Industry Technical Advisory Committee

Industry Research Efforts

Tom Coolbaugh

itac: Industry Technical Advisory Committee
for oil spill response

Recent ExxonMobil Participation at IOSC

Tom Coolbaugh	Joint industry-sponsored effort to evaluate post-Macondo dispersant research
Marusia Popovech	Analysis of Hazards of Dispersant Constituents and Review of Toxicological Studies.
Tim Nedwed	Overview of the American Petroleum Institute (API) Joint Industry Task Force SSDI Project
Dave Palandro	Advances in Remote Sensing Research on Oil and Ice from the IOGP Arctic OSR Technology JIP
Dave Palandro	Oil in and under Ice Detection using Nuclear Magnetic Resonance
Wolfgang Konkel	Analysis of Potential for Human Exposure to Aerial Dispersant Application
Dave Palandro	Surveillance and Remote Sensing

Erik DeMicco, Tim Nedwed, David Palandro, Peter Lane (Desmi), Chris Chase, Steve Van Bibber (InterOceans Systems)
Advances in Oil Detection and Monitoring using a Smart Boom Monitoring System

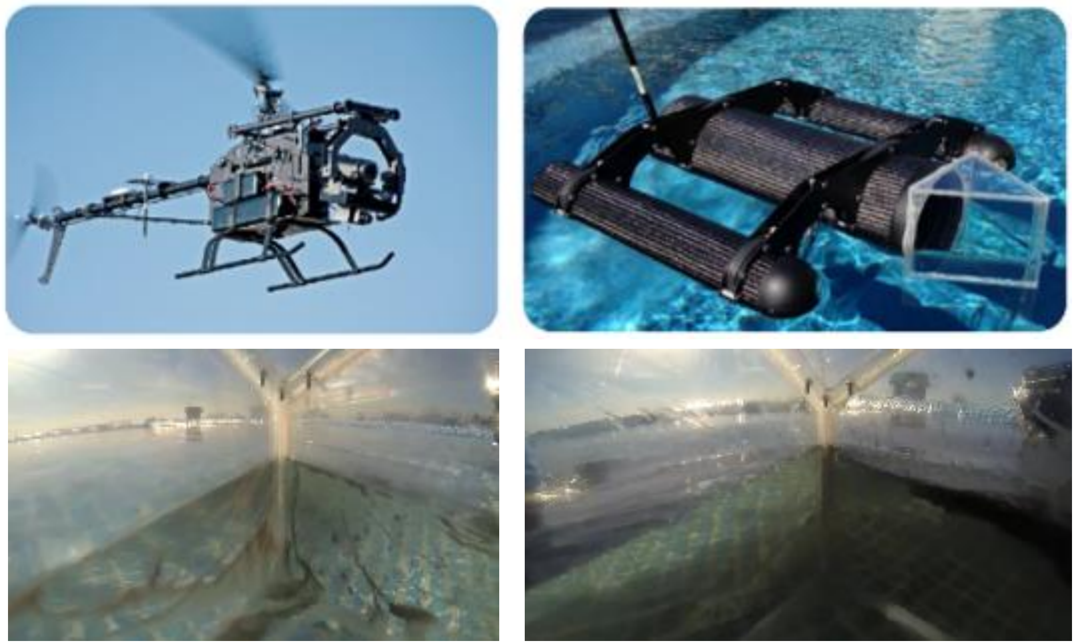
David B. Chenault, Justin P. Vaden (Polaris Sensor Technologies), Douglas A. Mitchell, **Erik DeMicco**
Thermal Infrared Polarimetric Sensor for Automated Detection of Oil Spills

Rob Holland, Geeva Varghese, Lucy Heathcote, Victoria Broje, **Tom Coolbaugh**
Dispersant Technical Information Sheets: Conveying Multifaceted Toxicity and Effectiveness Data

- Planning for AMOP, Clean Gulf, GoMOSES, Interspill, etc.

Surveillance and Monitoring

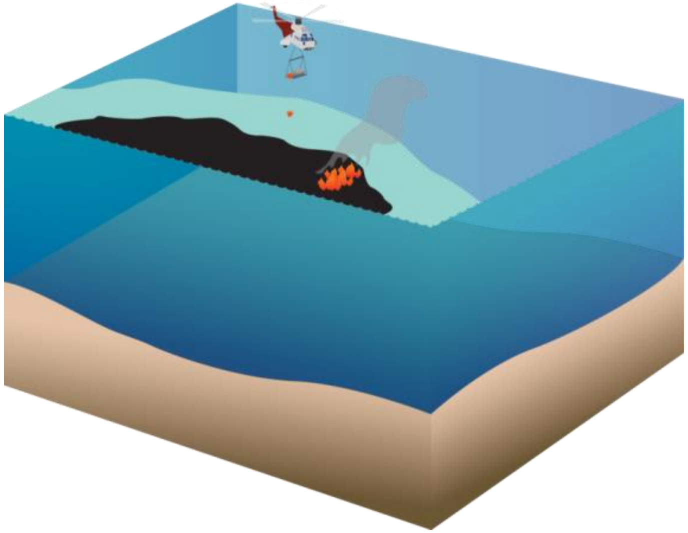
- New techniques are being considered

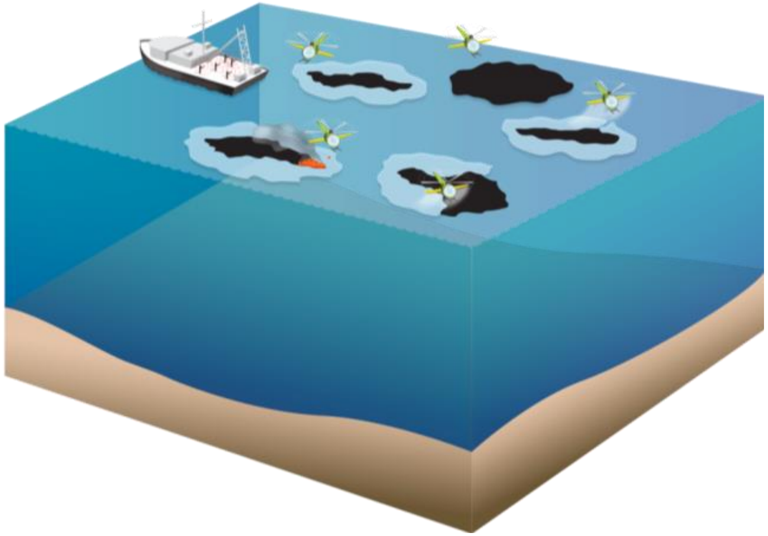


- A goal is to be able to target the thickest oil

Herding Agents / ISB

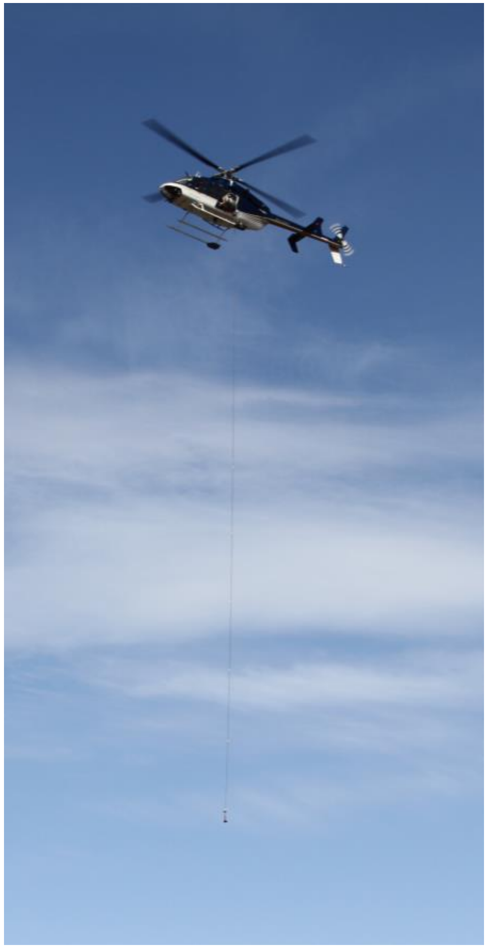
- Primary goal is to use a manned helicopter to both spray herder and ignite slick
- Secondary goal was to use a remote-controlled helicopter to perform same activities





Field Trial: 2016

Poker Flats, Alaska



Nuclear Magnetic Resonance

- Can discriminate between water/ice/oil

Responding to Publications

PNAS

Chemical dispersants can suppress the activity of natural oil-degrading microorganisms

Sara Kleindienst[a,1], Michael Seidel[e,2], Kai Ziervogel[b], Sharon Grim[c,3], Kathy Loftis[a,4], Sarah Harrison[a], Sairah Y. Malkin[a], Matthew J. Perkins[d], Jennifer Field[d], Mitchell L. Sogin[c], Thorsten Dittmar[e,f], Uta Passow[g], Patricia M. Medeiros[a], and Samantha B. Joye[a,5]

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Edited by William H. Schlesinger, Cary Institute of Ecosystem Studies, Millbrook, NY, and approved September 25, 2015 (received for review April 15, 2015)

During the *Deepwater Horizon* oil well blowout in the Gulf of Mexico, the application of 7 million liters of chemical dispersants aimed to stimulate microbial crude oil degradation by increasing the bioavailability of oil compounds. However, the effects of dispersants on oil biodegradation rates are debated. In laboratory experiments, we simulated environmental conditions comparable to the hydrocarbon-rich, 1,100 m deep plume that formed during the *Deepwater Horizon* discharge. The presence of dispersant significantly altered the microbial community composition through selection for potential dispersant-degrading *Colwellia*, which also bloomed in situ in Gulf deep waters during the discharge. In contrast, oil addition to deepwater samples in the absence of dispersant stimulated growth of natural hydrocarbon-degrading *Marinobacter*. In these deepwater microcosm experiments, dispersants did not enhance heterotrophic microbial activity or hydrocarbon oxidation rates. An experiment with surface seawater from an anthropogenically derived oil slick corroborated the deepwater microcosm results as inhibition of hydrocarbon turnover was observed in the presence of dispersants, suggesting that the microcosm findings are broadly applicable across marine habitats. Extrapolating this comprehensive dataset to real world scenarios questions whether dispersants stimulate microbial oil degradation in deep ocean waters and instead highlights that dispersants can exert a negative effect on microbial hydrocarbon degradation rates.

oceanography | microbial dynamics | hydrocarbon cycling | chemical dispersants | oil spills

Crude oil enters marine environments through geophysical processes at natural hydrocarbon seeps (1) at a global rate of ~700 million liters per year (2). In areas of natural hydrocarbon seepage, such as the Gulf of Mexico (hereafter, the Gulf), exposure of indigenous microbial communities to oil and gas fluxes can select for microbial populations that use petroleum-derived hydrocarbons as carbon and energy sources (3, 4). The uncontrolled deep-water oil well blowout that followed the explosion and sinking of the *Deepwater Horizon* (DWH) drilling rig in 2010 released about 750 million liters of oil into the Gulf. Seven million liters of chemical dispersants were applied (5) with the goal of dispersing hydrocarbons and stimulating oil biodegradation. A deep-water (1,000–1,300 m) plume, enriched in hydrocarbons (6–11) and dioctyl sodium sulfosuccinate (DOSS) (12, 13), a major component of chemical dispersants (14), formed early in the discharge (7). The chemistry of the hydrocarbon plume significantly altered the microbial community (11, 15–17), driving rapid enrichment of low-abundance bacterial taxa such as *Oceanospirillum*, *Cycloclasticus*, and *Colwellia* (18). The natural hydrocarbon degraders in Gulf waters were either in low abundance or absent in DWH deep-water plume samples (18).

Chemical dispersants emulsify surface oil slicks, reduce oil delivery to shorelines (19), and increase dissolved oil concentrations, which should make oil more bioavailable (20) and stimulate biodegradation (21). The efficacy of dispersants in stimulating oil biodegradation is debated (22) and negative environmental effects have been documented (23). Dispersant application often requires ecological tradeoffs (24). Surprisingly little is known about the impacts of dispersants on the activity and abundance of hydrocarbon-degrading microorganisms (25). This work addressed three key questions: (*i*) Do dispersants influence microbial community composition? (*ii*) Is the indigenous microbial community as effective at oil biodegradation as microbial populations following dispersant/dispersed oil exposure? (*iii*) Does chemically dispersed oil stimulate hydrocarbon biodegradation rates?

Laboratory experiments were used to unravel the effects of oil-only (supplied as a water-accommodated fraction, "WAF"), Corexit 9500 ("dispersant-only"), oil–Corexit 9500 mixture (chemically enhanced

Significance

Oil spills are a significant source of hydrocarbon inputs into the ocean. In response to oil spills, chemical dispersants are applied to the oil-contaminated seawater to disperse surface slicks into smaller droplets that are presumed to be more bioavailable to microorganisms. We provide evidence that chemical dispersants applied to either deep water or surface water from the Gulf of Mexico did not stimulate oil biodegradation. Direct measurement of alkane and aromatic hydrocarbon oxidation rates revealed either suppression or no stimulation of oil biodegradation in the presence of dispersants. However, dispersants affected microbial community composition and enriched bacterial populations with the ability to use dispersant-derived compounds as growth substrates, while oil-alone amendments enriched for natural hydrocarbon degraders.

Author contributions: S.K., S.H., S.Y.M., and S.B.J. designed research; S.K., M.S., K.Z., K.L., S.H., S.Y.M., M.J.P., J.F., and U.P. performed research; S.G., K.L., M.J.P., J.F., M.L.S., T.D., and P.M.M. contributed new reagents/analytic tools; S.K., M.S., K.Z., S.G., S.H., S.Y.M., M.J.P., J.F., M.L.S., T.D., U.P., P.M.M., and S.B.J. analyzed data; and S.K., M.L.S., P.M.M., and S.B.J. wrote the paper.

The authors declare no conflict of interest.

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Data deposition: 16S rRNA amplicon Illumina sequencing data were deposited in the GenBank database (BioProject accession no. PRJNA253405).

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PNAS Early Edition | 1 of 6

PNAS

LETTER

Oil dispersants do facilitate biodegradation of spilled oil

Roger C. Prince[a,1], Thomas S. Coolbaugh[b], and Thomas F. Parkerton[c]

PNAS

LETTER

REPLY TO PRINCE ET AL.:

Ability of chemical dispersants to reduce oil spill impacts remains unclear

Sara Kleindienst[a,1], Michael Seidel[a,2], Kai Ziervogel[b], Sharon Grim[c,3], Kathy Loftis[a,4], Sarah Harrison[a], Sairah Y. Malkin[a], Matthew J. Perkins[d], Jennifer Field[d], Mitchell L. Sogin[c], Thorsten Dittmar[e,f], Uta Passow[g], Patricia Medeiros[a], and Samantha B. Joye[a,5]

- Would rather discuss methodologies in advance

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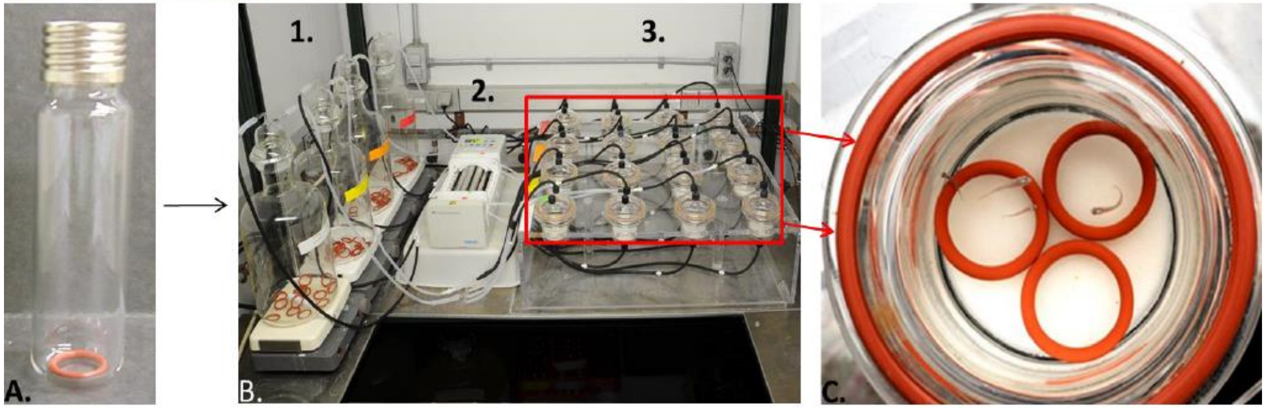
Provide information as often as possible

- For example, toxicity studies from ExxonMobil Biomedical Sciences, Inc (EMBSI)
  - Butler, JD, DJ Letinski TF Parkerton, AD Redman[a], KR Cooper (2016) Assessing Aromatic Hydrocarbon Toxicity to Fish Early Life Stages Using Passive Dosing Methods and Target Lipid / Chemical Activity Models, Submitted to *Environmental Sci. Technol*.
  - Bragin,GE, TF Parkerton, AD Redman, DJ Letinksi, JD. Butler, ML Paumen, CS Sutherland, TM. Knarr, M Comber, K den Haan (2016). Chronic Toxicity of Selected Polycyclic Aromatic Hydrocarbons to Algae and Crustaceans Using Passive Dosing, Accepted in *Environ. Chem & Toxicol.*
  - Redman, AD, TF Parkerton (2015). Guidance for improving comparability and relevance of oil toxicity tests, *Marine Pollution Bulletin* 98:156-170.

'igure 2. Experimental design of 30-day ELS test



- It's an ongoing effort – conferences, papers, workshops, one-on-one…