	1.678	0.209	0.096	0.09	8.119
mb9	21.9	0.2184	0.0546	5	0.247	0.003	0.294	2.235	0.365	0.195	0.229	10.54
mb10	25	0.3156	0.1052	5	0.376	0.005	0.167	2.786	0.274	0.126	0.124	17.98
mb11	26.2	0.3427	0.1142	5	0.252	0.005	0.214	2.157	0.355	0.164	0.143	20.26
				LOD	0.0031	0.0060	0.0030	0.0040	0.0080	0.0326	0.0026	0.0037
				LOQ	0.0102	0.0184	0.0089	0.0110	0.0245	0.0815	0.0088	0.0124

Concentration (ug/g) ==>

Sample #								
mb1	10.8		3.23	100.5	7.578		1.807	419.3
mb2	8.25		2.38	66.25	6.207		1.418	281.0
mb3	10.7		3.24	116.0	5.801	5.405	1.760	322.3
mb4	10.2	0.25	3.13	107.7	6.474	2.747	2.236	363.9
mb5	8.16		3.20	82.76	6.325	2.747	2.156	306.6
mb6	6.83		2.69	67.15	6.229	2.705	1.752	304.5
mb7	4.98		3.30	45.81	5.252	2.377	2.260	218.0
mb8	5.17		3.42	46.24	5.754	2.649	2.485	223.7
mb9	5.67		6.74	51.16	8.353	4.474	5.239	241.3
mb10	5.96	0.07	2.65	44.14	4.349	1.990	1.959	284.8
mb11	3.67	0.07	3.12	31.47	5.184	2.387	2.090	295.6

Content (ug) ==>

Sample #								
mb1	0.056		0.017	0.523	0.0394		0.0094	2.18
mb2	0.062		0.018	0.497	0.0466		0.0106	2.11
mb3	0.105		0.032	1.137	0.0569	0.0530	0.0173	3.16
mb4	0.131	0.003	0.040	1.378	0.0829	0.0352	0.0286	4.66
mb5	0.120		0.047	1.217	0.0930	0.0404	0.0317	4.51
mb6	0.112		0.044	1.101	0.1022	0.0444	0.0287	4.99
mb7	0.167		0.110	1.535	0.1760	0.0796	0.0757	7.30
mb8	0.235		0.155	2.099	0.2612	0.1203	0.1128	10.15
mb9	0.309		0.368	2.793	0.4561	0.2443	0.2860	13.18
mb10	0.627	0.008	0.279	4.644	0.4575	0.2094	0.2061	29.96
mb11	0.420	0.008	0.357	3.594	0.5920	0.2726	0.2387	33.75

Macoma balthica: Palo Alto 3/22/94

–	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	5.5	0.2	2.1	44.1	4.9	2.1	1.7	308
STD	2.4	0.1	0.6	14.7	0.8	0.5	0.5	93
SEM	0.7	0.0	0.2	4.4	0.2	0.2	0.2	28
CV%	43.7	35.4	28.0	33.3	16.2	22.1	31.0	30.1
n	11	7	11	11	11	8	11	11
r wt x [ ]	0.816	0.000	0.306	0.595	0.708	0.203	0.435	0.260
X 100mg	6.529	0.000	2.208	48.457	5.178	2.047	1.835	320.281
r l x [ ]	0.820	0.000	0.405	0.711	0.678	0.014	0.526	0.401
X 20mm	5.6	0.0	2.1	44.2	4.9	2.1	1.7	309
X 25mm	7.0	0.0	2.3	51.8	5.3	2.1	1.9	336

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.34		0.13	2.75	0.31	0.13	0.11	19
25mm	0.69		0.24	5.35	0.56	0.21	0.20	34

Estimated weight for 15mm clam

0.032 gm
32 mg

Estimated weight for 20mm clam

0.063 gm
63 mg

Estimated weight for 25mm clam

0.107 gm
107 mg

Macoma balthica: Palo Alto 3/22/94

Sample #	Average Length (mm)	Total Dry Wt (g)	Average Dry Wt (g)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.5	0.0602	0.012	5	0.061	0.005	0.028	0.411	0.057	0.022	0.023	3.272
mb2	11.4	0.0674	0.0169	5	0.051	0.003	0.018	0.439	0.058	0.015	0.012	3.969
mb3	13	0.0934	0.0234	5	0.062	0.003	0.034	0.586	0.085	0.031	0.026	4.591
mb4	15.4	0.1809	0.0362	5	0.11	0.007	0.063	1.129	0.151	0.062	0.047	9.056
mb5	18.6	0.1481	0.0494	5	0.119	0.007	0.082	1.335	0.149	0.077	0.063	8.487
mb6	19.5	0.1956	0.0652	5	0.179	0.005	0.088	2.054	0.16	0.094	0.069	10.66
mb7	20.9	0.2087	0.0696	5	0.201	0.008	0.055	1.613	0.184	0.072	0.047	10.77
mb8	24.7	0.3271	0.109	5	0.394	0.006	0.161	2.531	0.377	0.121	0.14	32.45
mb9	26.6	0.3624	0.1208	5	0.479	0.013	0.138	3.578	0.32	0.123	0.118	27.97
mb10	28.6	0.2402	0.1201	5	0.516	0.015	0.157	3.922	0.299	0.134	0.134	21.15
mb11	29.6	0.1807	0.1807	5	0.323	0.005	0.075	1.785	0.223	0.061	0.065	6.796
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	-0.0002
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	5.056		2.343	34.12	4.728		1.944	271.8
mb2	3.751		1.308	32.59	4.317		0.922	294.5
mb3	3.325		1.844	31.37	4.525		1.370	245.7
mb4	3.032	0.2067	1.745	31.19	4.178	1.718	1.311	250.3
mb5	4.027	0.2525	2.783	45.09	5.021	2.584	2.122	286.5
mb6	4.571		2.241	52.50	4.091	2.410	1.768	272.4
mb7	4.810	0.1929	1.311	38.65	4.402	1.731	1.118	258.0
mb8	6.017	0.0968	2.459	38.69	5.768	1.846	2.134	496.0
mb9	6.610	0.1827	1.903	49.36	4.413	1.696	1.632	385.9
mb10	10.750	0.3114	3.270	81.65	6.216	2.782	2.793	440.3
mb11	8.940	0.1433	2.080	49.39	6.183	1.701	1.788	188.0

Content (ug) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	0.0607		0.0281	0.409	0.0567		0.02	3.26
mb2	0.0634		0.0221	0.551	0.0730		0.02	4.98
mb3	0.0778		0.0432	0.734	0.1059		0.03	5.75
mb4	0.1098	0.0075	0.0632	1.129	0.1512	0.06	0.05	9.06
mb5	0.1989	0.0125	0.1375	2.227	0.2481	0.13	0.10	14.15
mb6	0.2980		0.1461	3.423	0.2667	0.16	0.12	17.76
mb7	0.3348	0.0134	0.0913	2.690	0.3063	0.12	0.08	17.96
mb8	0.6559	0.0105	0.2680	4.217	0.6288	0.20	0.23	54.06
mb9	0.7985	0.0221	0.2299	5.963	0.5331	0.20	0.20	46.61
mb10	1.2911	0.0374	0.3927	9.806	0.7465	0.33	0.34	52.88
mb11	1.6155	0.0259	0.3759	8.926	1.1172	0.31	0.32	33.98

Macoma balthica: Palo Alto 4/20/94

-	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	2.7	0.2	6.6	31.3	7.5	4.3	5.2	276
STD	0.8	0.0	1.7	4.0	1.3	1.0	1.3	66
SEM	0.2	0.0	0.5	1.2	0.4	0.3	0.4	19
CV%	30.5	29.8	25.9	12.7	17.2	22.2	25.6	23.9
n	12	7	12	12	12	12	12	12
r wt x [ ]	0.766	0.000	0.467	0.109	0.314	0.611	0.418	0.760
X 100mg	2.904	0.000	6.323	31.448	7.315	4.061	4.997	295.231
r l x [ ]	0.685	0.000	0.577	0.125	0.416	0.695	0.526	0.660
X 20mm	2.8	0.0	6.3	31.4	7.3	4.1	5.0	289
X 25mm	3.3	0.0	5.5	31.9	6.8	3.5	4.4	327

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.21		0.46	2.39	0.55	0.30	0.37	22
25mm	0.46		0.79	4.63	0.99	0.51	0.64	45

Estimated weight for 15mm clam

0.033 gm
33 mg

Estimated weight for 20mm clam

0.076 gm
76 mg

Estimated weight for 25mm clam

0.147 gm
147 mg

Macoma balthica: Palo Alto 4/20/94

Sample #	Average Length (mm)	Total Dry Wt (g)	Average Dry Wt (g)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.9	0.0515	0.0129	5	0.032	0	0.087	0.323	0.087	0.054	0.066	2.57
mb2	12.4	0.1132	0.0189	5	0.045	0.003	0.237	0.673	0.232	0.137	0.189	5.968
mb3	13.4	0.1159	0.0232	5	0.048	0	0.134	0.594	0.155	0.09	0.104	5.731
mb4	14.2	0.2031	0.0290	5	0.096	0.005	0.305	1.452	0.34	0.222	0.241	10.55
mb5	15.6	0.2608	0.0373	5	0.08	0.007	0.331	1.435	0.353	0.216	0.254	13.46
mb6	16.7	0.3276	0.0468	5	0.167	0.009	0.494	2.073	0.544	0.307	0.384	16.54
mb7	17.5	0.1577	0.0526	5	0.068	0.005	0.146	1.169	0.171	0.11	0.113	7.561
mb8	18.9	0.2474	0.0619	5	0.117	0.009	0.316	1.683	0.397	0.207	0.242	12.99
mb9	21.3	0.4274	0.0855	5	0.275	0.012	0.429	2.655	0.541	0.299	0.347	20.72
mb10	24.5	0.4536	0.1512	5	0.286	0.008	0.654	2.377	0.665	0.412	0.524	23.15
mb11	25.8	0.4810	0.1603	5	0.27	0.014	0.45	2.743	0.611	0.278	0.371	29.42
mb12	28.9	0.4372	0.2186	5	0.408	0.021	0.485	3.228	0.65	0.29	0.387	41.86
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	-0.0002
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #								
mb1	3.140		8.432	31.41	8.408	5.229	6.384	249.5
mb2	1.989		10.476	29.71	10.226	6.051	8.335	263.6
mb3	2.066		5.798	25.64	6.670	3.882	4.487	247.2
mb4	2.374		7.502	35.75	8.369	5.472	5.925	259.6
mb5	1.542	0.1434	6.340	27.51	6.759	4.142	4.875	258.0
mb6	2.542	0.1406	7.538	31.64	8.301	4.686	5.865	252.4
mb7	2.166		4.615	37.06	5.422	3.488	3.598	239.7
mb8	2.359	0.1744	6.379	34.00	8.019	4.181	4.900	262.6
mb9	3.212	0.1347	5.013	31.06	6.333	3.502	4.056	242.4
mb10	3.156	0.0887	7.213	26.20	7.327	4.537	5.776	255.2
mb11	2.807	0.1436	4.679	28.51	6.350	2.887	3.859	305.9
mb12	4.661	0.2370	5.543	36.92	7.431	3.319	4.425	478.7

Content (ug) ==>

Sample #								
mb1	0.0405		0.1088	0.4051	0.1085	0.0675	0.0824	3.22
mb2	0.0376		0.1980	0.5615	0.1933	0.1144	0.1575	4.98
mb3	0.0479		0.1345	0.5948	0.1548	0.0901	0.1041	5.74
mb4	0.0689		0.2176	1.0366	0.2427	0.1587	0.1718	7.53
mb5	0.0575	0.0053	0.2365	1.0261	0.2521	0.1545	0.1818	9.62
mb6	0.1190	0.0066	0.3528	1.4806	0.3885	0.2193	0.2745	11.81
mb7	0.1139		0.2428	1.9496	0.2852	0.1834	0.1893	12.61
mb8	0.1460	0.0108	0.3948	2.1049	0.4964	0.2588	0.3033	16.26
mb9	0.2747	0.0115	0.4286	2.6556	0.5415	0.2995	0.3468	20.72
mb10	0.4771	0.0134	1.0907	3.9619	1.1078	0.6859	0.8734	38.59
mb11	0.4500	0.0230	0.7501	4.5705	1.0179	0.4627	0.6186	49.03
mb12	1.0190	0.0518	1.2116	8.0697	1.6244	0.7256	0.9674	104.64

Macoma balthica: Palo Alto 6/13/94

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	2.9	0.6	1.8	39.3	4.5	2.2	1.4	260
STD	1.3	0.7	0.6	9.6	0.7	0.5	0.4	83
SEM	0.3	0.5	0.2	2.6	0.2	0.1	0.1	22
CV%	44.4	113.3	35.3	24.5	16.2	23.4	30.8	32.0
n	14	2	14	14	14	14	14	14
r wt x [ ]	0.731	0.000	0.082	0.245	0.023	0.332	0.189	0.362
X 100mg	3.137	0.000	1.821	39.947	4.511	2.137	1.377	268.593
r l x [ ]	0.780	0.000	0.109	0.171	0.038	0.394	0.163	0.308
X 20mm	2.8	0.0	1.8	39.1	4.5	2.2	1.3	258
X 25mm	3.6	0.0	1.8	40.5	4.5	2.0	1.4	280

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.1753	1.0000	0.1132	2.4948	0.2907	0.1383	0.0849	16.2066
25mm	0.4155	1.0000	0.2067	4.8232	0.5376	0.2396	0.1659	32.4049

Estimated weight for 15mm clam

0.029 gm
29 mg

Estimated weight for 20mm clam

0.065 gm
65 mg

Estimated weight for 25mm clam

0.122 gm
122 mg

Macoma balthica: Palo Alto 6/13/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	12.5	0.0492	0.0164	5	0.015	-0.00	0.016	0.27	0.048	0.028	0.011	1.675
mb2	13.6	0.1195	0.0199	5	0.064	-0.00	0.078	1.386	0.136	0.077	0.051	5.93
mb3	14.4	0.1039	0.0260	5	0.044	-0.00	0.03	0.796	0.095	0.047	0.019	5.338
mb4	15.4	0.1443	0.0289	5	0.051	-0.00	0.037	1.141	0.116	0.056	0.025	6.671
mb5	16.5	0.2074	0.0415	5	0.087	*****	0.12	1.587	0.237	0.113	0.084	9.762
mb6	17.4	0.2224	0.0445	5	0.105	*****	0.071	1.887	0.173	0.097	0.045	10.16
mb7	19.0	0.2212	0.0553	5	0.09	-0.00	0.086	1.322	0.175	0.076	0.059	11.16
mb8	21.3	0.2037	0.1019	5	0.095	-0.00	0.077	1.101	0.153	0.081	0.055	5.785
mb9	22.5	0.1661	0.0831	5	0.066	*****	0.031	0.915	0.126	0.048	0.03	10.72
mb10	23.2	0.2114	0.1057	5	0.18	0.001	0.055	1.72	0.168	0.073	0.047	16.99
mb11	25.6	0.2658	0.1329	5	0.209	0.000	0.088	2.158	0.225	0.104	0.069	13.72
mb12	26.5	0.3166	0.1583	5	0.282	0.004	0.092	2.603	0.267	0.105	0.08	20.26
mb13	27.8	0.3615	0.1808	5	0.192	0.008	0.15	4.107	0.351	0.17	0.122	30.39
mb14	31.1	0.1666	0.1666	5	0.197	0.035	0.08	1.402	0.191	0.085	0.063	5.001
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	-0.0002
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	1.558		1.629	27.40	4.860	2.858	1.166	170.2
mb2	2.668		3.272	57.98	5.670	3.235	2.115	248.1
mb3	2.105		1.426	38.29	4.568	2.282	0.936	256.9
mb4	1.768		1.275	39.53	4.019	1.940	0.881	231.2
mb5	2.091		2.895	38.27	5.704	2.713	2.037	235.3
mb6	2.361		1.604	42.42	3.900	2.173	1.001	228.4
mb7	2.040		1.937	29.89	3.959	1.719	1.342	252.3
mb8	2.322		1.878	27.04	3.764	1.998	1.344	142.0
mb9	1.989		0.919	27.53	3.797	1.441	0.911	322.7
mb10	4.257		1.290	40.68	3.969	1.722	1.102	401.7
mb11	3.940		1.661	40.59	4.224	1.963	1.289	258.1
mb12	4.453		1.455	41.11	4.210	1.663	1.265	319.9
mb13	2.651	0.117	2.069	56.81	4.854	2.357	1.682	420.3
mb14	5.915	1.062	2.397	42.08	5.721	2.555	1.883	150.1

Content (ug) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	0.0256		0.0267	0.4493	0.0797	0.0469	0.0191	2.7910
mb2	0.0531		0.0651	1.1538	0.1128	0.0644	0.0421	4.9377
mb3	0.0547		0.0371	0.9957	0.1188	0.0593	0.0243	6.6790
mb4	0.0511		0.0369	1.1424	0.1162	0.0561	0.0255	6.6806
mb5	0.0868		0.1201	1.5882	0.2367	0.1126	0.0845	9.7670
mb6	0.1050		0.0714	1.8878	0.1735	0.0967	0.0446	10.1624
mb7	0.1128		0.1071	1.6530	0.2189	0.0951	0.0742	13.9515
mb8	0.2366		0.1914	2.7551	0.3836	0.2036	0.1369	14.4705
mb9	0.1653		0.0764	2.2878	0.3155	0.1197	0.0757	26.8141
mb10	0.4500		0.1363	4.2997	0.4195	0.1820	0.1165	42.4648
mb11	0.5237		0.2207	5.3951	0.5614	0.2609	0.1713	34.3028
mb12	0.7050		0.2303	6.5083	0.6665	0.2632	0.2002	50.6417
mb13	0.4794	0.0212	0.3740	10.2709	0.8775	0.4262	0.3042	75.9883
mb14	0.9855	0.1770	0.3993	7.0101	0.9531	0.4256	0.3137	25.0034

Macoma balthica: Palo Alto 9/20/94

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	4.4	0.3	2.2	61.55	5.8	2.6	1.9	251.7
STD	1.1	0.1	0.4	13.69	0.8	0.3	0.3	81.8
SEM	0.4	0.0	0.1	4.33	0.3	0.1	0.1	25.9
CV%	25.8	21.7	17.5	22.2	14.2	13.2	16.6	32.5
n	10	10	10	10	10	10	10	10
r wt x [ ]	0.132	0.241	0.555	0.354	0.525	0.376	0.172	0.301
X 100mg	4.475	0.292	2.067	59.340	5.574	2.524	1.868	240.439
r l x [ ]	0.119	0.081	0.463	0.281	0.551	0.278	0.014	0.373
X 20mm	4.4	0.3	2.2	61.761	5.8	2.6	1.9	253.3
X 25mm	4.5	0.3	2.0	58.604	5.4	2.5	1.9	228.3

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2179	0.0149	0.1074	3.0412	0.2890	0.1299	0.0949	11.9386
25mm	0.4433	0.0288	0.1976	5.6680	0.5385	0.2491	0.1863	20.9260

Estimated weight for 15mm clam

0.021 gm
21 mg

Estimated weight for 20mm clam

0.051 gm
51 mg

Estimated weight for 25mm clam

0.101 gm
101 mg

Macoma balthica: Palo Alto 9/20/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	13.0	0.1058	0.0132	5	0.137	0.007	0.055	1.598	0.157	0.065	0.045	7.056
mb2	14.6	0.1605	0.0201	5	0.162	0.01	0.074	1.784	0.19	0.091	0.059	8.341
mb3	15.5	0.1830	0.0229	5	0.096	0.009	0.074	2.508	0.191	0.085	0.058	12.03
mb4	16.6	0.2496	0.0312	5	0.17	0.017	0.116	2.769	0.292	0.134	0.099	13.34
mb5	17.4	0.2679	0.0335	5	0.204	0.015	0.126	3.776	0.36	0.129	0.107	12.29
mb6	18.6	0.3385	0.0423	5	0.238	0.014	0.132	4.223	0.35	0.149	0.111	11.43
mb7	23.5	0.2056	0.0685	5	0.191	0.014	0.073	1.759	0.208	0.107	0.07	15.28
mb8	26.4	0.3871	0.129	5	0.33	0.02	0.193	4.015	0.435	0.191	0.174	8.453
mb9	27.1	0.1059	0.1059	5	0.12	0.009	0.052	1.831	0.127	0.065	0.051	3.838
mb10	30.6	0.2262	0.2262	5	0.21	0.01	0.062	2.105	0.213	0.096	0.064	12.09
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	-0.0002
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #								
mb1	6.457	0.3497	2.589	75.50	7.432	3.086	2.141	333.4
mb2	5.061	0.3265	2.310	55.56	5.929	2.845	1.836	259.9
mb3	2.629	0.2358	2.030	68.54	5.210	2.331	1.584	328.8
mb4	3.413	0.3458	2.316	55.48	5.848	2.692	1.988	267.3
mb5	3.813	0.2876	2.350	70.47	6.718	2.412	1.992	229.3
mb6	3.509	0.2095	1.951	62.37	5.175	2.198	1.640	168.9
mb7	4.647	0.3448	1.785	42.78	5.052	2.594	1.693	371.6
mb8	4.261	0.2548	2.490	51.86	5.621	2.466	2.242	109.2
mb9	5.650	0.4075	2.444	86.44	6.013	3.085	2.394	181.2
mb10	4.631	0.2317	1.361	46.53	4.716	2.124	1.415	267.1

Content (ug) ==>

Sample #								
mb1	0.0852	0.0046	0.0342	0.9966	0.0981	0.0407	0.0283	4.4014
mb2	0.1017	0.0066	0.0464	1.1168	0.1192	0.0572	0.0369	5.2230
mb3	0.0602	0.0054	0.0465	1.5695	0.1193	0.0534	0.0363	7.5297
mb4	0.1065	0.0108	0.0723	1.7309	0.1824	0.0840	0.0620	8.3401
mb5	0.1277	0.0096	0.0787	2.3608	0.2251	0.0808	0.0667	7.6832
mb6	0.1484	0.0089	0.0825	2.6383	0.2189	0.0930	0.0694	7.1436
mb7	0.3183	0.0236	0.1223	2.9307	0.3461	0.1777	0.1160	25.4526
mb8	0.5496	0.0329	0.3213	6.6899	0.7250	0.3181	0.2892	14.0854
mb9	0.5984	0.0432	0.2588	9.1541	0.6368	0.3267	0.2536	19.1889
mb10	1.0475	0.0524	0.3080	10.5244	1.0667	0.4804	0.3202	60.4257

Macoma balthica: Palo Alto 10/17/94

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	6.0	0.3	2.1	66.1	5.7	2.3	1.7	280.0
STD	1.5	0.1	0.6	15.1	1.1	0.3	0.7	98.1
SEM	0.5	0.0	0.2	4.8	0.3	0.1	0.2	31.0
CV%	24.5	18.8	28.2	22.8	18.5	13.9	39.9	35.1
n	10	5	10	10	10	8	8	10
r wt x [ ]	0.302	0.000	0.924	0.520	0.689	0.723	0.936	0.570
X 100mg	4.802	0.000	3.525	44.600	7.648	2.838	3.333	126.677
r l x [ ]	0.450	0.000	0.842	0.559	0.649	0.641	0.961	0.503
X 20mm	5.4	0.0	2.5	58.8	6.3	2.4	2.2	237.2
X 25mm	4.7	0.0	3.0	49.3	7.0	2.7	3.1	181.5

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.2567	1.0000	0.1132	2.8015	0.2928	0.1148	0.1032	10.0400
25mm	0.4547	1.0000	0.2537	4.9324	0.6115	0.2422	0.3112	15.9989

Estimated weight for 15mm clam

0.021 gm
21 mg

Estimated weight for 20mm clam

0.048 gm
48 mg

Estimated weight for 25mm clam

0.093 gm
93 mg

Macoma balthica: Palo Alto 10/17/94

Note: Mb11 was not analyzed

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	8.6	0.0123	0.0041	5	0.018	*****	0.004	0.165	0.012	0.003	-0.00	0.855
mb2	12.6	0.0347	0.0116	5	0.065	*****	0.01	0.626	0.043	0.002	0.001	2.143
mb3	13.4	0.0878	0.0146	5	0.092	*****	0.036	1.283	0.094	0.038	0.013	6.308
mb4	14.6	0.1468	0.021	5	0.195	0.01	0.047	2.661	0.156	0.07	0.038	7.873
mb5	15.5	0.1325	0.0189	5	0.151	0.007	0.054	1.736	0.14	0.061	0.045	5.296
mb6	16.2	0.1564	0.0261	5	0.153	0.007	0.058	2.006	0.164	0.061	0.045	6.357
mb7	17.5	0.1625	0.0325	5	0.158	0.008	0.057	1.805	0.163	0.07	0.049	11.99
mb8	18.6	0.1799	0.045	5	0.16	0.013	0.082	1.765	0.165	0.074	0.069	9.106
mb9	19.7	0.0882	0.0441	5	0.094	0.004	0.042	0.829	0.124	0.037	0.035	7.158
mb10	24.9	0.1835	0.0918	5	0.232	0.009	0.128	2.163	0.288	0.109	0.113	3.117
				LOD	0.0021	0.006	0.0019	0.0043	0.0096	0.0326	0.0022	-0.0002
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	7.500		1.679	67.18	4.695			347.7
mb2	9.300		1.454	90.18	6.241			308.8
mb3	5.216		2.022	73.06	5.364	2.153	0.718	359.2
mb4	6.637		1.598	90.62	5.330	2.370	1.307	268.1
mb5	5.706	0.2642	2.056	65.53	5.267	2.320	1.698	199.8
mb6	4.900	0.2238	1.863	64.12	5.259	1.959	1.443	203.2
mb7	4.870	0.2545	1.754	55.53	5.025	2.154	1.509	369.0
mb8	4.449	0.3538	2.285	49.06	4.590	2.068	1.916	253.1
mb9	5.340		2.357	47.01	7.014	2.111	2.011	405.8
mb10	6.328	0.2428	3.485	58.94	7.843	2.967	3.077	84.9

Content (ug) ==>

Sample #	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	0.0308		0.0069	0.2755	0.0193			1.4257
mb2	0.1079		0.0169	1.0461	0.0724			3.5822
mb3	0.0762		0.0295	1.0667	0.0783	0.0314	0.0105	5.2447
mb4	0.1394		0.0336	1.9031	0.1119	0.0498	0.0274	5.6310
mb5	0.1078	0.0050	0.0389	1.2385	0.0995	0.0438	0.0321	3.7770
mb6	0.1279	0.0058	0.0486	1.6736	0.1373	0.0511	0.0377	5.3043
mb7	0.1583	0.0083	0.0570	1.8046	0.1633	0.0700	0.0490	11.9937
mb8	0.2002	0.0159	0.1028	2.2076	0.2065	0.0931	0.0862	11.3887
mb9	0.2355		0.1040	2.0732	0.3093	0.0931	0.0887	17.8959
mb10	0.5809	0.0223	0.3199	5.4106	0.7200	0.2724	0.2825	7.7956

APPENDIX 4. Metal concentrations in the clam *Macoma balthica* collected at the San Jose mudflat. Each monthly collection is reported on two pages. The first page contains summary statistics:

Mean concentrations in microgram per gram dry tissue weight (ug/g).

STD is the standard deviation of the mean.

SEM is the standard error of the mean.

CV percent is the coefficient of variation.

r wt x [] is the correlation coefficient for the concentration versus weight correlation for each element.

X 100mg is the concentration interpolated from the above regression for a 100 mg animal.

r l x [] is the correlation coefficient for the concentration versus shell length regression.

X 20 mm and X 25 mm are concentrations interpolated from the regression for 20mm and 25 mm animals.

Content (a measure of metal bioaccumulation that is independent of mass) is also shown for 20 and 25 mm animals, as is the weight determined for animals of 15 mm and 20 mm shell length.

The second page for each month shows each analysis of each composite sample, the number of animals composited in each, concentration as calculated from sample dry weight and the dilution factor and the metal content for each sample.

Macoma balthica: San Jose 2/10/94

-	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	12.19	ERR	3.93	126	6.54	4.80	2.44	423
STD	2.73	ERR	1.27	22	1.51	1.31	0.81	94
SEM	1.03	ERR	0.48	8	0.57	0.50	0.31	35
CV%	22.4	ERR	32.3	17.1	23.0	27.3	33.1	22.1
n	7	0	7	7	7	7	7	7
r wt x [ ]	0.948	0.000	0.823	0.518	0.717	0.730	0.707	0.849
X 100mg	-46.88	0.000	-19.97	-129	-18.09	-17.04	-10.62	-1391
r l x [ ]	0.897	0.000	0.904	0.469	0.833	0.649	0.797	0.777
X 20mm	6.48	0.000	1.26	102	3.62	2.82	0.94	253
X 25mm	1.52	0.000	-1.08	82	1.07	1.10	-0.37	106

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.1712		0.0473	2.2768	0.0958	0.0680	0.0312	6.2389
25mm	0.2458		0.0621	3.8138	0.1411	0.0990	0.0426	9.2511

Estimated weight for 15mm clam

0.010 gm
10 mg

Estimated weight for 20mm clam

0.021 gm
21 mg

Estimated weight for 25mm clam

0.039 gm
39 mg

Macoma balthica: San Jose 2/10/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.4	0.0336	0.0037	5	0.106	0.0029	0.044	0.773	0.064	0.037	0.028	3.644
mb2	12.0	0.0395	0.0049	5	0.111	0.0007	0.033	1.15	0.053	0.039	0.018	3.926
mb3	13.6	0.0376	0.0075	5	0.099	0.0000	0.031	1.154	0.053	0.044	0.019	3.217
mb4	14.5	0.0254	0.0085	5	0.071	0.0007	0.017	0.675	0.026	0.033	0.01	2.406
mb5	15.5	0.0529	0.0106	5	0.106	0.0036	0.039	1.377	0.064	0.047	0.027	3.4
mb6	16.4	0.0849	0.0142	5	0.143	0.0050	0.052	1.985	0.103	0.056	0.033	4.794
mb7	17.4	0.0532	0.0133	5	0.106	0.0014	0.028	0.943	0.055	0.032	0.018	4.403
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	0.0037
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0124

Concentration (ug/g) ==>

Sample #							
mb1	15.8	6.53	115	9.56	5.49	4.12	542
mb2	14.1	4.20	146	6.65	4.95	2.25	497
mb3	13.1	4.07	153	7.08	5.90	2.59	428
mb4	14.0	3.27	133	5.20	6.53	1.96	474
mb5	10.0	3.73	130	6.10	4.45	2.57	321
mb6	8.41	3.07	117	6.06	3.27	1.96	282
mb7	9.92	2.65	88.6	5.14	3.02	1.67	414

Content (ug) ==>

Sample #							
mb1	0.0584	0.0242	0.4254	0.0354	0.0203	0.0152	2.0066
mb2	0.0689	0.0206	0.7131	0.0326	0.0242	0.0110	2.4350
mb3	0.0983	0.0305	1.1507	0.0531	0.0443	0.0194	3.2084
mb4	0.1189	0.0278	1.1286	0.0442	0.0555	0.0167	4.0265
mb5	0.1063	0.0395	1.3800	0.0646	0.0472	0.0272	3.4063
mb6	0.1194	0.0436	1.6598	0.0860	0.0465	0.0278	4.0091
mb7	0.1319	0.0353	1.1786	0.0683	0.0402	0.0222	5.5034

Macoma balthica: San Jose 4/21/94

–	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	1.8	0.1	5.9	30.5	7.8	4.1	4.6	231
STD	0.3	ERR	2.0	3.9	1.9	1.0	1.5	21
SEM	0.1	ERR	0.8	1.6	0.8	0.4	0.6	9
CV%	14.5	ERR	33.3	12.9	24.2	24.7	32.4	9.2
n	6	1	6	6	6	6	6	6
r wt x [ ]	0.400	0.000	0.894	0.097	0.867	0.899	0.863	0.373
X 100mg	1.670	0.000	3.898	30.908	5.972	3.081	3.134	222.259
r l x [ ]	0.459	0.000	0.851	0.106	0.841	0.853	0.826	0.416
X 20mm	1.7	0.0	4.9	30.2	6.9	3.6	3.9	226
X 25mm	1.6	0.0	3.4	29.9	5.5	2.8	2.8	218

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.1031		0.2602	1.8122	0.3960	0.2057	0.2091	13.6858
25mm	0.1837		0.3802	3.3187	0.6343	0.3265	0.3121	24.8784

Estimated weight for 15mm clam

0.027 gm
27 mg

Estimated weight for 20mm clam

0.061 gm
61 mg

Estimated weight for 25mm clam

0.114 gm
114 mg

Macoma balthica: San Jose 4/21/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES							
					Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	10.3	0.0474	0.0095	5	0.019	0.002	0.07	0.343	0.093	0.046	0.055	2.398
mb2	13.0	0.1431	0.0179	5	0.06	0.005	0.153	0.913	0.201	0.112	0.114	6.236
mb3	14.8	0.1954	0.0279	5	0.055	0.006	0.299	1.033	0.353	0.195	0.234	9.348
mb4	16.6	0.1336	0.0334	5	0.051	0.004	0.178	0.764	0.238	0.125	0.136	6.802
mb5	18.2	0.2468	0.0494	5	0.081	0.007	0.287	1.312	0.377	0.193	0.227	9.935
mb6	26.9	0.1395	0.1395	5	0.046	0.001	0.065	0.926	0.127	0.064	0.055	6.174
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	-0.0002
				LOQ	*0.0102*	*0.0139*	*0.0089*	*0.0110*	*0.0245*	*0.0553*	*0.0088*	0.0124

Concentration (ug/g) ==>

Sample #							
mb1	1.989		7.410	36.16	9.805	4.877	5.831	253.0
mb2	2.105		5.347	31.92	7.008	3.901	3.981	217.9
mb3	1.417		7.655	26.44	9.027	5.001	5.979	239.2
mb4	1.914		6.671	28.58	8.907	4.692	5.104	254.6
mb5	1.643	0.1398	5.811	26.58	7.638	3.919	4.604	201.3
mb6	1.649		2.315	33.20	4.553	2.276	1.966	221.3

Content (ug) ==>

Sample #							
mb1	0.0189		0.0704	0.3435	0.0931	0.0463	0.0554	2.4031
mb2	0.0377		0.0957	0.5713	0.1254	0.0698	0.0713	3.9000
mb3	0.0395		0.2136	0.7376	0.2518	0.1395	0.1668	6.6735
mb4	0.0639		0.2228	0.9546	0.2975	0.1567	0.1705	8.5027
mb5	0.0812	0.0069	0.2871	1.3131	0.3773	0.1936	0.2274	9.9430
mb6	0.2300		0.3230	4.6316	0.6351	0.3175	0.2742	30.8677

Macoma balthica: San Jose 6/17/94

-	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	1.3	0.3	1.6	29.6	4.3	1.7	1.2	229.0
STD	0.4	0.2	0.6	10.4	1.2	0.5	0.5	26.7
SEM	0.2	0.1	0.2	3.7	0.4	0.2	0.2	9.4
CV%	33.4	57.9	38.9	35.2	26.6	30.0	46.1	11.7
n	8	8	8	8	8	7	8	8
r wt x [ ]	0.099	0.766	0.319	0.125	0.457	0.389	0.076	0.083
X 100mg	1.191	-0.003	1.131	32.607	3.139	1.225	1.067	223.991
r l x [ ]	0.025	0.819	0.294	0.196	0.464	0.369	0.045	0.111
X 20mm	1.3	0.2	1.4	31.2	3.9	1.6	1.1	226.8
X 25mm	1.3	-0.0	1.2	34.3	3.1	1.2	1.1	222.2

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.0771	0.0126	0.0865	1.8453	0.2472	0.0965	0.0670	14.4320
25mm	0.1422	0.0146	0.1425	3.6093	0.4106	0.1503	0.1225	27.0531

Estimated weight for 15mm clam

0.028 gm
28 mg

Estimated weight for 20mm clam

0.064 gm
64 mg

Estimated weight for 25mm clam

0.124 gm
124 mg

Macoma balthica: San Jose 6/17/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
mb1	12.7	0.0619	0.0155	5	0.017	0.008	0.023	0.347	0.059	0.03	0.012	3.027
mb2	14.6	0.1355	0.0271	5	0.052	0.014	0.074	1.104	0.182	0.073	0.059	6.593
mb3	15.5	0.2542	0.0318	5	0.05	0.014	0.07	1.293	0.231	0.082	0.053	11.7
mb4	17.1	0.2096	0.0419	5	0.037	0.008	0.049	1.025	0.154	0.059	0.037	8.992
mb5	18.5	0.2394	0.0479	5	0.068	0.009	0.056	1.235	0.15	0.067	0.036	10.94
mb6	19.3	0.2496	0.0624	5	0.051	0.012	0.059	1.085	0.182	0.074	0.044	8.541
mb7	20.3	0.2249	0.0750	5	0.038	0.009	0.043	0.921	0.153	0.054	0.033	11.57
mb8	22.5	0.1587	0.0794	5	0.059	0.006	0.068	1.6	0.152	0.063	0.058	7.72
				LOD	0.0021	0.0060	0.0019	0.0043	0.0095	0.0326	0.0022	-0.0002
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #								
mb1	1.372	0.6519	1.834	28.05	4.799		0.994	244.5
mb2	1.926	0.5041	2.745	40.72	6.704	2.677	2.169	243.3
mb3	0.988	0.2809	1.379	25.43	4.552	1.613	1.034	230.1
mb4	0.880	0.1925	1.178	24.45	3.666	1.396	0.872	214.5
mb5	1.426	0.1815	1.176	25.79	3.138	1.409	0.761	228.5
mb6	1.016	0.2364	1.186	21.74	3.647	1.474	0.889	171.1
mb7	0.837	0.1932	0.965	20.48	3.400	1.201	0.731	257.1
mb8	1.859	0.1957	2.141	50.40	4.786	1.991	1.822	243.2

Content (ug) ==>

Sample #								
mb1	0.0213	0.0101	0.0284	0.4348	0.0744		0.0154	3.7893
mb2	0.0522	0.0137	0.0744	1.1036	0.1817	0.0726	0.0588	6.5928
mb3	0.0314	0.0089	0.0438	0.8088	0.1447	0.0513	0.0329	7.3179
mb4	0.0369	0.0081	0.0494	1.0245	0.1536	0.0585	0.0366	8.9880
mb5	0.0683	0.0087	0.0563	1.2352	0.1503	0.0675	0.0365	10.9454
mb6	0.0634	0.0148	0.0740	1.3568	0.2276	0.0920	0.0555	10.6767
mb7	0.0628	0.0145	0.0724	1.5357	0.2550	0.0901	0.0548	19.2818
mb8	0.1476	0.0155	0.1700	4.0017	0.3800	0.1580	0.1446	19.3132

Macoma balthica: San Jose 9/13/94

–	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mean(ug/g)	1.6	0.3	4.8	33.8	7.6	4.4	3.9	163
STD	0.3	ERR	1.6	5.8	1.6	0.8	1.3	24
SEM	0.1	ERR	0.5	1.9	0.5	0.3	0.4	8
CV%	17.2	ERR	33.6	17.2	21.4	18.1	33.5	14.8
n	9	1	9	9	9	9	9	9
r wt x [ ]	0.061	0.000	0.144	0.473	0.120	0.158	0.185	0.765
X 100mg	1.501	0.000	5.723	22.789	8.401	3.894	4.865	89.243
r l x [ ]	0.263	0.000	0.081	0.635	0.017	0.224	0.121	0.845
X 20mm	1.4	0.0	5.0	27.1	7.7	4.1	4.2	126
X 25mm	1.3	0.0	5.2	22.3	7.7	3.8	4.4	100

Estimated content (ug) for 20mm and 25mm clam

	Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
20mm	0.09		0.28	1.69	0.44	0.25	0.23	7.98
25mm	0.16		0.57	3.08	0.88	0.47	0.48	14.42

Estimated weight for 15mm clam

0.025 gm
25 mg

Estimated weight for 20mm clam

0.061 gm
61 mg

Estimated weight for 25mm clam

0.122 gm
122 mg

Macoma balthica: San Jose 9/13/94

Sample #-n	Average Length (mm)	Total Dry Wt (gm)	Average Dry Wt (gm)	Recon Amt (ml)	Concentration (ug/ml) - Blank Corrected from ICP-AES Ag	Cd	Cr	Cu	Ni	Pb	V	Zn
Mb1	8.3	0.0775	0.0043	5	0.026	0.004	0.086	0.645	0.132	0.082	0.071	2.807
Mb2	9.5	0.0848	0.0061	5	0.034	0.004	0.094	0.754	0.138	0.081	0.074	3.296
Mb3	10.6	0.1048	0.0081	5	0.036	0.005	0.066	0.711	0.136	0.077	0.052	3.912
Mb4	11.5	0.1315	0.0101	5	0.043	0.007	0.079	0.781	0.182	0.093	0.062	4.939
Mb5	12.5	0.0950	0.0136	5	0.024	0.006	0.099	0.605	0.143	0.091	0.08	3.05
Mb6	13.6	0.0877	0.0175	5	0.024	0.002	0.123	0.608	0.146	0.097	0.099	2.569
Mb7	14.7	0.0680	0.0227	5	0.015	0.001	0.034	0.359	0.066	0.045	0.029	1.925
Mb8	16.8	0.0829	0.0415	5	0.027	0.002	0.109	0.504	0.179	0.077	0.091	2.197
Mb9	20.5	0.1921	0.0640	5	0.065	0.007	0.181	1.194	0.269	0.156	0.15	5.369
				LOD	0.002	0.006	0.002	0.004	0.01	0.033	0.01	*****
				LOQ	0.0064	0.0184	0.0053	0.0129	0.0225	0.0815	0.0047	0.0251

Concentration (ug/g) ==>

Sample #								
Mb1	1.692		5.546	41.60	8.501	5.263	4.565	181.1
Mb2	2.009		5.541	44.46	8.161	4.801	4.343	194.4
Mb3	1.700		3.134	33.94	6.467	3.670	2.500	186.7
Mb4	1.625	0.2814	2.992	29.69	6.935	3.528	2.366	187.8
Mb5	1.275		5.193	31.82	7.531	4.781	4.203	160.5
Mb6	1.384		6.989	34.66	8.306	5.541	5.624	146.4
Mb7	1.104		2.471	26.41	4.878	3.282	2.114	141.6
Mb8	1.625		6.590	30.39	10.788	4.644	5.467	132.5
Mb9	1.688		4.723	31.07	6.989	4.059	3.907	139.7

Content (ug) ==>

Sample #								
Mb1	0.0073		0.0238	0.1789	0.0366	0.0226	0.0196	0.7786
Mb2	0.0123		0.0338	0.2712	0.0498	0.0293	0.0265	1.1855
Mb3	0.0138		0.0254	0.2749	0.0524	0.0297	0.0203	1.5119
Mb4	0.0164	0.0028	0.0302	0.2998	0.0700	0.0356	0.0239	1.8967
Mb5	0.0173		0.0706	0.4328	0.1024	0.0650	0.0572	2.1829
Mb6	0.0242		0.1223	0.6065	0.1454	0.0970	0.0984	2.5627
Mb7	0.0251		0.0561	0.5994	0.1107	0.0745	0.0480	3.2134
Mb8	0.0674		0.2735	1.2613	0.4477	0.1927	0.2269	5.4997
Mb9	0.1080		0.3023	1.9885	0.4473	0.2597	0.2500	8.9430