OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Risk Assessment of Seafood Consumption Following the Refugio Beach Oil Spill Incident in Santa Barbara County, California

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Fish, Ecotoxicology, and Water Section
Pesticide and Environmental Toxicology Branch
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LIST OF ABBREVIATIONS

BaPE	benzo[a]pyrene equivalent
CDFW	California Department of Fish and Wildlife
	(formerly California Department of Fish and Game, CDFG)
cPAH(s)	carcinogenic polycyclic aromatic hydrocarbon(s)
LOC	Level of Concern
MDL	method detection limit
NAS	National Academy of Sciences
NOAA	National Oceanic and Atmospheric Administration
OEHHA	Office of Environmental Health Hazard Assessment
OSPR	Office of Spill Prevention and Response
PAH(s)	polycyclic aromatic hydrocarbon(s)
QA	quality assurance
ppb	parts per billion
WPCL	Water Pollution Control Laboratory
∑BaPE	total benzo[a]pyrene equivalents

PREFACE

The Office of Environmental Health Hazard Assessment (OEHHA), a department within the California Environmental Protection Agency, is responsible for evaluating potential public health risks associated with seafood consumption following marine oil spills in California. This task includes making recommendations on fisheries closure and rescinding closures to the California Department of Fish and Wildlife. OEHHA's authorities to conduct these activities are based on a mandate in the:

- California Fish and Game Code
  - Section 5654

This report presents a seafood risk assessment conducted by OEHHA to support these recommendations following the Refugio Beach oil spill incident.

ACKNOWLEDGMENTS

OEHHA acknowledges the numerous staff from the California Department of Fish and Wildlife (CDFW), Office of Spill Prevention and Response (OSPR) and CDFW Marine Region for their efforts and collaboration during the fisheries closure spill response and their assistance in the review of this document. In particular, Lori Chumney and Carlos Mireles were essential in developing and implementing the sampling and analysis plan; David Witting (National Oceanic and Atmospheric Administration; NOAA) was also very helpful in developing the sampling plan. Numerous staff from OSPR and CDFW Marine Region participated in fisheries closure sampling activities including CDFW Fish and Game Wardens, specifically Santos Cabral who was integral in handling sampling logistics. Further, staff from OSPR's Water Pollution Control Laboratory (WPCL) prepared and analyzed fisheries closure samples. Julie Yamamoto, Randy Imai, Craig Shuman, and Michael Sowby also assisted with various fisheries closure-related activities. Additionally, Gail Cho reviewed the analytical results and QA documentation, and contributed to the laboratory methods section of the report. OEHHA also thanks individuals from other organizations who assisted in fisheries closure sampling. OEHHA thanks Lori Chumney, Regina Donohoe, Bryand Duke, Bruce Joab, and Beckye Stanton, who reviewed this report.

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EXECUTIVE SUMMARY

On May 19, 2015, a 24-inch pipeline, the Plains All American Line 901 that runs from Las Flores to Gaviota, ruptured on the north side of Highway 101 near Refugio State Beach in Santa Barbara County, California. An estimated 101,000 to 140,000 gallons of Outer Continental Shelf (OCS) Las Flores crude oil leaked from the broken pipe; an estimated 21,000 gallons drained into a culvert under Highway 101 and rolled over a bluff into the Pacific Ocean. A final estimate of spilled oil volume is not yet available and is currently under investigation.

Adequate information was not immediately available to determine the potential threat to public health from the consumption of seafood collected from the area affected by the spill. Thus, on the evening of May 19, the Office of Environmental Health Hazard Assessment (OEHHA) recommended to the California Department of Fish and Wildlife (CDFW) that a fishing and shellfish harvesting closure be initiated for the coastal area near Refugio State Beach, pending receipt of additional information to determine the degree and nature of any potential public health threat posed by the spill. The initial closure extended from approximately one mile west of the beach (near the intersection of Highway 101 and Calle Real Road) to approximately one mile east of the beach (near the intersection of Highway 101 and Venadito Canyon Road), and included the shoreline and offshore areas between these points to one-quarter mile offshore. The closure area was expanded significantly on May 21, based on aerial observations and review of National Oceanic and Atmospheric Administration (NOAA) oil spill trajectory models of where the oil was likely to move. The expanded closure area included coastal areas from Canada de Alegeria at the western edge to Coal Oil Point at the eastern edge, and included the shoreline and offshore areas between these points to 6 miles offshore (approximately 138 square miles; see Figure 1).

Fish and Game Code §5654 requires that, if a closure is in effect for more than 48 hours after notification of the spill, expedited testing of seafood is required before the fisheries closure can be lifted. On May 20, OEHHA and CDFW's Office of Spill Prevention and Response (OSPR) staff met to begin coordinating a sampling and analysis plan to establish the degree and geographic extent of seafood contamination. A variety of finfish and invertebrate species, as well as kelp, were collected from the closure area on multiple occasions between May 24 and June 17 in order to inform fisheries closure decisions.

OEHHA has established a protocol for assessing the risk associated with consuming seafood following an oil spill. The contaminants of concern in seafood following an oil spill are specific polycyclic aromatic hydrocarbons (PAHs) that are considered to have the potential to cause cancer (cPAHs). The concentrations of cPAHs measured in seafood are compared to a Level of Concern (LOC), i.e., a concentration that is considered to pose an unacceptable health risk if consumed at the stated rate and for the predicted duration. The LOC for the most sensitive population, based on sensitivities related to age (which affects sensitivity to cancer) and seafood consumption

rate, is 27 parts per billion (ppb) (wet weight) cPAH, expressed as total benzo[a]pyrene equivalents (∑BaPE).

Results of cPAH analyses showed that no samples of offshore finfish, invertebrates, or kelp exceeded the LOC. Finfish and crustaceans had very low or non-detectable levels of ∑BaPE throughout the closure area. Red sea urchins and warty sea cucumbers had somewhat elevated levels of ∑BaPE in block 655 (nearest Refugio Beach) (13.6 and 6.9 ppb ∑BaPE, respectively). Red sea urchins had slightly elevated ∑BaPE levels in blocks 656 and 654 (5.7 and 2.5 ppb, respectively). ∑BaPE concentrations in all kelp samples were very low (0.2 to 0.3 ppb). Abalone had very low ∑BaPE concentrations in the first sampling event (June 5) and non-detectable concentrations in the second sampling event (June 18).

Among the sites where mussels were collected and analyzed, mussels initially (May 24) had very high levels at Refugio Beach, El Capitan Beach, and Haskell's Beach (264.3, 180.1, and 101.6 ppb ∑BaPE, respectively). However, by the last mussel sampling period (June 17 and 18), all mussels samples had fallen below the LOC. Following a recommendation from OEHHA, CDFW lifted the existing closure area on June 29, 2015. The public was advised to continue to follow state advisories or quarantines regarding other health concerns in seafood species, such as the annual quarantine of sport-harvested mussels, which began May 1, to protect the public from paralytic shellfish poisoning and domoic acid poisoning.

INTRODUCTION

On May 19, 2015, a 24-inch pipeline, the Plains All American Line 901 that runs from Las Flores to Gaviota, ruptured on the north side of Highway 101 near Refugio State Beach in Santa Barbara County, California. An estimated 101,000 to 140,000 gallons of Outer Continental Shelf (OCS) Las Flores crude oil leaked from the broken pipe; an estimated 21,000 gallons drained into a culvert under Highway 101 and rolled over a bluff into the Pacific Ocean. A final estimate of spilled oil volume is not yet available.

The incident was reported to the Governor's Office of Emergency Services (Cal OES) at 1243 hours. The California Department of Fish and Wildlife (CDFW), Office of Spill Prevention and Response (OSPR) informed OEHHA about the spill at 1441 hours, as required by state law (Fish and Game Code §5654). At 1510 hours, a caller to Cal OES estimated that the spill was greater than 500 barrels (22,000 gallons) and local media outlets had begun to publish pictures of significant amounts of oil on the water. Because adequate information was not available to determine the potential threat to public health resulting from the consumption of fish and shellfish from the spill-impacted area, OEHHA sent a memorandum to CDFW at 1821 hours recommending that a fishing and shellfish harvesting closure be initiated for the coastal area near Refugio State Beach. OEHHA and OSPR jointly defined the closure boundaries to extend from approximately one mile to the west and one mile to the east of Refugio State Beach, and to include the shoreline and offshore areas between these points to one-quarter

mile offshore. After receiving this recommendation from OEHHA, CDFW declared an immediate fisheries closure for the area at 1748 hrs.

The closure area was expanded significantly on May 21, based on aerial observations and review of National Oceanic and Atmospheric Administration (NOAA) oil spill trajectory models of where the oil was likely to move. The extended closure area included coastal areas from Canada de Alegeria on the western edge to Coal Oil Point on the eastern edge and included the onshore and offshore areas between these points to six miles offshore (approximately 138 miles).

Fish and Game Code §5654 requires that, if a closure is in effect for more than 48 hours after notification of the spill, expedited testing of seafood is required before a fishery closure can be lifted. On May 20, OEHHA and OSPR staff met to begin coordinating a sampling and analysis plan.

CONTAMINANTS AND SPECIES OF CONCERN RELATING TO SEAFOOD CONSUMPTION FOLLOWING OIL SPILLS

Contaminants of Concern

Oil, as defined under California Government Code §8670.3, is “any kind of petroleum, liquid hydrocarbons, or petroleum products or any fraction or residues there from, including, but not limited to, crude oil, bunker fuel, gasoline, diesel fuel, aviation fuel, oil sludge, oil refuse, oil mixed with waste, and liquid distillates from unprocessed natural gas.” The contaminants of concern in seafood following an oil spill are specific polycyclic aromatic hydrocarbons (PAHs) that are considered to have the potential to cause cancer (cPAHs). Cancer is the effect of greatest concern related to human consumption of seafood contaminated by oil-spill-related chemicals (see OEHHA, 2015, for discussion).

Species of Concern Relating to Seafood Consumption

The determination of species and locations to sample following an oil spill is dependent on knowledge of the environmental fate of oil and its constituents and the specific spill scenario (e.g., volume, product, location, shoreline type, trajectory, and weather). Fish and shellfish accumulate PAHs to varying degrees, depending on seafood species and chemical structure. Finfish, in particular, can often swim away from a spill, depending on the extent of the spill relative to the home range and the availability of suitable habitat. Bivalve mollusks such as mussels, on the other hand, are not mobile and do not metabolize PAHs as rapidly as do finfish and some other shellfish (Meador et al., 1995; NAS, 2003; Yender et al., 2002). As a result, they pose a greater likelihood of accumulating specific oil-spill-related chemicals of human health concern. Finfish tend to accumulate lower molecular weight PAHs that are less toxic to humans, whereas mussels accumulate higher molecular weight PAHs that are more likely to be carcinogens. Crustaceans, such as crabs, have an intermediate ability to metabolize PAHs and generally accumulate lower molecular weight PAHs (Eisler, 2000; Meador et

al., 1995; Topping et al., 1997). Thus, mussels may be used as an indicator species when assessing the risk of seafood consumption following an oil spill. However, given the estimated volume of the spill and the large geographic area and number of species potentially impacted following the Refugio Beach incident, it was important to more fully characterize the degree of contamination in a variety of species and include offshore as well as onshore locations.

IDENTIFYING CONTAMINANT LEVELS IN SHELLFISH FOLLOWING THE REFUGIO BEACH OIL SPILL INCIDENT

Sampling Activities

California Department of Fish and Wildlife Commercial Fishing Blocks

Commercial fishing areas are designated geographically as “California Department of Fish and Wildlife Commercial Fishing Blocks” (“blocks” in this report). Blocks consist of approximately 10 x 10 nautical-mile areas that commercial fishermen use to report the location of their catch. The vast majority of the fishery closure area was encompassed by blocks 654 (the eastern portion of the closure area), 655 (the central portion of the closure area, including the Refugio Beach area), and 656 (the western portion of the closure area). Within each of these blocks, smaller, centrally-located “sampling blocks” were identified to target sampling efforts. The goal was to be able to make decisions regarding lifting the fishery closure on a block-by-block basis. The fisheries closure area, fishing blocks, and sampling blocks are shown in Figure 1.

Marine Species Sampling Plan

CDFW and OEHHA jointly developed a sampling and analysis plan to establish the degree and geographic extent of seafood contamination in species from the impacted area. Species were selected for sampling based on three factors: 1) potential for exposure to oil, 2) recreational or commercial importance, and 3) representation of different feeding ecologies and habitat types within the closure zone.

Finfish, invertebrate species, and kelp were collected and analyzed from each of the blocks on seven days during the period of June 10-19, approximately three to four weeks after the spill, to represent the entire closure area. The locations of species collected from each block are shown in Figures 2, 3 and 4 for blocks 654, 655, and 656, respectively. In total, the number of finfish and (non-mussel) invertebrate samples collected and analyzed from blocks 654, 655, and 656 were 106, 150, and 105, respectively. Thirty-six samples of kelp were also collected, including nine from each of the blocks and nine from an area west of the closure area (Figure 5). A summary of offshore samples analyzed for fisheries closure purposes, including block, species, date, individuals per composite, fishing/harvesting method, sample identification number, and sample location coordinates, is shown in Table 1.

Mussel samples were collected from multiple sites along the affected shoreline. A total of 341 mussels were collected and analyzed during three sampling events over a 26 day period (Figure 6). The first sampling event was conducted on May 24, 2015. Mussels collected from six locations within the closure area were analyzed for fisheries closure purposes. Additional mussel samples collected in two locations to the east of the closure area were analyzed to determine whether the closure area should be expanded. A second sampling event was conducted on June 4 and 5, 2015. Mussels were collected from a total of eight locations, including the same two sites east of the closure area. Additionally, nine market-sized abalone were collected from a total of three tanks (three abalone per tank) at an onshore abalone farm (Figure 6) and composited to form one sample for analysis. A third sampling event was conducted on June 17 and 18, 2015. Mussels were collected from nine locations, including the same two sites east of the closure area. Nine abalone were also collected, as before, during the third sampling. A summary of onshore samples analyzed for fisheries closure purposes, including site name, species, date, individuals per composite, sample identification number, and sample location coordinates, is shown in Table 2.

Sampling Methods, Documentation, and Custody

For all sampling activities, collection was documented with GPS, photographs, and a photo and sample log form. Samplers wore nitrile gloves to collect samples and changed gloves between sample locations. Additional personal protective equipment, such as Tyvek® suits, outer gloves and booties, high visibility vests, and hardhats were worn as dictated by the site safety plan. Offshore samples of finfish, invertebrates, and kelp were collected by hook and line, trap, trawl, diver, or hand harvest, depending on species and location (see Table 1). Mussels and abalone from an onshore abalone farm were collected by hand. Samples were double wrapped in foil, dull side to the samples, before being placed in a heavy duty sealed plastic bag. The sample I.D., date and time of collection, site name, sampler, and latitude/longitude of the sampling location were written in indelible ink on an adhesive label, which was placed on the sealed plastic bag. This sealed bag was then placed in a second plastic bag before being sealed and placed on ice in a cooler. Samples were held on ice until transport via courier to the CDFW Water Pollution Control Laboratory (WPCL), in Gold River, CA.

Standard CDFW chain-of-custody procedures were followed. Chain of custody forms were filled out at the end of each sampling event and enclosed inside the cooler in a sealed plastic bag prior to transport.

Laboratory Methods

CDFW WPCL prepared and analyzed the tissue samples. Samples were received, processed, analyzed, and stored in accordance with WPCL standard operating procedures and/or US Environmental Protection Agency protocols, when available. Tissues were extracted by pressurized fluid extraction, followed by gel permeation chromatography and silica clean-up, and then analyzed for PAHs/alkylated homologs by GC/MS-SIM (SW846 EPA Method 8270 Mod). Results for 54 individual compounds or

groups of compounds (e.g., alkylated homologue groups) were reported. Of those, OEHHA considers eight to be carcinogens (cPAHs): chrysene, benz[a]anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo[a,h]anthracene, indeno[1,2,3,-cd]pyrene, naphthalene, and benzo[a]pyrene. The method detection limit (MDL) for all cPAHs was approximately 1 part per billion (ppb), or less.

CDFW WPCL provided results and associated Quality Assurance (QA) documentation for all samples, including controls, demonstrating that sample processing was reproducible, accurate, and free from cross-contamination. A certified reference material from the National Institute of Standards and Technology (NIST) for organics in mussels (SRM 1974c) was included in sample processing to provide an additional measure of analytical comparability. Reference materials and analytical quality controls were within acceptable ranges. All results passed QA review. cPAH concentrations less than five times the concentration in the method blank were censored (i.e., considered to be zero) for calculation of benzo[a]pyrene equivalent (BaPE) calculations (see below).

CONTAMINANT LEVELS IN FISH AND SHELLFISH TISSUE THAT POSE NO SIGNIFICANT RISK

OEHHA has established a protocol for assessing the risk to human health associated with consuming seafood following an oil spill (OEHHA, 2015). Concentrations of cPAHs in seafood are compared to an LOC, i.e., a concentration that is considered to pose an unacceptable health risk if consumed at the stated rate and for the predicted duration. LOCs were developed for three sensitive populations, defined by sensitivities related to age (which affects sensitivity to cancer) and seafood consumption rates. Of these three, the most health protective LOC was 27 nanograms per gram (ng/g) or ppb (wet weight) cPAH, expressed as total benzo[a]pyrene equivalents (∑BaPE) (see OEHHA, 2015, for details):

LOC (cancer) = 27 ng/g or ppb (wet weight) for ∑BaPE

RESULTS AND CONCLUSIONS

Laboratory results were received in eleven batches from June 9 until June 29. cPAH concentrations (including alkylated homologues, when detected) were converted to BaPE and summed, as described in OEHHA, 2015.

∑BaPE concentrations in offshore finfish, invertebrates, and kelp are presented in Table 3. Individual cPAH concentrations in offshore species from which ∑BaPE concentrations were calculated are presented in Appendices 1, 2 and 3 for blocks 654, 655, and 656, respectively. No samples of offshore finfish, invertebrates, or kelp exceeded the LOC. Finfish and crustaceans had very low or non-detectable levels of ∑BaPE throughout the closure area. Red sea urchins and warty sea cucumbers had somewhat elevated levels of ∑BaPE in block 655 (nearest Refugio Beach) (13.6 and 6.9 ppb ∑BaPE, respectively). Red sea urchins had slightly elevated ∑BaPE levels in

blocks 656 and 654 (5.7 and 2.5 ppb, respectively). ∑BaPE concentrations in all kelp samples were very low (0.2 to 0.3 ppb).

∑BaPE concentrations in onshore invertebrates are presented in Table 4. Individual cPAH concentrations in onshore species from which ∑BaPE concentrations were calculated are presented in Appendix 4. Abalone had very low (1.6 ppb) ∑BaPE concentrations in the first sampling event (June 5) and non-detectable concentrations in the second sampling event (June 18).

Among the sites where mussels were collected and analyzed, mussels initially (May 24) had very high ∑BaPE levels at Refugio Beach, El Capitan Beach, and Haskell's Beach (264.3, 180.1, and 101.6 ppb ∑BaPE, respectively). By the second sampling event (June 4 and 5), ∑BaPE levels at Refugio Beach and El Capitan Beach had dropped to 120.1 and 58.2 respectively. By the last mussel sampling period (June 17th and 18th), all mussels samples had fallen below the LOC. Thus, OEHHA recommended on June 29 that CDFW rescind the fishery closure order. The public was advised to continue to follow state advisories or quarantines regarding other health concerns in seafood species, such as the annual quarantine of sport-harvested mussels, which began May 1, to protect the public from paralytic shellfish poisoning and domoic acid poisoning.

In conclusion, based on a recommendation by OEHHA following the Refugio Beach oil spill incident in Santa Barbara County, CDFW declared a fisheries closure on May 19, 2015. The closure area was significantly increased on May 21. Sampling activities for fisheries closure purposes were conducted on multiple occasions between May 23 and June 19. Results were compared to the LOC. Although ∑BaPE concentrations were initially elevated in mussels, no other species exceeded the LOC. By the last mussel sampling event, all mussel samples had fallen below the LOC. Final results were made available to OEHHA on June 29, 2015, whereupon OEHHA recommended to CDFW that consumption of seafood from the area posed no significant ongoing oil spill-related human health risk.

TABLE 1. SUMMARY OF SAMPLING ACTIVITIES FOR OFFSHORE SPECIES

Species	Date	Number of individuals/ composite	Fishing Method	Sample I.D. WPCL Lab Number	GPS Coordinates (DD)*
Block 654					
Barred Surfperch (*Hyperprosopon ellipticum)*	6/10/15	9	Hook and line	SBNS001061015BSP1	34.43099, -119.91615
California Spiny Lobster (*Panulirus interruptus)*	6/15/15	3	Trap	B654061515LB1	34.4444167, -119.9750
Giant Kelp (*Macrosystis pyrifera)*	6/19/15	9	Hand harvested	B654061915KEL1	9 coordinates (see map)
Giant Red Cucumber (*Apostichopus californicus)*	6/12/15	8	Trawl	B654061215RSC1	34.41222, -119.95100 to 34.40146, -119.91866; 34.41343, -119.95132 to 34.41305, -119.93243
Grass Rockfish (*Sebastes rastrelliger*)	6/12/15	11	Trap	B654061215GRR1	34.44619, -119.97855
Kelp Rockfish (*Sebastes atrovirens)*	6/10/15	9	Hook and line	B654061015KRF1	34.42565, -119.91768; 34.42446, -119.91813; 34.42073, -119.90715; 34.42098, -119.90473 34.42616, -119.91921
Pacific Sanddab (deeper water) (*Citharichthys sordidus)*	6/10/15	9	Hook and line	B654061015SDB1	34.39735, -120.00616
Red Sea Urchin (*Strongylocentrotus franciscanus)*	6/10/15	9	Diver	B654061015RSU1	34.42073, -119.90715
Ridgeback Prawn (*Sicyonia ingentis*)	6/12/15	12	Trawl	B654061215RBP1	34.41222, -119.95100 to 34.40146, -119.91866 34.41343, -119.95132 to 34.41305, -119.93243
Rock Crab (Yellow) (*Sicyonia ingentis*)	6/15/15	10	Trap	B654061515RCR1	34.41446, -119.94668
Sheep Crab (*Loxorhynchus grandis)*	6/18/15	9	Trap	B654061815SHP1	34.42781, -119.9259 to 34.44696, -119.9867167
Vermillion Rockfish (*Sebastes miniatus)*	6/10/15	8	Hook and line	B654061015VRF1	34.39735, -120.00616

Species	Date	Number of individuals/ composite	Fishing Method	Sample I.D. WPCL Lab Number	GPS Coordinates (DD)*
Warty Sea Cucumber	6/10/15	9	Diver	B654061015WSC1	34.42780, -119.92590 34.42446, -119.91813 34.42073, -119.90715
Block 655					
Barred Surfperch	6/10/15	4	Hook and line	SBJS001061015BSP1	34.46305, -120.06953
Black & Yellow Rockfish (*Sebastes chrysomelas)*	6/11/15	7	Hook and line; Trap	B655061115BYR1-1	34.46214, -120.10530 34.46345, -120.10518 to 34.45954, -120.07320
Bocaccio Rockfish (*Sebastes paucispinis*)	6/11/15	9	Hook and line	B655061115BOC1	34.42297, -120.11377
California Spiny Lobster	6/15/15	1	Trap	B655061515LB1	34.4591833, -120.093933
Giant Kelp	6/19/15	9	Hand harvest	B655061915KEL1	9 coordinates (see map)
Giant Red Cucumber	6/12/15	12	Trawl	B655061215RSC1	34.45162, -120.10248 to 34.44212, -120.02342
Grass Rockfish	6/11/15	13	Trap	B655061115GRR1	34.46345, -120.10518 to 34.45954, -120.07320
Kelp Rockfish	6/11/15	9	Hook and line	B655061115KRF1	34.46162, -120.10496
Pacific Mackerel	6/19/15	10	Hook and line	B655061915MKL1	34.46117, -120.03898 34.45529, 120.05912
Pacific Sanddab (deeper water)	6/11/15	11	Hook and line	B655061115SDB1	34.42395, -120.11348
Pacific Sanddab (shallower water)	6/19/15	10	Hook and line	B655061915SDB1	34.45425, -120.07253 to 34.45646, -120.09665
Red Sea Urchin	6/11/15	9	Diver	B655061115RSU1	34.46045, -120.06634
Ridgeback Prawn	6/12/15	11	Trawl	B655061215RBP1	34.45162, -120.10248 to 34.44212, -120.02342

Species	Date	Number of individuals/ composite	Fishing Method	Sample I.D. WPCL Lab Number	GPS Coordinates (DD)*
Rock Crab (Brown)	6/11/15	6	Diver	B655061115RCR1	34.46045, -120.06634
Rock Crab (Yellow)	6/15/15	10	Trap	B655061515RCR1	34.4470333, - 120.0997833
Sheep Crab	6/18/15	9	Trap	B655061815SHP1	34.4602500, -120.0381167 34.4652000, -120.1122667
Vermillion Rockfish	6/11/15	9	Hook and line	B655061115VRF1	34.42297, -120.11377
Warty Sea Cucumber	6/11/15	9	Diver	B655061115WSC1	34.46045, -120.06634
Block 656					
Barred Surf Perch	6/10/15	9	Hook and line	SBI001061015BSP1-1 SBI001061015BSP1-2	34.47120, -120.22811
Bocaccio Rockfish	6/12/15	9	Hook and line	B656061215BOC1	34.42959, -120.21442
Giant Kelp	6/19/15	9	Hand harvest	B656061915KEL1	9 coordinates (see map)
Grass Rockfish	6/12/15	7	Trap	B656061215GRR1	34.46957, -120.20779
Pacific Mackerel	6/19/15	9	Hook and line	B656061915MKL1	34.46458, -120.20978
Pacific Sanddab (deeper water)	6/12/15	12	Hook and line	B656061215SDB1	34.42959, -120.21442
Pacific Sanddab (shallower water)	6/19/15	9	Hook and line	B656061915SDB1	34.46056, -120.21584
Red Sea Urchin	6/11/15	9	Diver	B656061115RSU1	34.46840, -120.18636
Rock Crab (Brown)	6/11/15	6	Diver	B656061115RCR1	34.46840, -120.18636

Species	Date	Number of individuals/ composite	Fishing Method	Sample I.D. WPCL Lab Number	GPS Coordinates (DD)*
Rock Crab (Yellow)	6/15/15	10	Trap	B656061515RCR1	34.449850, -120.2423667
Sheep Crab	6/18/15	6	Trap	B656061815SHP1	34.4679667, -120.18540 to 34.4671667, -120.206233
Vermillion Rockfish	6/12/15	9	Hook and line	B656061215VRF1	34.42959, - 120.21442
Warty Sea Cucumber	6/11/15	10	Diver	B656061115WSC1	34.46840, -120.18636
Reference Area					
Giant Kelp	6/19/15	9	Hand harvest	DRK061915KEL1	9 coordinates (see map)

*GPS waypoints (latitude, longitude) reported in decimal degrees (DD) in WGS 84.

TABLE 2. SUMMARY OF SAMPLING ACTIVITIES FOR ONSHORE SPECIES

Species	Location	Date	Number of individuals/ composite	Sample I.D.	GPS Coordinates (DD)*
Mussels (*Mytilus californiensis*)	Gaviota East	5/24/15	16	SBIS001ED1052415MU1	34.47062, -120.22444
Mussels	Gaviota East	6/4/15	14	SBIS001FC3060415MU1	34.47333, -120.14016
Mussels	Gaviota East	6/17/15	14	SBIS001MU3061715MU1	34.47057, -120.22614
Mussels	Arroyo Hondo	5/24/15	12	SBIS003ED1052415MU1	34.47337, -120.14495
Mussels	Arroyo Hondo	6/4/15	12	SBIS003FC3060415MU1	34.47057, -120.2262
Mussels	Arroyo Hondo	6/17/15	12	SBIS003MU3061715MU2	34.47335, -120.14015
Mussels	Tajiguas	5/24/15	16	SBIS004ED3052415MU1	34.46376, -120.10217

Species	Location	Date	Number of individuals/ composite	Sample I.D.	GPS Coordinates (DD)*
Mussels	Tajiguas	6/17/15	12	SBIS005MU1061715MU1	34.46376, -120.10207
Mussels	Refugio State Beach	5/24/15	25	SBJS001ED3052415MU2	34.46119, -120.05845
Mussels	Refugio State Beach	6/5/15	16	SBJS001FC1060515MU1	34.46123, -120.05903
Mussels	Refugio State Beach	6/17/15	11	SBJS001MU1061715MU1	34.46124, -120.05904
Mussels	El Capitan	5/24/15	12	SBKS002ED4052415MU2	34.4582, -120.02455
Mussels	El Capitan	6/4/15	12	SBKS001FC1060415MU2	34.45813, -120.0246167
Mussels	El Capitan	6/17/15	12	SBKS001MU1061715MU1	34.45813, -120.02464
Mussels	Haskell's East	5/24/15	20	SBNS001ED6052415MU1	34.4259, -119.90872
Mussels	Venoco Pier	6/17/15	5	SBNS001MU2061715MU1	34.43294, -119.921
Mussels	Coal Oil Point	6/4/15	5	SBNS003FC2060415MU1	34.40695, 119.87718
Mussels	Coal Oil Point	6/17/15	5	SBNS003MU2061715MU1	34.40699, -119.87719
Mussels	Isla Vista	5/24/15	18	E008IV001*	34.408619, -119.857171
Mussels	Isla Vista	6/4/15	13	SBNS004FC2060415MU1	34.40865, -119.85705
Mussels	Isla Vista	6/17/15	10	SBNS004MU2061715MU1	34.40865, -119.85705
Mussels	Goleta Beach	5/24/15	27	E008GP001*	34.416378, -119.811697

Species	Location	Date	Number of individuals/ composite	Sample I.D.	GPS Coordinates (DD)*
Mussels	Goleta Beach	6/4/15	14	SBPS002FC1060415MU1	34.4164667, -119.8116667
Mussels	Goleta Beach	6/18/15	10	SBPS001MU1061815MU1	34.41637, -119.81172
Red Abalone (*Haliotis rufescens)*	Dos Pueblos Abalone Farm	6/5/15	9	SBMS001FC1060515AB1-1 SBMS001FC1060515AB1-2 SBMS001FC1060515AB1-3	34.44318, -119.96222 34.44329, -119.96227 34.4433, -119.96235
Red Abalone	Dos Pueblos Abalone Farm	6/18/15	9	SBMS001FC1061815AB1-1 SBMS001FC1061815AB1-2 SBMS001FC1061815AB1-3	34.44318, -119.96222 34.44329, -119.96227 34.4433, -119.96235

*Transcription error from Chain of Custody; correct identification number begins with ED08

TABLE 3. ∑BAPE CONCENTRATIONS IN OFFSHORE SPECIES

Species	Date	Number of individuals/ Composite*	Sample I.D.	∑BaPE ng/g or ppb (wet weight)**
Block 654				
Barred Surfperch	6/10/15	9	SBNS001061015BSP1	0
California Spiny Lobster	6/15/15	3	B654061515LB1	0.7
Giant Kelp	6/19/15	9	B654061915KEL1	0.2
Giant Red Cucumber	6/12/15	8	B654061215RSC1	1.0
Grass Rockfish	6/12/15	11	B654061215GRR1	0.1
Kelp Rockfish	6/10/15	9	B654061015KRF1	0

Species	Date	Number of individuals/ Composite*	Sample I.D.	∑BaPE ng/g or ppb (wet weight)**
Pacific Sanddab (deeper water)	6/10/15	9	B654061015SDB1	0
Red Sea Urchin	6/10/15	9	B654061015RSU1	2.5
Ridgeback Prawn	6/12/15	12	B654061215RBP1	0
Rock Crab (Yellow)	6/15/15	10	B654061515RCR1	ND
Sheep Crab	6/18/15	9	B654061815SHP1	0.2
Vermillion Rockfish	6/10/15	8	B654061015VRF1	0
Warty Sea Cucumber	6/10/15	9	B654061015WSC1	1.0
Block 655				
Barred Surfperch	6/10/15	4	SBJS001061015BSP1	0.1
Black & Yellow Rockfish	6/11/15	7	B655061115BYR1-1	0.1
Bocaccio Rockfish	6/11/15	9	B655061115BOC1	0
California Spiny Lobster	6/15/15	1	B655061515LB1	0.5
Giant Kelp	6/19/15	9	B655061915KEL1	0.3
Giant Red Cucumber	6/12/15	12	B655061215RSC1	0.9
Grass Rockfish	6/11/15	13	B655061115GRR1	0

Species	Date	Number of individuals/ Composite*	Sample I.D.	∑BaPE ng/g or ppb (wet weight)**
Kelp Rockfish	6/11/15	9	B655061115KRF1	0.1
Pacific Mackerel	6/19/15	10	B655061915MKL1	0.6
Pacific Sanddab (deeper water)	6/11/15	11	B655061115SDB1	0
Pacific Sanddab (shallower water)	6/19/15	10	B655061915SDB1	0
Red Sea Urchin	6/11/15	9	B655061115RSU1	13.6
Ridgeback Prawn	6/12/15	11	B655061215RBP1	0.1
Rock Crab (Brown)	6/11/15	6	B655061115RCR1	0.2
Rock Crab (Yellow)	6/15/15	10	B655061515RCR1	ND
Sheep Crab	6/18/15	9	B655061815SHP1	1.3
Vermillion Rockfish	6/11/15	9	B655061115VRF1	0
Warty Sea Cucumber	6/11/15	9	B655061115WSC1	6.9
Block 656				
Barred Surf Perch	6/10/15	9	SBI001061015BSP1	0
Bocaccio Rockfish	6/12/15	9	B656061215BOC1	0.1
Giant Kelp	6/19/15	9	B656061915KEL1	0.3

Species	Date	Number of individuals/ Composite*	Sample I.D.	∑BaPE ng/g or ppb (wet weight)**
Grass Rockfish	6/12/15	7	B656061215GRR1	0.1
Pacific Mackerel	6/19/15	9	B656061915MKL1	0.3
Pacific Sanddab (deeper water)	6/12/15	12	B656061215SDB1	0
Pacific Sanddab (shallower water)	6/19/15	9	B656061915SDB1	0
Red Sea Urchin	6/11/15	9	B656061115RSU1	5.7
Rock Crab (Brown)	6/11/15	6	B656061115RCR1	0.1
Rock Crab (Yellow)	6/15/15	10	B656061515RCR1	ND
Sheep Crab	6/18/15	6	B656061815SHP1	0.2
Vermillion Rockfish	6/12/15	9	B656061215VRF1	ND
Warty Sea Cucumber	6/11/15	10	B656061115WSC1	0.8
Reference Area				
Giant Kelp	6/19/15	9	DRK061915KEL1	0.3

*One composite was analyzed per species per block, when available.

** ∑BaPE = the sum of benzo[a]pyrene equivalents, a measure of the ability of oil-related chemicals to cause cancer. OEHHA's "Level of Concern" (LOC) for ∑BaPE is 27 ng/g or ppb (wet weight). ∑BaPE concentrations below 27 ng/g are considered safe.

ND = concentrations for all carcinogenic PAHs were below detection limits.

In calculating BaPE for individual carcinogenic PAHs, PAH concentrations less than 5 times the concentration in the method blank were censored.

0 = concentrations for ∑BaPE that were <0.05.

TABLE 4. ∑BAPE CONCENTRATIONS IN ONSHORE SPECIES

Species	Location	Date	Number of individuals/ Composite*	Sample I.D.	∑BaPE ng/g or ppb (wet weight)**
Mussels	Gaviota East	5/24/15	16	SBIS001ED1052415MU1	1.5
Mussels	Gaviota East	6/4/15	14	SBIS001FC3060415MU1	2.8
Mussels	Gaviota East	6/17/15	14	SBIS001MU3061715MU1	1.3
Mussels	Arroyo Hondo Marine Site	5/24/15	12	SBIS003ED1052415MU1	3.3
Mussels	Arroyo Hondo Marine Site	6/4/15	12	SBIS003FC3060415MU2	9.5
Mussels	Arroyo Hondo Marine Site	6/17/15	12	SBIS003MU3061715MU2	1.9
Mussels	Tajiguas	5/24/15	16	SBIS004ED3052415MU1	**28.6**
Mussels	Tajiguas	6/17/15	12	SBIS005MU1061715MU1	8.9
Mussels	Refugio State Beach	5/24/15	25	SBJS001ED3052415MU2	**264.3**
Mussels	Refugio State Beach	6/5/15	16	SBJS001FC1060515MU1	**120.1**
Mussels	Refugio State Beach	6/17/15	11	SBJS001MU1061715MU1	26.9
Mussels	El Capitan	5/24/15	12	SBKS002ED4052415MU2	**180.1**
Mussels	El Capitan	6/4/15	12	SBKS001FC1060415MU2	**58.2**
Mussels	El Capitan	6/17/15	12	SBKS001MU1061715MU1	22.7

Species	Location	Date	Number of individuals/ Composite*	Sample I.D.	∑BaPE ng/g or ppb (wet weight)**
Mussels	Haskell's East	5/24/15	20	SBNS001ED6052415MU1	**101.6**
Mussels	Venoco Pier	6/17/15	5	SBNS001MU2061715MU1	9.8
Mussels	Coal Oil Point	6/4/15	5	SBNS003ED7052415MU2	12.5
Mussels	Coal Oil Point	6/17/15	5	SBNS003MU2061715MU1	8.5
Mussels	Isla Vista	5/24/15	18	E008IV001	2.5
Mussels	Isla Vista	6/4/15	13	SBNS004FC2060415MU1	24.2
Mussels	Isla Vista	6/17/15	10	SBNS004MU2061715MU1	17.1
Mussels	Goleta Beach	5/24/15	27	E008GP001	14.6
Mussels	Goleta Beach	6/4/15	14	SBPS002FC1060415MU1	6.1
Mussels	Goleta Beach	6/18/15	10	SBPS001MU1061815MU1	5.9
Red Abalone	Dos Pueblos Abalone Farm	6/5/15	9	SBMS001FC1060515AB1-1 SBMS001FC1060515AB1-2 SBMS001FC1060515AB1-3	1.6
Red Abalone	Dos Pueblos Abalone Farm	6/18/15	9	SBMS001FC1061815AB1-1 SBMS001FC1061815AB1-2 SBMS001FC1061815AB1-3	ND

*One composite was analyzed per species per block, when available.

** ∑BaPE = the sum of benzo[a]pyrene equivalents, a measure of the ability of oil-related chemicals to cause cancer. OEHHA's "Level of Concern" (LOC) for ∑BaPE is 27 ng/g or ppb (wet weight). ∑BaPE concentrations below 27 ng/g are considered safe. Samples above the LOC are bolded in the table.

ND = concentrations for all carcinogenic PAHs were below detection limits.

In calculating BaPE for individual carcinogenic PAHs, PAH concentrations less than 5 times the concentration in the method blank were censored.
0 = concentrations for ∑BaPE that were <0.05.

FIGURE 1. FISHERIES CLOSURE AREA, COMMERCIAL FISHING BLOCKS, AND SAMPLING BLOCKS

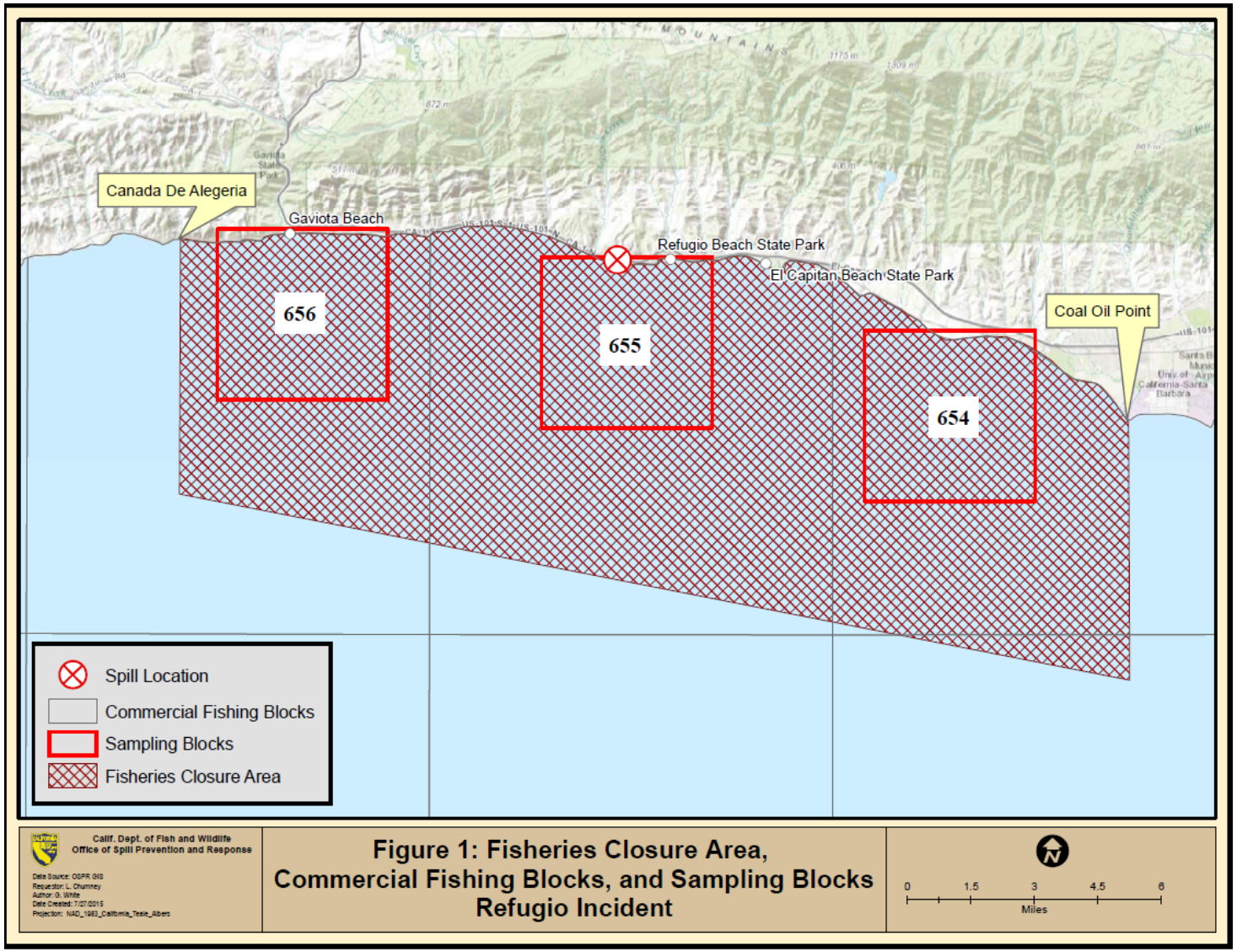


FIGURE 2. BLOCK 654 SAMPLING SITES

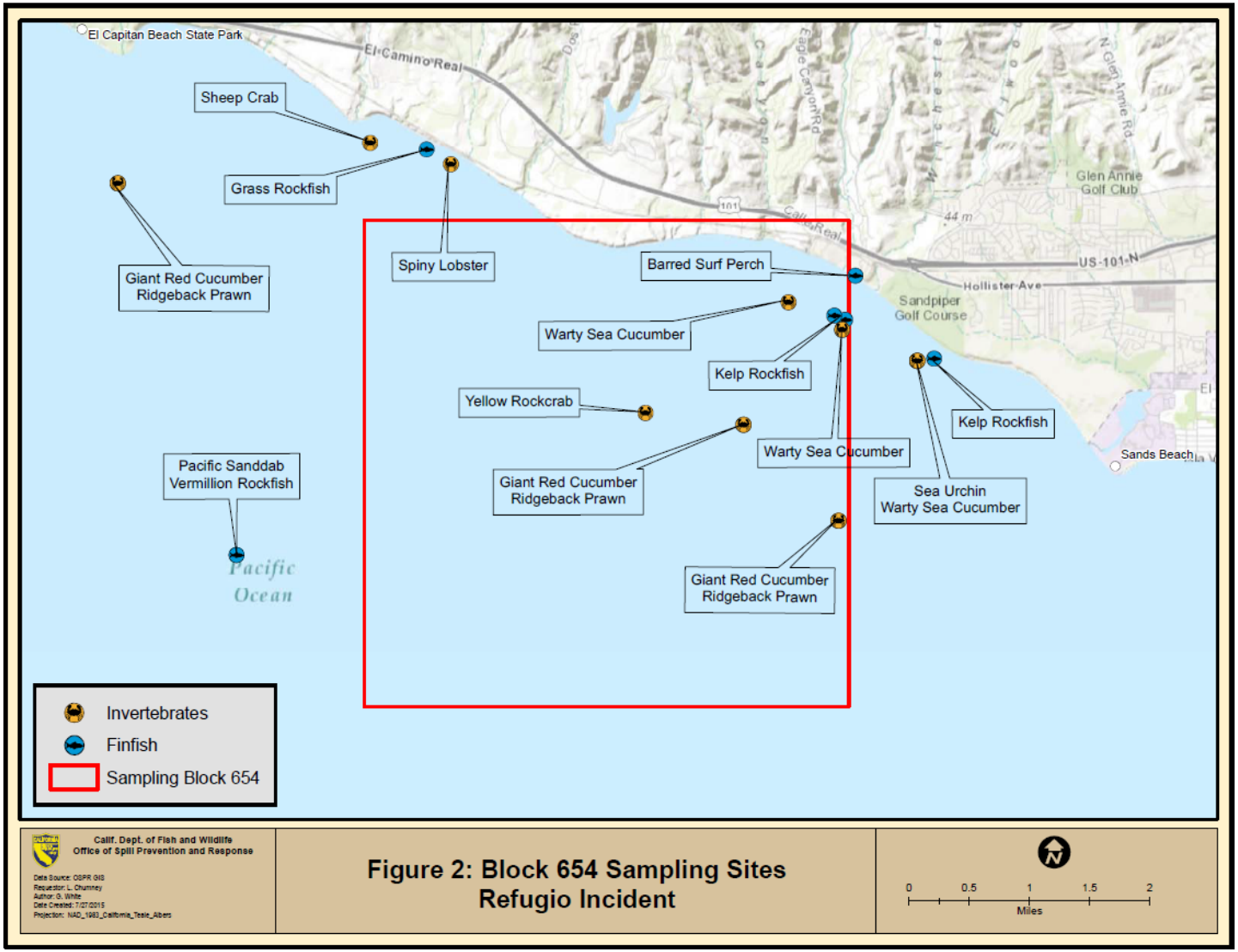


FIGURE 3. BLOCK 655 SAMPLING SITES

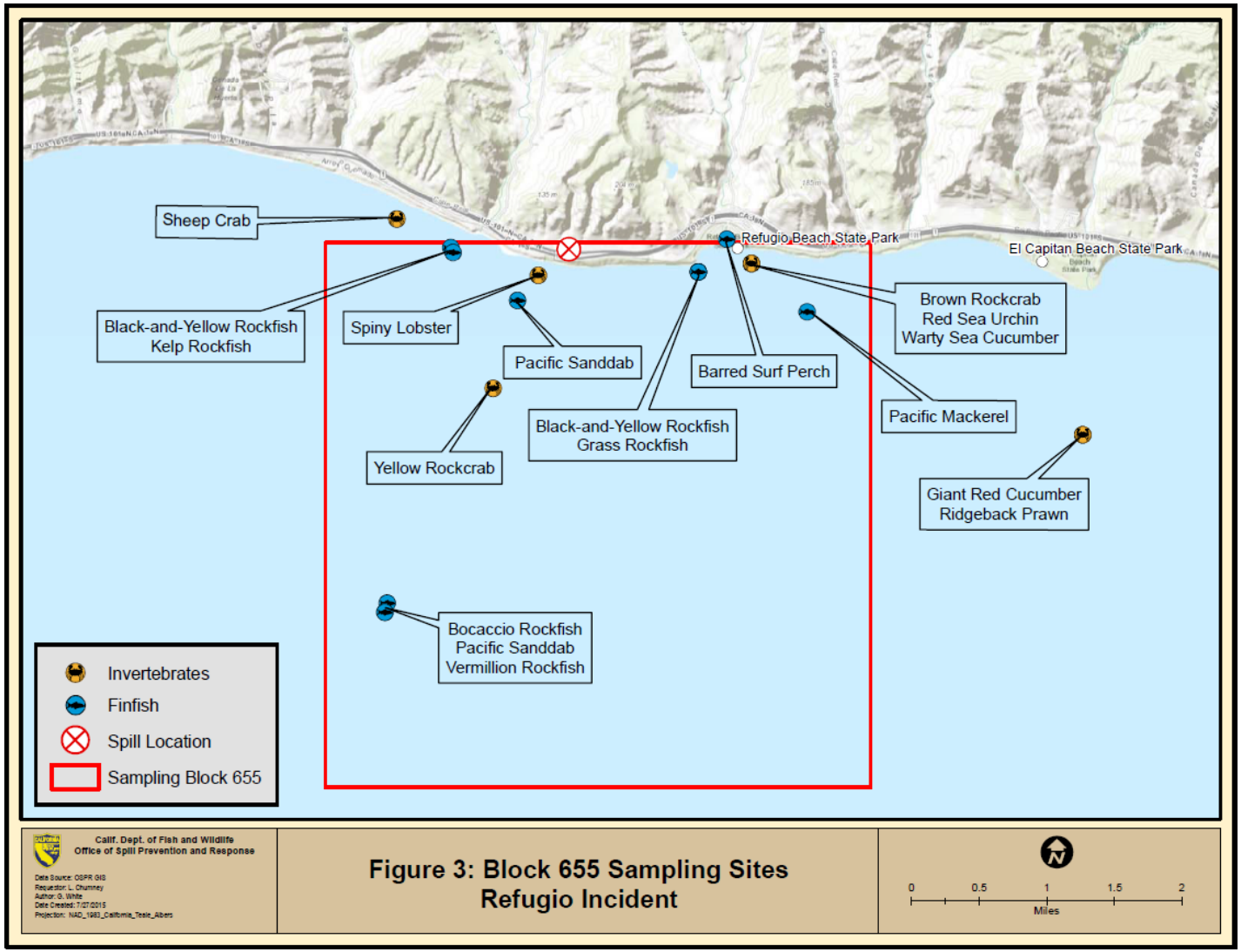


FIGURE 4. BLOCK 656 SAMPLING SITES

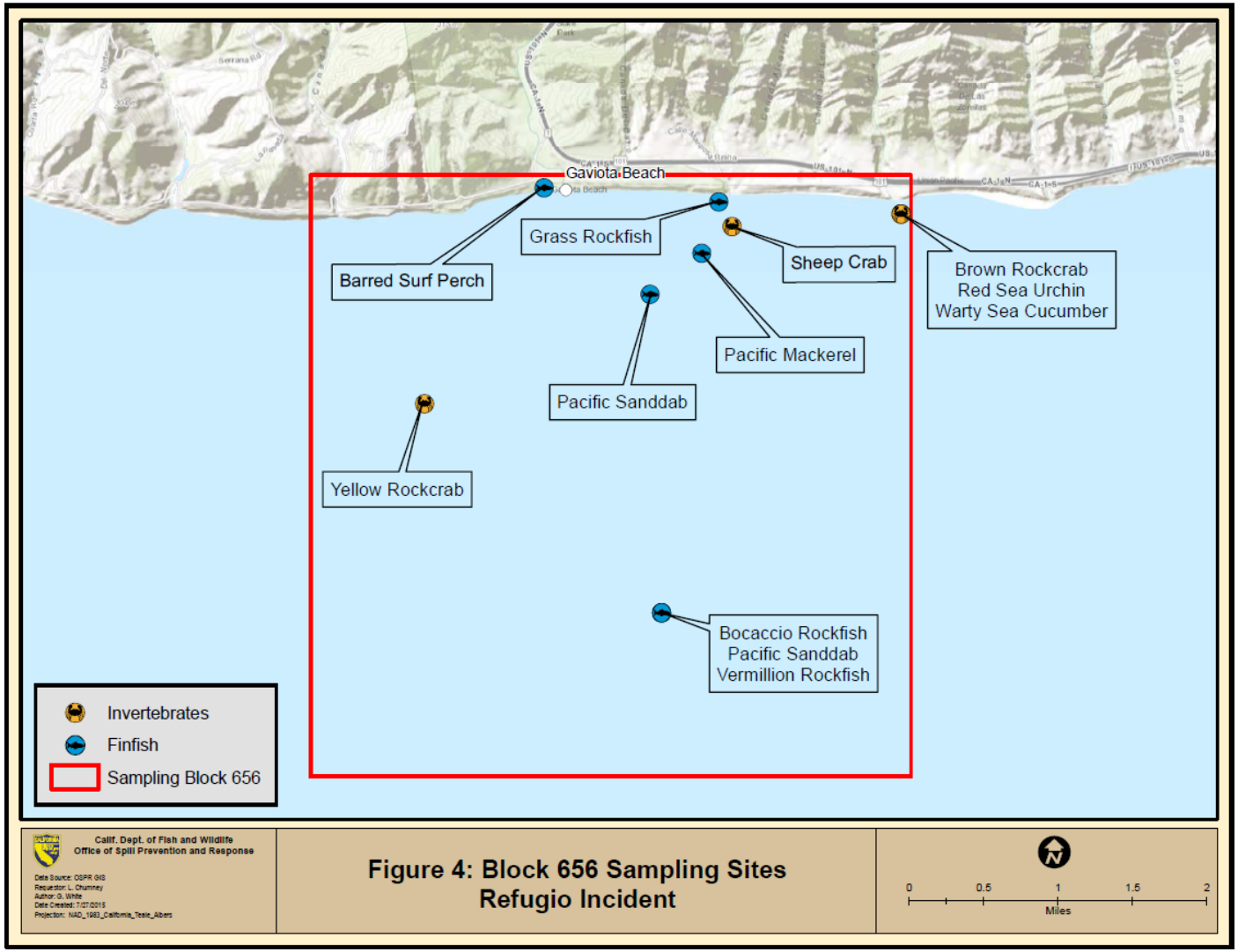


FIGURE 5. KELP SAMPLING SITES

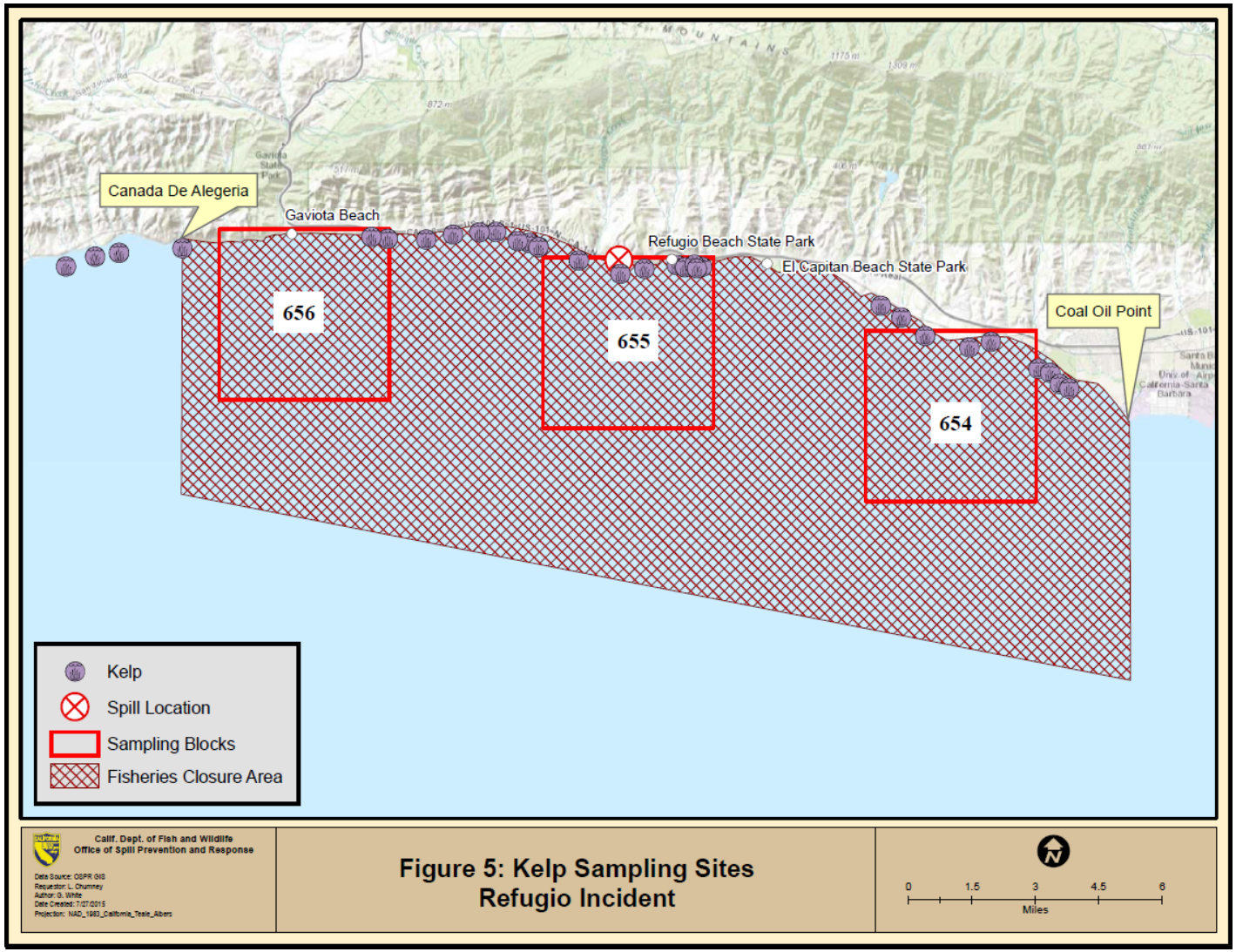
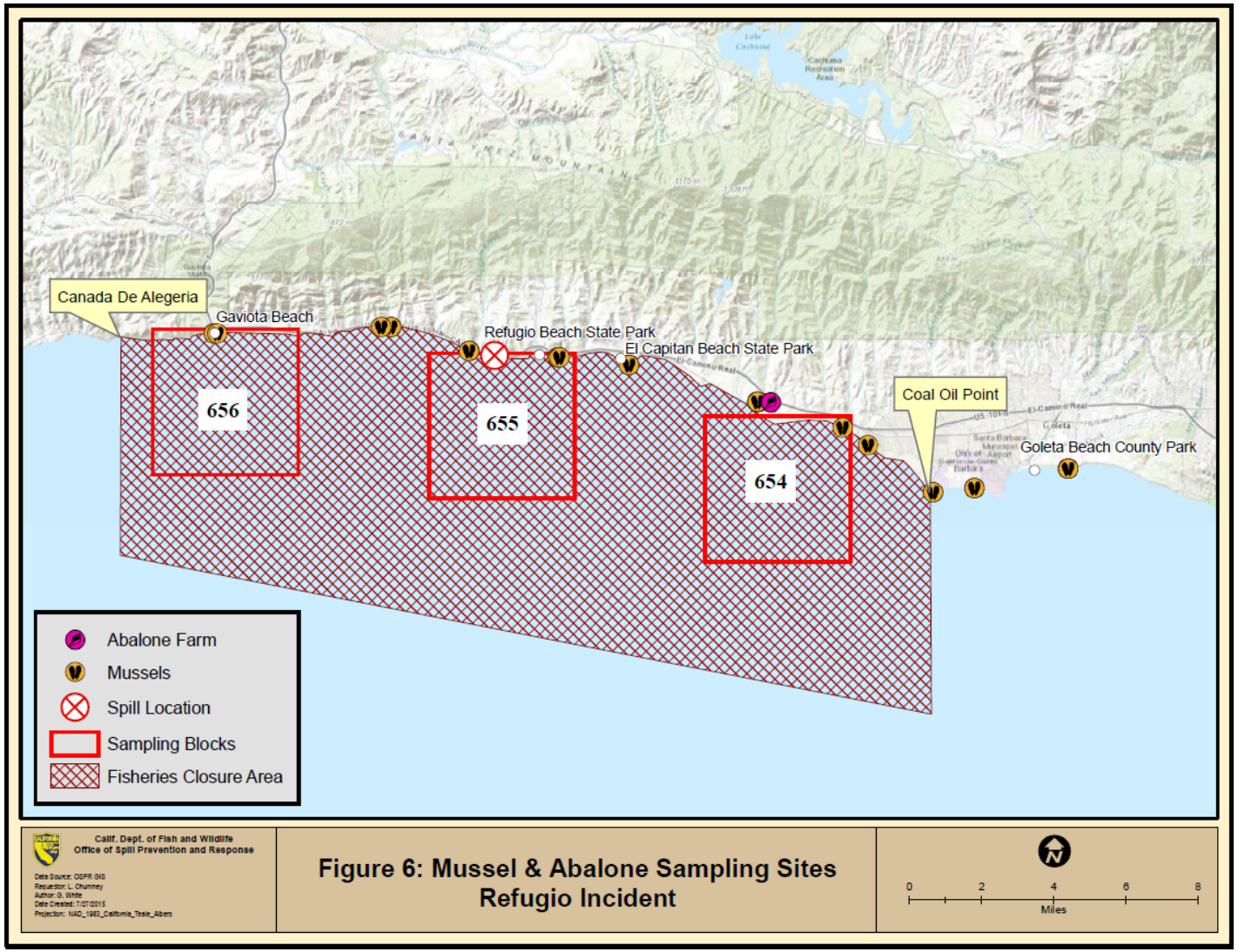


FIGURE 6. MUSSEL AND ABALONE SAMPLING SITES



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APPENDIX 1. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 654 OFFSHORE SPECIES

Target Compound	Sample Identification			
	SBNS001061015BSP1	B654061515LB1	B654061915KEL1	B654061215RSC1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	ND	2.31*	1.138*	0.927
C2-Naphthalene	0.784*	6.32	2.299	2.33
C3-Naphthalene	ND	3.74	0.630	1.44*
C4-Naphthalene	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	1.37
C2-Chrysene	ND	ND	ND	1.56
C3-Chrysene	ND	ND	ND	1.52
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0	0.7	0.2	1.0
	B654061215GRR1	B654061015KRF1	B654061015SDB1	B654061015RSU1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	0.976	ND	ND	2.22
C2-Naphthalene	0.933*	ND	ND	22.8
C3-Naphthalene	0.885*	ND	ND	5.64*
C4-Naphthalene	ND	ND	ND	6.13*
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	1.53
C2-Chrysene	ND	ND	ND	1.85
C3-Chrysene	ND	ND	ND	0.971
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0.1	ND	ND	2.49

APPENDIX 1. cPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 654 OFFSHORE SPECIES (CONTINUED)

Target Compound	Sample Identification			
	B654061215RBP1	B654061515RCR1	B654061815SHP1	B654061015VRF1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	0.597	ND	1.14*	ND
C2-Naphthalene	1.64*	ND	1.65	ND
C3-Naphthalene	0.868*	ND	1.58	ND
C4-Naphthalene	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	ND
C2-Chrysene	ND	ND	ND	ND
C3-Chrysene	ND	ND	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0	ND	0.2	ND
	B654061015WSC1			
Naphthalene	ND			
C1-Naphthalene	ND			
C2-Naphthalene	0.870*			
C3-Naphthalene	1.67*			
C4-Naphthalene	4.52*			
Benz(a)anthracene	ND			
Chrysene	0.994			
C1-Chrysene	2.16			
C2-Chrysene	1.92			
C3-Chrysene	1.05			
C4-Chrysene	ND			
Benzo(b)fluoranthene	ND			
Benzo(k)fluoranthene	ND			
Benzo(a)pyrene	ND			
Indeno(1,2,3-c,d)pyrene	ND			
Dibenzo(a,h)anthracene	ND			
∑BaPE	1.04			

*Values <5x the method blank were censored in ∑BaPE calculations.

APPENDIX 2. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 655 OFFSHORE SPECIES

Target Compound	Sample Identification			
	SBJS001061015BSP1	B655061115BYR1-1	B655061115BOC1	B655061515LB1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	1.72	0.665	ND	1.79*
C2-Naphthalene	2.69*	0.625*	ND	4.36
C3-Naphthalene	1.51*	ND	ND	2.22
C4-Naphthalene	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	1.37
C2-Chrysene	ND	ND	ND	1.56
C3-Chrysene	ND	ND	ND	1.52
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0.1	0.1	ND	0.5
	B655061915KEL1	B655061215RSC1	B655061115GRR1	B655061115KRF1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	2.68*	0.826	0.657*	1.07
C2-Naphthalene	3.94	2.27*	1.37*	0.644*
C3-Naphthalene	ND	1.46*	0.937*	0.968*
C4-Naphthalene	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	1.15	ND	ND
C2-Chrysene	ND	1.53	ND	ND
C3-Chrysene	ND	1.31	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0.3	1.0	0	0.1

APPENDIX 2. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 655 OFFSHORE SPECIES (CONTINUED)

Target Compound	Sample Identification			
	B655061915MKL1	B655061115SDB1	B655061915SDB1	B655061115RSU1
Naphthalene	ND	ND	ND	1.10
C1-Naphthalene	2.44*	0.633*	0.757*	7.90
C2-Naphthalene	4.83	ND	0.710	53.2
C3-Naphthalene	3.52	ND	ND	54.9
C4-Naphthalene	ND	ND	ND	59.8
Benz(a)anthracene	ND	ND	ND	0.693
Chrysene	ND	ND	ND	1.79
C1-Chrysene	ND	ND	ND	2.79
C2-Chrysene	ND	ND	ND	2.05
C3-Chrysene	ND	ND	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0.6	ND	0	13.6
	B655061215RBP1	B655061115RCR1	B655061515RCR1	B655061815SHP1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	0.835	ND	ND	1.516*
C2-Naphthalene	1.80*	1.30*	ND	5.047
C3-Naphthalene	1.02*	3.01*	ND	7.138
C4-Naphthalene	ND	3.43	ND	6.796
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	ND
C2-Chrysene	ND	ND	ND	ND
C3-Chrysene	ND	ND	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0.1	0.2	ND	1.3

APPENDIX 2. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 655 OFFSHORE SPECIES

Target Compound	Sample Identification	
	B655061115VRF1	B655061115WSC1
Naphthalene	ND	ND
C1-Naphthalene	ND	1.05*
C2-Naphthalene	ND	6.07
C3-Naphthalene	ND	22.4
C4-Naphthalene	ND	41.8
Benz(a)anthracene	ND	ND
Chrysene	ND	2.19
C1-Chrysene	ND	3.96
C2-Chrysene	ND	3.74
C3-Chrysene	ND	1.91
C4-Chrysene	ND	ND
Benzo(b)fluoranthene	ND	ND
Benzo(k)fluoranthene	ND	ND
Benzo(a)pyrene	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND
Dibenzo(a,h)anthracene	ND	ND
∑BaPE	ND	6.9

*Values <5x the method blank were censored in ∑BaPE calculations.

APPENDIX 3. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 656 AND REFERENCE AREA OFFSHORE SPECIES

Target Compound	Sample Identification			
	SBI001061015BSP1	B656061215BOC1	B656061915KEL1	B656061215GRR1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	ND	1.02	0.938*	1.60
C2-Naphthalene	1.49*	0.458*	3.81	1.42*
C3-Naphthalene	0.841*	0.722*	ND	1.17*
C4-Naphthalene	ND	ND	ND	ND
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	ND
C2-Chrysene	ND	ND	ND	ND
C3-Chrysene	ND	ND	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0	0.1	0.3	0.1
	B656061915MKL1	B656061215SDB1	B656061115RSU1	B656061115RCR1
Naphthalene	ND	ND	1.15	ND
C1-Naphthalene	1.66*	0.623	6.24	1.12
C2-Naphthalene	1.99	ND	57.1	1.15*
C3-Naphthalene	2.10	ND	12.9	1.64*
C4-Naphthalene	ND	ND	9.64	ND
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	ND
C2-Chrysene	ND	ND	ND	ND
C3-Chrysene	ND	ND	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	0.3	0	5.7	0.1

APPENDIX 3. cPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN BLOCK 656 AND REFERENCE AREA OFFSHORE SPECIES

Target Compound	Sample Identification			
	B656061515RCR1	B656061815SHP1	B656061215VRF1	B656061115WSC1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	ND	0.948*	ND	ND
C2-Naphthalene	ND	1.64	ND	1.43*
C3-Naphthalene	ND	0.956	ND	2.72*
C4-Naphthalene	ND	ND	ND	5.56
Benz(a)anthracene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
C1-Chrysene	ND	ND	ND	1.05
C2-Chrysene	ND	ND	ND	0.861
C3-Chrysene	ND	ND	ND	0.454
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	ND	0.2	ND	0.8
	B656061915SDB1	Ref: DRK061915KEL1		
Naphthalene	ND	ND		
C1-Naphthalene	0.775*	0.741*		
C2-Naphthalene	ND	3.85		
C3-Naphthalene	ND	ND		
C4-Naphthalene	ND	ND		
Benz(a)anthracene	ND	ND		
Chrysene	ND	ND		
C1-Chrysene	ND	ND		
C2-Chrysene	ND	ND		
C3-Chrysene	ND	ND		
C4-Chrysene	ND	ND		
Benzo(b)fluoranthene	ND	ND		
Benzo(k)fluoranthene	ND	ND		
Benzo(a)pyrene	ND	ND		
Indeno(1,2,3-c,d)pyrene	ND	ND		
Dibenzo(a,h)anthracene	ND	ND		
∑BaPE	0	0.3		

*Values <5x the method blank were censored in ∑BaPE calculations.

APPENDIX 4. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN MUSSELS AND ABALONE

Target Compound	Sample Identification			
	SBIS001ED1052415MU1	SBIS001FC3060415MU1	SBIS001MU3061715MU1	SBIS003ED1052415MU1
Naphthalene	ND	0.625 GAV	ND	ND
C1-Naphthalene	2.84	2.44*	2.02	10.6
C2-Naphthalene	4.05	5.73	2.39	8.40
C3-Naphthalene	3.4	9.81	2.43	9.7
C4-Naphthalene	4.31	14.0	2.98	11.4
Benz(a)anthracene	0.775	1.43	1.53	0.628
Chrysene	1.15	1.82	1.68	1.21
C1-Chrysene	1.22	1.20	1.08	1.13
C2-Chrysene	ND	ND	ND	ND
C3-Chrysene	ND	ND	ND	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	1.5	2.8	ND	3.3
	SBIS003FC3060415MU2	SBIS003MU3061715MU2	SBIS004ED3052415MU1	SBIS005MU1061715MU1
Naphthalene	0.561	ND	ND	ND
C1-Naphthalene	4.03*	1.80	11.3	2.48
C2-Naphthalene	11.6	2.71	40.2	7.47
C3-Naphthalene	32.5	4.58	142	29.8
C4-Naphthalene	52.4	6.64	176	51.9
Benz(a)anthracene	ND	ND	0.636	1.24
Chrysene	2.73	1.60	4.27	4.34
C1-Chrysene	4.37	1.96	4.82	5.35
C2-Chrysene	4.86	1.32	4.51	4.31
C3-Chrysene	3.91	ND	2.24	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	9.5	1.93	28.6	8.92

APPENDIX 4. cPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN MUSSELS AND ABALONE (CONTINUED)

Target Compound	Sample Identification			
	SBJS001ED3052415MU2	SBJS001FC1060515MU1	SBJS001MU1061715MU1	SBKS002ED4052415MU2
Naphthalene	17.7	1.77	ND	19.4
C1-Naphthalene	247	26.5	6.42	208
C2-Naphthalene	872	178	24.9	499
C3-Naphthalene	1200	525	94.9	831
C4-Naphthalene	1080	718	163	805
Benz(a)anthracene	3.12	2.77	1.22	3.20
Chrysene	20.3	14.4	7.74	16.1
C1-Chrysene	33.6	28.1	11.7	20.5
C2-Chrysene	43.0	31.9	11.3	20.6
C3-Chrysene	29.0	18.5	7.96	13.7
C4-Chrysene	9.39	5.70	ND	5.10
Benzo(b)fluoranthene	2.96	2.67	ND	2.44
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	264.3	120.09	26.94	180.1
	SBKS001FC1060415MU2	SBKS001MU1061715MU1	SBNS001ED6052415MU1	SBNS001MU2061715MU1
Naphthalene	ND	ND	1.30	ND
C1-Naphthalene	11.9	6.08	22.3	2.81
C2-Naphthalene	60.4	29.4	112	6.91
C3-Naphthalene	225	88.5	384	24.4
C4-Naphthalene	365	131	458	41.3
Benz(a)anthracene	1.96	1.19	1.75	ND
Chrysene	11.5	6.49	30.8	6.21
C1-Chrysene	18.0	9.03	59.3	9.29
C2-Chrysene	19.6	8.29	53.0	7.24
C3-Chrysene	11.6	4.06	30.5	3.72
C4-Chrysene	ND	ND	6.14	ND
Benzo(b)fluoranthene	2.08	ND	3.88	ND
Benzo(k)fluoranthene	ND	ND	0.00	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	58.2	22.70	101.6	9.78

APPENDIX 4. cPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN MUSSELS AND ABALONE (CONTINUED)

Target Compound	Sample Identification			
	SBNS003MU2061715MU1	E008IV001	SBNS004FC2060415MU1	SBNS004MU2061715MU1
Naphthalene	ND	ND	ND	ND
C1-Naphthalene	2.60	ND	2.96*	2.88
C2-Naphthalene	5.15	35.9	11.7	7.39
C3-Naphthalene	15.0	ND	48.2	18.4
C4-Naphthalene	26.4	ND	91.3	34.6
Benz(a)anthracene	0.827	ND	9.19	12.1
Chrysene	6.39	ND	14.5	14.6
C1-Chrysene	10.7	ND	21.1	19.2
C2-Chrysene	7.57	ND	17.2	11.6
C3-Chrysene	4.40	ND	9.21	4.85
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	3.40	4.67
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	8.468	2.5	24.2	17.08
	E008GP001	SBPS002FC1060415MU1	SBPS001MU1061815MU1	SBMS001FC1060515AB1
Naphthalene	ND	ND	ND	6.70
C1-Naphthalene	7.28	1.50*	3.34	10.8
C2-Naphthalene	9.39	5.09	4.94	5.43
C3-Naphthalene	25.3	11.2	9.14	4.01*
C4-Naphthalene	44.0	18.0	15.8	ND
Benz(a)anthracene	2.37	1.73	1.43	ND
Chrysene	9.47	4.22	4.53	ND
C1-Chrysene	16.2	6.58	6.94	ND
C2-Chrysene	12.1	4.64	5.38	ND
C3-Chrysene	6.36	3.06	3.10	ND
C4-Chrysene	ND	ND	ND	ND
Benzo(b)fluoranthene	1.40	0.646	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND	ND
∑BaPE	14.6	6.1	5.86	1.6

APPENDIX 4. CPAH CONCENTRATIONS (NG/G, WET WEIGHT) IN MUSSELS AND ABALONE (CONTINUED)

Target Compound	Sample Identification
	SBMS001FC1061815AB1
Naphthalene	ND
C1-Naphthalene	ND
C2-Naphthalene	ND
C3-Naphthalene	ND
C4-Naphthalene	ND
Benz(a)anthracene	ND
Chrysene	ND
C1-Chrysene	ND
C2-Chrysene	ND
C3-Chrysene	ND
C4-Chrysene	ND
Benzo(b)fluoranthene	ND
Benzo(k)fluoranthene	ND
Benzo(a)pyrene	ND
Indeno(1,2,3-c,d)pyrene	ND
Dibenzo(a,h)anthracene	ND
∑BaPE	ND

*Values <5x the method blank were censored in ∑BaPE calculations.