2010 Gulf Oil Spill

Louisiana Seafood Safety and Monitoring Plan
Sample Results (4/30/10-1/31/14)

FINAL REPORT
September 2015

Summary
Following the oil spill in the Gulf of Mexico in 2010, the public had great concern about the safety of Gulf seafood. The Louisiana Departments of Health and Hospitals (DHH), Wildlife and Fisheries (DWF), Environmental Quality (DEQ), and Agriculture and Forestry (DAF) actively monitored Louisiana seafood to ensure it was safe to eat. The agencies developed a long-term seafood safety and monitoring plan that regularly tested seafood along the Gulf Coast of Louisiana. The seafood monitoring plan was not intended to monitor known contamination, but to provide data to allow fishing and shellfish harvesting in areas where testing demonstrated the seafood was safe to eat.

Of 7071 seafood samples collected from areas without visible oil contamination between April 30, 2010 and January 31, 2014, none of the analyses indicated levels of concern in the seafood. Trace levels of polycyclic aromatic hydrocarbons (PAHs) were detected in 753(11%) samples and dioctyl sodium sulfosuccinate (DOSS), a major component of the dispersants used in the Gulf, was detected in 511(9%) samples. All sample results were below levels of concern, meaning that any substances detected were below concentrations that could potentially threaten the public's health.

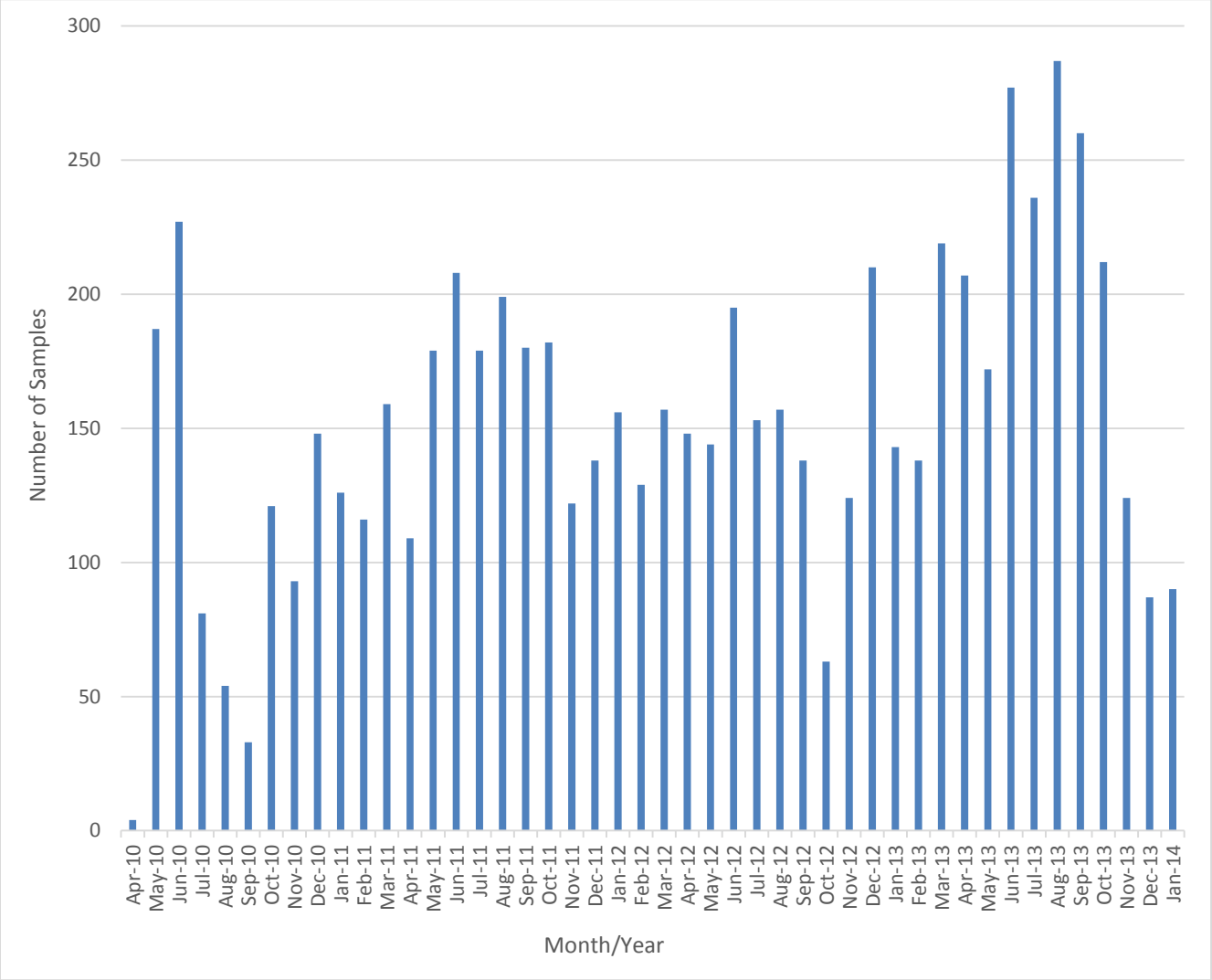
Background
In the weeks after the spill in 2010, federal and state officials closely monitored the waters where seafood was harvested. All areas threatened by the oil spill were closed to fishing and shellfish harvesting. Closing harvest waters is an effective means to protect the public from potentially contaminated seafood because it keeps the product from entering the food supply. Closures are made with the intent to ensure seafood is as safe as possible, while not closing any fishing areas unnecessarily. Closed fishing areas could not be reopened until the testing proved the seafood was free from contaminants.

NOAA has the authority to close federal waters to fishing, and states have the authority to close state waters within their jurisdiction. When necessary, DHH and DWF issued closures of recreational and commercial fishing in state waters based on the best information from field staff and trajectory models from NOAA. When reports of oil in a fishing area were received or oil was predicted to impact an area, DHH and DWF closed the area to fishing and initiated a field survey and began seafood collection.

Waters were re-opened for fishing and shellfish harvesting when oil from the spill was no longer present and the seafood samples from the area successfully passed chemical testing. If, despite these steps, adulterated seafood had been found in the market, both DHH and the FDA have the authority to seize such product and remove it from the food supply. All commercial seafood facilities are permitted by DHH and inspected on a quarterly basis to help ensure their product is safe to eat.

Seafood Collection
DHH and DWF have been collecting seafood samples since April 30, 2010. To date, thousands of oysters, shrimp, crab and fish have been collected from state waters by DHH and DWF personnel. Individual specimens are collected from a single sampling location and grouped by seafood type to form a composite sample. For instance, approximately 100 shrimp are collected at a single location for 1 shrimp composite sample. The edible tissue, or the portion of the catch that we eat (e.g., fish fillet, shrimp tail, crab meat) is separated and submitted to the lab to be tested.

Figure 1. Seafood Samples Collected and Analyzed (2010 Gulf Oil Spill, Louisiana, 2010-2014)



Sample Locations

DHH and DWF collected samples from areas across the Louisiana coast from Lake Pontchartrain to Cameron Parish. The DHH/Office of Public Health is the regulatory agency for the oyster harvesting waters along Louisiana's Gulf Coast. DHH personnel collected oysters from most of the 30 oyster lease areas designated by the Louisiana Sanitary Code and the National Shellfish Sanitation Program. DWF's Marine Fisheries Division, which was responsible for collecting a majority of the shrimp, crabs and finfish, divides Louisiana's coastal zone into 7 Coastal Study Areas.

DHH and the FDA also implemented a sampling program of seafood products at Louisiana-primary processing plants. The agencies targeted oysters, crabs and shrimp, which could retain contaminants longer than finfish. This sampling is designed to provide verification that seafood being harvested is safe to eat. DHH collected samples from nine (9) seafood processing/wholesale facilities across six (6) Southeastern Louisiana parishes.

Table 1. Total Oyster Sample[1] Count by DHH Oyster Lease Area (2010 Gulf Oil Spill, Louisiana, 2010-2014)

DHH Oyster Lease Area[2]	N	DHH Oyster Lease Area[2]	N
1	157	**17**	234
2	94	**18**	0
3	313	**19**	226
4	196	**20**	21
5	245	**21**	175
6	176	**22**	0
7	113	**23**	167
8	1	**24**	18
9	224	**25**	1
10	280	**26**	12
11	170	**27**	16
12	227	**28**	120
13	241	**29**	7
14	220	**30**	3
15	217	**Unknown**	4
16	3	**All areas**	**3881**

[1]Represents a composite sample.

[2]See Figure 3.

Table 2. Total Seafood Sample[1] Count by DWF Coastal Study Area (2010 Gulf Oil Spill, Louisiana, 2010-2014)

DWF Coastal Study Area[2]	Shrimp	Crab	Finfish
1	95	24	250
2	131	24	567
3	85	40	412
4	50	28	234
5	73	32	142
6	113	49	447
7	119	17	235
Unknown	8	5	10
All Areas	**674**	**219**	**2297**

[1]Represents a composite sample.

[2]See Figure 4.

Seafood Testing

Once collected, samples were delivered to a laboratory by the agencies to undergo chemical analysis. Samples were tested for components of crude oil called hydrocarbons. Crude oil is a complex mixture of many hydrocarbon compounds. Polycyclic aromatic hydrocarbons (PAHs) are of greatest concern because compounds in the PAH family have carcinogenic potential. In order for a sample to pass chemical analysis, any chemicals detected by the laboratory must be below established "levels of concern", or exposure levels that may cause health problems.

In addition to PAHs, seafood was tested for dioctyl sodium sulfosuccinate (DOSS), a component of one of the dispersants used to break up oil. State agencies worked closely with the federal government to better understand any impact dispersants may have on seafood. For more information on dispersants, please visit http://www.fda.gov/downloads/Food/FoodSafety/Product-SpecificInformation/Seafood/UCM221659.pdf

Seafood tissue samples also underwent sensory analysis, meaning trained scientists smell and/or taste the sample to determine if it has an unusual smell or taste called taint. Taint does not necessarily mean that fish or shellfish are unsafe to eat, but tainted seafood is not allowed to be sold in interstate commerce. In order to determine if closed areas could be reopened, additional seafood samples collected by DHH and DWF personnel were submitted to the National Oceanic and Atmospheric Administration (NOAA) and the Food and Drug Administration (FDA) to undergo sensory and chemical analysis. The chemical analysis results are posted at http://www.fda.gov/food/recallsoutbreaksemergencies/emergencies/ucm221959.htm#louisiana

Table 3. Seafood Sampling Results[1] (2010 Gulf Oil Spill, Louisiana, 2010-2014)

Seafood Type	Total Samples	# of PAH Detects[2]	PAH Percent Detected	Total Samples Analyzed for DOSS[5]	# of DOSS Detects	DOSS Percent Detected	Above Levels of Concern[3]	PAH[4] Range (mg/kg)	DOSS[5] Range (mg/kg)
Oysters	3881	587	15%	3124	132	4%	0	ND-0.057	ND-0.325
Shrimp	674	58	9%	507	25	5%	0	ND-0.140	ND-0.578
Crab	219	34	16%	126	28	22%	0	ND-0.105	ND-1.90
Finfish	2297	74	3%	2083	326	16%	0	ND-0.168	ND-3.40
All seafood	**7071**	**753**	**11%**	**5840**	**511**	**9%**	**0**	**ND-0.168**	**ND-3.40**

[1]Includes both baseline, re-opening and long term monitoring sampling efforts. Sample Dates: 4/30/2010-1/31/2014.
[2]Number of samples in which 1 or more PAH compound was detected.
[3]See Table 4.
[4]PAH compounds detected include Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene,Benzo(a)pyrene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluorene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene. See Figure 2.
[5]DOSS Analysis began on March 1, 2011.

Table 4. Comparison Values and Maximum Detected Values for Polycyclic Aromatic Hydrocarbon Compounds and Dioctyl Sodium Sulfosuccinate (DOSS) (2010 Gulf Oil Spill, Louisiana, 2010-2014)

Compound	Levels of Concern[1] (LOC) mg/kg			MAX DETECT (mg/kg)			
	Oyster	Shrimp/Crab	Finfish	Oyster	Shrimp	Crab	Finfish
Anthracene	2,000	1846	490	0.0162	0.0009	ND[2]	0.0021
Benzo(a)anthracene	1.43	1.32	0.35	0.0026	ND	0.0006	0.0037
Benzo(a)pyrene	0.143	0.132	0.035	0.0007	ND	ND	0.004
Benzo(b)fluoranthene	1.43	1.32	0.35	ND	0.006	ND	0.006
Benzo(k)fluoranthene	14.3	13.2	3.5	ND	ND	ND	0.004
Chrysene	143	132	35	0.057	0.003	0.001	0.003
Dibenzo(a,h)anthracene	0.143	0.132	0.035	ND	ND	ND	0.005
Fluoranthene	267	246	65	0.017	0.0025	0.008	0.01
Fluorene	267	246	65	0.0324	0.0247	0.105	0.029
Indeno(1,2,3-CD)pyrene	1.43	1.32	0.35	0.008	0.14	ND	ND
Naphthalene	133	123	33	0.0417	0.0209	0.0142	0.168
Phenanthrene	2,000	1846	490	0.0284	0.0027	0.0037	0.01
Pyrene	200	185	49	0.015	0.062	0.0014	0.007
DOSS	500	500	100	0.325	0.578	1.9	3.4

[1] Protocol for Interpretation and Use of Sensory Testing and Analytical Chemistry Results for Re-Opening Oil-Impacted Areas Closed to Seafood Harvesting Due to The Deepwater Horizon Oil Spill (FDA and NOAA, June 2010, Updated November 2010)

[2]ND indicates that the compound was not detected.

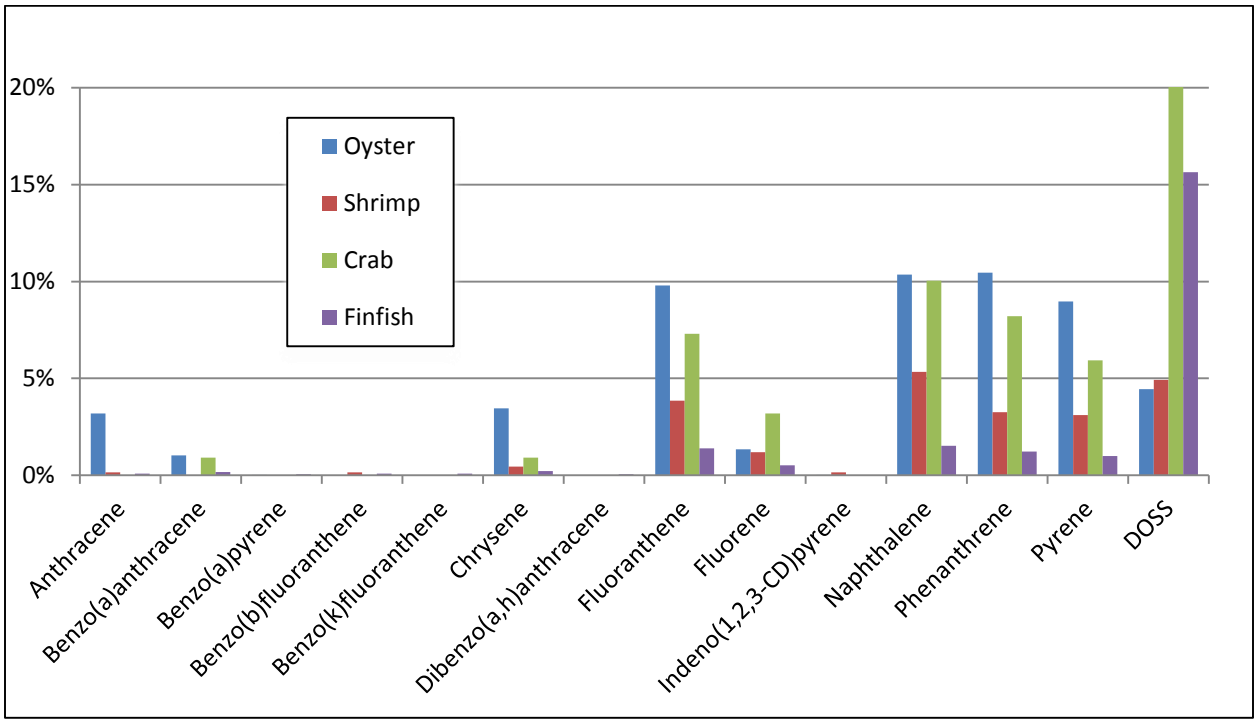
Table 5. Comparison of Levels of Concern[1] (LOC) with Maximum Detected Values for Polycyclic Aromatic Hydrocarbon Compounds and Dioctyl Sodium Sulfosuccinate (DOSS) (2010 Gulf Oil Spill, Louisiana, 2010-2014)

Compound	% DETECTED (FLAGGED ≥ 5%)				MAX DET as a percentage of the corresponding LOC (FLAGGED ≥0.10%-MAX DET WITHIN 3 ORDERS OF MAGNITUDE OF THE LOC)			
	Oyster	**Shrimp**	**Crab**	**Finfish**	**Oyster**	**Shrimp**	**Crab**	**Finfish**
Anthracene	3%	0%	0%	0%	0.00%	0.00%	ND[2]	0.00%
Benzo(a)anthracene	1%	0%	1%	0%	0.18%	ND	0.05%	1.06%
Benzo(a)pyrene	0%	0%	0%	0%	0.49%	ND	ND	11.43%
Benzo(b)fluoranthene	0%	0%	0%	0%	ND	0.45%	ND	1.71%
Benzo(k)fluoranthene	0%	0%	0%	0%	ND	ND	ND	0.11%
Chrysene	3%	0%	1%	0%	0.04%	0.00%	0.00%	0.01%
Dibenzo(a,h)anthracene	0%	0%	0%	0%	ND	ND	ND	14.29%
Fluoranthene	10%	4%	7%	1%	0.01%	0.00%	0.00%	0.02%
Fluorene	1%	1%	3%	1%	0.01%	0.01%	0.04%	0.04%
Indeno(1,2,3-CD)pyrene	0%	0%	0%	0%	0.56%	10.61%	ND	ND
Naphthalene	10%	5%	10%	2%	0.03%	0.02%	0.01%	0.51%
Phenanthrene	10%	3%	8%	1%	0.00%	0.00%	0.00%	0.00%
Pyrene	9%	3%	6%	1%	0.01%	0.03%	0.00%	0.01%
DOSS	4%	**5%**	**22%**	**16%**	0.07%	**0.12%**	**0.38%**	**3.40%**

[1] Protocol for Interpretation and Use of Sensory Testing and Analytical Chemistry Results for Re-Opening Oil-Impacted Areas Closed to Seafood Harvesting Due to The Deepwater Horizon Oil Spill (FDA and NOAA, June 2010, Updated November 2010)

[2]ND indicates that the compound was not detected.

Figure 2. Polycyclic Aromatic Hydrocarbon (PAH) Compounds Percent Detected[1] and Dioctyl Sodium Sulfosuccinate (DOSS) Percent Detected (2010 Gulf Oil Spill, Louisiana, 2010-2014)

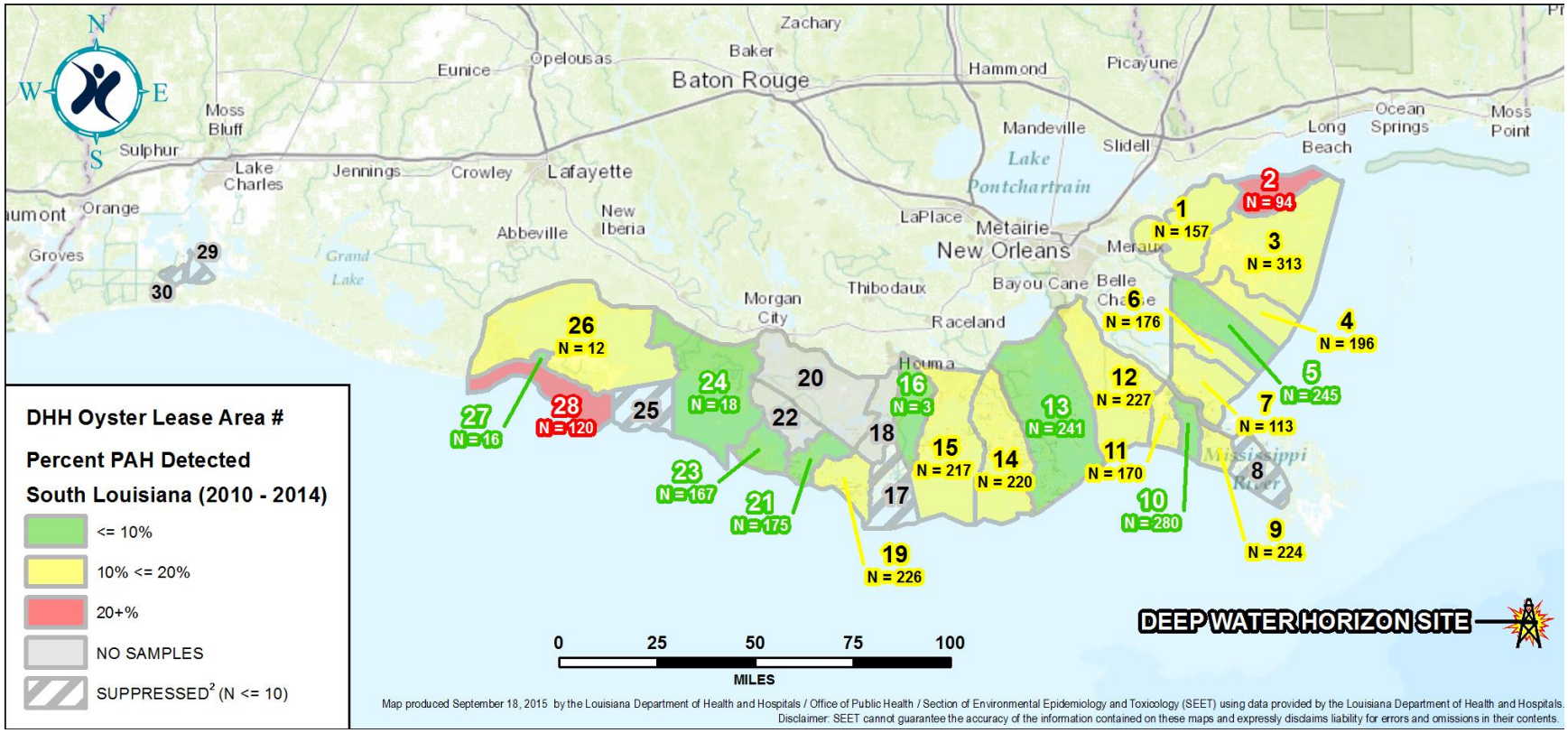


[1]Percent of samples in which 1 or more PAH compound was detected.

Spatial Analysis

Detection frequency for PAHs was evaluated by DHH oyster lease area for oysters and coastal study area (CSA) for shrimp, crab, and finfish combined.

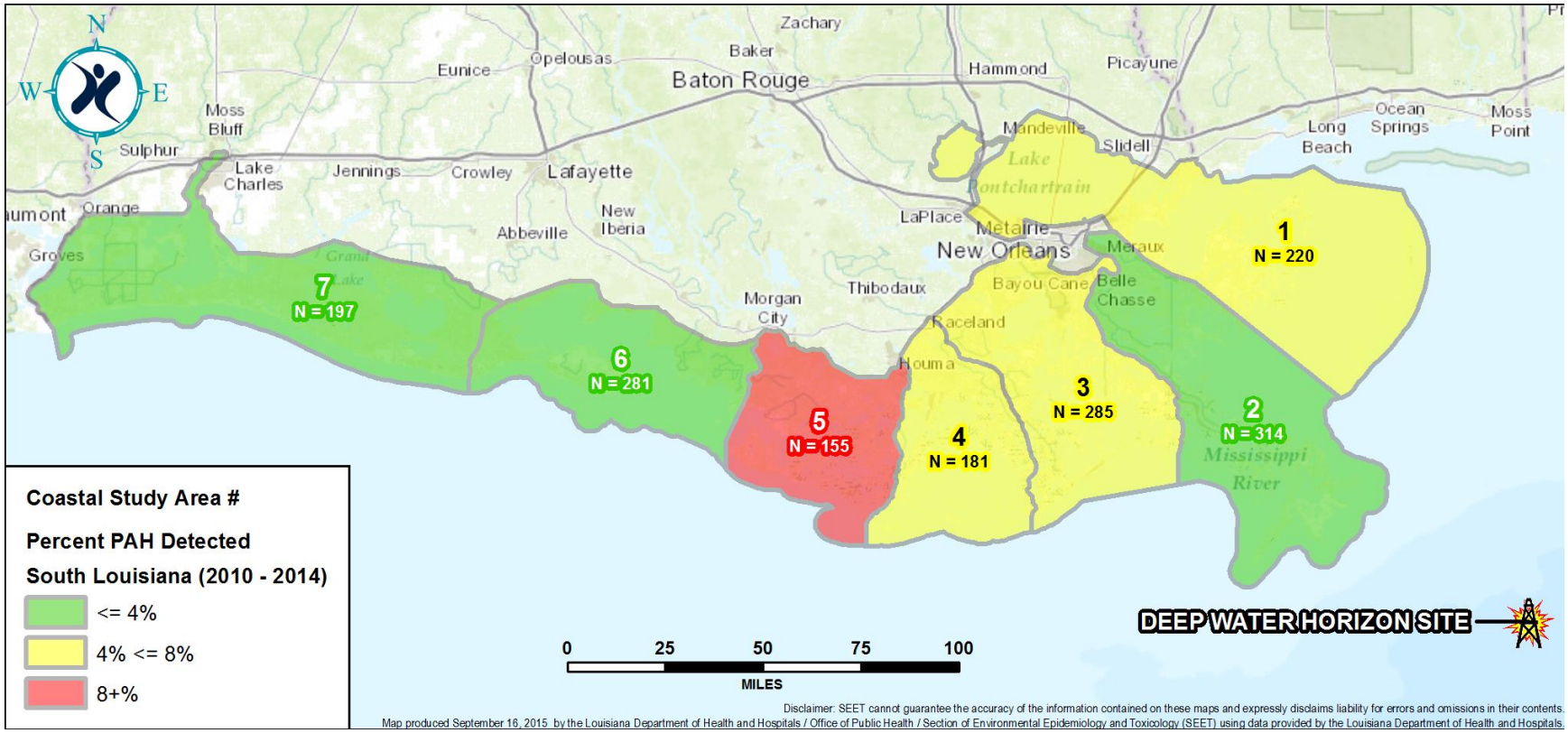
Figure 3. Polycyclic Aromatic Hydrocarbon (PAH) Compounds in Oysters: Percent Detected[1] (2010 Gulf Oil Spill, Louisiana, 2010-2014)



[1]Percent of samples in which 1 or more PAH compound was detected.

[2]Percentage calculations based on a count greater than zero but less than 10 were suppressed to prevent unreliable (or unstable) rates.

Figure 4. Polycyclic Aromatic Hydrocarbon (PAH) Compounds in Shrimp, Crab and Finfish Combined: Percent Detected[1] (2010 Gulf Oil Spill, Louisiana, 2010-2014)

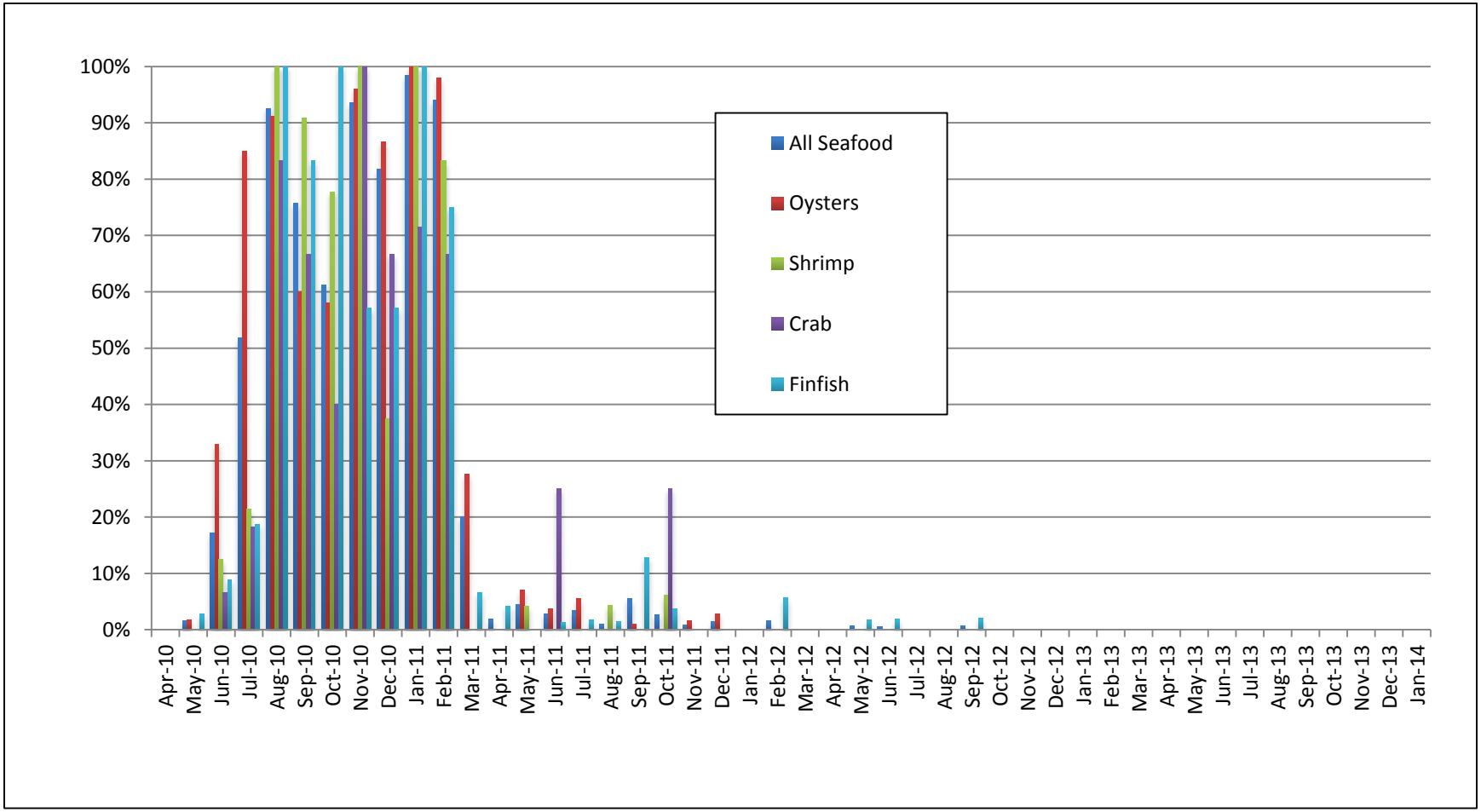


[1]Percent of samples in which 1 or more PAH compound was detected.

Temporal Analysis

Changes in PAH concentrations over time were largely due to differences in analysis methods and detection limits. See Analysis Limitations Section for more detail.

Figure 5. Polycyclic Aromatic Hydrocarbons: Percent Detected[1] Over Time (2010 Gulf Oil Spill, Louisiana, 2010-2014)



[1]Percent of samples in which 1 or more PAH compound was detected.

Analysis Limitations

At the beginning of the event, samples were collected from areas that had not been impacted by oil to determine "background" levels of chemicals in seafood and provide baseline information for comparison should oil have moved into those areas in the future. Unfortunately, a comparison of contaminant levels between "background" samples and samples from "impacted" areas could not be completed because information on field conditions at the time of sampling was not made available. In addition, data comparability was limited because there were multiple laboratories doing tissue analysis during this event. Several different methods were used and detection limits varied.

Table 6. Laboratory Methods for Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Method	N	% DETECT[1]	Sample Date Began	Sample Date End	Average Maximum Detection Limit[2] (mg/kg)
Tissue Analysis for PAHs by GC/MS (Internal Method based on NIST 1632 SRM)	326	9%	Apr-10	Jul-10	0.0018
Semi volatile Organic Compounds by GC/MS (EPA)	125	6%	Jun-10	Jul-10	0.0300
Extraction, Cleanup, and GC/MS Analysis for Organic Contaminants (NOAA/NMFS)	770	87%	Jun-10	Mar-11	0.0004
Liquid chromatography-fluorescence detection screen (FDA)	5850	<1%	Feb-11	Jan-14	0.0094

[1]Percent of samples in which 1 or more PAH compound was detected.

[2]Because the detection limit for a sample could vary among the compounds tested, the maximum value was used to represent a sample's detection limit and an average was calculated.

Conclusion

The Louisiana DHH, DWF, DEQ, and DAF actively monitored seafood from the coastal areas impacted by the oil spill between April 30, 2010 and January 31, 2014 to ensure its safety. Of the 7071 samples collected and tested, none were found to exceed the levels of concern. Although trace amounts of polycyclic aromatic hydrocarbons (PAHs) and dioctyl sodium sulfosuccinate (DOSS), a major component of one of the dispersants used in the Gulf, were periodically detected in Gulf seafood during the sampling period, levels were consistently lower than established levels of concern used to determine potential human health impacts of seafood consumption.