

FINAL REPORT

**RECALCULATION OF SCREENING LEVEL CONCENTRATIONS
FOR NONPOLAR ORGANIC CONTAMINANTS IN MARINE SEDIMENTS**

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Submitted by

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INTRODUCTION

In Work Assignment 56, Task IV, Battelle evaluated the screening level concentration (SLC) approach to developing sediment quality criteria for nonpolar organic contaminants in freshwater and marine sediments. The results of that effort were summarized in a final report titled, Sediment Quality Criteria Methodology Validation: Calculation of Screening Level Concentrations from Field Data. The report was submitted to EPA in July 1986. In that report, Battelle identified a lack of standardization of taxonomic nomenclature and identifications of benthic infauna among the several large field databases used for calculating marine SLCs. Therefore, it was decided to review the marine databases to identify synonymies and inappropriate taxonomic distinctions, and to eliminate data sets in which the taxonomy was suspected of being inaccurate. This work was performed as a task in Work Assignment 77.

The objectives of this task were to

- o Edit the database used to calculate SLC values for marine sediments
- o Remove any questionable data sets from the SLC database
- o Based on the revised data base, recalculate SLCs for selected nonpolar organic contaminants in marine sediments.

MATERIALS AND METHODS

The species lists from the data sets for southern California and Puget Sound were reviewed. Species names that were synonymous were combined. In addition, the reasonableness and rigor of the overall taxonomic identifications were reviewed on the basis of knowledge of the taxonomy of the benthic fauna of the study areas. Inappropriate taxonomic distinctions were identified and corrected.

Any suspect species lists were noted and the data sets containing them were eliminated from the database. Species that were identified as synonymous were combined, inappropriate taxonomic distinctions were corrected, and this information was entered into the database. In addition, the two southern California data sets were reviewed and all species that occurred in both data sets were combined if the resulting combination produced the minimum of 20 observations required for calculating a species screening level concentration (SSLC).

The revised database was then used to calculate SSLCs, SLCs, and the 95 percent confidence intervals for the SLCs for 12 nonpolar organic contaminants in marine sediments. The methods used were those described in detail in the 1986 final report (Neff et al., 1986). The compounds were total DDT, total polychlorinated biphenyls (PCBs), and 10 polycyclic aromatic hydrocarbons (acenaphthalene, naphthalene, fluorene, phenanthrene, anthracene, fluoranthene, benz(a)anthracene, chrysene, pyrene, and benzo(a)pyrene).

RESULTS

Several synonymies or inappropriate taxonomic distinctions were identified in the data sets. The corrected species were combined under the currently accepted taxonomic designation. The following synonymies or inappropriate taxonomic distinctions were identified and corrected:

- o Ampharete arctica, A. goesi, A. labrops, A. acutifrons
- o Goniada brunnea, G. maculata
- o Mediomastus ambiseta, M. spp., M. californiensis
- o Prionospio cirriferra, Minuspio cirriferra.

Serious technical problems were identified in the taxonomy of the Puget Sound "Eight Bay Study." Therefore, this data set was deleted from the database. This resulted in loss of some data for 20 species and loss of some SSLC values for all contaminants except DDT, pyrene, and benzo(a)pyrene.

By combining species that were present in the two southern California data sets, it was possible to calculate SSLC values for five additional species. These SSLCs then were added to those already in the database and were used in the recalculation of SLCs.

The SLC values derived from the revised database are summarized in Table 1. The SSLC values and resulting frequency distribution curves are presented in Attachments 1 through 12. In all but one case, the SLC values calculated with the revised database were higher than the values calculated with the old database. The exception was PCBs. The SLC value for PCBs dropped slightly from 4.26 to 3.66 $\mu\text{g/g}$ organic carbon. None of the changes should be considered statistically significant, given the relatively large 95 percent confidence intervals for most values.

Revision of the database allowed us to calculate SLCs for three compounds for which SLCs were not calculated as part of the original work assignment. These were acenaphthalene, fluorene, and anthracene. SLCs for these compounds were in the range of 4.74 to 16.3 $\mu\text{g/g}$ organic carbon.

DISCUSSION

Quality control review of the data sets used to calculate SLCs resulted in the combination of several entries for synonymous or misidentified species in the species lists, addition of species occurrences for species that occurred in two data sets, and elimination of one questionable data set. These changes in the database resulted in small changes in the calculated SLC values for several nonpolar organic contaminants

TABLE 1. OLD AND RECALCULATED SCREENING LEVEL CONCENTRATIONS FOR NONPOLAR ORGANIC COMPOUNDS IN MARINE SEDIMENTS (ALL VALUES ARE $\mu\text{g/g}$ ORGANIC CARBON)

Compound	Screening Level Concentration	
	Old Value	New Value
DDT	42.8	50.5
PCB	4.26	3.66
Acenaphthalene	--	4.74
Naphthalene	36.7	41.4
Fluorene	--	10.1
Phenanthrene	25.9	36.8
Anthracene	--	16.3
Fluoranthene	43.2	64.4
Benz(a)anthracene	26.1	26.1
Chrysene	38.4	38.4
Pyrene	43.4	66.5
Benzo(a)pyrene	39.6	39.7

in marine sediments. There was no change for three compounds, a decrease in the SLC for one compound, and an increase in the SLC for five compounds. None of the changes were sufficiently large that the new value was outside the 95 percent confidence interval for the old value. Therefore, the differences were considered statistically insignificant. The largest change was an approximately 50 percent increase in the SLC for pyrene from 43.4 to 66.5 $\mu\text{g/g}$ organic carbon. Most of the changes were between 10 and 15 percent.

These results indicate that the SLC approach is not particularly sensitive to minor changes in the database from which SLCs are calculated. As the number of observations increases and the number of SSLCs used to calculate SLCs grows, the sensitivity of the calculated SLC values to small changes in the database will decrease further.

These results confirm that the SLC approach to sediment criteria development or validation has basic technical validity. Its strengths include the use of real field data on the cooccurrence of contaminants and infaunal animals in sediments and the lack of any a priori assumptions about the relationship between the distribution of benthic fauna and the concentrations of contaminants in sediments. These attributes of the SLC approach make it an ideal candidate for a method to validate sediment quality criteria developed by more theoretical approaches, such as equilibrium partitioning.

The SLC approach should be further developed to improve the statistical rigor of the SLC calculation process and the technical validity of the SLC values generated. Several variations of different aspects of the method for calculating the SLC should be tried and evaluated by sensitivity analysis. As many additional data sets as possible should be added to the database. A large number of additional data sets have been identified and it may be possible to increase the number of stations in the database to about 1000. All data sets should be subjected to rigorous quality assurance review. Entry of the

complete database into a sophisticated computer database management system will facilitate combination of species lists from different data sets, entry of new data sets as they become available, and performance of sensitivity and statistical analyses on the SLC calculation method and the resulting SLC values.

It is essential that EPA has an independent method to validate the EP approach or other approach for derivation of sediment quality criteria. The SLC approach is the ideal one for that purpose.

LITERATURE CITED

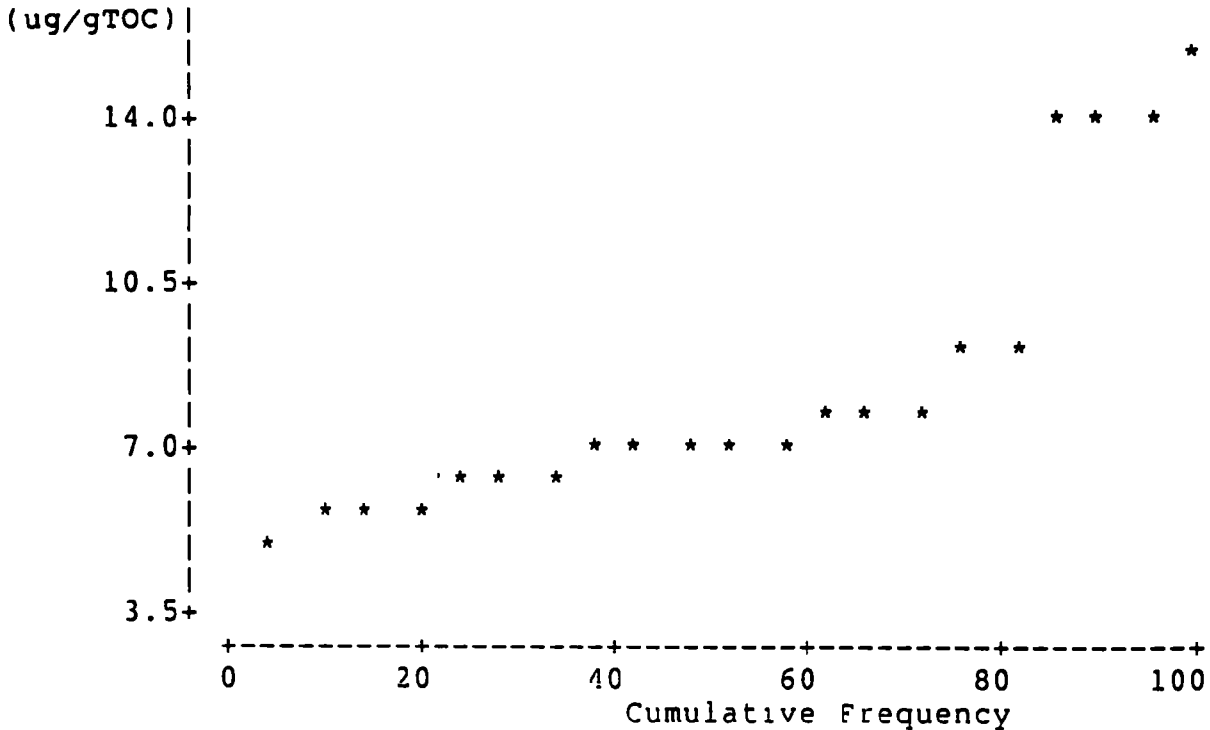
Neff, J.M., D.J. Bean, B.W. Cornaby, R.M. Vaga, T.C. Gulbransen, and J.A. Scanlon. 1986. Sediment Quality Criteria Methodology Validation: Calculation of Screening Level Concentrations from Field Data. Report to U.S. Environmental Protection Agency, Criteria and Standards Division, Office of Water Regulation and Standards, Washington D.C. 60 pp.

ACENAPHTHALENE

SLC = 4.739 ug/gTOC (0.0 - 5.714) a=0.02

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.8	4.706	24	COMPSOMYAX SUBDIAPHANA
2	9.5	5.479	25	PRAXILLELLA GRACILIS
3	14.3	5.714	21	PECTINARIA CALIFORNIENSIS
4	19.0	5.714	28	AMPHIODIA (AMPHISPINA) URTICA
5	23.8	6.522	23	EUCHONE INCOLOR
6	28.6	6.522	41	CAPITELLA CAPITATA
7	33.3	6.522	49	AXINOPSIDA SERICATA
8	38.1	7.190	33	NEPHTYS CORNUTA FRANCISCANA
9	42.9	7.190	53	MACOMA CARLOTTENSIS
10	47.6	7.190	24	GONIADA BRUNNEA
11	52.4	7.190	51	EUPHILOMEDES CARCHARODONTA
12	57.1	7.190	25	ARMANDIA BREVIS
13	61.9	7.391	47	PRIONOSPPIO STEENSTRUPI
14	66.7	7.391	47	NEPHTYS FERRUGINEA
15	71.4	7.391	49	GLYCERA CAPITATA
16	76.2	9.286	28	PLATYNEREIS BICANALICULATA
17	81.0	9.286	28	GLYCERA AMERICANA
18	85.7	13.861	26	SPIOCHAETOPTERUS COSTARUM
19	90.5	13.861	27	PHOLOE MINUTA
20	95.2	13.861	25	PARVILUCINA TENUISCUPTA
21	100.0	15.702	20	SPIOPHANES BERKELEYORUM

ACENAPHTHALENE vs. CUMULATIVE FREQUENCY

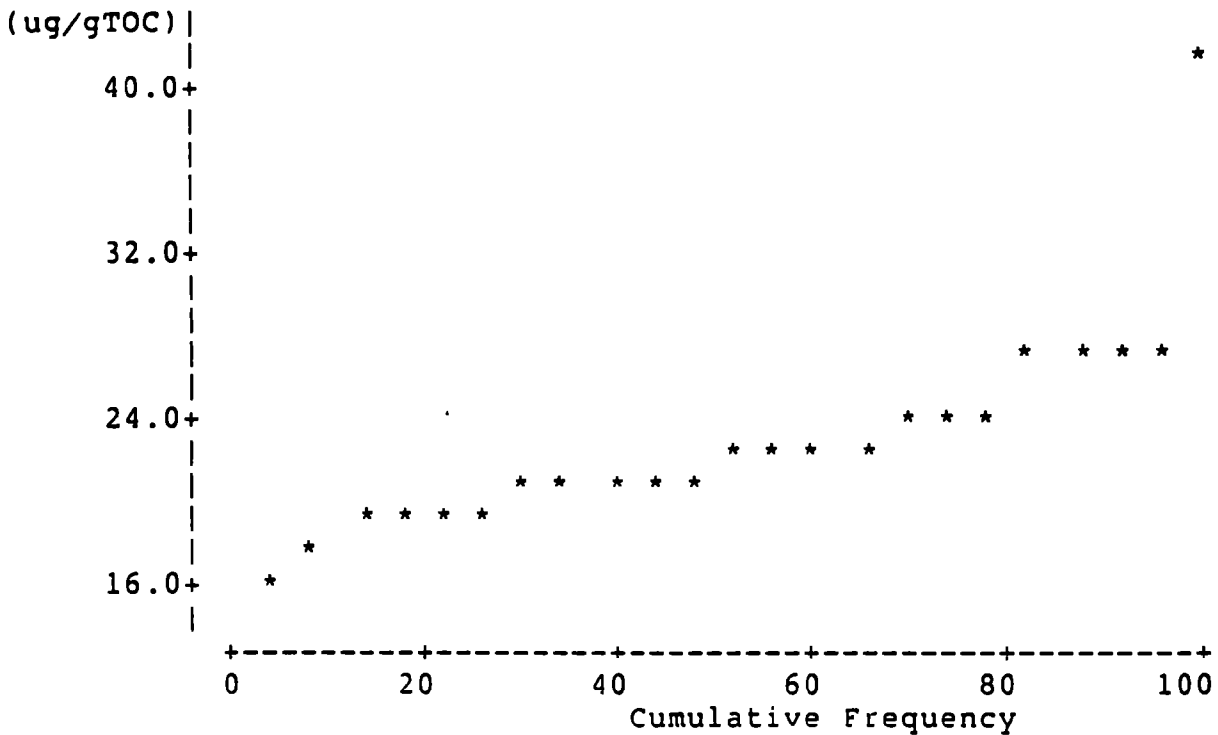


ANTHRACENE

SLC = 16.316 ug/gTOC [0.0 - 19.596) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	15.953	25	ARMANDIA BREVIS
2	8.7	18.235	23	EUCHONE INCOLOR
3	13.0	19.130	20	PRIONOSPPIO CIRRIFERA
4	17.4	19.595	20	PHYLLODOCE HARTMANAE
5	21.7	19.595	35	NEPHTYS CORNUTA FRANCISCANA
6	26.1	19.595	25	COMPSOMYAX SUBDIAPHANA
7	30.4	20.000	21	SPIOPHANES BERKELEYORUM
8	34.8	20.000	52	AXINOPSIDA SERICATA
9	39.1	20.183	26	GONIADA BRUNNEA
10	43.5	20.183	53	EUPHILOMEDES CARCHARODONTA
11	47.8	20.183	43	CAPITELLA CAPITATA
12	52.2	21.739	25	PRAXILLELLA GRACILIS
13	56.5	21.739	50	NEPHTYS FERRUGINEA
14	60.9	21.739	56	MACOMA CARLOTTENSIS
15	65.2	21.739	52	GLYCERA CAPITATA
16	69.6	23.288	50	PRIONOSPPIO STEENSTRUPI
17	73.9	23.288	21	PECTINARIA CALIFORNIENSIS
18	78.3	23.288	30	GLYCERA AMERICANA
19	82.6	27.273	26	SPIOCHAETOPTERUS COSTARUM
20	87.0	27.273	30	PHOLOE MINUTA
21	91.3	27.273	27	PARVILUCINA TENUISCUPTA
22	95.7	27.273	29	AMPHIODIA (AMPHISPINA) URTICA
23	100.0	42.353	30	PLATYNEREIS BICANALICULATA

ANTHRACENE vs. CUMULATIVE FREQUENCY

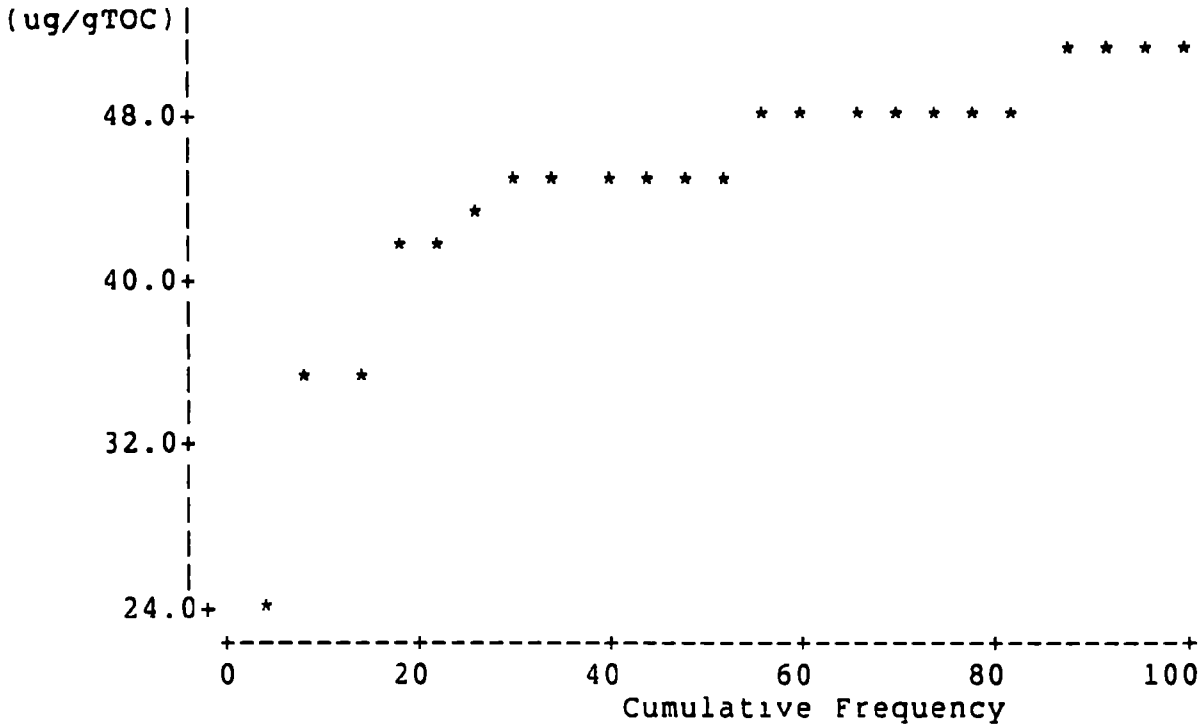


BENZ(A)ANTHRACENE

SLC = 26.119 ug/gTOC (0.0 - 40.952) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	24.348	20	PRIONOSPIO CIRRIFFERA
2	8.7	35.477	21	SPIOPHANES BERKELEYORUM
3	13.0	35.477	25	ARMANDIA BREVIS
4	17.4	40.952	26	GONIADA BRUNNEA
5	21.7	41.322	26	SPIOCHAETOPTERUS COSTARUM
6	26.1	42.466	52	AXINOPSIDA SERICATA
7	30.4	44.118	56	MACOMA CARLOTTENSIS
8	34.8	44.118	52	GLYCERA CAPITATA
9	39.1	44.118	53	EUPHILOMEDES CARCHARODONTA
10	43.5	44.118	28	EUCHONE INCOLOR
11	47.8	44.118	25	COMPSOMYAX SUBDIAPHANA
12	52.2	44.118	49	CAPITELLA CAPITATA
13	56.5	47.647	57	PRIONOSPIO STEENSTRUPI
14	60.9	47.647	25	PRAXILLELLA GRACILIS
15	65.2	47.647	21	PECTINARIA CALIFORNIENSIS
16	69.6	47.647	27	PARVILUCINA TENUISCULPTA
17	73.9	47.647	50	NEPHTYS FERRUGINEA
18	78.3	47.647	35	NEPHTYS CORNUTA FRANCISCANA
19	82.6	47.945	29	AMPHIODIA (AMPHISPINA) URTICA
20	87.0	51.765	38	PHOLOE MINUTA
21	91.3	51.765	30	GLYCERA AMERICANA
22	95.7	51.802	30	PLATYNEREIS BICANALICULATA
23	100.0	51.802	20	PHYLLODOCE HARTMANAE

BENZ(A)ANTHRACENE vs. CUMULATIVE FREQUENCY

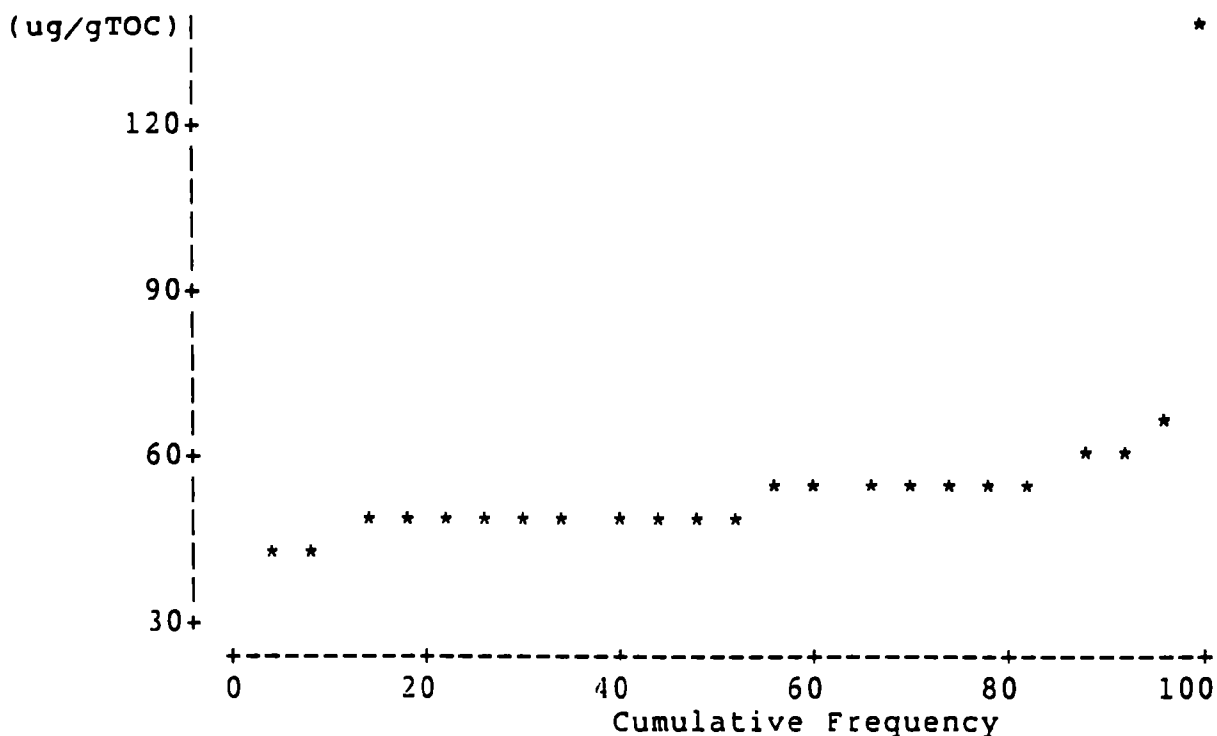


BENZO(A)PYRENE

SLC = 39.667 ug/gTOC (0.0 - 46.795) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	39.604	21	SPIOPHANES BERKELEYORUM
2	8.7	40.000	20	PRIONOSPION CIRRIFERA
3	13.0	46.552	49	CAPITELLA CAPITATA
4	17.4	46.795	26	SPIOCHAETOPTERUS COSTARUM
5	21.7	49.315	25	GONIADA BRUNNEA
6	26.1	49.315	28	EUCHONE INCOLOR
7	30.4	50.000	25	PRAXILLELLA GRACILIS
8	34.8	50.000	51	GLYCERA CAPITATA
9	39.1	50.000	52	EUPHILOMEDES CARCHARODONTA
10	43.5	50.000	25	COMPSOMYAX SUBDIAPHANA
11	47.8	50.000	51	AXINOPSIDA SERICATA
12	52.2	50.588	34	NEPHTYS CORNUTA FRANCISCANA
13	56.5	52.910	56	PRIONOSPION STEENSTRUPI
14	60.9	52.910	55	MACOMA CARLOTTENSIS
15	65.2	52.910	25	ARMANDIA BREVIS
16	69.6	55.372	37	PHOLOE MINUTA
17	73.9	55.372	21	PECTINARIA CALIFORNIENSIS
18	78.3	55.372	26	PARVILUCINA TENUISCUPTA
19	82.6	55.372	49	NEPHTYS FERRUGINEA
20	87.0	61.644	29	GLYCERA AMERICANA
21	91.3	61.644	29	AMPHIODIA (AMPHISPINA) URTICA
22	95.7	66.667	29	PLATYNEREIS BICANALICULATA
23	100.0	137.387	20	PHYLLODOCE HARTMANAE

BENZO(A)PYRENE vs. CUMULATIVE FREQUENCY

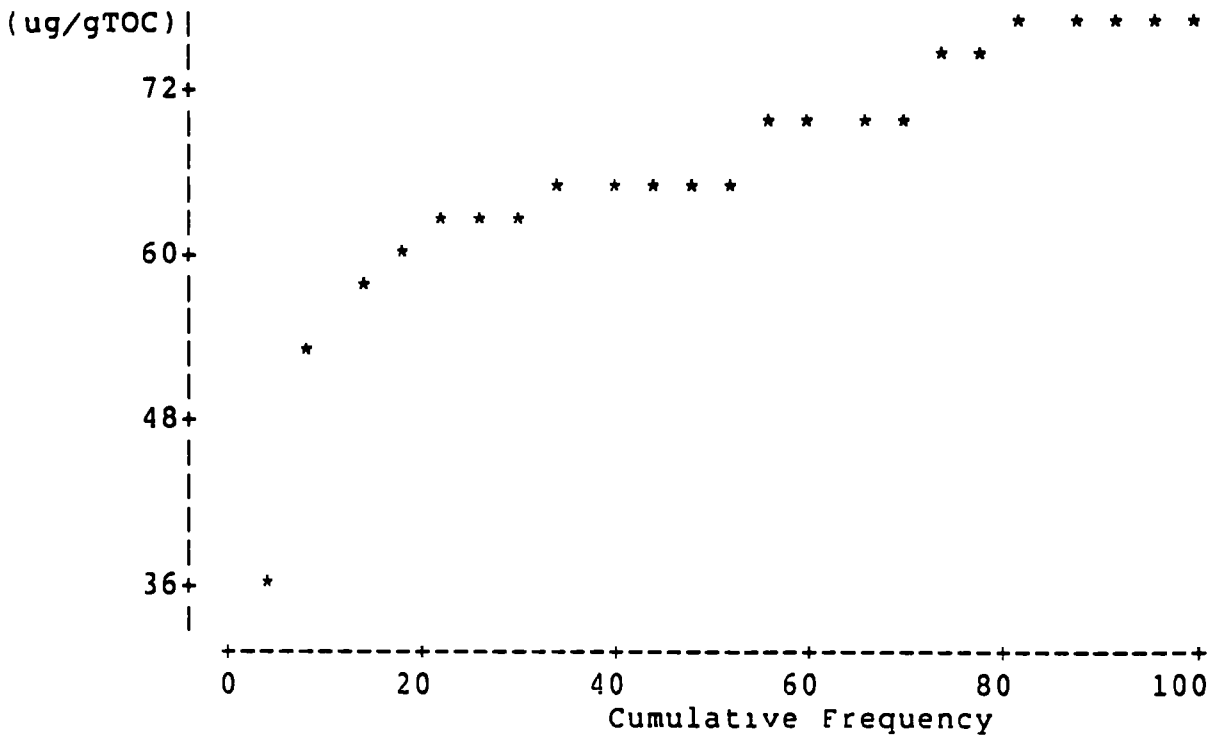


CHRYSENE

SLC = 38.395 ug/gTOC (0.0 - 60.847) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	35.652	20	PRIONOSPIO CIRRIFERA
2	8.7	52.893	21	SPIOPHANES BERKELEYORUM
3	13.0	57.143	26	GONIADA BRUNNEA
4	17.4	60.847	25	ARMANDIA BREVIS
5	21.7	62.084	20	PHYLLODOCE HARTMANAE
6	26.1	62.084	48	CAPITELLA CAPITATA
7	30.4	62.084	51	AXINOPSIDA SERICATA
8	34.8	63.694	57	PRIONOSPIO STEENSTRUPI
9	39.1	63.694	28	EUCHONE INCOLOR
10	43.5	64.706	50	NEPHTYS FERRUGINEA
11	47.8	64.706	55	MACOMA CARLOTTENSIS
12	52.2	64.706	52	EUPHILOMEDES CARCHARODONTA
13	56.5	68.966	25	SPIOCHAETOPTERUS COSTARUM
14	60.9	68.966	51	GLYCERA CAPITATA
15	65.2	69.863	25	PRAXILLELLA GRACILIS
16	69.6	69.863	21	PECTINARIA CALIFORNIENSIS
17	73.9	75.314	35	NEPHTYS CORNUTA FRANCISCANA
18	78.3	75.314	25	COMPSOMYAX SUBDIAPHANA
19	82.6	76.471	30	PLATYNEREIS BICANALICULATA
20	87.0	76.471	38	PHOLOE MINUTA
21	91.3	76.471	26	PARVILUCINA TENUISCUPTA
22	95.7	76.471	29	GLYCERA AMERICANA
23	100.0	76.471	29	AMPHIODIA (AMPHISPINA) URTICA

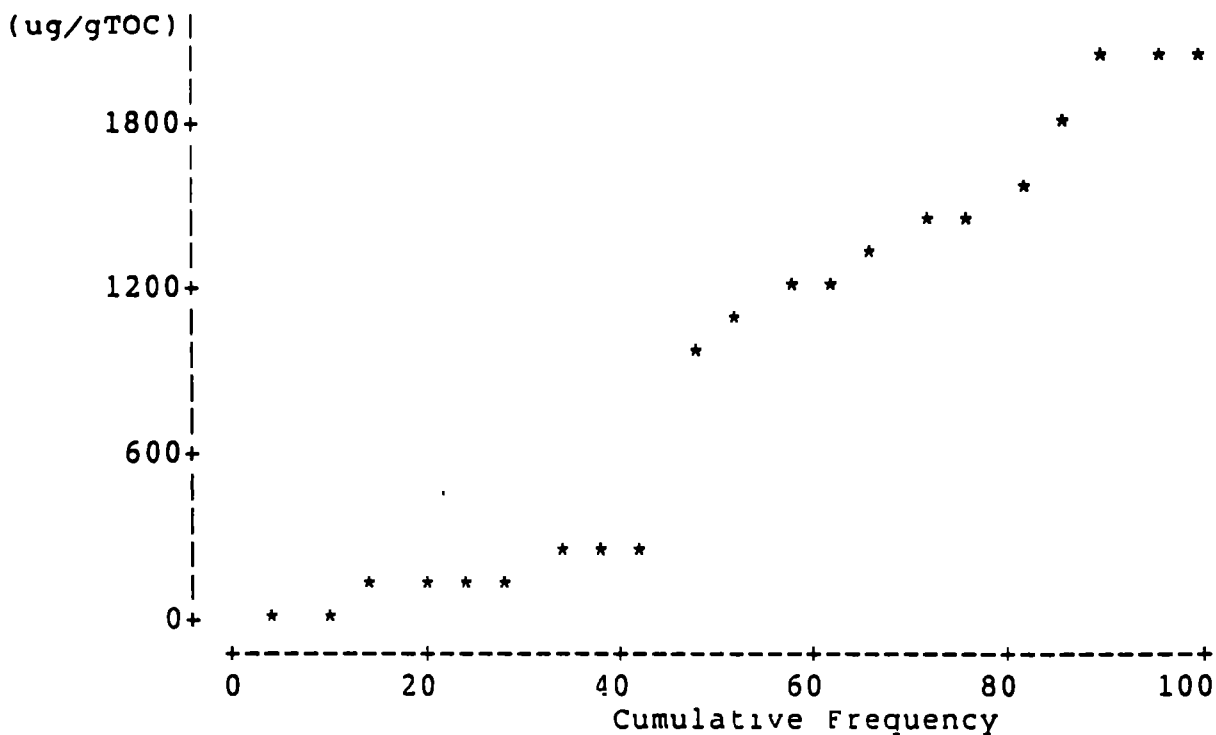
CHRYSENE vs. CUMULATIVE FREQUENCY



$$\text{SLC} = 50.488 \text{ ug/gTOC} \frac{\text{DDT}}{(0.0 - 113.684)} \text{ a}=0.02$$

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.8	50.488	21	AMPELISCA BREVISIMULATA
2	9.5	50.488	27	AMPHIODIA (AMPHISPINA) URTICA
3	14.3	68.696	29	EUPHILOMEDES CARCHARODONTA
4	19.0	113.684	21	HETEROPHOXUS OCULATUS
5	23.8	137.692	20	STHENELANELLA UNIFORMIS
6	28.6	137.692	29	COMPSOMYAX SUBDIAPHANA
7	33.3	202.441	25	GONIADA BRUNNEA
8	38.1	207.917	20	CHLOEIA PINNATA
9	42.9	222.389	22	GNATHIA CRENULATIFRONS
10	47.6	954.033	62	PECTINARIA CALIFORNIENSIS
11	52.4	1136.319	44	MEDIOMASTUS AMBISETA
12	57.1	1146.004	22	PRIONOSPPIO CIRRIFERA
13	61.9	1186.331	79	AXINOPSIDA SERICATA
14	66.7	1260.058	45	PARAPRIONOSPPIO PINNATA
15	71.4	1392.128	86	GLYCERA CAPITATA
16	76.2	1407.287	61	PRIONOSPPIO STEENSTRUPI
17	81.0	1511.990	101	PARVILUCINA TENUISCULPTA
18	85.7	1816.188	51	MACOMA CARLOTTENSIS
19	90.5	1999.961	44	CAPITELLA CAPITATA
20	95.2	2069.586	37	SPIOPHANES BERKELEYORUM
21	100.0	2069.586	57	TELLINA CARPENTERI

DDT vs. CUMULATIVE FREQUENCY

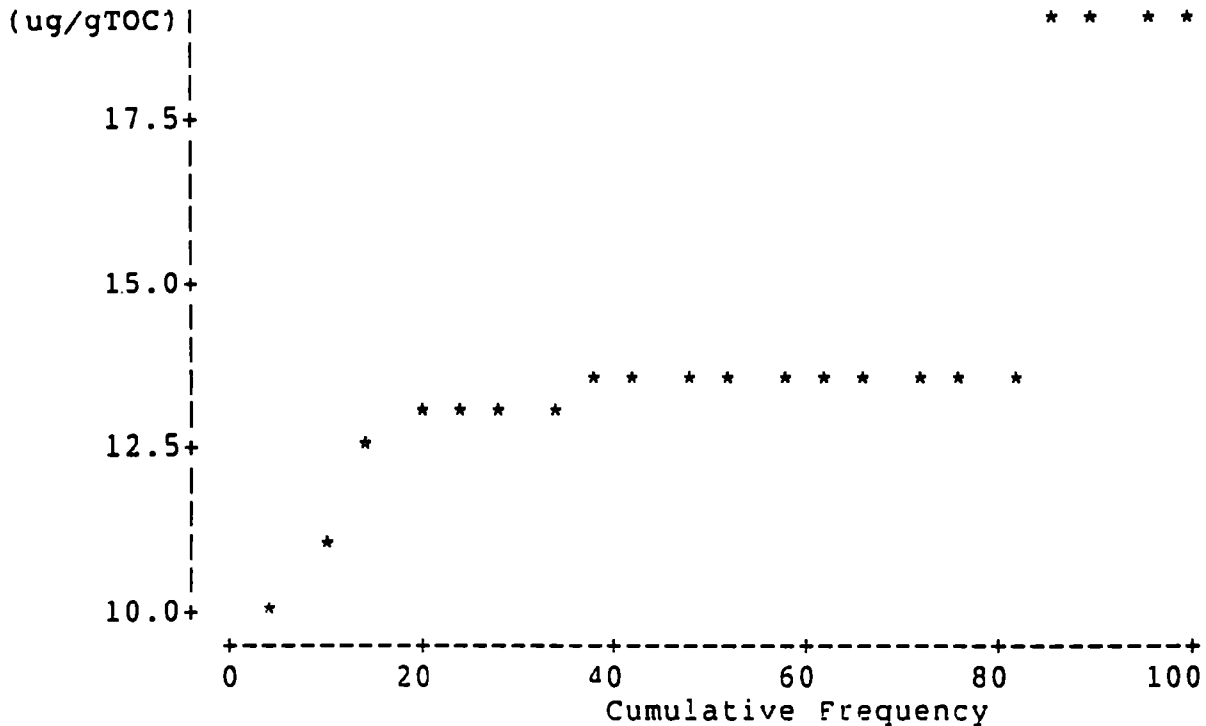


FLUORENE

SLC = 10.123 ug/gTOC (0.0 - 13.233) a=0.02

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.8	10.092	24	GONIADA BRUNNEA
2	9.5	10.811	24	ARMANDIA BREVIS
3	14.3	12.353	49	AXINOPSIDA SERICATA
4	19.0	13.223	21	PECTINARIA CALIFORNIENSIS
5	23.8	13.223	53	MACOMA CARLOTTENSIS
6	28.6	13.223	51	EUPHILOMEDES CARCHARODONTA
7	33.3	13.223	42	CAPITELLA CAPITATA
8	38.1	13.366	20	SPIOPHANES BERKELEYORUM
9	42.9	13.366	26	SPIOCHAETOPTERUS COSTARUM
10	47.6	13.366	49	PRIONOSPIO STEENSTRUPI
11	52.4	13.366	47	NEPHTYS FERRUGINEA
12	57.1	13.366	23	EUCHONE INCOLOR
13	61.9	13.529	25	PRAXILLELLA GRACILIS
14	66.7	13.529	25	PARVILUCINA TENUISCUPTA
15	71.4	13.529	33	NEPHTYS CORNUTA FRANCISCANA
16	76.2	13.529	49	GLYCERA CAPITATA
17	81.0	13.529	24	COMPSOMYAX SUBDIAPHANA
18	85.7	18.824	27	PLATYNEREIS BICANALICULATA
19	90.5	18.824	28	PHOLOE MINUTA
20	95.2	18.824	28	GLYCERA AMERICANA
21	100.0	18.824	28	AMPHIODIA (AMPHISPINA) URTICA

FLUORENE vs. CUMULATIVE FREQUENCY

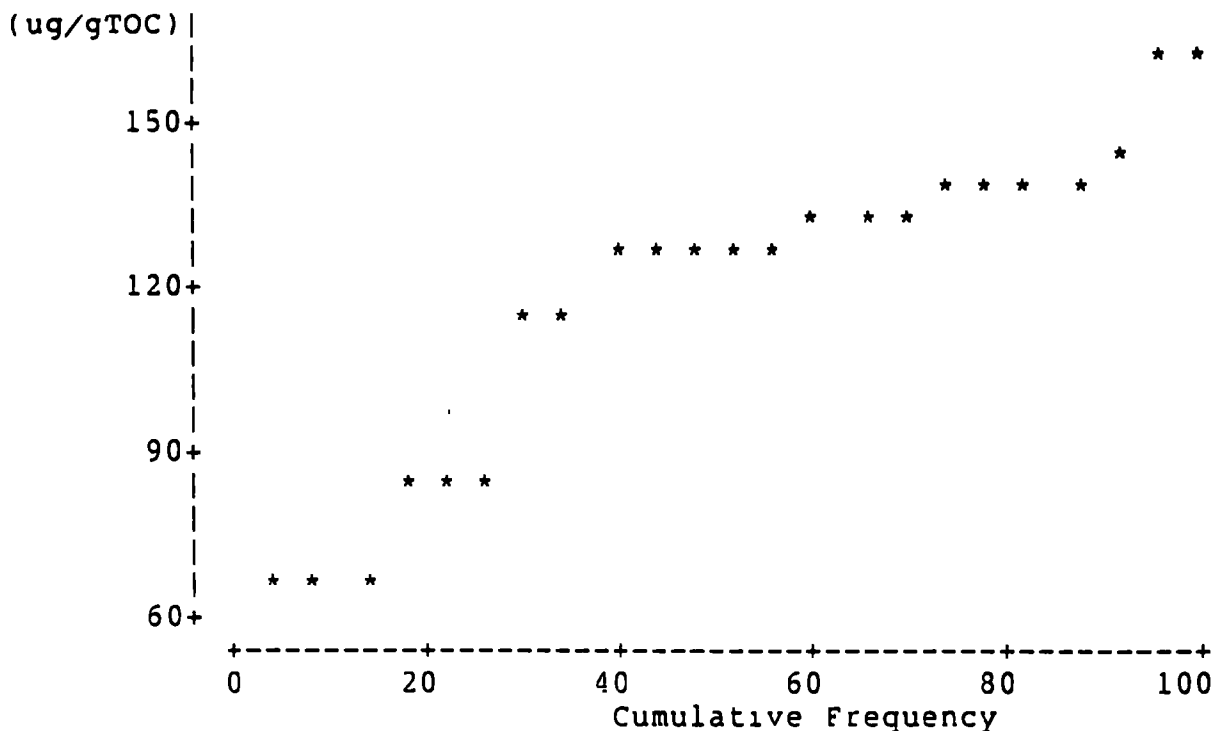


FLUORANTHENE

SLC = 64.434 ug/gTOC (0.0 - 81.081) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	64.286	22	SPIOPHANES BERKELEYORUM
2	8.7	65.217	20	PRIONOSPIO CIRRIFERA
3	13.0	66.138	25	ARMANDIA BREVIS
4	17.4	81.081	20	PHYLLODOCE HARTMANAE
5	21.7	81.651	26	SPIOCHAETOPTERUS COSTARUM
6	26.1	81.651	27	GONIADA BRUNNEA
7	30.4	111.765	48	CAPITELLA CAPITATA
8	34.8	111.765	52	AXINOPSIDA SERICATA
9	39.1	124.658	58	PRIONOSPIO STEENSTRUPI
10	43.5	124.658	51	NEPHTYS FERRUGINEA
11	47.8	124.658	55	MACOMA CARLOTTENSIS
12	52.2	124.658	53	EUPHILOMEDES CARCHARODONTA
13	56.5	124.658	28	EUCHONE INCOLOR
14	60.9	129.412	36	NEPHTYS CORNUTA FRANCISCANA
15	65.2	129.412	52	GLYCERA CAPITATA
16	69.6	129.412	25	COMPSOMYAX SUBDIAPHANA
17	73.9	135.294	25	PRAXILLELLA GRACILIS
18	78.3	135.294	39	PHOLOE MINUTA
19	82.6	135.294	21	PECTINARIA CALIFORNIENSIS
20	87.0	135.294	27	PARVILUCINA TENUISCULPTA
21	91.3	146.552	31	PLATYNEREIS BICANALICULATA
22	95.7	164.384	29	GLYCERA AMERICANA
23	100.0	164.384	29	AMPHIODIA (AMPHISPINA) URTIC.

FLUORANTHENE vs. CUMULATIVE FREQUENCY

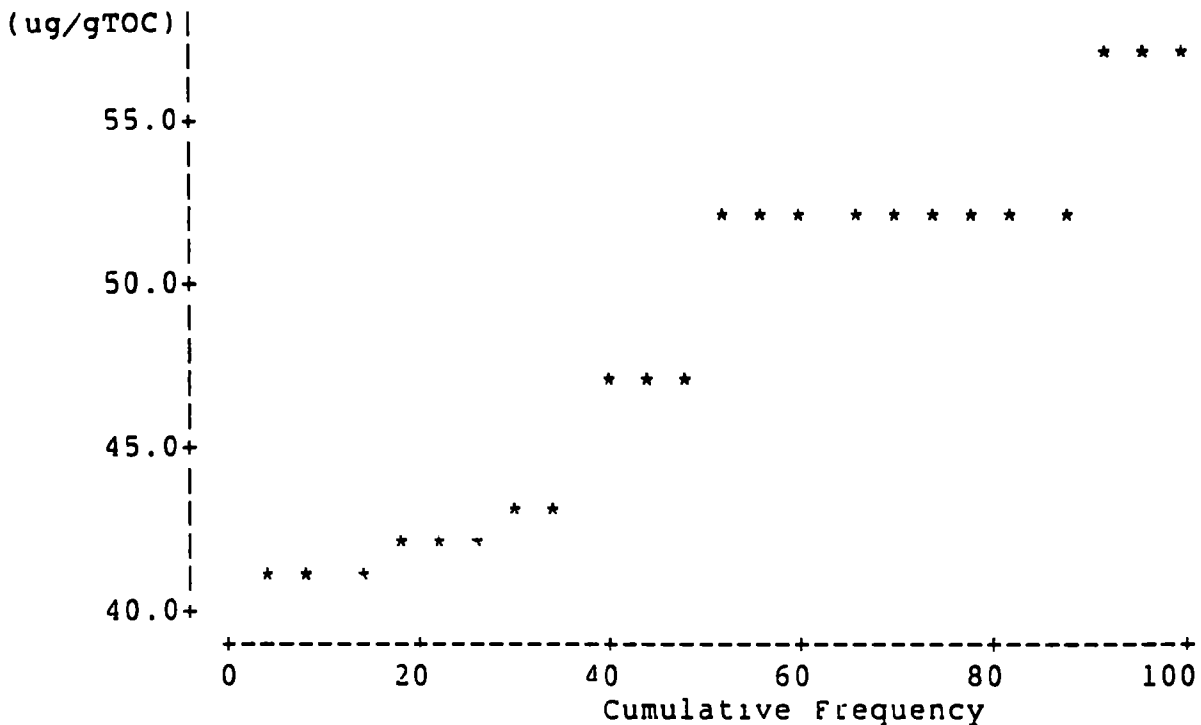


NAPHTHALENE

SLC = 41.394 ug/gTOC [0.0 - 41.765) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	41.394	20	PRIONOSPPIO CIRRIFFERA
2	8.7	41.394	43	CAPITELLA CAPITATA
3	13.0	41.394	25	ARMANDIA BREVIS
4	17.4	41.765	24	PRAXILLELLA GRACILIS
5	21.7	41.765	22	EUCHONE INCOLOR
6	26.1	41.765	51	AXINOPSIDA SERICATA
7	30.4	43.333	25	GONIADA BRUNNEA
8	34.8	43.333	24	COMPSOMYAX SUBDIAPHANA
9	39.1	47.436	55	MACOMA CARLOTTENSIS
10	43.5	47.436	51	GLYCERA CAPITATA
11	47.8	47.436	52	EUPHILOMEDES CARCHARODONTA
12	52.2	51.980	21	SPIOPHANES BERKELEYORUM
13	56.5	51.980	26	SPIOCHAETOPTERUS COSTARUM
14	60.9	51.980	50	PRIONOSPPIO STEENSTRUPI
15	65.2	51.980	20	PHYLLODOCE HARTMANAE
16	69.6	51.980	49	NEPHTYS FERRUGINEA
17	73.9	51.980	34	NEPHTYS CORNUTA FRANCISCANA
18	78.3	52.055	30	PLATYNEREIS BICANALICULATA
19	82.6	52.055	21	PECTINARIA CALIFORNIENSIS
20	87.0	52.055	29	GLYCERA AMERICANA
21	91.3	57.059	29	PHOLOE MINUTA
22	95.7	57.059	27	PARVILUCINA TENUISCUPTA
23	100.0	57.059	28	AMPHIODIA (AMPHISPINA) URTICA

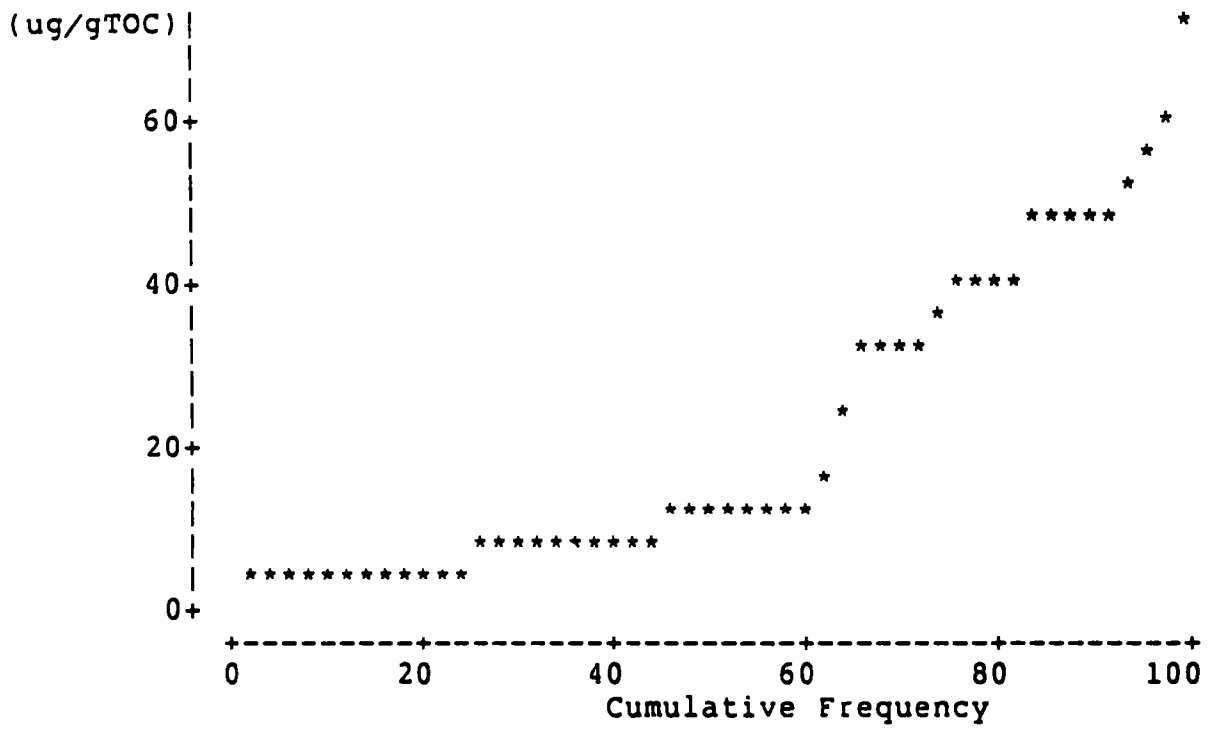
NAPHTHALENE vs. CUMULATIVE FREQUENCY



PCB
 SLC = 3.656 ug/gTOC (0.0 - 4.583) a=0.03

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	2.0	2.222	21	SCALIBREGMA INFLATUM
2	3.9	3.394	21	SPIOCHAETOPTERUS COSTARUM
3	5.9	3.871	32	NEPHTYS FERRUGINEA
4	7.8	4.583	24	HARMOTHOE EXTENUATA
5	9.8	4.634	22	EUCHONE ELEGANS
6	11.8	4.714	24	DRILONEREIS LONGA
7	13.7	4.714	27	SPIOPHANES BOMBYX
8	15.7	4.841	30	EUCHONE INCOLOR
9	17.6	4.841	29	ANOBOTHRUS GRACILIS
10	19.6	4.841	27	ARCTICA ISLANDICA
11	21.6	4.841	20	PARAONIS GRACILIS
12	23.5	4.841	26	NINOE NIGRIPES
13	25.5	6.000	33	NUCULA PROXIMA
14	27.5	6.000	23	COSSURO LONGOCIRRATA
15	29.4	6.000	23	NEPHTYS INCISA
16	31.4	6.000	51	PHOLOE MINUTA
17	33.3	7.500	33	THARYX ACUTUS
18	35.3	8.000	39	ARICIDEA CATHERINAE
19	37.3	8.000	24	UNCIOLA IRRORATA
20	39.2	8.000	22	CAULLERIELLA CF KILLARIENSIS
21	41.2	8.000	24	GONIADELLA GRACILIS
22	43.1	8.854	25	LUMBRINEREIS HEBES
23	45.1	10.000	27	PHERUSA AFFINIS
24	47.1	10.000	33	THARYX ANNULOSUS
25	49.0	10.000	26	PHYLLODOCE MUCOSA
26	51.0	10.625	29	PITAR MORRHUANUS
27	52.9	10.625	30	LUMBRINEREIS ACICULARUM
28	54.9	10.941	32	TELLINA AGILIS
29	56.9	11.417	24	GLYCERA DIBRANCHIATA
30	58.8	11.731	37	AMPHIODIA (AMPHISPINA) URTICA
31	60.8	13.769	25	HETEROPHOXUS OCULATUS
32	62.7	16.935	55	EUPHILOMEDES CARCHARODONTA
33	64.7	25.000	36	GONIADA BRUNNEA
34	66.7	30.118	21	AMPELISCA BREVISIMULATA
35	68.6	33.103	35	COMPSOMYAX SUBDIAPHANA
36	70.6	33.905	20	AMPHARETE ARCTICA
37	72.5	33.905	20	STHENELANELLA UNIFORMIS
38	74.5	34.194	54	MEDIOMASTUS AMBISETA
39	76.5	39.683	20	ARMANDIA BREVIS
40	78.4	40.017	56	PECTINARIA CALIFORNIENSIS
41	80.4	41.143	28	PRIONOSPIO CIRRIFERA
42	82.4	41.143	109	PRIONOSPIO STEENSTRUPI
43	84.3	46.025	90	AXINOPSIDA SERICATA
44	86.3	46.307	20	CHLOEIA PINNATA
45	88.2	47.817	50	PARAPRIONOSPIO PINNATA
46	90.2	47.911	95	GLYCERA CAPITATA
47	92.2	49.547	64	CAPITELLA CAPITATA
48	94.1	52.058	67	MACOMA CARLOTTENSIS
49	96.1	56.307	89	PARVILUCINA TENUISCUPTA
50	98.0	58.774	42	SPIOPHANES BERKELEYORUM
51	100.0	71.315	40	TELLINA CARPENTERI

PCB vs. CUMULATIVE FREQUENCY

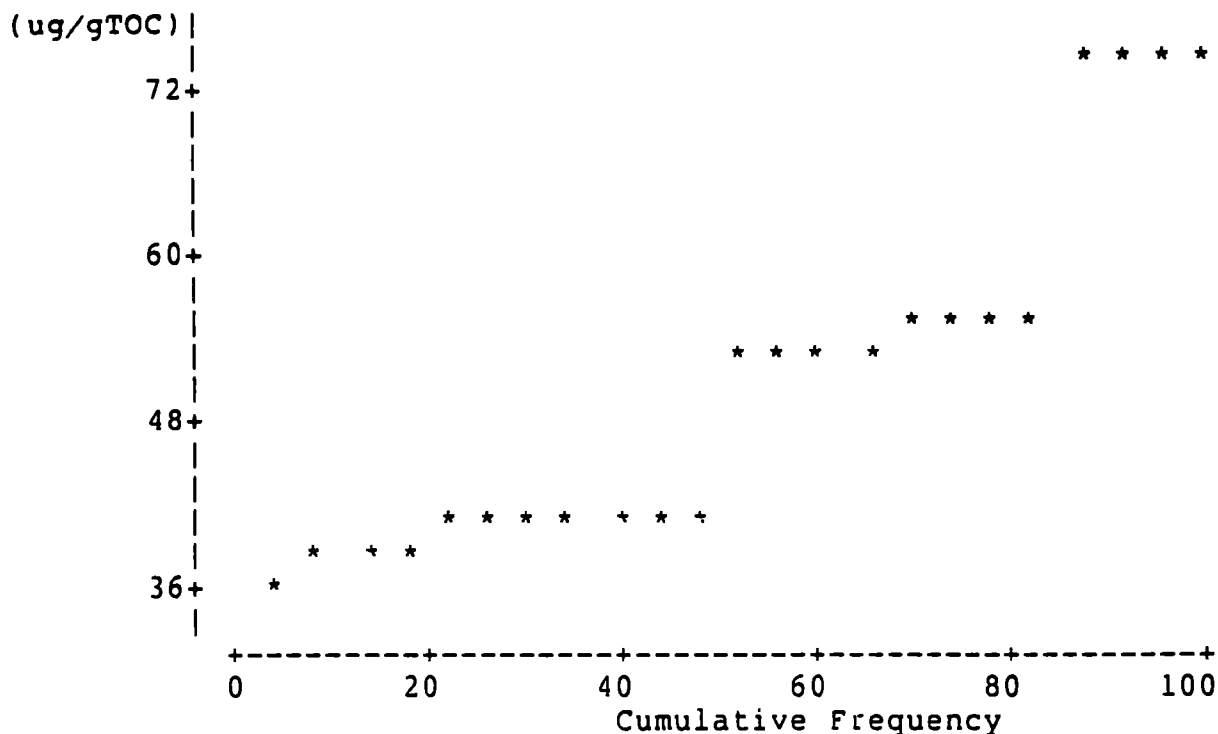


PHENANTHRENE

SLC = 36.775 ug/gTOC (0.0 - 38.514) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	36.576	25	ARMANDIA BREVIS
2	8.7	37.826	20	PRIONOSPPIO CIRRIFERA
3	13.0	38.356	25	EUCHONE INCOLOR
4	17.4	38.514	20	PHYLLODOCE HARTMANAE
5	21.7	39.726	27	GONIADA BRUNNEA
6	26.1	39.726	52	AXINOPSIDA SERICATA
7	30.4	40.588	25	PRAXILLELLA GRACILIS
8	34.8	40.588	51	NEPHTYS FERRUGINEA
9	39.1	40.588	36	NEPHTYS CORNUTA FRANCISCANA
10	43.5	40.588	53	EUPHILOMEDES CARCHARODONTA
11	47.8	40.588	25	COMPSOMYAX SUBDIAPHANA
12	52.2	52.294	21	PECTINARIA CALIFORNIENSIS
13	56.5	52.294	55	MACOMA CARLOTTENSIS
14	60.9	52.294	52	GLYCERA CAPITATA
15	65.2	52.294	46	CAPITELLA CAPITATA
16	69.6	54.167	54	PRIONOSPPIO STEENSTRUPI
17	73.9	55.372	22	SPIOPHANES BERKELEYORUM
18	78.3	55.372	35	PHOLOE MINUTA
19	82.6	55.372	29	AMPHIODIA (AMPHISPINA) URTICA
20	87.0	75.000	26	SPIOCHAETOPTERUS COSTARUM
21	91.3	75.000	31	PLATYNEREIS BICANALICULATA
22	95.7	75.000	27	PARVILUCINA TENUISCUPTA
23	100.0	75.000	29	GLYCERA AMERICANA

PHENANTHRENE vs. CUMULATIVE FREQUENCY



PYRENE

SLC = 66.482 ug/gTOC (0.0 - 75.00) a=0.026

Rank	Cumulative Freq. (%)	SSLC (ug/g Org.C)	No. of Obser.	Organism
1	4.3	65.217	20	PRIONOSPPIO CIRRIFFERA
2	8.7	73.171	25	ARMANDIA BREVIS
3	13.0	74.380	22	SPIOPHANES BERKELEYORUM
4	17.4	75.000	27	GONIADA BRUNNEA
5	21.7	82.375	26	SPIOCHAETOPTERUS COSTARUM
6	26.1	82.375	20	PHYLLODOCE HARTMANAE
7	30.4	84.932	52	AXINOPSIDA SERICATA
8	34.8	87.671	51	NEPHTYS FERRUGINEA
9	39.1	87.671	55	MACOMA CARLOTTENSIS
10	43.5	87.671	53	EUPHILOMEDES CARCHARODONTA
11	47.8	94.118	58	PRIONOSPPIO STEENSTRUPI
12	52.2	94.118	52	GLYCERA CAPITATA
13	56.5	94.118	48	CAPITELLA CAPITATA
14	60.9	100.000	25	PRAXILLELLA GRACILIS
15	65.2	100.000	21	PECTINARIA CALIFORNIENSIS
16	69.6	100.000	36	NEPHTYS CORNUTA FRANCISCANA
17	73.9	100.000	28	EUCHONE INCOLOR
18	78.3	100.000	25	COMPSOMYAX SUBDIAPFANA
19	82.6	105.882	31	PLATYNEREIS BICANALICULATA
20	87.0	105.882	27	PARVILUCINA TENUISCULPTA
21	91.3	105.882	29	GLYCERA AMERICANA
22	95.7	105.882	29	AMPHIODIA (AMPHISPINA) URTICA
23	100.0	123.529	39	PHOLOE MINUTA

PYRENE vs. CUMULATIVE FREQUENCY

