ERRATA TO SEPTEMBER 26, 2014 EXPERT REPORT OF DR. STANLEY D. RICE

Attached is a revised Appendix B (TREX-233296.032 - TREX-233296.046) and revised Appendix C (TREX-233296.047 - TREX-233296.052) to the September 26, 2014 Expert Report of Dr. Stanley D. Rice as well as an explanation of corrections made to these Appendices (TREX-233296.002).

Stanley D. Rice

Stanley D. Rice (Ph.D.)

January 14, 2015

Corrected Appendix B to Dr. Rice's September 26, 2014 Report (TREX-13332):

In Dr. Rice's deposition, he was asked about apparent errors in the depths corresponding to water chemistry samples analyzed in Appendix B to his September 26, 2014 report. Dr. Rice understood at the time, and testified at 315:17-317:12 of his deposition, that these apparent errors were present in the original data. However, upon further investigation, the error was discovered to have come from Dr. Carls' analysis of the data: after Dr. Carls classified samples into Surface, Intermediate, and Deep categories, the column containing those classifications became scrambled or unlinked to the rest of the data. Thus, the depth classifications did not correspond to the correct samples. In the process of correcting this error, Dr. Carls also discovered that a small number of samples had been misclassified as "offshore" instead of "nearshore." Both of these errors have been corrected in the Corrected Appendix B. While some of the values in the figures change as a result of these corrections, they do not change the substance of Dr. Rice's opinions, which are that, in the summer of 2010, far more than 2% of the relevant water samples in areas of concern exhibited the potential for toxicity.

Corrected Appendix C to Stanley Rice's September 26, 2014 Report (TREX- 13332):

In Dr. Rice's deposition, he acknowledged that this Appendix mis-reported the results of several toxicological studies that he relies upon, in that the wrong species is listed in the Appendix. The Corrected Appendix C contains corrected species information for the studies listed. It does not change the substance of any of Dr. Rice's opinions.

Corrected Appendix B

Source Information

Data file:

WaterChemistry_W-01v02-01.csv

..\analysis\WaterChemistryPAH.mdb

..\analysis\HC Gulf Mexico WATER 2010 combined v5.xlsx

..\analysis\EPA tox estimates WATER.xlsx

..\analysis\TPAH by month place depth.xlsx

..\reports\ Estimation of toxic potential in DWH water samples Dec 1 2014 update.docx

..\analysis\maps\Water TPAH surface May Jun Jul.mxd

..\analysis\maps\Water TPAH surface CHECK May Jun Jul.mxd

Estimation of toxic potential in DWH water samples.

1. Samples were obtained from "BP Gulf Science Data (NRDA-publicly available)," file name "WaterChemistry_W-01v02-01.csv" dated 5/23/2014.
2. The CSV file was too long to read directly with Excel, thus was subdivided into several files.
3. All 2010 data were extracted into Excel.
4. PAH data were assembled to yield one record per sample. Samples were identified by "Laboratory sample ID." This resulted in 16,167"natural samples" in 2010, excluding replicate samples. (There were 138 replicates, labeled "field duplicate.") For comparison with Dr. Shea's analysis, there were 17,881 "natural samples" in the NRDA database, thus 1714 samples were collected after 2010; these were not analyzed here.
5. Polynuclear aromatic hydrocarbon (PAH) analytes are listed below. Not all of these were measured in every sample. ND concentrations were 0.

N0	D0	PYR	BBF
N1	D1	FP1	BKF
N2	D2	FP2	BEP
N3	D3	FP3	BAP
N4	P0	FP4	PER
ACN	P1	BAA	ICP
ACE	P2	C0	DBA
F0	P3	C1	BZP
F1	P4	C2	
F2	ANT	C3	
F3	FLU	C4	

6. Concentrations were summed to yield total PAH (TPAH). Data were analyzed by month, depth, and location (Fig. 1).
7. The EPA threshold method was applied to each water sample. The acute version was corrected per discussion with Dr. David Mount, one of the original EPA authors. All alkylated PAHs were included in the model, thus no alkyl-adjustment multipliers were required (Fig. 2).
8. Alternative estimations of toxicity were based on Gulf of Mexico larval fish assays: (Incardona et al. 2014) reported threshold TPAH concentrations as low as 0.3 µg/L. Numbers of samples above this threshold (and several other comparison values, 0.5, 1, and 2 µg/L) were summed by month to calculate the fraction toxic (per month, depth, and location) (Fig. 3a-d).
9. To estimate fractions toxic within the slick area only, data were plotted by month with ArcMap along with satellite slick information (SAR). Offshore samples within polygons bounding the slick area were identified with ArcMap (Fig. 4).
10. The toxic fraction in the offshore surface water (0 2 m) within slick boundaries was estimated for May through July with the TPAH concentration method described in step 8 (Figs. 5 - 6).
11. It should be noted that this analysis is not intended to be a quantitative assessment of the extent of oil contamination in the Gulf. That is more properly a part of the NRD Assessment, which is still ongoing and may employ additional data and methods of analysis. The purpose of

this exercise is simply to point out that Dr. Shea's opinion regarding the extent of toxic concentrations of PAHs in the Gulf is misleading because it fails to employ the appropriate toxicological thresholds and fails to focus on the areas and times when high concentrations of PAHs were likely to occur.

12. This Appendix was updated Dec 1, 2014 to correct errors. Mapped data were re-inspected and positions were re-categorized as necessary (shore, offshore). Errors in depth coding were also identified and corrected. The depth coding used during the original analysis was scrambled, possibly by a sorting error in Excel; this was discovered because "deep" samples were erroneously associated with nearshore samples. This problem was explored with GIS to verify geographic locations and sample depths and was corrected. Updated data were verified against the original CSV file. Legends were corrected to reflect the updated number of samples in each category. These corrections do not change the total number of toxic samples, rather they only change the distribution among location and depth categories. The toxicity estimates in Fig. 5 increased as a result of sample re-categorization and are consistent with the estimates provided in Fig. 3: the general increase in percent toxic offshore water reflects a higher probability of toxicity in offshore water than nearshore and discovery of some nearshore samples mixed with offshore samples in the original analysis.

Roughly one quarter of the samples were collected nearshore (29%); the remainder were collected offshore.

	n Offshore	n Total	% Nearshore	% Offshore
May	644	970	33.6	66.4
Jun	2329	3093	24.7	75.3
Jul	2218	2962	25.1	74.9
Aug	2952	3643	19.0	81.0
Sep	1811	2525	28.3	71.7
Oct	198	920	78.5	21.5
Nov	631	1067	40.9	59.1
Dec	710	987	28.1	71.9

Within the offshore data set, about 13% of the samples were from the surface (upper 2 m), 38% were from plume depths (≥1000 m), and the remaining half (49%) were from elsewhere in the water column.

	n Surface	n Plume	% Surface	% Plume	% Other
May	128	198	19.9	30.7	49.4
Jun	255	737	10.9	31.6	57.4
Jul	282	890	12.7	40.1	47.2
Aug	328	1161	11.1	39.3	49.6
Sep	251	711	13.9	39.3	46.9
Oct	28	23	14.1	11.6	74.2
Nov	127	219	20.1	34.7	45.2
Dec	104	377	14.6	53.1	32.3

Fig. 1. Mean total aqueous PAH concentration by month. Surface is ≤ 2 m, deep is ≥ 1000 m and intermediate is all depths between. The total number of samples analyzed each month for offshore and nearshore sets is listed along the x-axis.

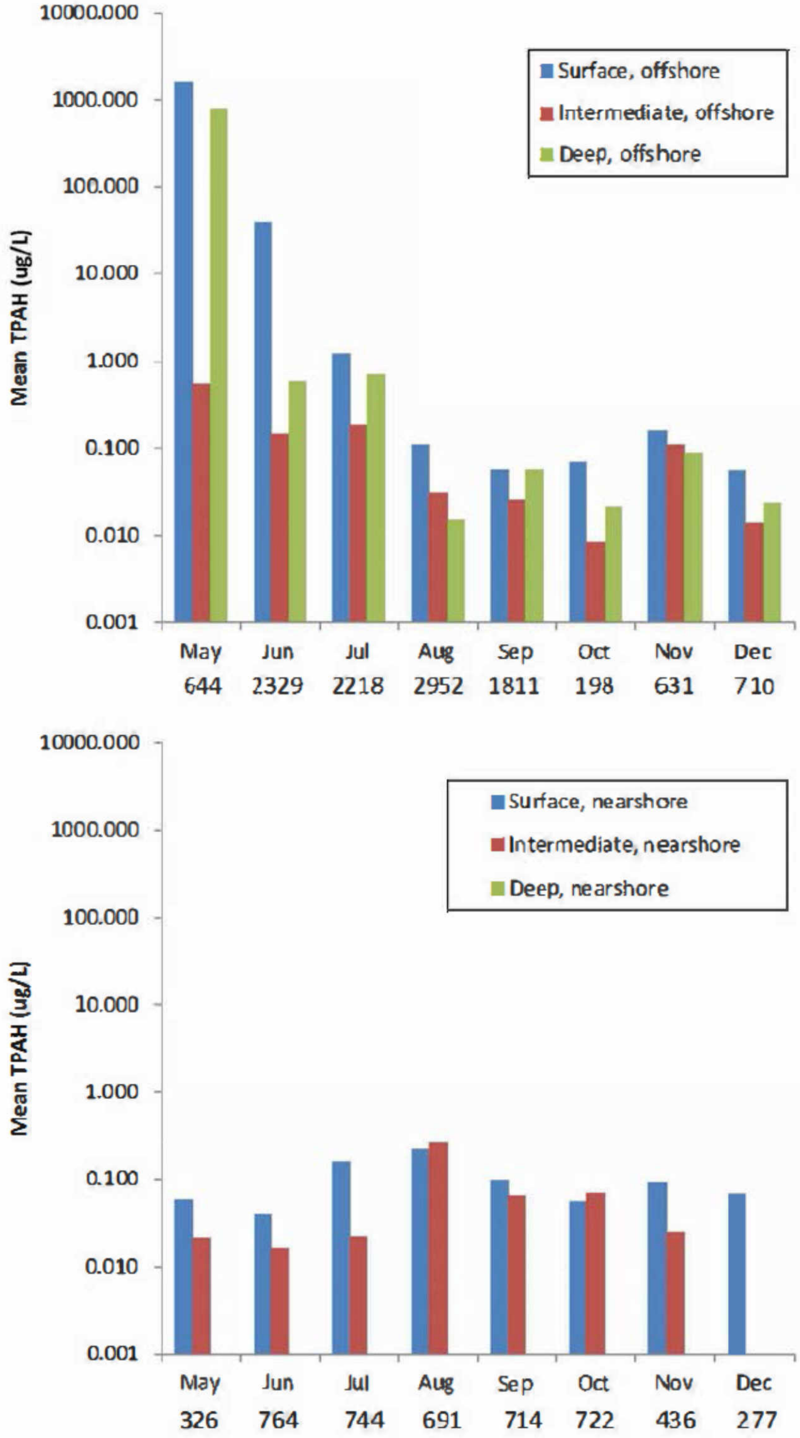
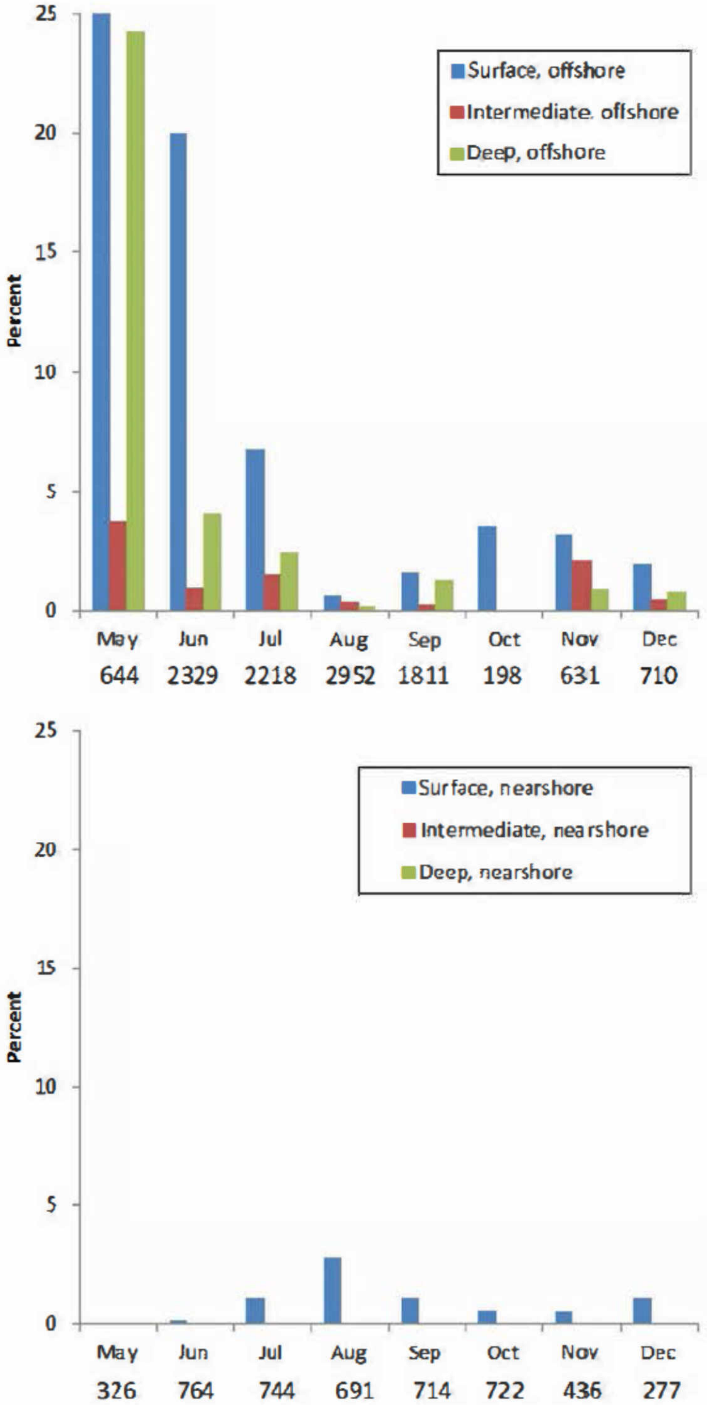
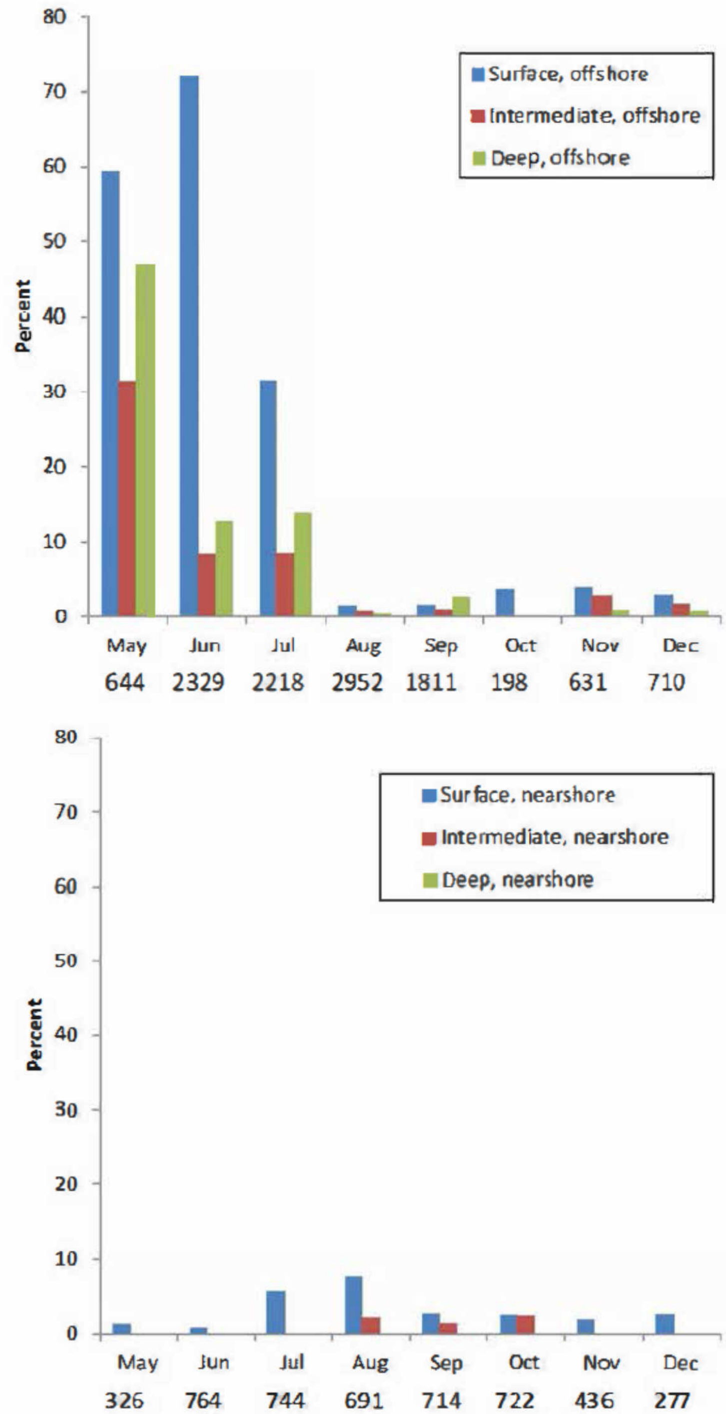


Fig. 2. Percent of samples exceeding EPA toxicity threshold for water samples as a function of time using the EPA threshold method (chronic toxicity).



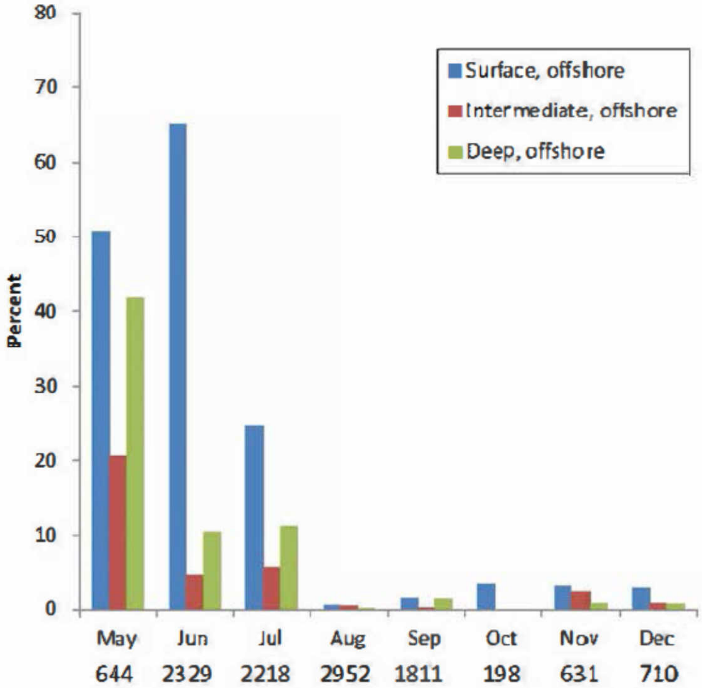
TREX-233296.000038
TREX-013332E.000009

Fig. 3a. Percent of water samples as a function of time that exceed toxicity threshold using embryo sensitivity estimates: 0.3 µg/L. Estimated embryo toxicity thresholds were as low as 0.3 for bluefin tuna and were between 1 and 6 µg/L for amberjack (Incardona et al. 2014).



TREX-233296.000039
TREX-013332E.000010

Fig. 3b. Percent of water samples as a function of time that exceed toxicity threshold using embryo sensitivity estimates: 0.5 µg/L. Estimated embryo toxicity thresholds were as low as 0.3 for bluefin tuna and were between 1 and 6 µg/L for amberjack (Incardona et al. 2014).



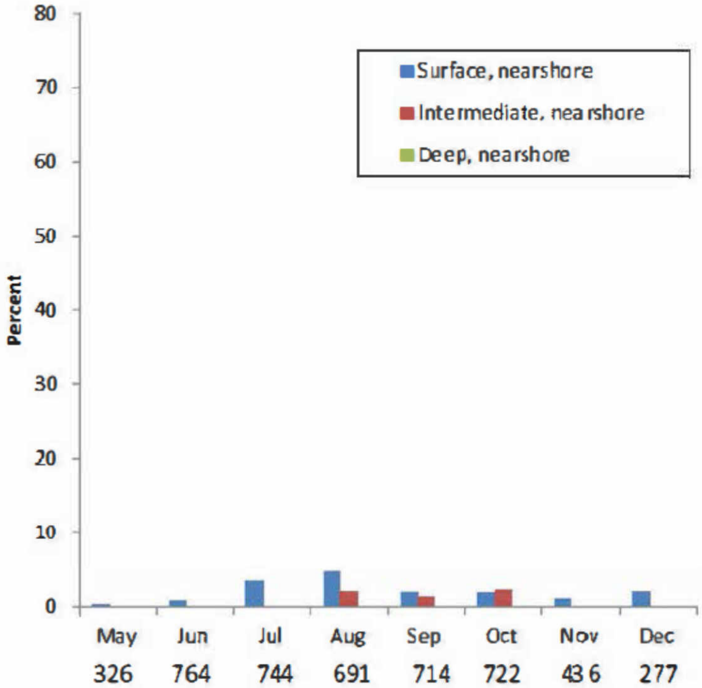


Fig. 3c. Percent of water samples as a function of time that exceed toxicity threshold using embryo sensitivity estimates: 1.0 µg/L. Estimated embryo toxicity thresholds were as low as 0.3 for bluefin tuna and were between 1 and 6 µg/L for amberjack (Incardona et al. 2014).

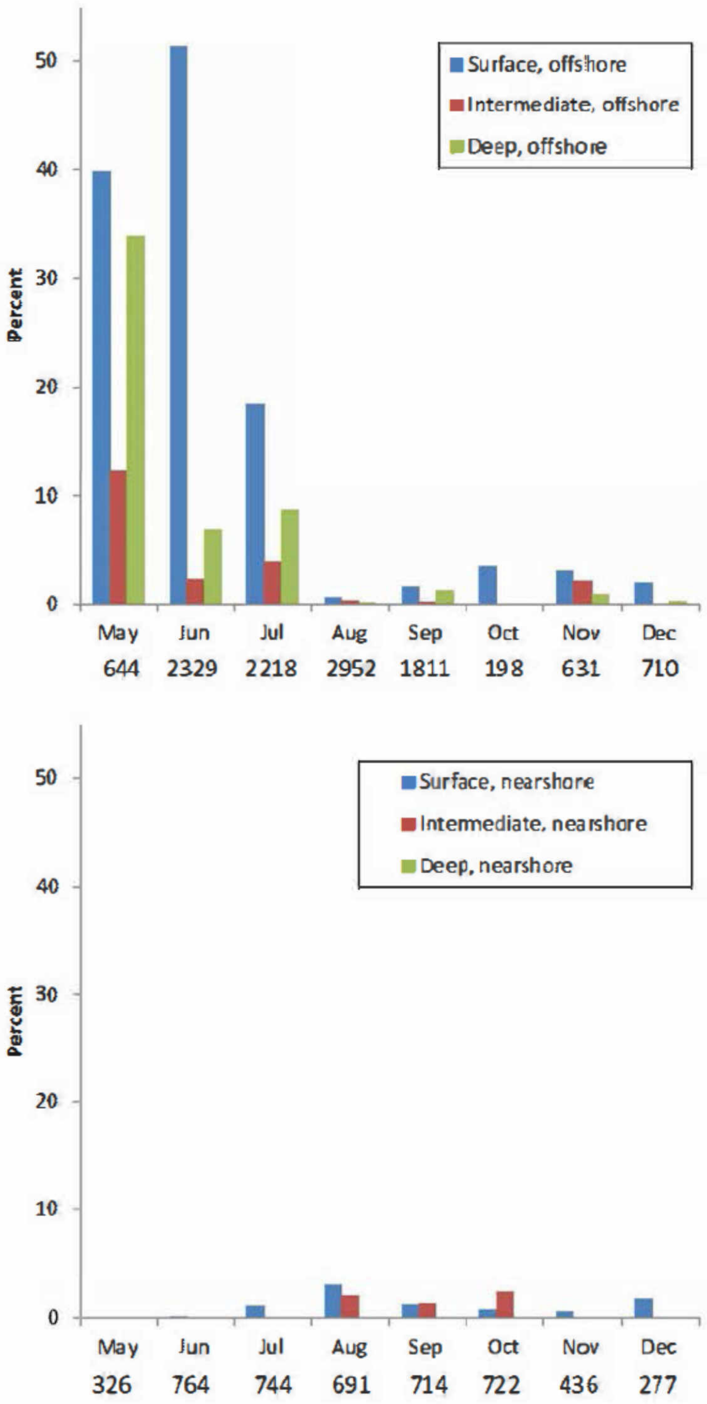
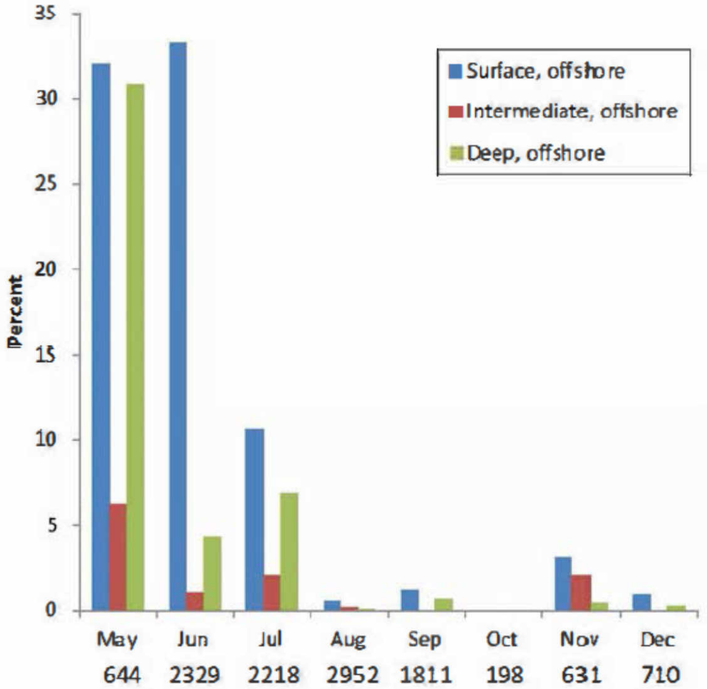


Fig. 3d. Percent of water samples as a function of time that exceed toxicity threshold using embryo sensitivity estimates: 2.0 µg/L. Estimated embryo toxicity thresholds were as low as 0.3 for bluefin tuna and were between 1 and 6 µg/L for amberjack (Incardona et al. 2014).



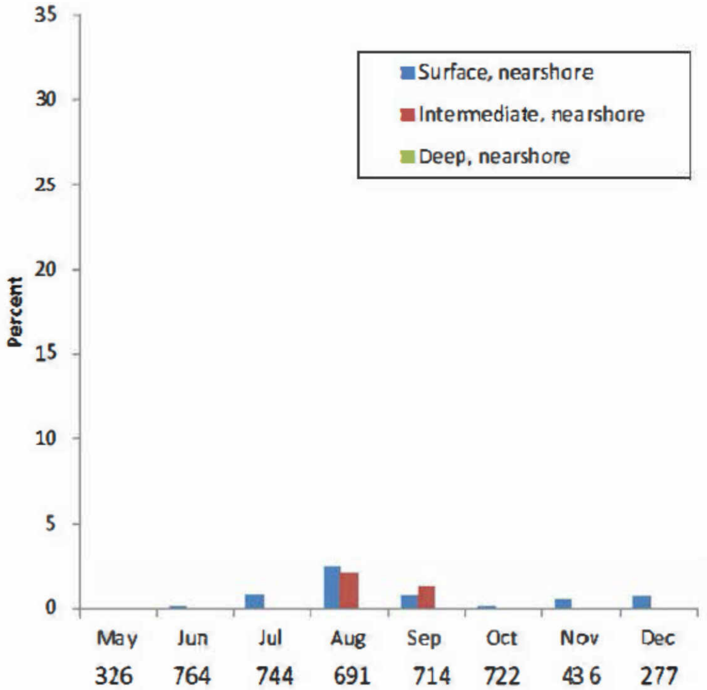


Fig. 4. Offshore samples within slick areas were defined as those within the slick boundaries identified by satellite (dark grey). Samples to the west of the primary slick boundary in June were not included as "within."

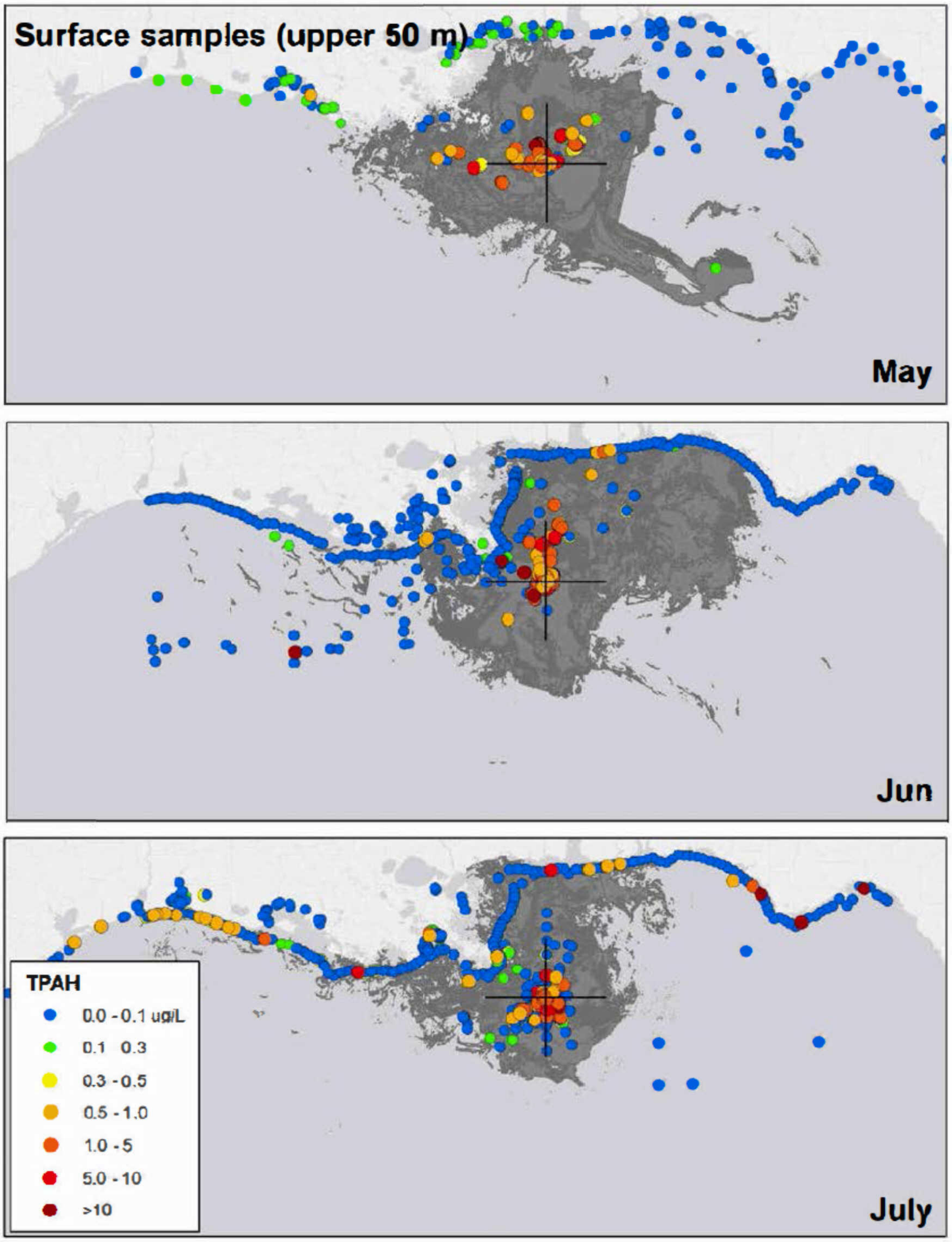
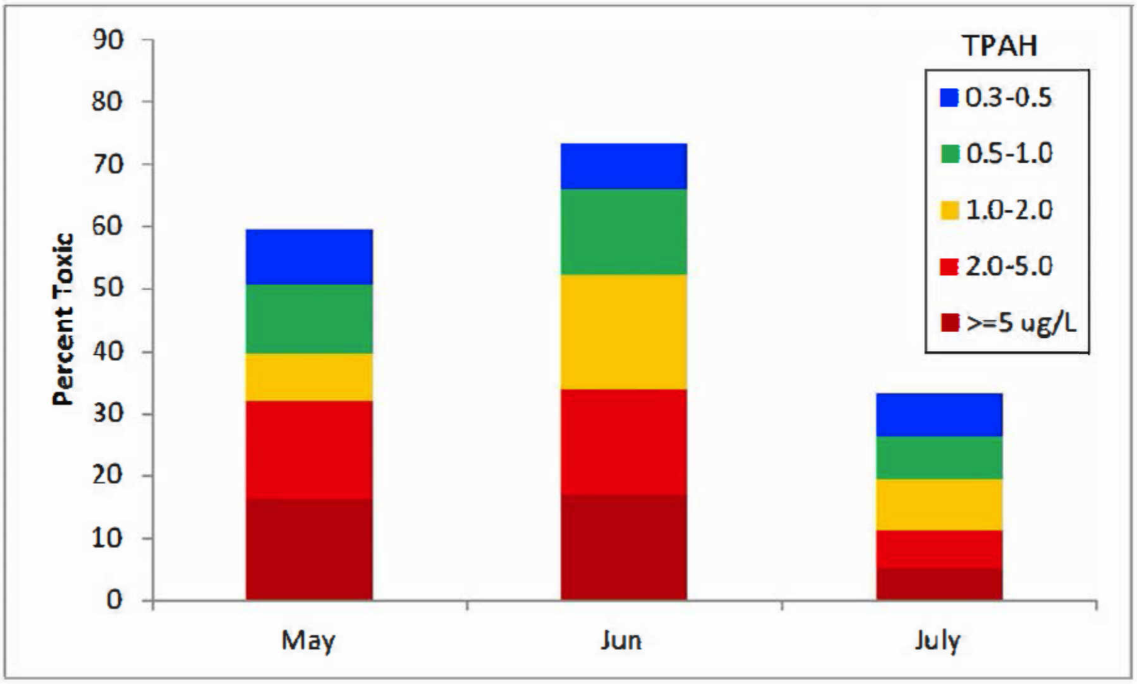


Fig. 5. Toxicity estimate in surface water (0 2 m) within the slick area only during the time the slick was present (May – July). Total slick area was determined by satellite and composited by month.



REDACTED

[redacted]

References

Incardona, J. P., L. D. Gardner, et al. (2014). "Deepwater Horizon crude oil impacts the developing hearts of large predatory pelagic fish." Proceedings of the National Academy of Sciences of the United States of America www.pnas.org/cgi/doi/10.1073/pnas.1320950111: E1510–E1518.

Corrected Appendix C

Species	Life stage	Response	Toxin	Conc. (µg/L)	Exposure time (d)	Method	Author
Southern bluefin tuna (*Thunnus maccoyii*)	Embryo	Pericardial & yolk-sac edema, threshold	DWH oil: TPAH	0.3	Incubation period	HEWAF (high energy water-accommodated fraction)	Incardona et al. 2014
Pacific herring (*Clupea pallasii*)	Embryo	Abnormalities, genetic damage, growth, mortality	aqueous TPAH, more weathered Alaska North Slope crude oil	0.4	16	ORC	Carls et al. 1999
Yellowfin tuna (*Thunnus albacares*)	Embryo	Pericardial & yolk-sac edema, threshold	DWH oil: TPAH	0.5 - 1.3	Incubation period	HEWAF	Incardona et al. 2014
Southern bluefin tuna (*Thunnus maccoyii*)	Embryo	EC50, edema	DWH oil: TPAH	0.8	Incubation period	HEWAF	Incardona et al. 2014
Southern bluefin tuna (*Thunnus maccoyii*)	Embryo	Pericardial & yolk-sac edema, EC50	DWH oil: TPAH	0.8	Incubation period	HEWAF	Incardona et al. 2014
Pink salmon (*Oncorhynchus gorbuscha*)	Embryo-larvae	Post-emergent growth	aqueous TPAH, weathered Alaska North Slope crude oil	0.94	~198	ORC	Carls et al. 2005
Pink salmon (*Oncorhynchus gorbuscha*)	Embryo-larvae	Mortality	aqueous TPAH, very weathered Alaska North Slope crude oil	1	~240	ORC	Heintz et al. 1999

Yellowfin tuna (*Thunnus albacares*)	Embryo	heart rate bradycardia threshold	DWH oil: TPAH	1.0 - 2.6	Incubation period	HEWAF	Incardona et al. 2014
Yellowtail amberjack (*Seriola lalandi*)	Embryo	Pericardial & yolk-sac edema, threshold	DWH oil: TPAH	1.0 - 6.0	Incubation period	HEWAF	Incardona et al. 2014
Atlantic cod (*Gadus morhua*)	Larvae	CYP3A Induction	unspecified crude oil, possibly North Sea	1.2	4	Mechanical dispersion	Olsvik et al 2011
Mahi-Mahi (*Coryphaena hippurus*)	embryo	Edema	DWH oil: TPAH	1.2	2	HEWAF	Mager et al 2014
Mahi-Mahi (*Coryphaena hippurus*)	embryo	Reduced swimming speed	DWH oil: TPAH	1.2	2		Mager et al 2014
Atlantic cod (*Gadus morhua*)	Larvae	Reduced survival	unspecified crude oil, possibly North Sea	<2	4	Mechanical dispersion	Olsvik et al 2012
Atlantic cod (*Gadus morhua*)	Larvae	CYP3A induction	unspecified crude oil, possibly North Sea	2.1	4	WSF isolated from Mechanical dispersion	Olsvik et al 2011
Yellowfin tuna (*Thunnus albacares*)	Embryo	EC50, edema	DWH oil: TPAH	2.3	Incubation period	HEWAF	Incardona et al. 2014
Yellowfin tuna (*Thunnus albacares*)	Embryo	Pericardial & yolk-sac edema, EC50	DWH oil: TPAH	2.3	Incubation period	HEWAF	Incardona et al. 2014

Yellowfin tuna (*Thunnus albacares*)	Embryo	EC50 for prolongation of systole	DWH oil: TPAH	2.6	Incubation period	HEWAF	Incardona et al. 2014
Yellowtail amberjack (Seriola lalandi)	Embryo	heart rate bradycardia threshold	DWH oil: TPAH	2.2 - 6.5	Incubation period	HEWAF	Incardona et al. 2014
Yellowfin tuna (*Thunnus albacares*)	Embryo	Extracardiac defects	DWH oil: TPAH	3.4	Incubation period	HEWAF	Incardona et al. 2014
Pink salmon (*Oncorhynchus gorbuscha*)	Embryo-larvae	CYP1A induction	aqueous TPAH, weathered Alaska North Slope crude oil	3.7	~198	ORC	Carls et al. 2005
Pacific herring (*Clupea pallasii*)	Embryo	Abnormalities	Whole oil	4	13	Flowing oil-water contact	Pearson et al. 1985
Southern bluefin tuna (*Thunnus maccoyii*)	Embryo	heart rate bradycardia threshold	DWH oil: TPAH	4	Incubation period	HEWAF	Incardona et al. 2014
Pink salmon (*Oncorhynchus gorbuscha*)	Embryo-larvae	Ascites, premature emergence, gonadal cell apoptosis, induction of CYP1A	aqueous TPAH, weathered Alaska North Slope crude oil	4.4	177	ORC	Marty et al. 1997
Yellowtail amberjack (*Seriola lalandi*)	Embryo	heart rhythm irregularities, minimum influential exposure conc.	DWH oil: TPAH	4.5	Incubation period	HEWAF	Incardona et al. 2014

Pink salmon (*Oncorhynchus gorbuscha*)	Embryo-larvae	Marine survival	aqueous TPAH, weathered Alaska North Slope crude oil	5.4	~240	ORC	Heintz et al. 2000
Yellowfin tuna (*Thunnus albacares*)	Embryo	heart rate IC50 (half max inhibitory conc)	DWH oil: TPAH	6.1	Incubation period	HEWAF	Incardona et al. 2014
Southern bluefin tuna (*Thunnus maccoyii*)	Embryo	heart rate IC50 (half max inhibitory conc)	DWH oil: TPAH	7.7	Incubation period	HEWAF	Incardona et al. 2014
Pink salmon (*Oncorhynchus gorbuscha*)	Embryo-larvae	Blue sac disease (ascites)	aqueous TPAH, weathered Alaska North Slope crude oil	7.8	83	ORC	Brannon et al. 2006
Southern bluefin tuna (*Thunnus maccoyii*)	Embryo	Extracardiac defects	DWH oil: TPAH	8.5	Incubation period	HEWAF	Incardona et al. 2014
Yellowtail amberjack (*Seriola lalandi*)	Embryo	EC50 for prolongation of systole	DWH oil: TPAH	8.6	Incubation period	HEWAF	Incardona et al. 2014
Pacific herring (*Clupea pallasii)*	Embryo	Abnormalities, growth, mortality	aqueous TPAH, weathered Alaska North Slope crude oil	9.1	16	ORC	Carls et al. 1999
Capelin (*Mallotus villosus*)	Embryo	Reduced hatching success	WSF, Ekofisk crude oil	<10	42-49	Flowing oil-water contact	Johannessen 1976

Japanese medaka (*Oryzias latipes*)	Embryo	LOEC, hatch length	PAHs	11	18	static renewal	Farwell et al. 2006
Yellowtail amberjack (*Seriola lalandi*)	Embryo	EC50, edema	DWH oil: TPAH	12.4	Incubation period	HEWAF	Incardona et al. 2014
Yellowtail amberjack (*Seriola lalandi*)	Embryo	Pericardial & yolk-sac edema, EC50	DWH oil: TPAH	12.4	Incubation period	HEWAF	Incardona et al. 2014
Yellowtail amberjack (*Seriola lalandi*)	Embryo	Extracardiac defects	DWH oil: TPAH	13.8	Incubation period	HEWAF	Incardona et al. 2014
Yellowtail amberjack (*Seriola lalandi)*	Embryo	heart rhythm irregularities, significant	DWH oil: TPAH	13.8	Incubation period	HEWAF	Incardona et al. 2014
Zebrafish (*Danio rerio*)	Embryo	Cardiac abnormalities	Aqueous TPAH, Alaska North Slope crude oil	15	2	Mechanical dispersion	Carls et al. 2008
Pink salmon (*Oncorhynchus gorbuscha)*	Embryo-larvae	Mortality	aqueous TPAH, weathered Alaska North Slope crude oil	16.4	83	ORC	Brannon et al. 2006
Pacific herring (*Clupea pallasii)*	Embryo	Edema	aqueous TPAH, more weathered Alaska North Slope crude oil	17.3	4	ORC	Carls et al. 1999
Pink salmon (*Oncorhynchus gorbuscha)*	Embryo-larvae	Post-emergent growth	aqueous TPAH, weathered Alaska North Slope crude oil	18	~240	ORC	Heintz et al. 2000
Yellowtail amberjack (*Seriola lalandi*)	Embryo	heart rate IC50 (half max inhibitory conc)	DWH oil: TPAH	18.2	Incubation period	HEWAF	Incardona et al. 2014