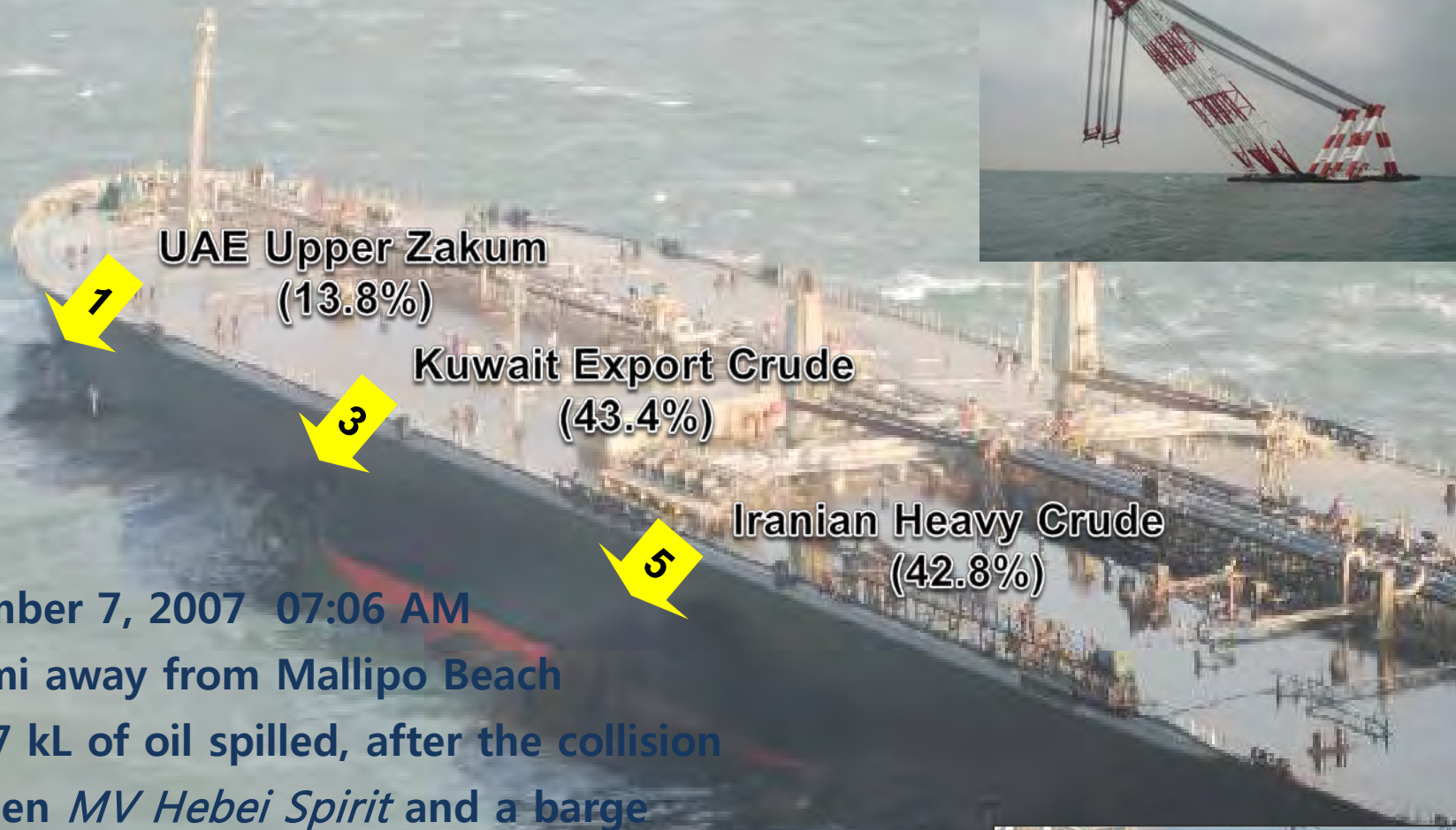


Lessons Learned from the *Hebei Spirit* Oil Spill:
Environmental Perspectives

2015 PICES Workshop 4

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Korea Institute of Ocean Science & Technology

Hebei Spirit Oil Spill



UAE Upper Zakum
(13.8%)

Kuwait Export Crude
(43.4%)

Iranian Heavy Crude
(42.8%)

- December 7, 2007 07:06 AM
- 6.5 nmi away from Mallipo Beach
- 12,547 kL of oil spilled, after the collision between *MV Hebei Spirit* and a barge carrying a crane
- Three different kinds of crude oil
- 375 km of coastline was contaminated
- 1.3 million volunteers



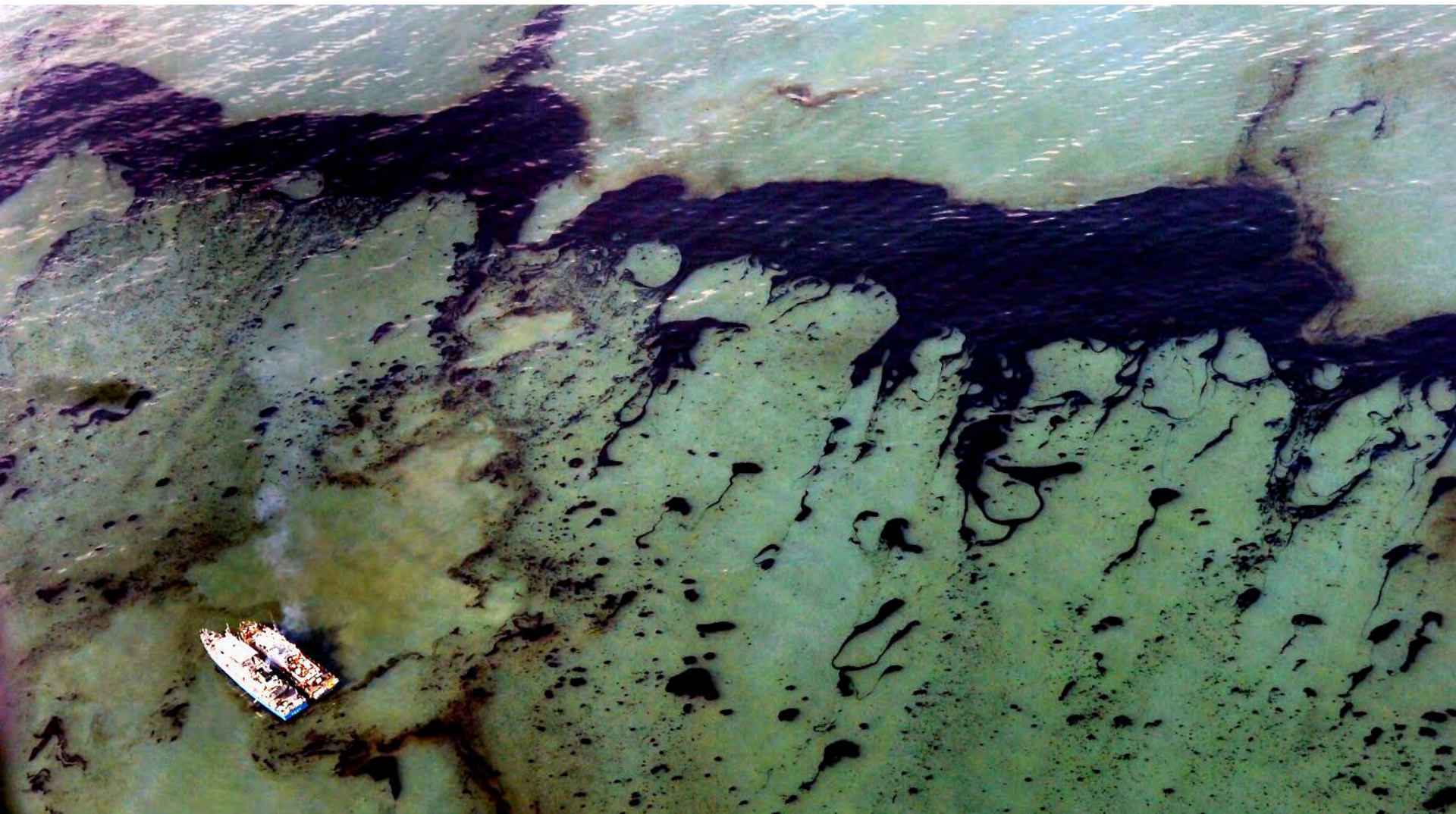


Photo courtesy of Jungdoilbo



Photo courtesy of Jungdoilbo

Evaporation Oil fence
 Sinking Dissolution Containment
 Dispersion **Oil** Time of Window
 Shipwreck OSA **Unknowns** Beach cleaner
 Collision Solubility **Weathering** SCAT Dispersant
 Blowout Degradation **Fingerprinting** Washing
 Oil rig Photooxidation In-situ burning No action Skimmer
 Exxon Valdez Biodegradation Nausea Dizziness
 Sedimentation **Toxicity** Headache Fisheries
 Amoco Cadiz Cancer
Hebei Spirit Alkanes Ecosystem
 PAHs UCM Damage
 Sea Prince **Emergency** Cleanup Restoration Compensation Remediation
 Prestige **NRDA** Erica
Deepwater Horizon Fisherman
 Biomarker Hopanes IOPC Steranes
 Decision-making ITOPF MOF



Lesson 1. Oil spill research in a legal framework



Farrington described the need and urgency for responsible science in a **crisis mode**: he imparted the need to bring the best science, engineering and research to serve present needs and expand the knowledge base for the future.

He cautioned the community to be mindful that research surrounding the spill is being conducted within an environment that is subject to **regulatory and legal actions** and encouraged scientists to pay special attention to **scientific record keeping** (i.e. sampling, shipboard notebooks, electronic data, correspondence) as all records can be subpoenaed.

He explained that this type of research activity is part of **a scientist's public service** and academicians should not avoid this research because of the legal environment.

Consortium for Ocean Leadership **SCIENTIFIC SYMPOSIUM MEETING**

LOUISIANA STATE UNIVERSITY, JUNE 23, 2010

Oil Spill Environmental Forensics: the *Hebei Spirit* oil spill case



ENVIRONMENTAL
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Feature

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Oil Spill Environmental Forensics: the *Hebei Spirit* Oil Spill Case

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- ✓ Rapid screening of shoreline contamination
- ✓ Long-term monitoring of residual oils in multimedia
- ✓ Varying degree mixture of three source oils
- ✓ Background contamination
- ✓ Weathering and its effects on oil fingerprints
- ✓ Emerging oil fingerprinting techniques
- ✓ Submerged oil

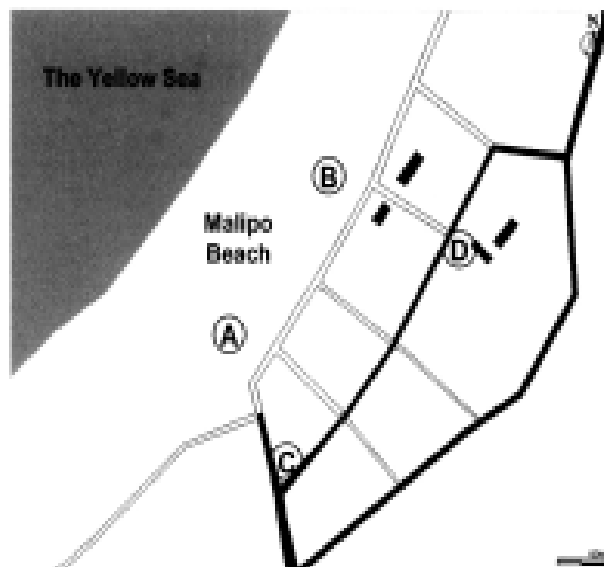
Lesson 2. Ephemeral data: Go to the scene ASAP

Volatile Organic Carbons

한국환경분석학회지 제11권 (제1호) 39~45, 2008
 J. of the Korean Society for Environmental Analysis

2007년 태안 원유유출사고 주변지역의 지정악취성분들에 대한 예비조사

김기현¹ · 이기환 · 안지원 · 박신영 · 임운혁¹
 세종대학교 지구환경과학과, ¹한국해양연구원 남해연구소



[a] The 1st campaign (100 hr after the accident: 9 Dec. 2007)

Group	Pollutants	Mean	Median	SD	Min	Max	N(> BDL)
A. VOC & TVOC	B	0.43	0.14	0.80	0.14	2.41	2
	T	1.23	1.16	0.78	0.11	2.92	7
	EB	0.33	0.11	0.63	0.11	1.90	1
	MPX	0.50	0.13	1.05	0.04	3.07	4
	OX	4.61	1.39	8.39	0.08	24.89	6
	STY	0.42	0.12	0.84	0.12	2.49	1
	BB	0.43	0.24	0.56	0.24	1.82	1
	1,3,5-TMB	0.65	0.15	1.29	0.15	3.83	3
	1,2,4-TMB	2.35	1.50	3.16	0.20	9.54	8
	p-IPT	0.72	0.16	1.60	0.16	4.68	1
	n-BB	0.38	0.23	0.29	0.23	0.99	2

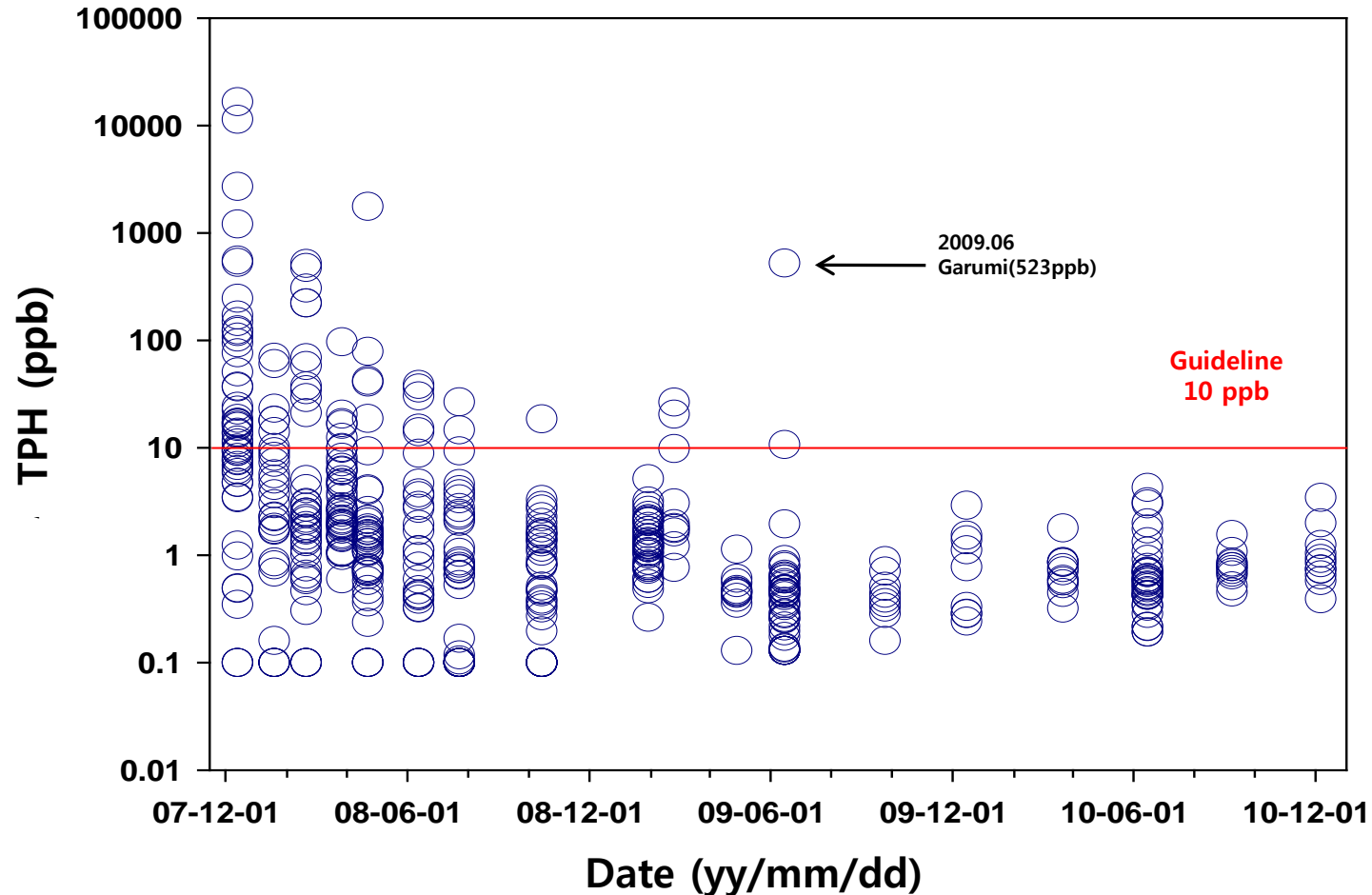
[b] The 2nd campaign (~1 month after the accident: 9 Jan. 2008)

Group	Pollutants	Mean	Median	SD	Min	Max	N(BDL)
A. VOC & TVOC	B	0.38	0.44	0.14	0.14	0.53	7
	T	4.17	3.20	3.14	2.20	11.70	1
	EB	0.27	0.27	0.05	0.20	0.36	7
	MPX	0.23	0.24	0.05	0.17	0.31	4
	OX	0.08	0.08	0.00	0.08	0.08	8
	STY	0.15	0.12	0.09	0.12	0.38	8
	BB	0.24	0.24	0.00	0.24	0.24	8
	1,3,5-TMB	0.15	0.15	0.00	0.15	0.15	8
	1,2,4-TMB	0.20	0.20	0.00	0.20	0.20	8
	p-IPT	0.16	0.16	0.00	0.16	0.16	8
	n-BB	0.23	0.23	0.00	0.23	0.23	8

J. Of the Korean Society for Environmental Analysis (2008)

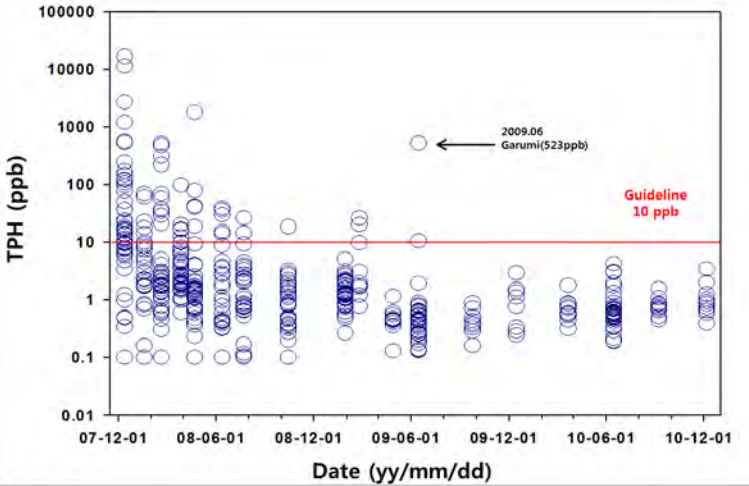
Lesson 2. Ephemeral data: Go to the scene ASAP

Temporal changes of TPH in seawater

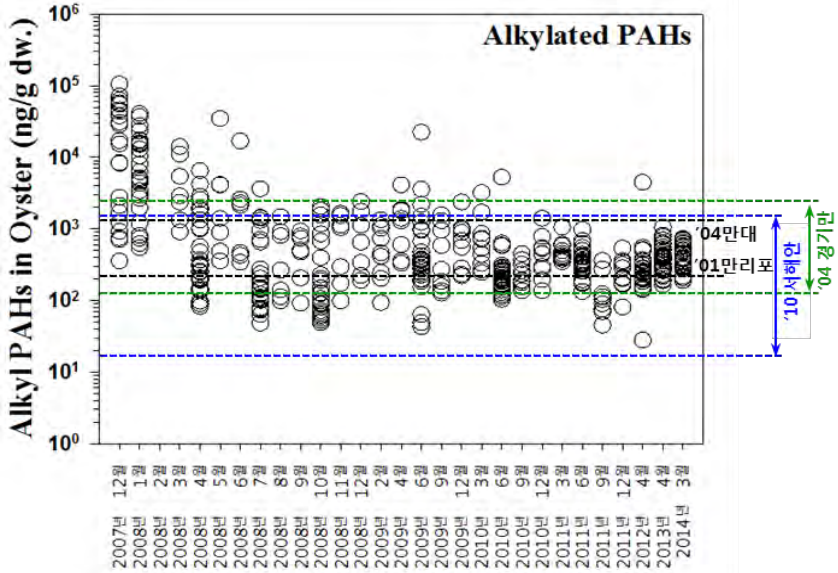


Lesson 3. Cover multimedia oiling at regionwide scale

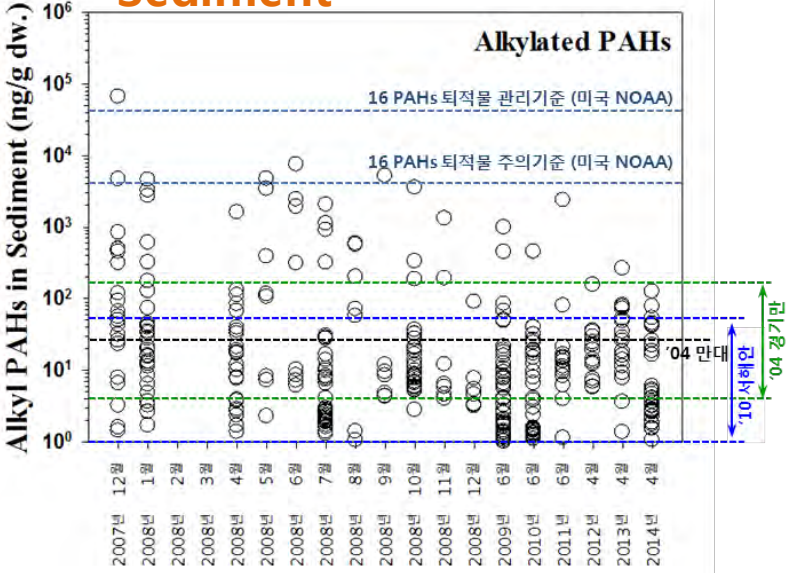
Seawater



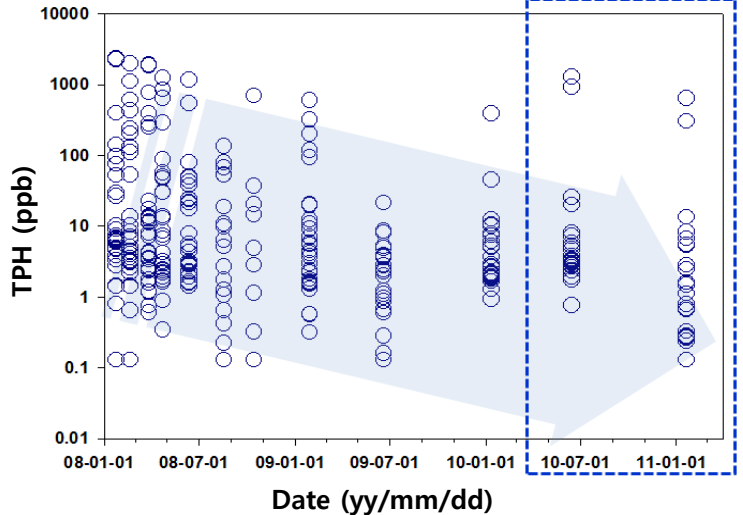
Biota



Sediment



Porewater

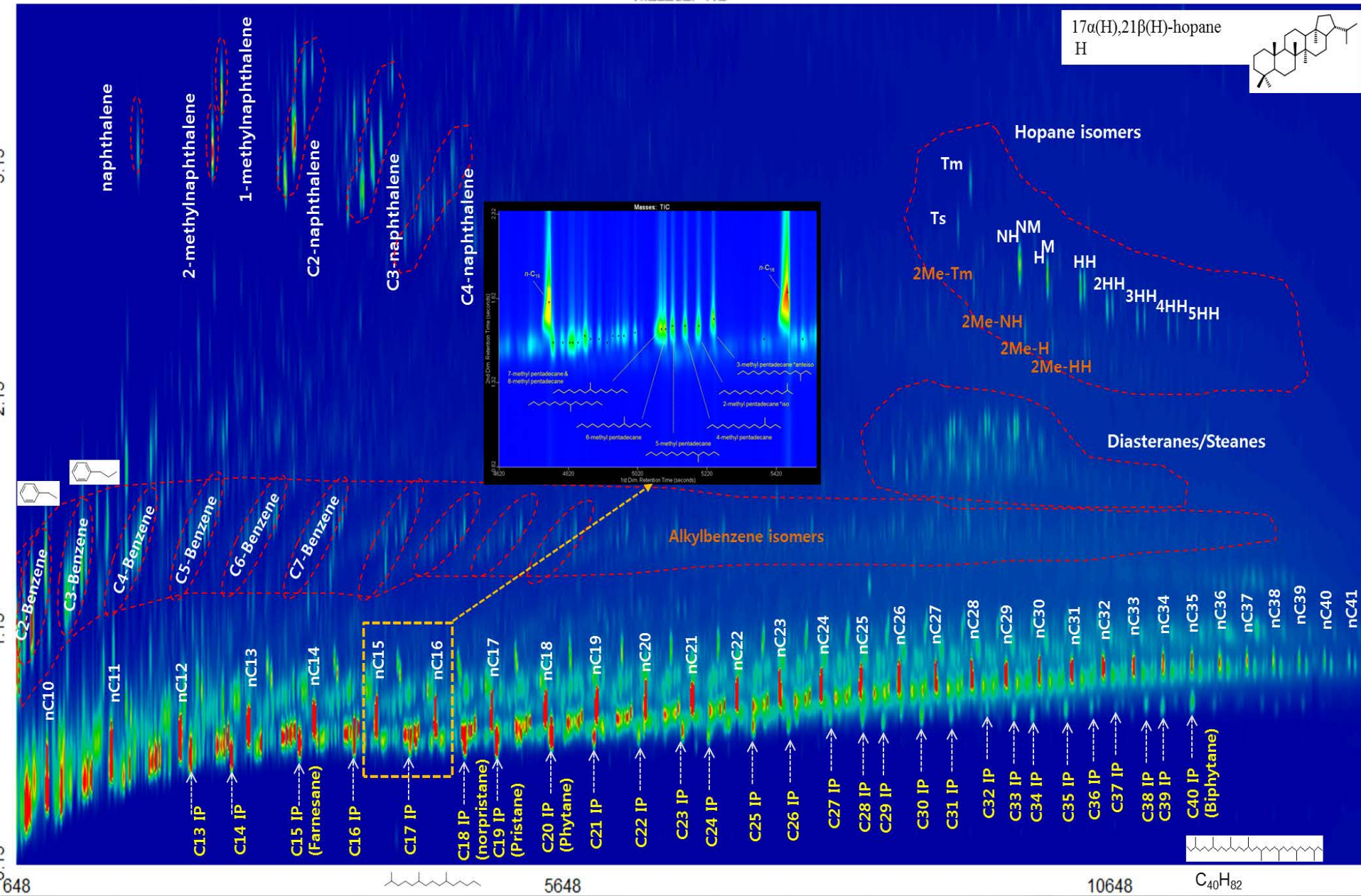
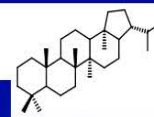


Lesson 4. Characterization of spilled oil

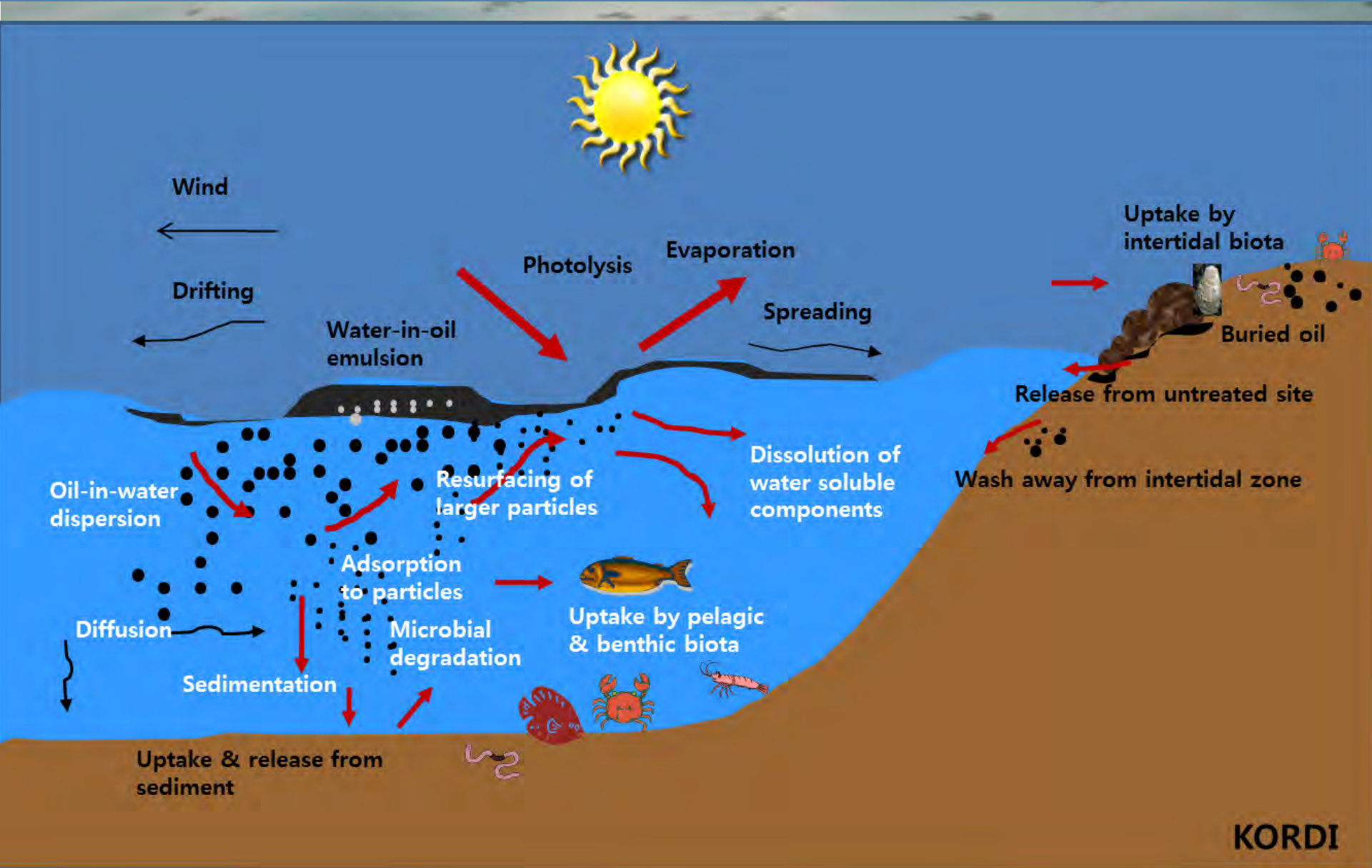
Iranian Heavy Crude oil

Masses: TIC

17 α (H),21 β (H)-hopane
H



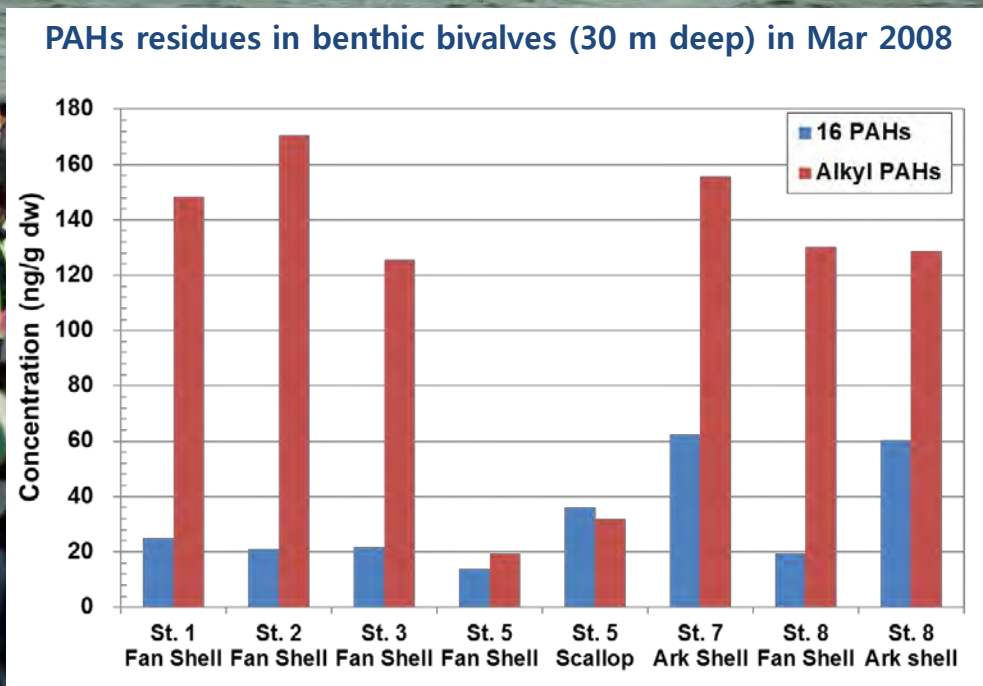
Lesson 5. Fate of spilled oil



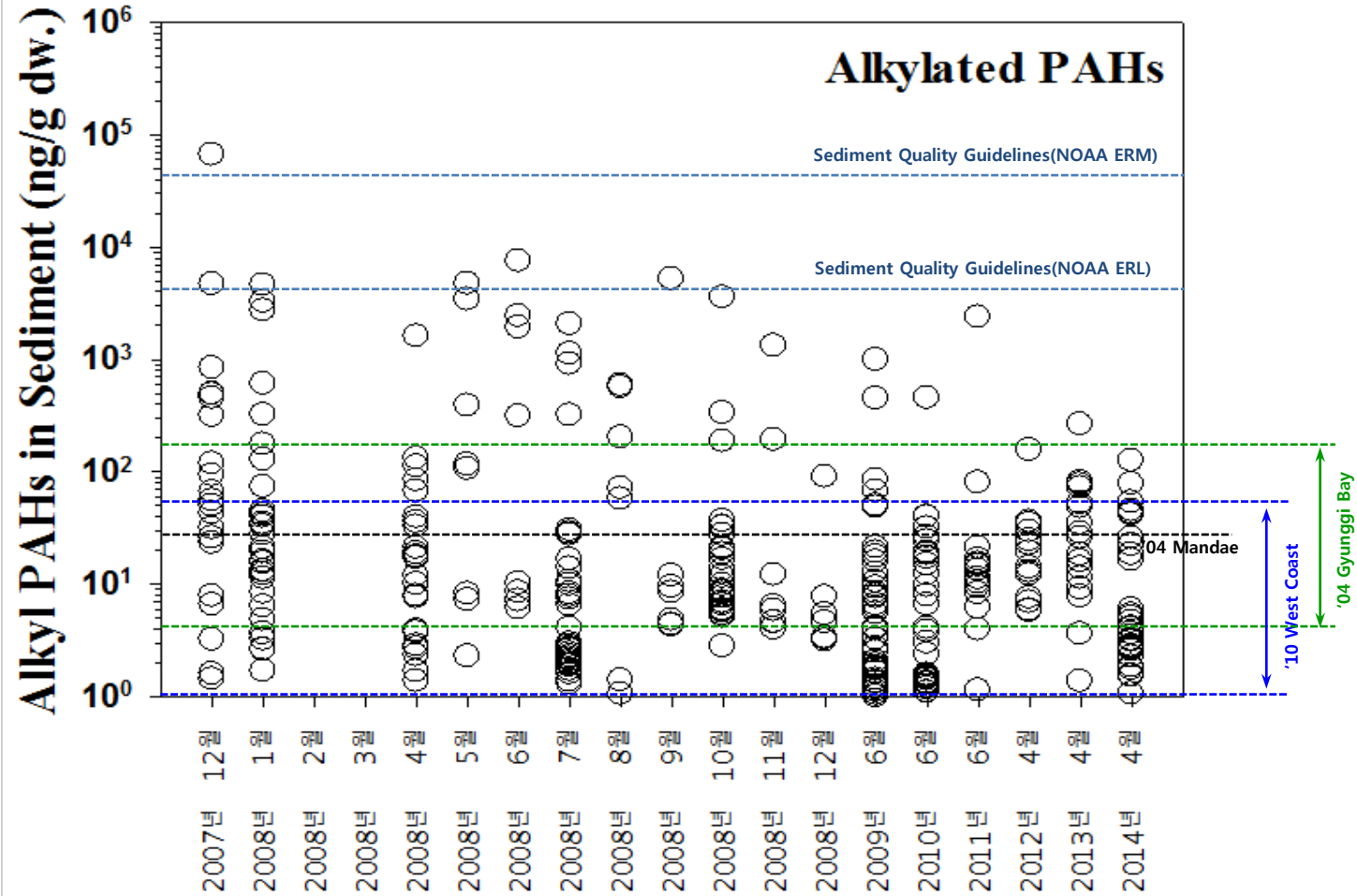
KORDI

Lesson 6. Effects of oil spill dispersant (OSD)

- OSD is one of emergency cleanup option (300 kl of OSD used in HSOS)
- Shellfish down to 20-30 m deep were exposed to spilled oil
- Need to revise dispersant application guidelines
- Need to monitor the efficiency and effects of dispersant
- NEBA should be considered before use

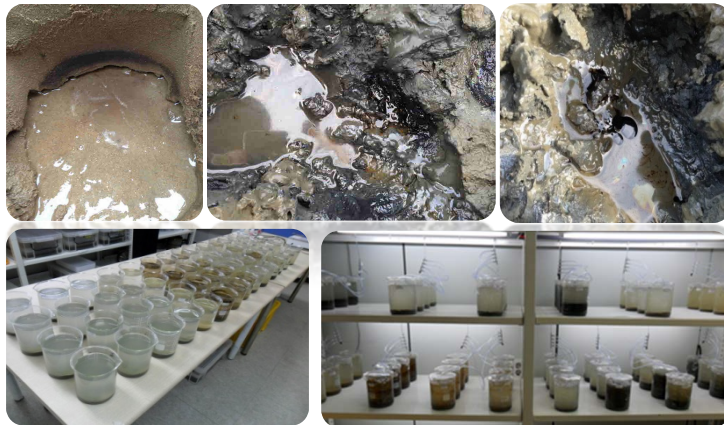
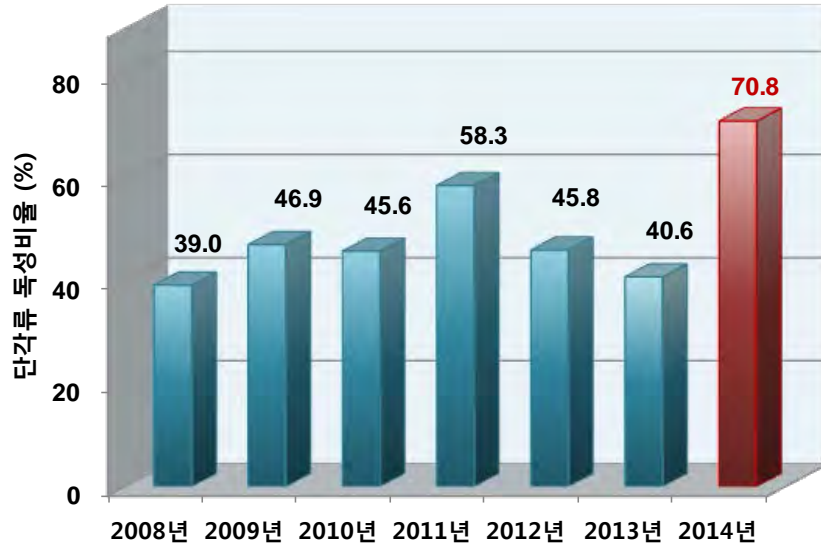


Lesson 7. Background data & guidelines

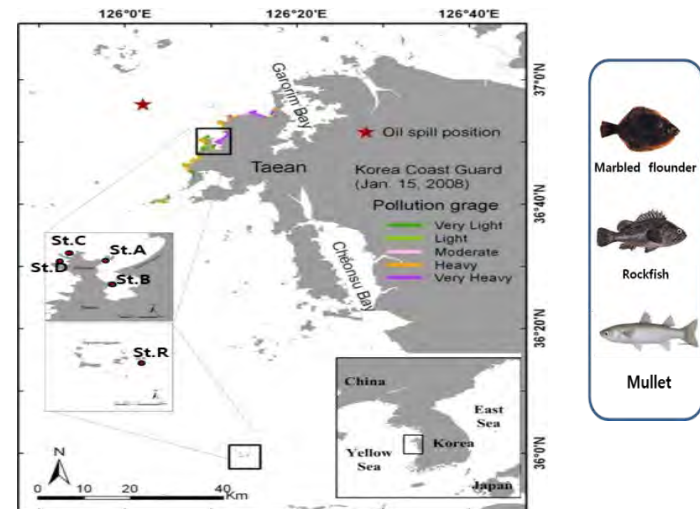
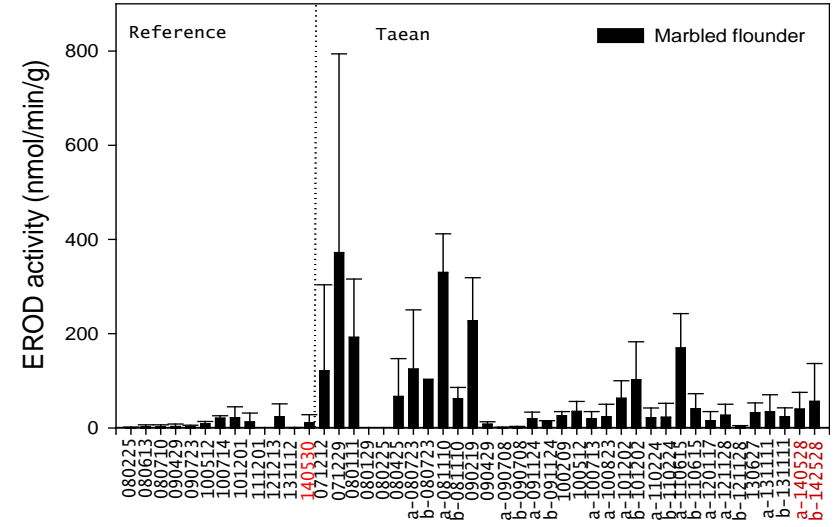


Lesson 8. What's the toxicological effects of spilled oil?

Ecotoxicity of residual oils

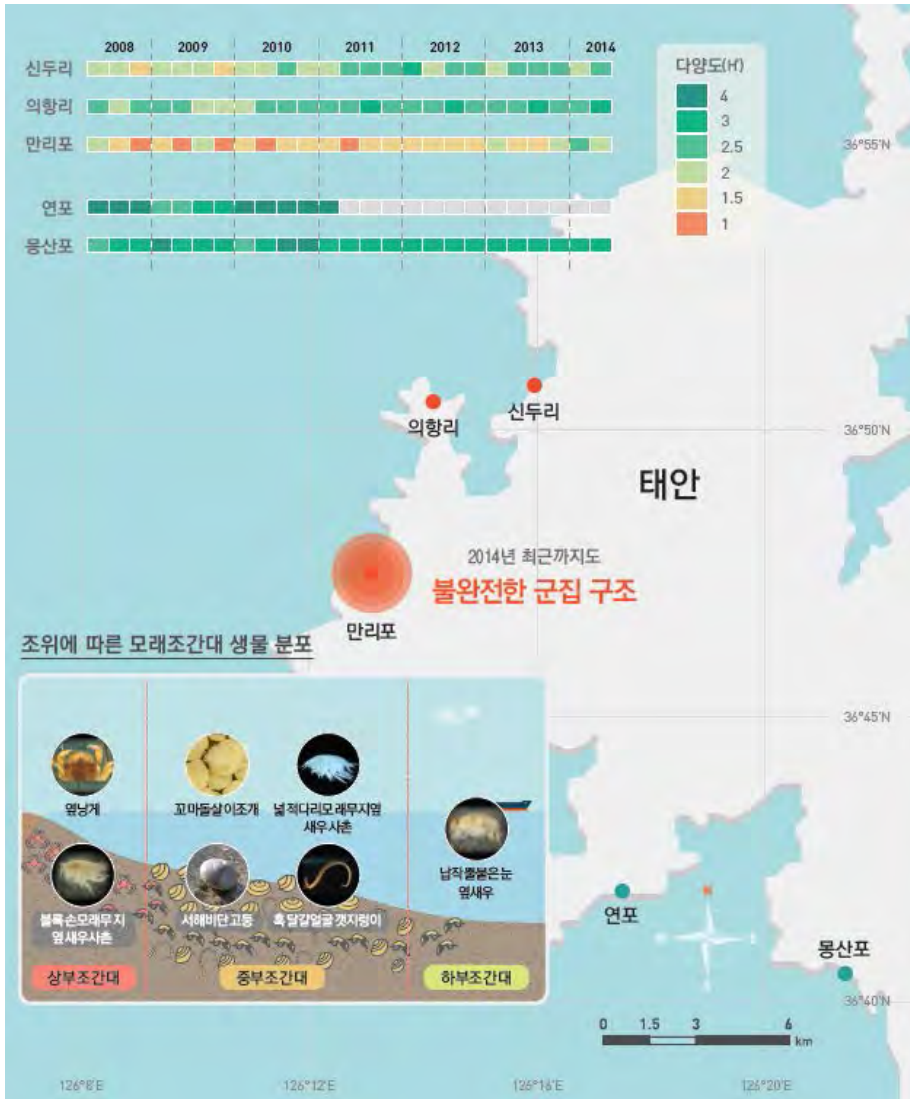


Exposure and effects



Lesson 9. Ecosystem effects

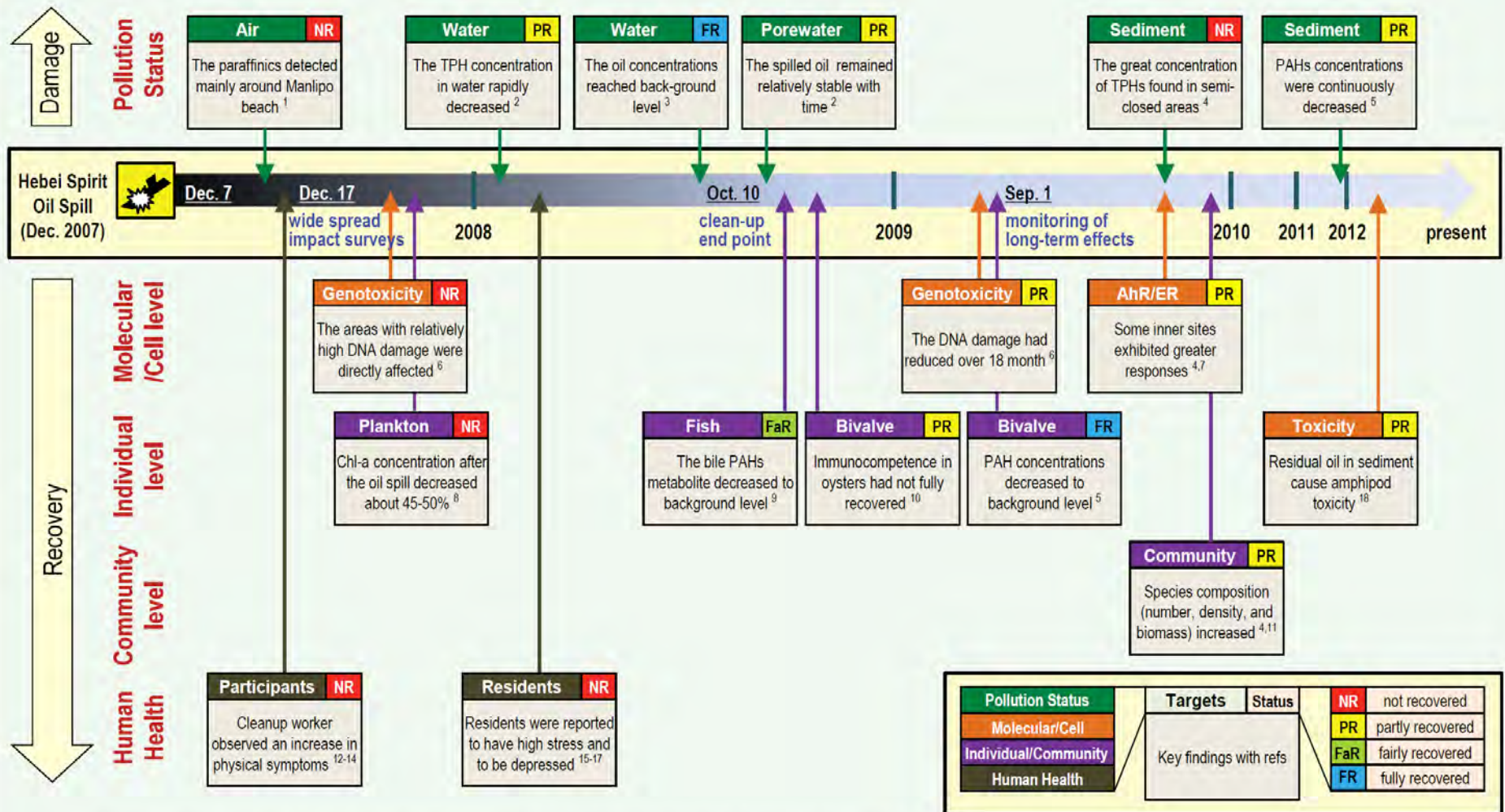
Sand beaches



Rocky shore



Lesson 10. Long-term monitoring

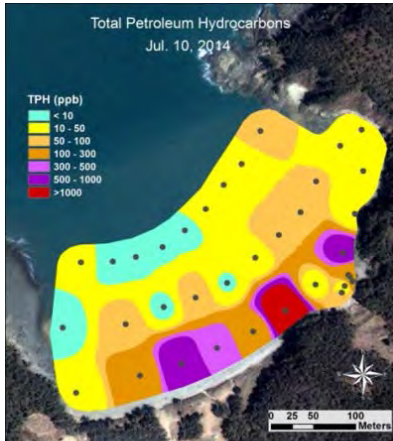
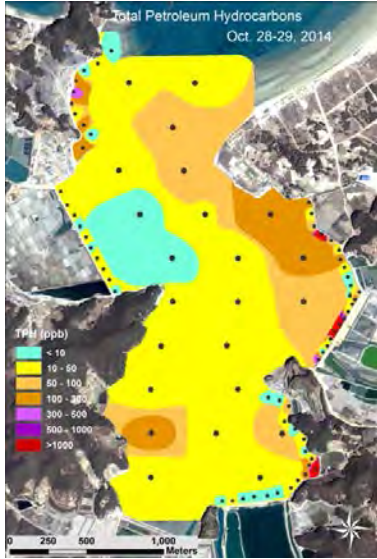


¹ Lee et al. 2008; ² Kim et al. 2013; ³ Kim et al. 2010; ⁴ Hong et al. 2012; ⁵ MLTM 2012; ⁶ Lee et al. 2011; ⁷ Ji et al. 2011; ⁸ Lee et al. 2009; ⁹ Jung et al. 2011; ¹⁰ Donaghy et al. 2010; ¹¹ Yu et al. 2013; ¹² Ha et al. 2012; ¹³ Kang et al. 2009; ¹⁴ Sim et al. 2010; ¹⁵ Song et al. 2009; ¹⁶ Kim et al. 2009; ¹⁷ Lee et al. 2010; ¹⁸ Lee et al., 2013a.

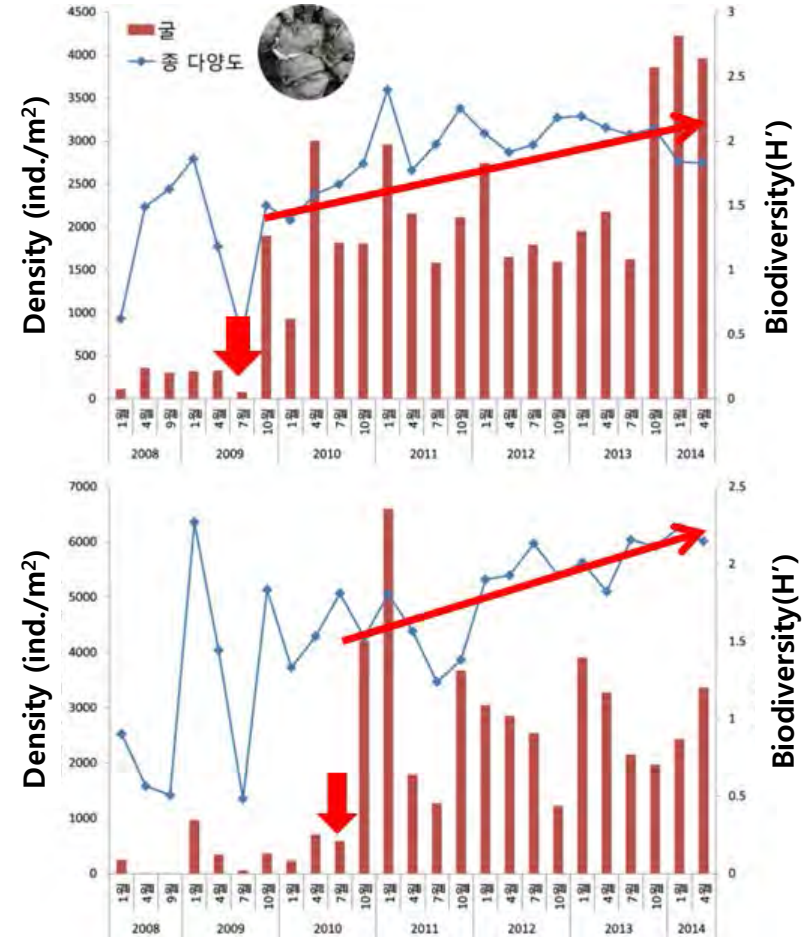
Hong et al., 2014. *Ocean Coast. Manage.* 102PB, 522-532.

Lesson 11. Environmental Restoration

Remediation of residual oils



Restoration using keystone species



Lesson 12. Dealing with Mass Media: Fact sheets

- ✓ They distribute wrong information in emergencies
- ✓ A small unintended wrong interview or information from government and expert really make big problem
- ✓ Need to establish protocol and to train related persons

Summary

1. Oil spill investigation is under regulatory framework
2. Go to the Scene ASAP and collect ephemeral data
3. Cover multi-media oiling at regionwide scale
4. Obtain physical & chemical characteristics of spilled oil
5. Share information about the fate of spilled oil
6. Proper use and effective monitoring of oil spill dispersant
7. Be prepared for background data & guidelines
8. Elucidate the toxicological effects of spilled oil
9. Ecological effects should be focused on oil
10. Oil has long-term effects
11. Restoration plan should be based on long-term monitoring
12. Provide scientific information to mass media

Contributors

A group of 14 people, including men and women, are posed in front of a traditional-style wooden building. They are all wearing bright blue jackets with dark grey or black accents. Some are standing in the back row, while others are kneeling or sitting in the front row. The scene is outdoors during the day, with a clear sky and a yellow trash bin visible on the left.

Thank You!