SCIENCE APPLICATIONS, INC.

INTERIM REPORT ON THE CONCENTRATION OF TRACE METALS IN *MYTILUS EDULIS* DEPLOYED AT THE WESTERN LONG ISLAND SOUND DISPOSAL SITE

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Submitted to:

Richard C. Semonian
New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Submitted by:

Sung Y. Feng
Marine Sciences Institute
University of Connecticut
Groton, CT 06340

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1.0 INTRODUCTION

The Western Long Island Sound Disposal Site (WLIS III) located in the waters off Norwalk, CT, was designated in March 1982 to accommodate the disposal of dredge material generated from that region. The site is in 40 meters of water on a flat bottom at the deepest part of an east-west trending trough (DAMOS Contribution #19).

Disposal operations began at the site in March 1982 and continued through June 1982; during this period approximately 40,000 cubic meters (53,000 yds^3) of dredge materials were dumped at the site. Dumping was resumed in December 1982 and halted in June 1983, during which time 71,000 cubic meters (93,000 yds^3) of material were dumped, making a total of 111,000 cubic meters (146,000 yds^3) since the site was opened. The disposal activities at the site are depicted as a function of time in Figure 1.

2.0 METHODS

A mussel platform similar to those used at other DAMOS sites was deployed prior to the disposal of dredge material in March 1982. *Mytilus edulis* collected from Latimer's Light, the reference site in Eastern Long Island Sound, were used to stock the platform. Samples from the platform were obtained by divers and the first phase monitoring was conducted from March to July 1982 until the platform was lost. The platform was replaced on November 22, 1982 using mussels from the same source. Sampling is continuing at this time.

During the period from March 1982 to March 1983, 38

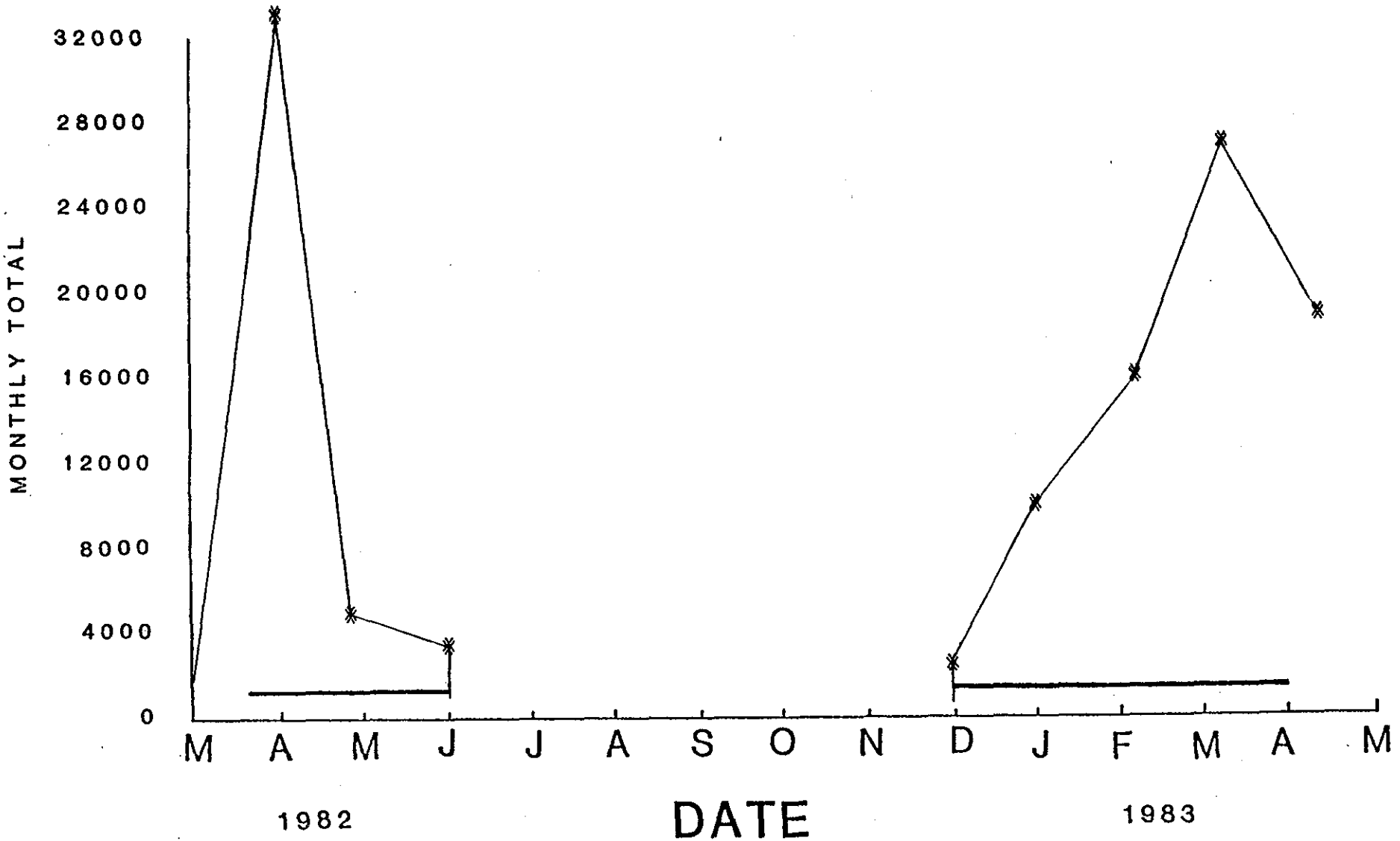

Figure 1 Cubic meters of dredge materials deposited at the Western Long Island Sound Site (March 1982 to March 1983).

samples were obtained from this site while a set of samples with roughly comparable time frames were collected from the reference site. These samples have been analyzed for Cd, Co, Cr, Fe, Hg, Ni, Zn and V; analyses of polycholorinated biphenyls (PCB's) are still incomplete.

3.0 RESULTS

Results of the trace metal levels in mussels are summarized in Tables 1 and 2 and shown in Figures 2 to 10. Several distinct patterns of trace metal behavior in the mussels can be discerned based on the trend of trace metal concentrations over time in the experimental (WLIS III) and the reference (Latimer's Light) groups.

One pattern is exemplified by the similar behavior of Cu, Zn and Cd (Figs. 2, 3 and 4) in the experimental group which generally exhibit higher levels of trace metals and which differ from the pattern of seasonal change of trace metals in the reference mussels. Although the higher levels of these trace metals occur during the period when dredge material was deposited at the site, no data for comparison are available during periods without disposal.

The concentrations of Co and Ni in the experimental group, for the most part, do not show significant deviations from those of the reference group (Figs. 5 and 6) except for the concentration of the two trace metals in the WLIS III mussels obtained during June 1982 and March 1983. In addition, the experimental group of December 1982 shows an unexpectedly high level of Ni (Fig. 6).

TABLE 1. Heavy Metal Concentrations in *Mytilus edulis* from Latimer's Light Reference Station

Mean Metal Concentration (ug/g dry tissue)

Sample Date	Cd	Cr	Co	Cu	Fe	Hg	Ni	V	Zn
3/25/82*	1.19 (.07)	3.72 (1.98)	.46 (.12)	8.12 (.41)	183.15 (24.89)	.164 (.011)	2.03 (1.01)	1.61 (.64)	140.19 (16.71)
4/10/82	1.65 (.49)	4.50 (3.36)	.45 (.44)	8.45 (.83)	222.6 (40.3)	.20 (.06)	4.45 (2.97)	1.80 (.81)	115.9 (20.8)
5/15/82	1.33 (.23)	5.15 (2.73)	.54 (.23)	9.03 (.78)	214.98 (40.41)	.18 (.03)	4.24 (.98)	1.51 (.40)	128.17 (18.81)
6/10/82	1.06 (.06)	2.97 (.50)	.24 (.05)	8.18 (1.00)	200.09 (27.55)	.13 (.01)	2.29 (.66)	NA	119.73 (25.11)
7/10/82	1.19 (.69)	1.45 (.98)	.28 (.09)	6.91 (.62)	136.18 (19.16)	.15 (.03)	1.44 (.68)	1.57 (1.24)	117.08 (25.40)
8/10/82	.74 (.06)	2.42 (1.18)	.23 (.07)	8.40 (.76)	180.99 (18.24)	.14 (.02)	2.64 (.79)	.97 (.23)	140.91 (15.38)
8/16/82*	1.17 (.72)	2.09 (.51)	.20 (.10)	9.70 (.63)	122.89 (23.34)	.126 (.011)	2.76 (.61)	.55 (.16)	148.54 (12.81)
9/30/82	.71 (.08)	1.91 (.18)	.53 (.07)	5.49 (.82)	152.24 (13.76)	.187 (.008)	.75 (.18)	2.24 (.58)	118.09 (21.21)
10/28/82	.71 (.09)	5.89 (3.83)	.62 (.18)	6.74 (.27)	252.95 (63.14)	.190 (.005)	3.62 (2.64)	1.67 (.86)	117.95 (10.53)
11/22/82*	1.22 (.61)	1.31 (.50)	.51 (.14)	8.72 (.89)	191.12 (29.41)	.142 (.010)	2.23 (.65)	1.22 (.59)	112.43 (21.90)
12/2/82	.94 (.35)	3.13 (1.05)	.58 (.18)	8.48 (1.22)	180.02 (27.70)	.145 (.005)	1.94 (1.02)	2.33 (.85)	135.13 (16.98)
1/7/83	2.06 (1.23)	2.85 (1.00)	1.24 (.10)	8.98 (.79)	588.82 (79.68)	.195 (.022)	2.63 (.77)	1.37 (.36)	155.06 (19.92)
1/27/83	.31 (.11)	10.21 (7.15)	.58 (.09)	9.16 (.47)	266.09 (89.65)	.160 (.013)	6.75 (2.40)	2.01 (1.28)	151.23 (12.31)

TABLE 1 (CONT.). Heavy Metal Concentrations in *Mytilus edulis* from Latimer's Light Reference Station

Sample Date	Mean Metal Concentration (ug/g dry tissue)								
	Cd	Cr	Co	Cu	Fe	Hg	Ni	V	Zn
2/23/83	.33 (.08)	1.82 (.16)	.35 (.09)	9.53 (.58)	259.61 (15.67)	.173 (.012)	1.66 (.64)	2.54 (.25)	130.07 (20.33)
2/28/83*	.93 (.13)	1.58 (.57)	.36 (.12)	9.57 (.53)	253.70 (21.91)	.182 (0.14)	2.16 (.40)	3.21 (.29)	140.16 (16.16)
4/16/83	.75 (.09)	3.64 (.81)	.36 (.08)	9.03 (.61)	182.77 (11.00)	.177 (.025)	3.28 (.73)	1.65 (.00)	110.56 (14.88)

Numbers in parenthesis equal one standard deviation

*denotes baseline sample

TABLE 2. Heavy Metal Concentrations in *Mytilus edulis* Deployed At the Western Long Island Sound Disposal Site

Mean Metal Concentration (ug/g dry tissue)

Sample Date	Cd	Cr	Co	Cu	Fe	Hg	Ni	V	Zn
5/20/82	1.70 (.27)	1.39 (.91)	.47 (.02)	11.18 (.27)	222.38 (16.9)	.142 (.012)	3.46 (.62)	.24 (.15)	156.35 (26.64)
5/20/82	.96 (.13)	1.71 (.24)	.47 (.15)	11.49 (1.07)	216.07 (68.7)	.135 (0.00)	3.20 (.69)	1.04 (.40)	144.91 (16.22)
6/29/82	1.38 (.07)	.52 (.04)	.52 (.04)	12.98 (1.31)	241.42 (22.76)	.176 (.004)	4.26 (.83)	.94 (.40)	182.67 (.80)
12/30/82	1.38 (.07)	3.12 (1.44)	.58 (.17)	11.14 (.96)	229.27 (23.01)	.173 (.025)	6.04 (2.84)	.51 (.26)	160.79 (17.60)
1/21/83	1.61 (.06)	2.94 (.17)	.72 (.10)	16.02 (1.03)	396.88 (74.08)	.185 (.010)	3.30 (.34)	.75 (.71)	179.89 (10.34)
3/14/83	2.36 (.12)	1.60 (.76)	.65 (.07)	17.05 (.23)	162.78 (36.07)	.150 (.008)	3.34 (1.00)	.75 (.71)	173.94 (14.40)
4/13/83	1.37 (.05)	2.66 (1.14)	.38 (.05)	14.68 (1.03)	266.45 (8.62)	.145 (.018)	3.25 (.31)	1.62 (.39)	167.55 (22.44)

Numbers in parenthesis equal one standard deviation

From Jim B

5/28/84

Contribution # 28

pg 1, 2.0 - Latimers Light is the control station, not reference

pg 3, 3.0, 2nd para - ~~Was there supposed to be data from post disposal periods~~? Why are they comparing the disposal site data to the controls? There should be a reference site close to the D.S. for comparison.

pg 3, last para - Whats so high about 6 ppm Ni? Why was it unexpected. How does the bulk chemical sediment data (dumped material) compare w/ the mussel uptake data?

pg 20, 1st para - They build up a good case here for comparing reference (near disposal site) instead of control data. Why was this program designed w/o a ref. station to begin with? The data generated at the disposal site is good only to establish some baseline conditions. It should be compared to bs results. Control data is not much help.

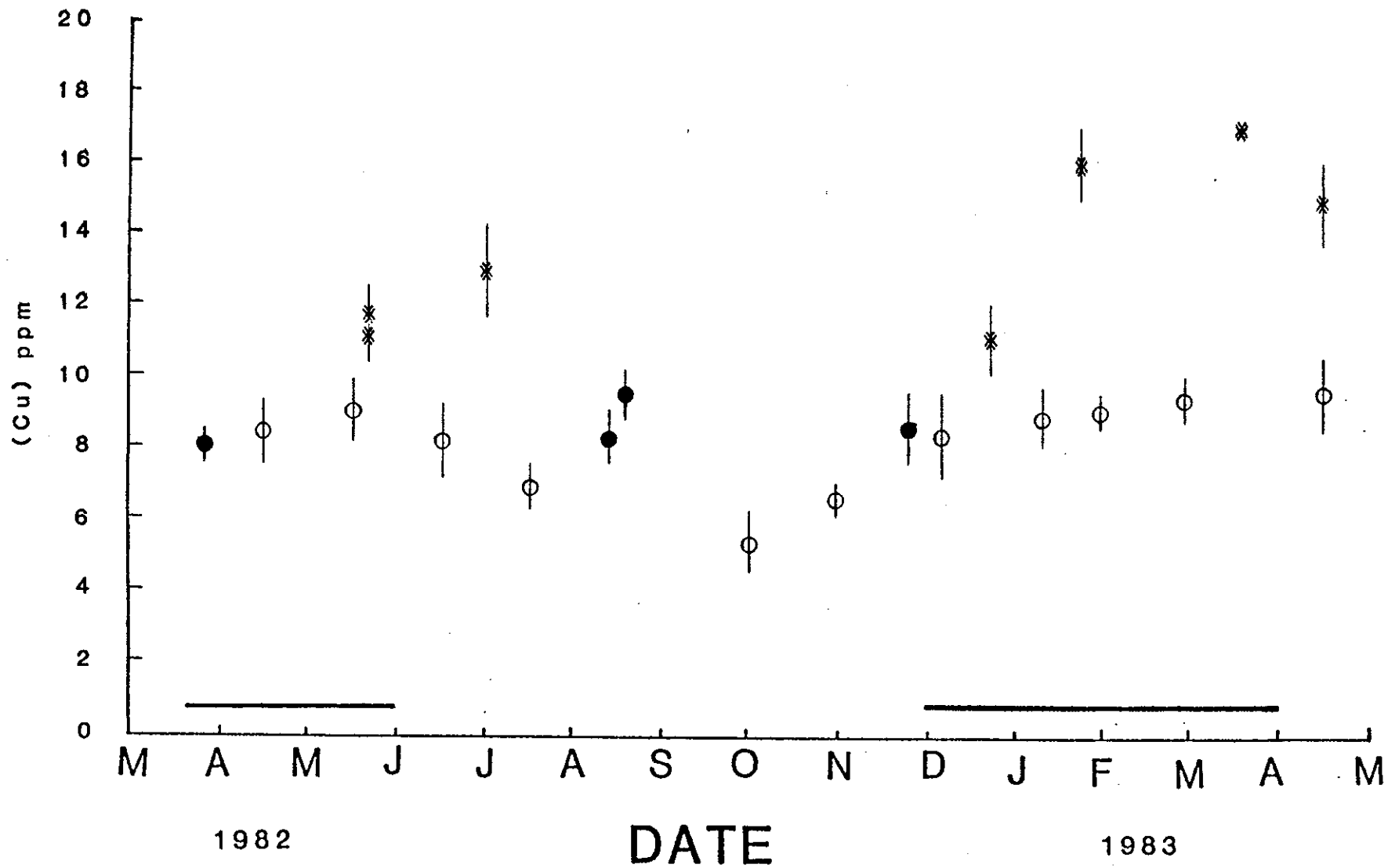

Figure 2. Concentration of Cu in *Mytilus edulis* from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

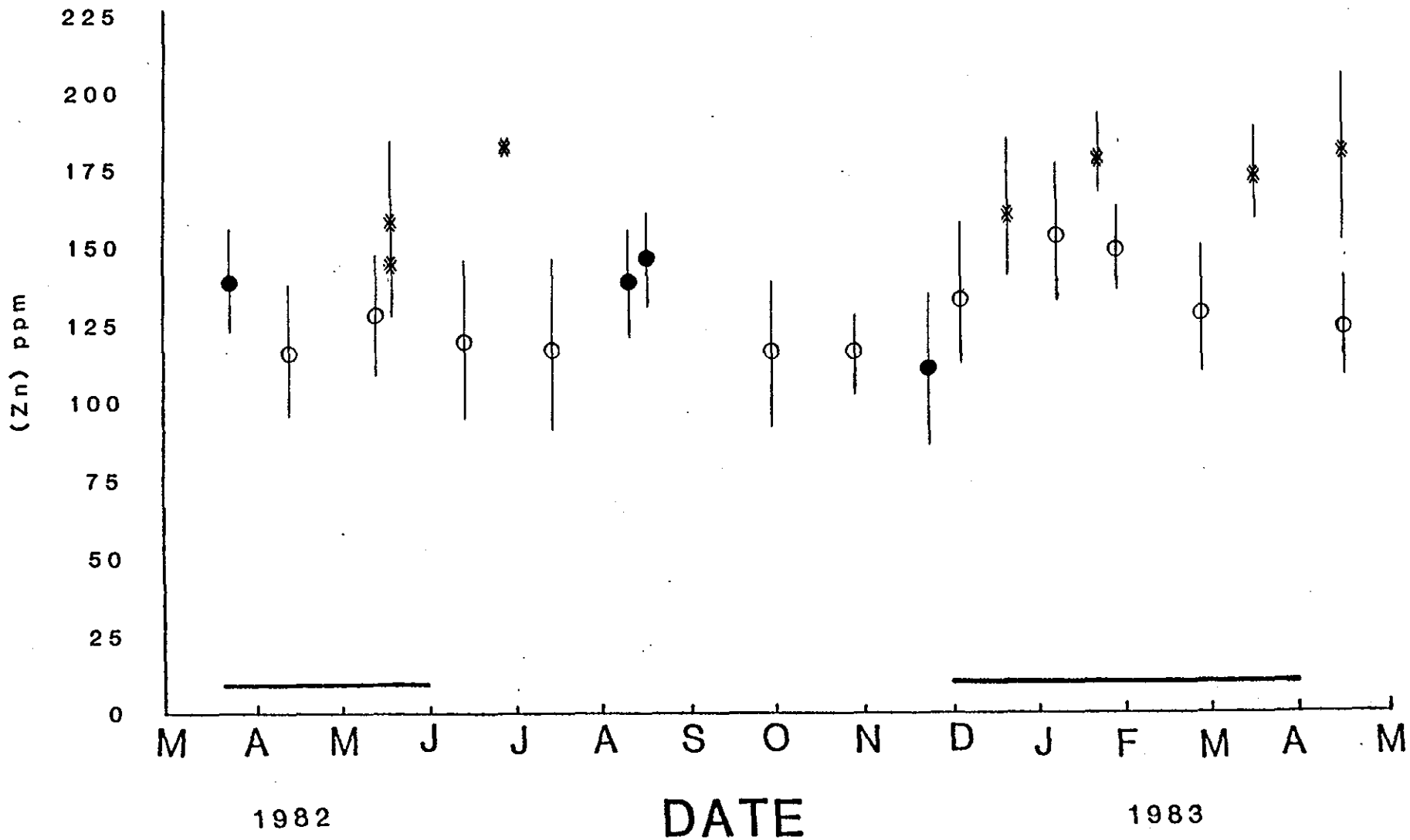

Figure 3. Concentration of Zn in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

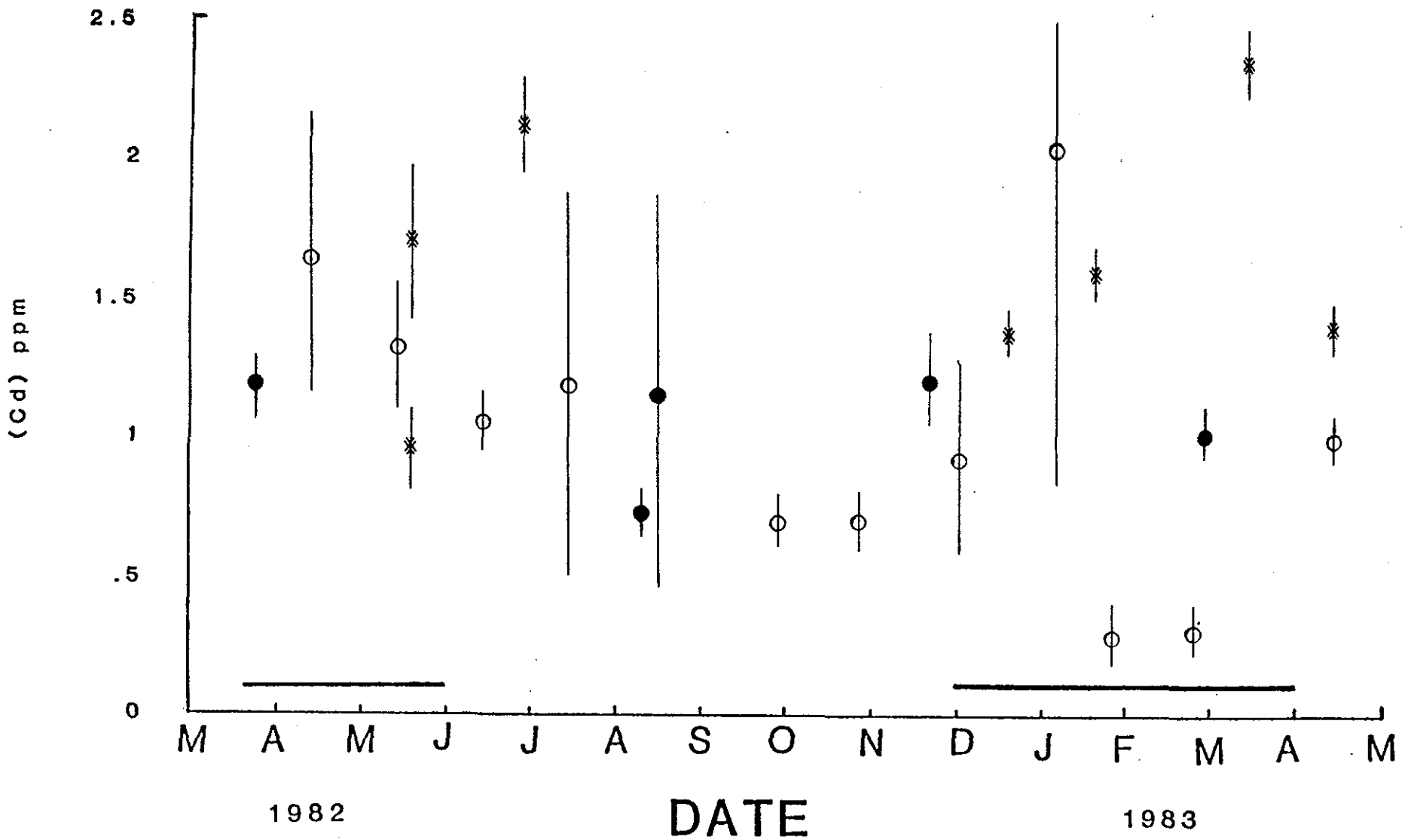

Figure 4. Concentration of Cd in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

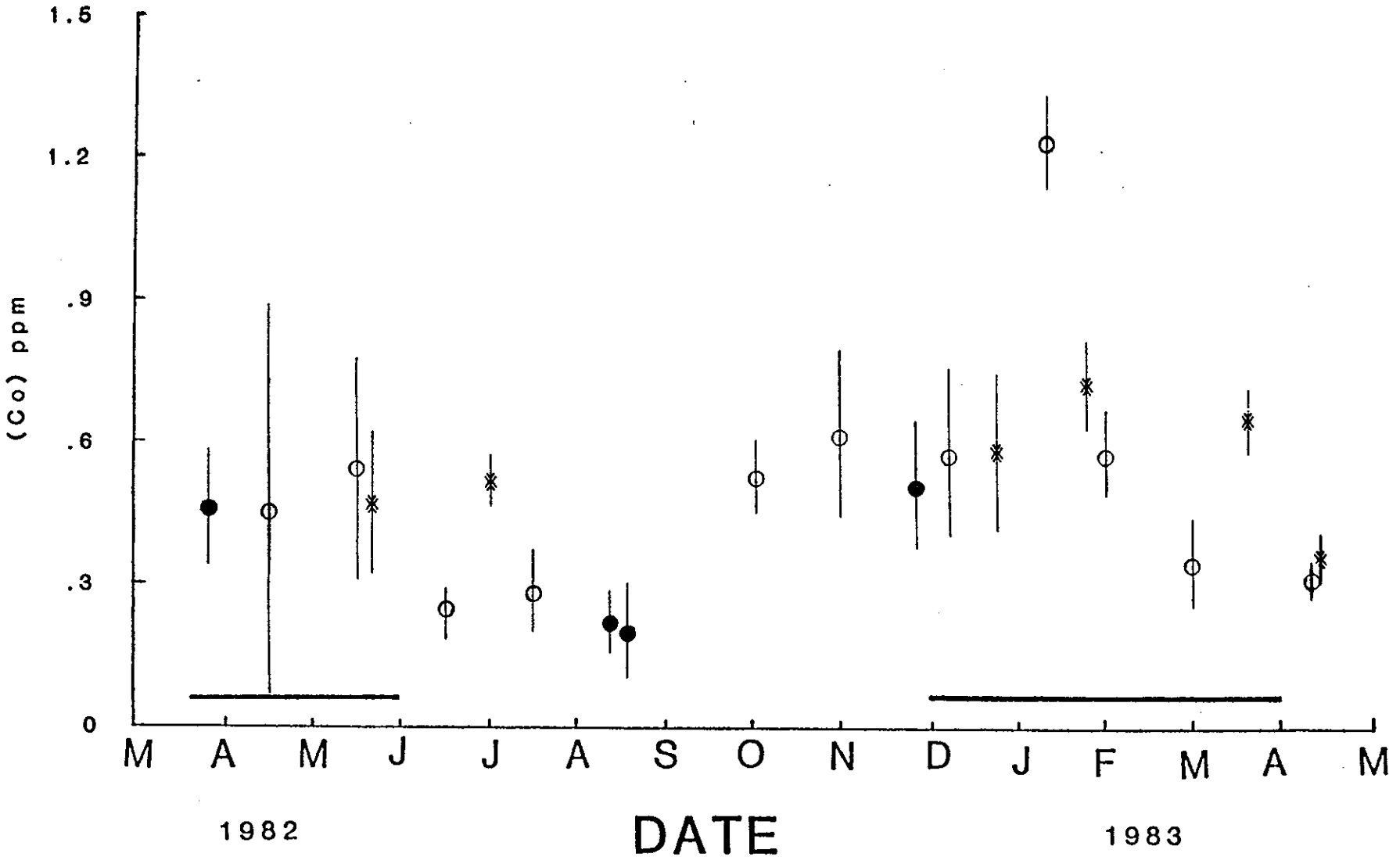

Figure 5. Concentration of Co in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

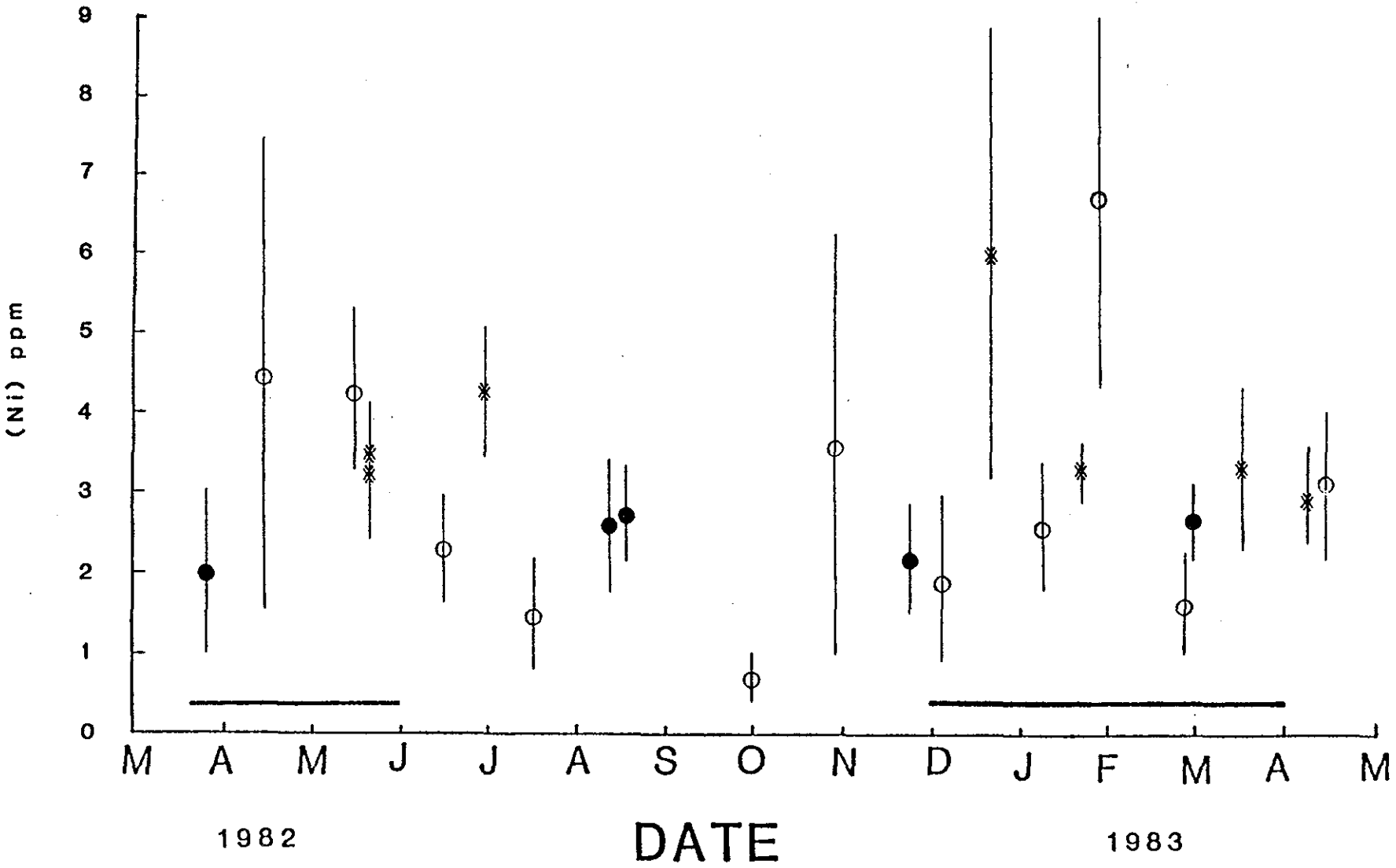

Figure 6. Concentration of Ni in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

There are no apparent differences in Fe or Hg concentrations between the experimental and reference mussels (Fig. 7 and 8) with the exception of the May 1982 sample which shows significantly lower concentration of Hg.

An overall lowering of the concentration of V is observed in the transplanted mussels at WLIS III as compared with that of the Latimer's Light mussels (Fig. 9).

The data on the concentrations of Cr strongly suggest that the trace metal is lower in the experimental mussels from March to July 1982, while the concentrations of Cr in the same group obtained during December 1982, January and March 1983, conform to that of the reference mussels (Fig. 10).

The heavy metal data are expressed on a wet weight basis in Tables 3 and 4. Although mussel wet weight is more variable than dry weight, depending on season and sample location, the comparisons of metal concentrations for the two sites are similar to those already described for dry tissue weights.

4.0 DISCUSSION

Based on the above observations, it appears that Fe and Hg concentrations in the mussels were independent of environmental changes experienced during transfer from Latimer's Light to the WLIS III disposal site, while the general lowering of V and Cr concentrations in the experimental mussels suggests the nonavailability of these trace metals at the dumpsite.

In the experimental mussels which exhibit heightened levels of Cu, Zn, Cd, Co and Ni, it is impossible to conclude

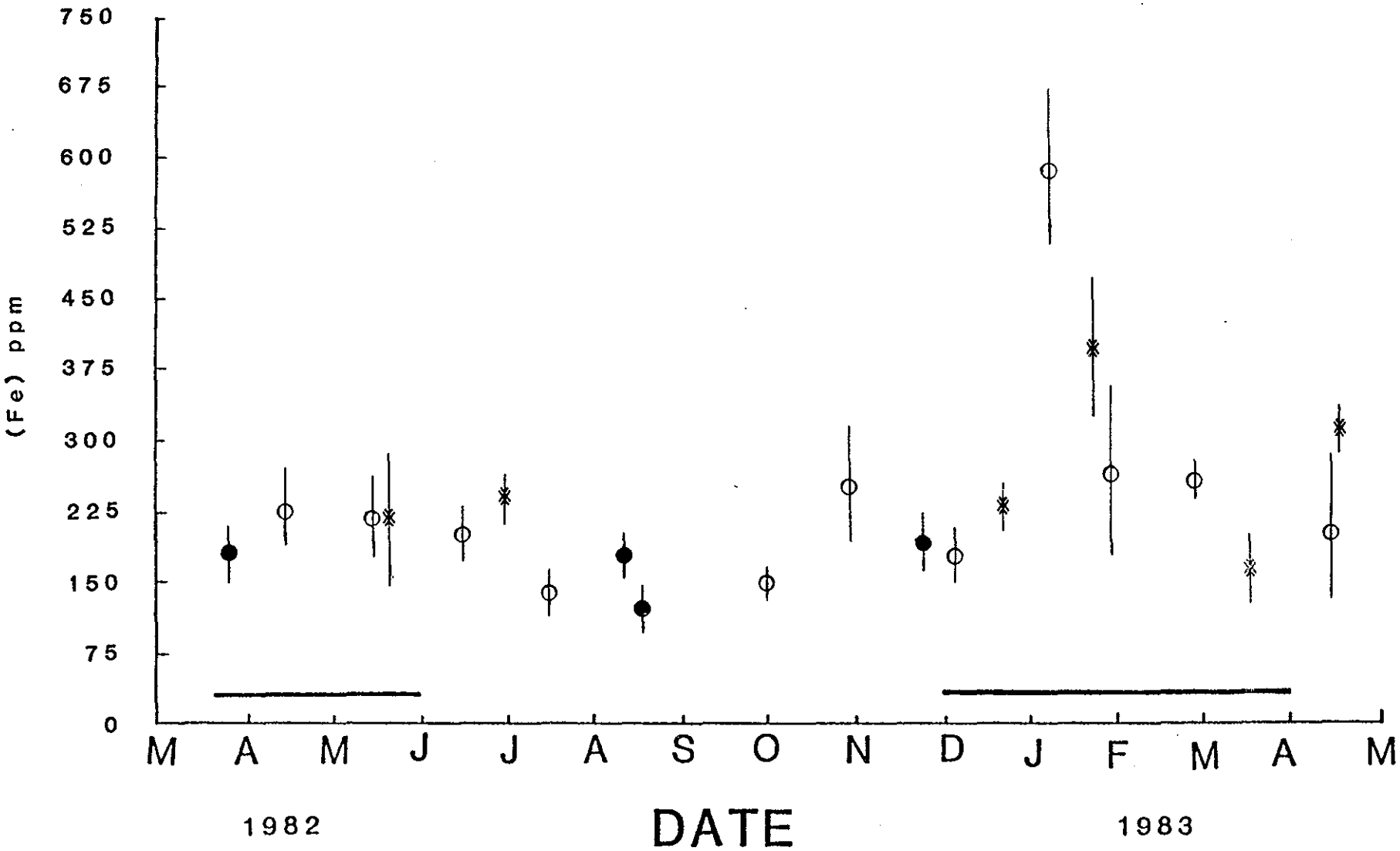

Figure 7. Concentration of Fe in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

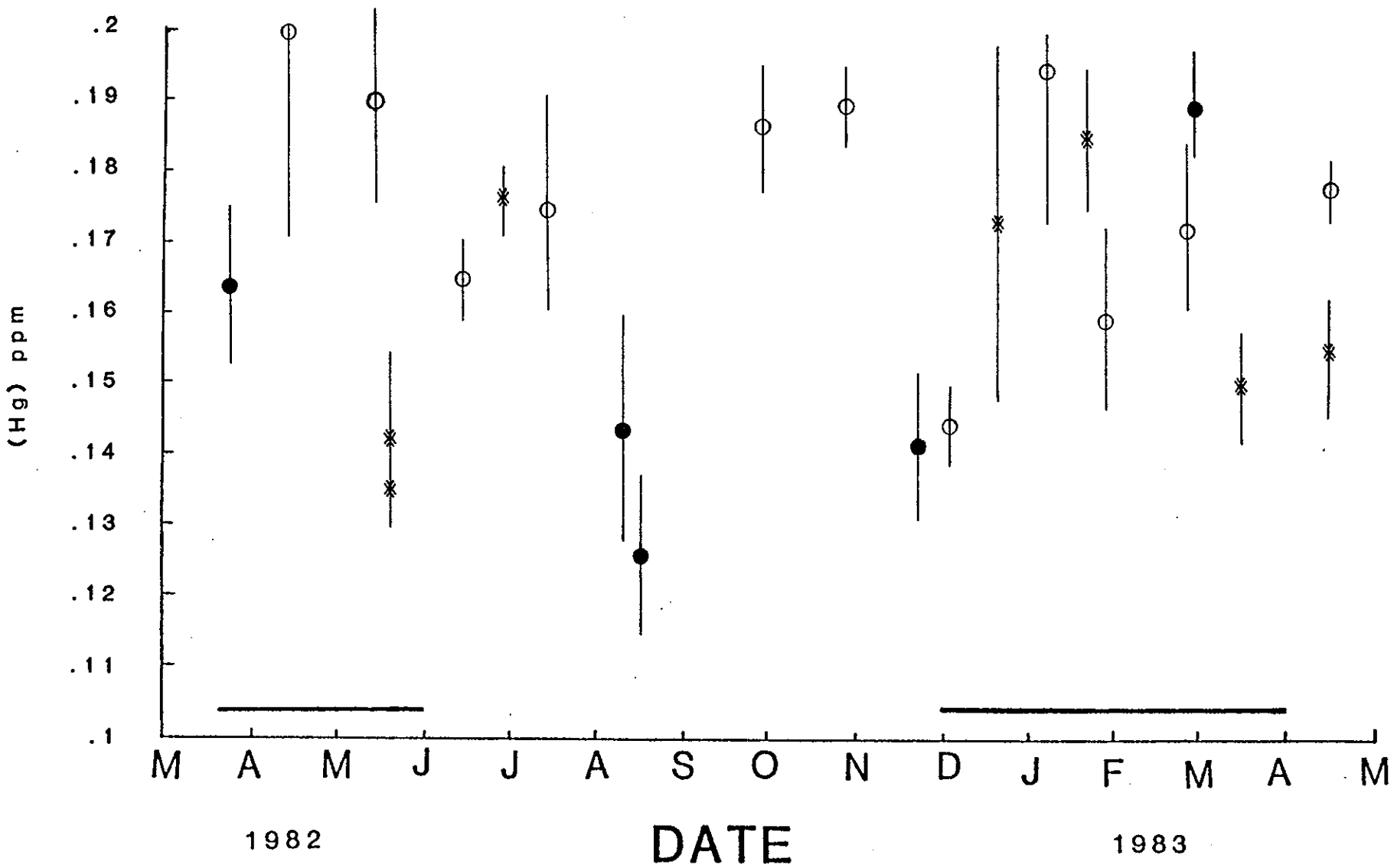

Figure 8. Concentration of Hg in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

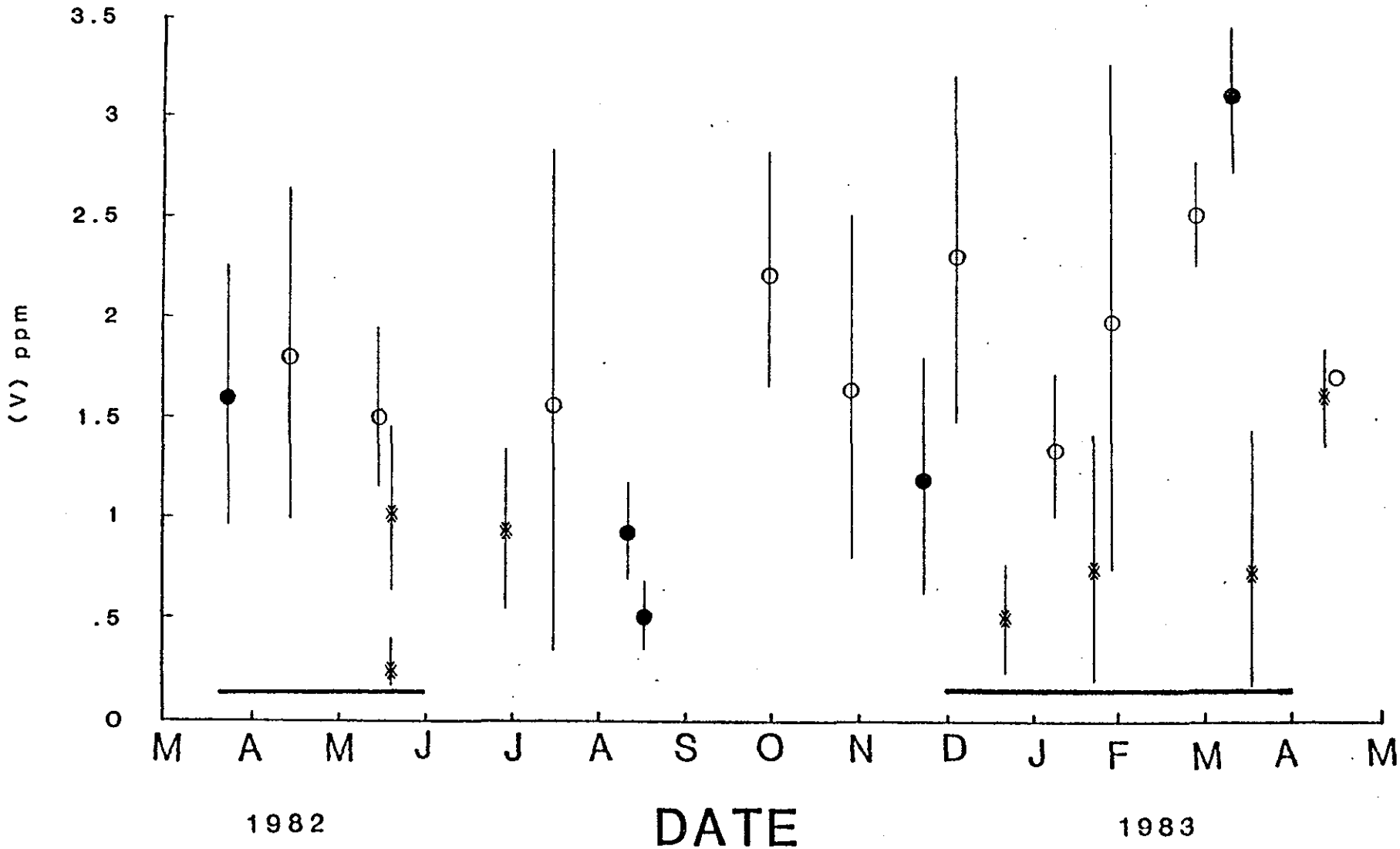

Figure 9. Concentration of V in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

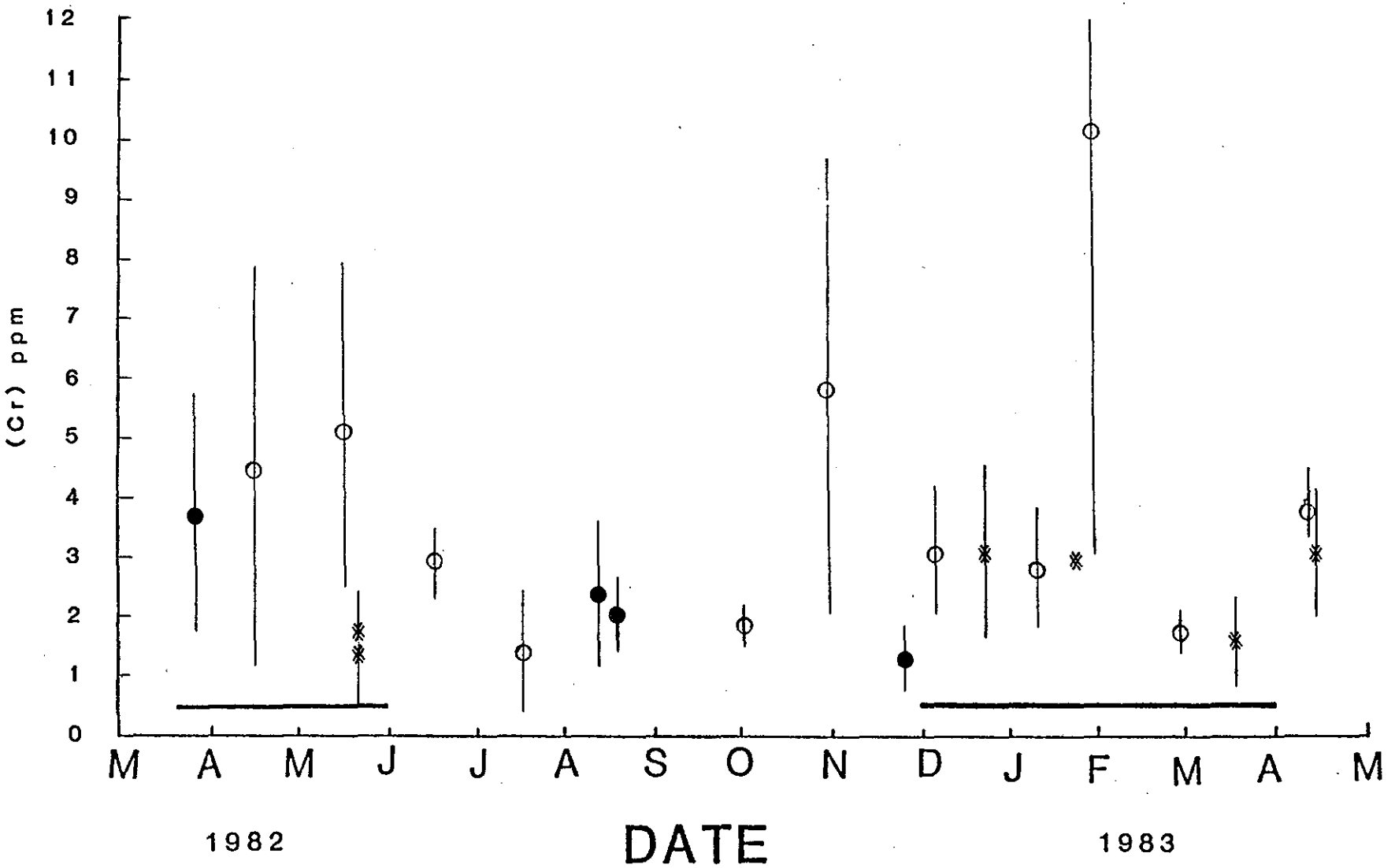

Figure 10. Concentration of Cr in Mytilus edulis from WLIS III and Latimer's Light.

Vertical bar = ±1S.D
Horizontal bar = period of disposal operations
* = WLIS III

o = Latimer's Light
● = Latimer's Light baseline samples

TABLE 3. Heavy Metal Concentrations in *Mytilus edulis* from Latimer's Light Reference Station

Mean Metal Concentration (ug/g wet tissue)

Sample Date	Cd	Cr	Co	Cu	Fe	Hg	Ni	V	Zn
3/25/82	.213 (.028)	.664 (.329)	.082 (.022)	1.47 (.28)	32.80 (5.24)	.029 (.003)	.363 (.169)	.288 (.117)	24.94 (3.24)
April*	.241 (.049)	.611 (.369)	.074 (.086)	1.30 (.30)	38.39 (6.79)	.033 (.020)	.601 (.251)	.264 (.120)	17.24 (3.72)
May*	.210 (.041)	.782 (.454)	.084 (.034)	1.42 (.17)	34.10 (7.55)	.029 (.003)	.618 (.208)	.238 (.067)	20.14 (2.99)
June*	.175 (.017)	.490 (.078)	.039 (.007)	1.28 (.12)	31.82 (5.82)	.021 (.002)	.376 (.100)	<.05 --	16.27 (8.17)
July*	.167 (.076)	.207 (.133)	.051 (.035)	1.06 (.26)	20.44 (3.96)	.022 (.004)	.416 (.617)	.214 (.143)	17.31 (3.23)
8/16/82	.191 (.117)	.342 (.084)	.034 (.015)	1.59 (.121)	20.22 (4.07)	.021 (.002)	.452 (.097)	.090 (.027)	24.42 (2.60)
9/30/82	.083 (.013)	.221 (.019)	.062 (.011)	.638 (.074)	17.91 (1.40)	.022 (.001)	.086 (.017)	.262 (.075)	13.65 (1.89)
10/28/82	.087 (.011)	.703 (.440)	.074 (.019)	.813 (.054)	30.46 (7.72)	.023 (.001)	.430 (.304)	.199 (.099)	14.19 (1.14)
11/22/82	.163 (.013)	.171 (.052)	.068 (.020)	1.18 (.17)	25.75 (4.37)	.019 (.002)	.302 (.096)	.166 (.086)	15.06 (2.62)
12/2/82	.118 (.040)	.397 (.138)	.072 (.019)	1.07 (.18)	22.65 (2.25)	.018 (.001)	.242 (.120)	.294 (.105)	17.06 (2.05)
1/7/83	.252 (.161)	.340 (.111)	.148 (.008)	1.08 (.14)	70.54 (7.04)	.023 (.002)	.319 (.107)	.147 (.045)	18.58 (1.71)
1/27/83	.040 (.012)	1.33 (.86)	.076 (.009)	1.21 (.09)	34.94 (10.53)	.021 (.001)	.892 (.318)	.266 (.169)	20.06 (2.71)
2/23/83	.044 (.010)	.244 (.030)	.047 (.014)	1.28 (.15)	34.79 (2.39)	.023 (.001)	.226 (.102)	.342 (.045)	17.42 (2.62)

TABLE 3 (CONT.). Heavy Metal Concentrations in *Mytilus edulis* from Latimer's Light Reference Station.

Mean Metal Concentration (ug/g wet tissue)

Sample Date	Cd	Cr	Co	Cu	Fe	Hg	Ni	V	Zn
2/28/83	.118 (.018)	.204 (.082)	.046 (.016)	1.21 (.08)	32.25 (4.08)	.023 (.002)	.275 (.061)	.407 (.049)	17.73 (1.91)
4/6/83	.091 (.007)	.444 (.101)	.043 (.007)	1.10 (.08)	22.30 (1.50)	.021 (.002)	.398 (.072)	.201 (.008)	13.47 (1.60)

*Composite values calculated from 1978-1981 samples.

Numbers in parenthesis equal one standard deviation.

TABLE 4. Heavy Metal Concentrations in *Mytilus edulis* Deployed at Western Long Island Sound Site.

Mean Metal Concentration (ug/g wet tissue)

Sample Date	Cd	Cr	Co	Cu	Fe	Hg	Ni	V	Zn
5/20/82	.295 (.047)	.267 (.111)	.081 (.001)	1.93 (.09)	38.46 (2.98)	.025 (.002)	.599 (.100)	.039 (.019)	27.15 (4.68)
5/20/82	.150 (.023)	.267 (.041)	.073 (.024)	1.79 (.19)	33.81 (11.27)	.021 (.000)	.500 (.114)	.162 (.064)	22.62 (2.61)
6/29/82	.281 (.052)	.143 (.012)	.069 (.007)	1.70 (.20)	31.70 (3.70)	.023 (.003)	.562 (.140)	.121 (.045)	24.04 (2.73)
12/20/82	.130 (.008)	.306 (.175)	.054 (.014)	1.05 (.12)	21.61 (1.07)	.016 (.001)	.590 (.346)	.047 (.019)	15.27 (2.74)
1/21/83	.163 (.009)	.296 (.011)	.073 (.010)	1.61 (.12)	39.91 (7.16)	.019 (.001)	.333 (.041)	.076 (.074)	18.10 (.78)
3/14/83	.357 (.035)	.238 (.103)	.099 (.014)	2.57 (.18)	24.39 (4.52)	.023 (.003)	.498 (.121)	.117 (.116)	26.22 (2.80)
4/13/83	.171 (.008)	.329 (.130)	.048 (.008)	1.83 (.15)	33.27 (.71)	.018 (.002)	.406 (.044)	.203 (.054)	20.98 (3.34)

Numbers in parenthesis equal one standard deviation.

with certainty the reasons for the observed higher levels of trace metals. This is because the disposal area is an historic dumpsite, and that due to restricted circulation and more numerous sources, the water in the western end of the sound contains higher levels of these trace metals than the eastern end. Hence, the mussels deployed here could have been exposed to at least three sources of trace metals, i.e., newly deposited dredged material, that disposed earlier and the in-situ water column.

The original design of the program plan for this project included sampling during periods of no dredged material disposal to compare uptake during and after disposal and thus isolate the impact of dredged material. However, loss of the platform and problems associated with redeployment prohibited sampling during non-disposal periods. Some samples have been obtained during the summer of 1983, during which no disposal took place, and these results will be presented in a later report.

A better, though more costly alternative, is to establish a second "reference" platform in the vicinity of the disposal site for direct comparison of mussels in the Western Long Island Sound environment. Such a platform will be established in the near future and subsequent reports will also include evaluation of the resulting data.

In summary, sampling problems at the WLIS III site have prohibited acquisition of sufficient data to quantitatively assess the impact of disposal operations on heavy metal uptake in Mytilus edulis. Based on the data collected from March 1982 through March 1983, only Cd, Cu and Zn show a consistent increase

in concentration following transfer from Latimer's Light to the WLIS III disposal site. Future monitoring efforts will stress isolation of disposal effects from background conditions.