APPENDIX A:

Quality Assurance/Quality Control

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QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) for benthic infaunal sampling and analysis included Minimum Quality Objectives (MQO's) for sample collection, sorting, counting, identification and biomass estimation (Table A1). In addition, a field audit was conducted to assure that every vessel carried the proper equipment and that samples were taken and processed according to specifications of the field manual developed for the survey (SCBPP 1994).

Field Sampling

The field audit showed that all vessels were using the proper equipment and were collecting and processing samples according to accepted procedures (Table A2).

The MQO for sample completeness was met by all agencies (Table A3). Of the 264 samples assigned, 252 were collected. One station was not sampled because it was located south of the U.S.-Mexico border and one station was too deep. Samples could not be collected at the other stations because the bottom was composed of rock, cobble or hard-packed sand. Most samples were collected within the area designated for the sample point. Of the three samples taken outside of the sample area, only one was taken at a distance of more than twice the radius of the area assigned to the station in the SCBPP sampling design; this sample was not sorted and identified. Three samples with incorrect latitudes and longitudes were assumed to have been taken on station.

Laboratory Processing

Sorting accuracy was measured by either re-sorting a 10% aliquot of every sample (the 10% method) or completely re-sorting 10% of the samples processed by each sorter (the 100% method). Each laboratory determined which of these two methods to use.

A data quality control and assessment procedure, involving redistribution and re-identification of samples, was developed to measure errors in identification and enumeration (Appendix B).

A procedure was also developed for biomass estimation. To measure precision, a second technician re-weighed 10% of the samples. Only samples with an original weight greater than 0.1 gm were re-weighed. An MQO of ±10% of the original weight was chosen as the best estimate of the achievable precision.

All laboratories surpassed the MQO for completing QC checks for sorting (Table A4). Sorting efficiencies averaged 98.1 to 99.7% (Table A5). Since a flotation method was used for re-sorting samples, sorting efficiency for Lab 1 is reported as the maximum estimated efficiency. The flotation method involved forcing water through the sample and screening the supernatant liquid for organisms. Since it is likely that some organisms remained in the sample, efficiency may be overestimated; it is possible Lab 1 did not meet the MQO of 95%. However, there is no reason to believe that if there was an exceedance of the MQO, it was substantial.

Almost 20% of the samples failed the MQO of ±10% for precision of biomass estimation (Table A6). However, the failures were not due to procedural deficiencies. Rather, it was found that samples lost weight over time, as is evidenced by the fact that 62% of the samples weighed less on the second weighing. The magnitude of the differences in weights was relatively small, ranging from < 0.1-0.5 gm. In most instances, the weights differed by less than 0.1 gm so the final weight reported for the sample was not changed. Approximately 8% of the reported weights were affected.

For the quality control exercise for measuring accuracy of identification and enumeration, twenty-six samples were distributed for re-identification. However, records of the results for six samples were lost prior to error classification and could not be used in the analysis. Twenty out of 251 (7.9%) of the samples were reanalyzed. Percent error in counts of taxa and specimens were 3.4% and 2.1%, respectively. Percent error in identification accuracy was 4.7% (Table A7). Counts of number of taxa and specimens were within the MQO of 10% in all samples. Identification accuracy did not meet the 10% criteria in two samples. Additional information about quality control of identification and enumeration is presented in Appendix B.

Table A1. Minimum Quality Objectives (MQO's) for benthic infaunal sample collection and processing. NA = not applicable.

Category	Accuracy	Precision	Completeness
Sample collection	NA	NA	90%
Sorting	5%	NA	90%
Counting	10%	NA	90%
Identification	10%	NA	90%
Biomass estimation	NA	10%	90%

Table A2. Field audit checklist for benthic sampling of the Southern California Bight. A check denotes vessels were using the proper equipment and were collecting and processing samples according to accepted procedures.

BENTHIC SAMPLING QA/QC CHECKLIST

Benthic Sample Processing Equipment	**Agency**			
Benthic Infaunal Samples	**1**	**2**	**3**	**4**
Catchment for grab overlying and wash water	v	v	v	v
Plastic ruler (mm)	v	v	v	v
Wash table (recommended)	v	v	v	v
Screen box with 1.0mm mesh screen	v	v	v	v
Borate buffered Formalin	v	v	v	v
MgSO4 relaxant sol.	v	v	v	v
Field computer	v	v	v	v
SCBPP format sample labels (external & internal)	v	v	v	v
Forceps for picking screen	v	v	v	v
Scrub brush for cleaning screen	v	v	v	v
Sample containers (none <16 oz capacity)	v	v	v	v
Adequate size range of sample containers	v	v	v	v
	v	v	v	v
Sediment Chemistry & Toxicity Samples				
Plastic scoop for sub-sampling	v	v	v	***
Soap & Water wash for scoop	v	v	v	
Scoop rinse	v	v	v	
SCBPP format sample labels	v	v	v	
4 oz plastic or glass containers for Grain Size	v	v	v	
4 oz pre-cleaned plastic or glass containers with TFE lined lids for TOC/Org N	v*	v	v	
8 oz pre-cleaned plastic or glass containers with TFE lined lids for Metals	v	v	v**	
8 oz pre-cleaned glass containers with TFE lined lids for Organics	v*	v	v**	
1 liter pre-cleaned HDP wide mouth jars for Sediment Toxicity	v	v	v	
Refrigerator or wet ice for cooling	v	v	v	
Freezer or dry ice for freezing	v	v	v	

*√ = Not TFE lined lids
**√ = Two 4 oz. jars were used.
*** = Toxicity samples not taken during QA/QC audit.

Table A2 continued.

Benthic Sample Processing Procedures	Agency			
Infaunal Sample Acceptance and Screening	**1**	**2**	**3**	**4**
Properly applies sample acceptance criteria	v	v	v	v
Means of collecting wash water/sample	v	v	v	v
Penetration depth properly measured	v	v	v	v
Filters wash water	v	v	v	v
Uses wash table	v	v	v	v
Screen mesh size = 1.0 mm	v	v	v	v
Screen surface area adequate for washing	v	v	v	v
Gentle treatment of sample during washing & screening	v	v	v	v
Thorough removal of sample from screen	v	v	v	v
Screen washed and scrubed between samples	v	v	v	v
Infaunal Sample Handling				
Labeling requirements met	v	v	v	v
Sample container <50% full of sample material	v	v	v	v
Adequate volume of relaxant used	v	v	v	v
Sample agitated to assure exposure to relaxant solution	v	v	v	v
Proper duration of exposure to relaxant	v	v	v	v
Measures to avoid environmental extremes during sample relaxation	v	v	v	v
Adequate fixative added	v	v	v	v
Sample agitated to assure exposure to fixative	v	v	v	v
Complete data entry	v	v	v	v
Sediment Chemistry & Toxicity Sample				
Properly applies sample acceptance criteria	v	v	v	***
Appropriate care draining overlying water from grab	v	v	v	
Avoids potential sources of contamination	v	v	v	
Subsamples to specified depth	v	v	v	
Avoids scoop contact with sides of grab	v	v	v	
Labeling requirements met	v	v	v	
Sample holding conditions met	v	v	v	
Washes scoop between stations	v	v	v	
Complete data entry	v	v	v	

*** = Toxicity samples not taken during QA/QC audit.

Table A3. Summary of quality control (QC) results for sample completeness. The distance from the nominal station is presented in terms of the radius of the area assigned to the station by the SCBPP design.

Laboratory	Samples Assigned	Samples Taken	Distance from Nominal Station			Percent Complete	MQO[a]
			> 2X radius	1.2-2 X radius	Unknown		
Organization 1	74	70	1	1		93	90
Organization 2	28	26		1		93	90
Organization 3	41	40				98	90
Organization 4	40	36			1	90	90
Organization 5	81	80			2	90	90
Total	264	252	1	2	3	99	90

[a]MQO = Minimum quality objective.

Table A4. Quality assurance (QA) completeness for infaunal sample sorting.

Laboratory	Samples Assigned	10% Method No. Required for [a]QC	10% Method No. QC[a] Checked	100% Method No. of Sorters	100% Method No. Required for [a]QC	100% Method No. QC[a] Checked	Percent Complete
Lab 1	60			6	6	14	100
Lab 2	40	-	-	6	6	8	100
Lab 3	73	73	73	-	-	-	100
Lab 4	79	-	-	13	13	24	100
All Labs	252	-	-	-	-	-	100

[a]QC = Quality control.

Table A5. Sorting efficiency for laboratories processing samples.

	Sorting Efficiency			
Laboratory	Low	High	Mean[a]	MQO[b] (%)
Lab 1[c]	95.0	99.8	98.1	95.0
Lab 2	98.9	100.0	99.7	95.0
Lab 3	95.0	100.0	96.7	95.0
Lab 4	97.4	100.0	99.3	95.0
All Labs	95.0	100.0	98.4	95.0

[a]Mean = Samples which were completely resorted after falling below 95% are assumed to have achieved 95% efficiency.
[b]MQO = Minimum quality objective.
[c]Maximum estimated efficiency (See text for explanation).

Table A6. Quality assurance (QA) results for estimation of biomass.

	Exceedance MQO[a]		Exceedances >= 0.1 (g)		
	No. Samples	Percent Samples	No. Samples	Range (g wet wt)	Mean (g wet wt)
Low (< 90% of weight)	20	15	9	0.1-0.5	0.2
High (> 110% of weight)	5	4	1	0.1	
Total exceedances	25	19			

[a]MQO = Minimum quality objective.

Table A7. Results of quality assessment for infaunal identification and enumeration.

Laboratory	No. of Samples Reanalyzed		Mean % Error			No. of Samples Exceeding MQO[a]		
	Planned	Actual	No. of Taxa	Count	ID[b] Accuracy	No. of Taxa	Count	ID[b] Accuracy
Lab 1	6	6	4.8	3.1	6.9	0	0	1
Lab 2	4	2	1.8	1.0	3.6	0	0	0
Lab 3	8	6	4.5	2.2	3.0	0	0	0
Lab 4	8	6	1.1	1.5	4.6	0	0	1
All Labs	26	20	3.4	2.1	4.7	0	0	2

[a]MQO = Minimum quality objective.
[b]ID = Identification.