# Coordinating R&D on Oil Spill Response In the Wake of Deepwater Horizon

Workshop Report

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Coastal Response Research Center

National Oceanic and Atmospheric Administration

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## FORWARD

The Coastal Response Research Center, a partnership between the National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration (ORR) and the University of New Hampshire (UNH), develops new approaches to spill response and restoration through research and synthesis of information. The Center's mission requires it to serve as a hub for research, development, and technology transfer to the oil spill community. To better guide future spill response efforts, the Center and ORR co-hosted a workshop to identify research and development (R&D) needs in the wake of the Deepwater Horizon incident. The workshop participants were asked to focus on seven areas identified by the organizing committee as important topics: dispersant and dispersed oil effects, dispersant efficacy, detection of oil in the surface and subsurface, modeling of oil transport and fate, human linkages and spill response, seafood safety monitoring, and acquisition synthesis and data management.

The workshop was held in Baton Rouge, LA on March 22-24, 2011. This report provides a summary of discussions that occurred at the workshop, including a list of priority R&D needs. Participants represented a broad spectrum of expertise and affiliations including government, academia and industry. This report is designed to serve as a resource for responders and government entities, and to aid in the allocation of funding to improve the efficiency and efficacy of response to spills in the coastal environment.

We hope you learn from reading the report and exploring the topics. If you have any comments about it, please contact us. This effort is part of the Center's on-going activities to improve oil spill response and restoration in the aftermath of Deepwater Horizon and as plans to drill in the Arctic continue to advance. Keep updated on all of these activities at the Center's website (www.crrc.unh.edu).

Sincerely,

Nancy E. Kinner, Ph.D.
UNH Co-Director
Professor of Civil/Environmental Engineering

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## 1.0 INTRODUCTION

In the years prior to the Deepwater Horizon (DWH) oil spill, the Coastal Response Research Center (CRRC), a partnership between NOAA's Office of Response and Restoration and the University of New Hampshire, developed several plans that prioritized research and development (R&D) needs on a range of spill response topics including: dispersants, modeling, human dimensions (linkages), and acquisition synthesis and management of information. In response to these plans, many projects were completed by coordinating R&D funding among state, federal and private sector entities. The total amount of funding directed towards oil spill response R&D between 2000 and April 2010 was ~$60M including all federal, state and private sector entities.

During and immediately after the DWH oil spill, R&D projects were rapidly solicited and funded by several entities including the British Petroleum (BP) Gulf Research Initiative (GRI) and the $19M in RAPID grants funded by the National Science Foundation (NSF). GRI awarded a total of $50M to Gulf Coast universities and institutes and the National Institutes of Health for one year starting June 2010. On April 25, 2011, the GRI released a request for proposal (RFP) for an additional $150M through June 2013. Over a 10 year period, BP has pledged $500M to GRI. While GRI and NSF account for the vast majority of funding towards general oil spill research, there are other entities (e.g., U.S. EPA, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), and the private sector) that have either begun or are preparing to fund R&D projects in the aftermath of the DWH spill. For example, the Marine Well Containment Company funded by several oil industry partners is developing new well capping strategies. In addition, there have been several meetings convened and reports published by universities, government agencies, and the private sector that have identified R&D needs for response technologies and on the effects of the oil on ecosystem services. For example, the Joint Industry Oil Spill Preparedness and Response Task Force released a report[1] in September 2010 detailing, among other things, R&D needs for improving future oil spill response practices.

Oil spill response research funding has once again significantly increased, as it did in the years immediately following the *Exxon Valdez* spill, though, other than NSF, federal funding has been minimal. With this large increase in funding there is clearly the potential for overlap in research activities. It is also important to address how R&D needs have changed in the wake of the DWH spill and whether previous studies have addressed these needs. In addition, the newly funded R&D projects must provide relevant results that can be transferred into practice as soon as possible and to the wide range of spills that could occur. Often, the next major spill is very different from the one previous (e.g., *Exxon Valdez* vs. DWH).

In order to continue coordination between researchers and oil spill response practitioners, the CRRC convened a workshop titled "Coordinating R&D on Oil Spill Response in the Wake of Deepwater Horizon" in Baton Rouge, LA on March 22-24, 2011. This workshop brought together approximately 70 oil spill practitioners and researchers from the public and private sectors and academia to discuss R&D needs and projects. The workshop included focus groups convering:

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[1] http://www.ipaa.org/news/docs/Oil_Spill_Response_3_SEP_2010_V2.pdf

- Dispersant and Dispersed Oil Effects
- Dispersant Efficacy
- Detection of Oil In the Surface and Subsurface and Fate
- Modeling Oil Transport and Fate
- Human Linkages and Spill Response
- Seafood Safety Monitoring
- Acquisition Synthesis and Information Management

The goals of the workshop were to: (1) develop an updated list of R&D needs for these topics; and (2) create a dialogue between researchers and responders in order to ensure transfer of research results into practice. This meeting did NOT cover any natural resource damage assessment (NRDA) activities, response issues unique to the Arctic (oil-in-ice), or research focusing on the impacts of the DWH spill on the Gulf of Mexico.

## 2.0 WORKSHOP ORGANIZATION & STRUCTURE

The workshop was held at the Lod Cook Alumni Conference Center on the campus of Louisiana State University in Baton Rouge, LA. Participation was by invitation only and included representatives from state and federal agencies, academia, and the private sector. Seventy participants attended a mix of plenary and breakout sessions. An organizing committee (OC) assigned participants to breakout groups that represented their expertise with respect to oil spill response. The OC was comprised of representatives from the U.S. Coast Guard, NOAA, Dauphin Island Sea Laboratory (Alabama), Florida Institute of Oceanography, HARTE Institute, Mississippi-Alabama Sea Grant Consortium, Northern Gulf Institute and the private sector. The CRRC also consulted with representatives from Louisiana State University, BOEMRE, and U.S. EPA for assistance with compiling the invitee list. The breakout groups included a group leader who facilitated discussion and a note taker who captured relevant information. Every group was tasked to answer questions designed to focus the discussion around the two overarching tasks. These questions, along with the invitee list and the agenda, were developed by the CRRC in collaboration with the OC.

## 3.0 TOPIC REPORTS

This section includes a summary of each breakout group's discussion. There were three breakout sessions. The first focused on setting the stage whereby group members discussed the state-of-the-art oil spill response practices, the R&D needs prior to DWH and if these needs being addressed. Breakout Session 2 was a dialogue between responders and researchers. In addition, group members listed the new R&D needs that became evident during and/or after DWH, and discussed how the newly funded projects are addressing the needs. During the final breakout session, the groups synthesized and prioritized the information gained during the previous breakout sessions. Ultimately, each breakout group compiled a list of R&D needs to improve and inform oil spill response going forward. A list of prioritized (e.g., first, second, third) R&D needs to improve oil spill response for each topic is given in each summary below.

The summaries below include relevant discussion for all three breakout sessions for each topic. Note: Not all groups were facilitated and/or approached the breakout questions in the same manner and thus the format for presenting the results varies. Please refer to Appendix 3 for the notes taken during each breakout session.

### 3.1 Dispersant and Dispersed Oil Effects

The group concluded that the main goal of R&D under this topic should help inform response decision-makers on the trade-offs associated with using dispersants; this was the focus of much of their discussion. Group members included:

Julie Anderson, Louisiana State University
Victoria Broje, Shell
Tracy Collier, NOAA Northwest Fisheries Science Center
Christopher Green, Louisiana State University
Marc Greenberg, U.S. Environmental Protection Agency
Joseph Griffitt, University of Southern Mississippi
Charlie Henry, NOAA Office of Response and Restoration (Group Facilitator)
Susan Laramore, Florida Atlantic University
Andy Nyman, Louisiana State University
Roger Prince, ExxonMobil

The group developed an extensive list of the current state of knowledge on dispersants and dispersed oil effects (See Appendix 3 for complete list). The group noted that current knowledge on effects is typically limited to single species effects sometimes at atypical (non-real world) concentrations. Currently, laboratory tests of dispersant and dispersed oil effects focus on LC-50s; the group noted that in some situations, LC-50 results are not helpful to the incident command system (ICS). These studies also tend to analyze the impacts from certain components in dispersed oil (e.g., PAHs) and neglect other potentially harmful constituents.

The R&D needs for assessing effects from dispersants and dispersed oil prior to DWH mainly addressed improving experimental methods. The need to use standardized methods for assessing impacts that incorporate real world concentrations and conditions is key. Relevant species should be used in these tests and lifecycle analyses should be included. The long-term effects of dispersants and dispersed oil are poorly understood. The R&D needs for dispersant and dispersed oil effects post DWH did not change drastically from the needs prior to this spill. One of the major additions, however, is the need to develop protocols to perform a net environmental benefit analysis (NEBA) and ecological risk assessment (ERA) during a spill to inform decision-makers of the trade-offs associated with dispersants. These analyses should incorporate population level ecological models. The group recommended conducting a retrospective NEBA on the DWH spill, with respect to control and abatement strategies. The ultimate output of this analysis would be a quantification of benefits for the various strategies used during the response. The group identified three overarching R&D needs and categorized more detailed needs into several subtopics (in order of priority) based on water depths for dispersant applications: deepwater subsurface, non-deepwater subsurface, and surface application.

Overall:

1. Improve decision-making by developing protocols for NEBAs and ERAs, specifically tailored to dispersant and dispersed oil efficacy and effects.
2. Evaluate dispersant and dispersed oil chronic and sub-lethal effects on key species for varying, real world exposure scenarios and durations.
3. Develop appropriate chemical (analytical) methods for detecting and quantifying dispersant constituents in environmental samples to assess biodegradation and bioaccumulation.

Deepwater Subsurface Application:

1. Develop criteria for classifying physical, chemical and biological characteristics of dispersants and dispersed oil in deepwater.
2. Determine whether current surrogate species used to evaluate dispersant and dispersed oil toxicity are sufficient to evaluate risks in deepwater subsurface environment.
3. Develop test protocols (e.g., toxicity dose curves, biodegradation, exposure methods) for assessing the effects of dispersants and dispersed oil recognizing different exposure regimes in various mixing systems.
4. Determine optimal dispersant application rates (Note: This is an efficacy issue, however, it relates to test protocols for determining effects.)

Non-Deepwater Subsurface Application:

1. Evaluate existing toxicity data for use in ERAs.
2. Improve understanding of the efficiency of dispersion into the water column and plume transport dynamics to inform exposure and risk assumptions.

Surface Application:

1. Compile and summarize all existing data on the effectiveness of dispersion of surface oil, dispersant and dispersed oil toxicity, and biodegradation and bioaccumulation of dispersants and dispersed oil.
2. Develop appropriate measures of success for dispersant operations.
3. Improve environmental and public health risk communications related to dispersant and dispersed oil issues.

### 4.2 Dispersant Efficacy

It is important to better understand the conditions (e.g., sea conditions, physical and chemical characteristics of dispersed oil, dispersant physical and chemical characteristics, dispersant application methods and rates) under which dispersant use is most useful and beneficial. Dispersant efficacy group members included:

Arden Ahnell, British Petroleum
Thomas Coolbaugh, ExxonMobil (Group Facilitator)
Per Daling, SINTEF
Cheryl Hawkins, U.S. Environmental Protection Agency

Vijay John, Tulane University
Ken Lee, Fisheries and Oceans Canada
CDR Eric Miller, U.S. Coast Guard
Tim Nedwed, ExxonMobil
Austa Marie Parker, University of Colorado

The group briefly discussed that the state-of-the-art practices with respect to dispersant efficacy are captured in the 2005 National Research Council (NRC) report: Oil Spill Dispersants, Efficacy and Effects. They also noted that the CRRC 2006 workshop report, Research & Development Needs For Making Decisions Regarding Dispersing Oil[2], contains information on state-of-the-art practices. The bulk of knowledge from these two resources is on oil properties (e.g., viscosity, chemical properties, weathering, emulsification, dispersability, oil fingerprinting) and studies on dispersant effectiveness (e.g., lab scale, wave tanks, sea trials). Effectiveness is measured in these studies visually or via detection instruments. The group also noted that aerial and vessel dispersant delivery systems are well established.

Some of the R&D needs identified prior to the DWH oil spill for dispersant efficacy were to widen the range of oils for which dispersants are effective, improve test methods (e.g., tank studies, lab studies), and develop more efficient dispersants. Laboratory scale tests need to be improved and standardized methods should be developed. Wave tank studies are limited because they are a closed system; therefore sea trials should validate tank studies and improve understanding of dispersant performance.

The largest and most apparent R&D need with respect to dispersant efficacy to results from the response to DWH is the need for understanding and improving subsea application of dispersants. The group noted the need to optimize subsea delivery systems. They also discussed the formulation for dispersants to be applied in the subsea may require less solvent. Another question born out of DWH is how to optimize dispersant stockpiles for future response. The group reached consensus on four R&D needs for dispersant efficacy (shown below in order of priority). They concluded that past studies and knowledge gained during the DWH spill must be recognized and used to inform future efforts to improve dispersant efficacy for oil spill response.

1. Revise and update dispersant use operation guidelines based on fundamental science.
2. Review current knowledge and past R&D on surface dispersant use to determine if existing information is useful for evaluating dispersant efficacy in other environments (e.g., deepwater subsurface, Arctic).
3. Improve models predicting dispersability using information on the physiochemical properties of oil.
4. Conduct studies to elucidate the factors influencing droplet size distribution, especially in a deepwater release scenario.

The group also identified several other R&D needs of importance.

- Determine mixing energy requirements for various dispersants.

[2] http://www.crrc.unh.edu/dwg/dispersant_workshop_report_complete.pdf

- Develop standardized methodology and reference oils to replicate environmental metrics for comparative studies.
- Investigate deepwater fate and transport modeling for dispersants and dispersed oil at different temperatures and pressures.
- Determine how dispersed oil transport mechanisms relate to an oil's migration to the benthic environment.
- Evaluate the efficacy of dispersant alternatives (e.g., solvent-free formulations, alternate delivery mechanisms, subsurface application).
- Optimize dispersant-to-oil ratios (DOR) for various conditions, specifically for subsurface application.
- Determine the usefulness of Special Monitoring of Applied Response Technologies (SMART) protocols and alternative detection and monitoring platforms and technologies for detecting and tracking dispersants and dispersed oil.

### 3.3 Detection of Oil in the Surface and Subsurface

This group focused on methods and technologies for detecting oil in the marine environment. They determined five major R&D needs to improve spill response going forward. The group noted that the most important factor for detection of oil is the ability to rapidly detect it and inform responders of the location of large collections to optimize recovery efficiency and mitigate environmental damage. Group members included:

Paula Coble, University of South Florida
CDR James Elliot, U.S. Coast Guard
Dirk Greene, Marathon Oil
Kurt Hansen, U.S. Coast Guard (Group Facilitator)
Raymond Highsmith, University of Mississippi
Bill Lehr, NOAA Office of Response and Restoration
Ed Overton, Louisiana State University
Mitchell Roffer, Roffer's Ocean Fishing Forecasting Service, Inc.
Hunter Rowe, BP
Dana Wetzel, Mote Marine Laboratory

The group compiled a list of the state-of-the-art practices with respect to detecting oil:

<u>Surface Detection</u>:

- Sensors
    - Radar, synthetic aperture radar (SAR), side looking airborne radar (SLAR)
    - Infrared (IR), forward looking infrared (FLIR)
    - Visual observation, photography, video
    - Floating detection systems
    - Fluorometers
    - Light detection and ranging (LIDAR)
    - Multispectral

    - Sniffers Visual (e.g. cameras)
    - 
- Platforms
    - Vessels
    - Aircraft
    - Satellites
    - Remotely operated underwater vehicles (ROV)
    - Buoys

Subsurface Detection:

- Sensors
    - Vessel submerged oil recovery systems (VSORS)
    - Sentinels divers
    - ROVs
    - Side scan SONAR
    - LIDAR
    - Fluorometers
- Platforms
    - Vessels
    - ROVs
    - Trawl nets

Below Sediments:

- Sensors
    - Pits
    - Trenches
    - Sediment core samples
    - Dredging
- Platforms
    - Vessels

The R&D needs prior to DWH that were identified by the group were: mitigate false alarms; improve radar capabilities; further develop airborne and laser fluorometers and hyperspectral technology; integrate airborne and satellite detection methods; decrease time lag between collecting and receiving data; improve calibration of instruments; advance ground truthing practices; broaden access for spill responders to classified platforms and sensors; and investigate the efficiency of VSORS and SONAR. Many of these R&D needs are being addressed in various on-going studies. A list of these studies can be found in the group's notes in Appendix 3.

The detection group discussed many R&D needs that became apparent during the DWH spill. The entire list can be found in Appendix 3. The major needs are listed below in order of priority.

1. Improve methods for detecting thick oil (i.e., large collections of oil) to assist in recovery operations.

    a. Develop cost effective laser fluorometers and hyperspectral systems.
    b. Conduct collaborative studies with satellite, airborne, and *in situ* sampling.
    c. Develop easy to deploy sampling systems (e.g., Popeie Sampling Buoy ,deployed from aircraft).
    d. Develop methods to calibrate sensor response to changing oil characteristics (e.g., oil dispersant mix, false alarms).
    e. Investigate alternative sensor technologies for oil spill application (classified and unclassified technologies).
    f. Improve acoustic survey resolution and processing speeds.
2. Optimize rapid data fusion and sharing (i.e., rapid transfer of data from field to command post).
    a. Develop robust ways to automate the collection, interpretation, integration, and distribution of remote sensing data; including near real-time access and tactical information.
    b. Incorporate *in situ* data.
    c. Archive sensor data.
3. Investigate emerging technologies for 24 hour operations.
    a. Investigate sensors for response vessels (e.g., personnel requirements, safety issues, logistical issues).
    b. Develop improved night time sensor capabilities.
    c. Develop improved reduced visibility sensors.
    d. Develop geostationary platforms (e.g., drones, satellites) for repeated multi-spectral synoptic views.
4. Develop a robust optical detection method that can sufficiently determine locations of thick oil and eliminate false alarms (e.g., multi-channel fluorometers, particle analyzers, oxygen sensors) including retrievable and expendable sensors.
    a. Develop expendable airborne deployable probe packages
    b. Develop retrievable systems that can be deployed to full ocean depths
    c. Develop autonomous systems for surface and subsurface (e.g., wave gliders, Argo floats, gliders, AUVs, moorings)
    d. Identify new non-oil markers (e.g., radiological and biological/bacterial markers) to identify the presence of oil
5. Improve techniques for locating and sampling contaminated sediments, including both on shore and offshore
    a. Improve acoustic survey resolution and processing speeds
    b. Develop alternate sampling and detection methods that cover more area in a shorter time period for shoreline and deep sea sediments

### 3.4 Modeling Oil Transport and Fate

Spill response models provide trajectories relative to transport and fate to assist responders in predicting the location of oil. The group focused on research needs for improving trajectory models where output can be used by responders and decision-makers. Group members included:

Chris Barker, NOAA Office of Response and Restoration (Group Facilitator)

CJ Beegle-Krause, Research4D
Mike Carron, Gulf Research Initiative
Milton Halem, Louisiana State University
Haosheng Huang, Louisiana State University
Wolfgang Konkel, ExxonMobil
Amy MacFadyen, NOAA Office of Response and Restoration
Brendan O'Connor, University of South Florida
Kyeong Park, Dauphin Island Sea Laboratory
Louis Thibodeaux, Louisiana State University

The group discussed an existing list of state-of-the-art knowledge with respect to modeling oil spill transport and fate. This list can be found in the modeling group notes from the workshop. This list was divided into six categories:

- Transport
- Source
- Fate
- Effects
- Presentation/visualization
- Modeling response technologies

The state-of-the-art list was compiled during previous CRRC workshops and meetings. These forums, which convened prior to the DWH spill, included discussion on R&D needs. More information on these reports and meetings can be found on the Modeling Working Group site: http://www.crrc.unh.edu/mwg/index.html. There are gaps in knowledge within each category listed above, the R&D needs aim to address these gaps. As an example, the R&D needs for transport are: improve understanding of vertical plus horizontal diffusion, Langmuir circulation, and oil-sediment interactions. The list of R&D needs for each category is included in the group notes (Appendix 3). The group reviewed the list of pre-existing R&D needs and discussed whether these needs were still applicable and developed a revised list of needs incorporating modeling issues that arose during the DWH spill. The group identified many R&D needs, however, seven were seen as major priorities for future spill response.

1. Conduct studies investigating oil droplet size distribution from well heads under various conditions, including natural and chemical dispersion scenarios.
2. Optimize methods for stitching together small-scale and large-scale hydrodynamic models.
3. Improve ensemble modeling and adjoint techniques.
4. Perform observing system simulation experiments (OSSE) with the DWH data to inform future response models.
5. Improve oil weathering and fate information for models (e.g., solubilization, emulsification, biodegradation).
6. Determine methods for leveraging field observations:
    a. Improve methods for assimilating observational data (e.g., satellite information, social media, drifting buoys).
    b. Understand the connection between field observations and operational models.
    c. Improve visualization and command/control of the models.
7. Improve access to existing hydrodynamic models.

The remaining R&D needs were of equal priority:

- Improve understanding of hydrodynamics, including:
  - Flow in the continental slope.
  - Deep water.
  - Estuarine plume dynamics in inner shelf areas, both generally and site specific.
  - Exchange between the shelf and estuaries.
  - Open-mode analysis for post-processing circulation models to improve bathymetry.
- Develop improved climatological flow fields for remote locations.
- Develop protocol for interfacing (oil spill modeling framework and open framework).
- Conduct deep ocean seep research and use results to inform models.
- Improve Lagrangian coherent structures.
- Develop optimal oil spill model validation protocols.
- Investigate deepwater plume models (given lessons learned from DWH).

The following R&D needs are to improve modeling capabilities, but do not necessarily have to be conducted from a modeling perspective:

- Improve methods for measuring plume dynamics at the release point.
- Address the depth limitations of gliders.

Note: The above summary for the modeling group is focused on R&D needs. However, there was significant discussion on specific modeling projects being conducted on the DWH spill. While this discussion was important, it is not captured in this summary. Please review Appendix 3 for details.

### 3.5 Human Linkages and Spill Response

The human linkages group focused its discussion on: risk and crisis communication, incorporating social linkages into the spill response framework, developing rapid assessments of socio-economic impacts to inform response; and examining how policy and politics can influence response. The DWH spill response was often portrayed by the media and perceived by the public in a negative light. This was seen as one of the greatest flaws in the response. The group concluded that it is crucial to include methods for improving communication about spill response activities within the regulatory framework. The oil spill community must also ensure that societal impacts and perceptions are adequately incorporated into the decision-making components of the response process, without compromising response efficiency and safety. Group members included:

Loren Marks, Louisiana State University
M.E. Betsy Garrison, Louisiana State University
Ann Hayward Walker, SEA Associates
Bobby Hugh Fletcher, Louisiana State University
Doug Helton, NOAA Office of Response and Restoration
Steve Picou, University of South Alabama
Ben Posadas, Mississippi State University

LT Jeffrey Rubini, U.S. Coast Guard
Susan Shelnutt, Center for Toxicology and Environmental Health LLC
Steve Sempier, Mississippi Alabama Sea Grant Consortium (Group Facilitator)
LaDon Swann, Mississippi Alabama Sea Grant Consortium
Seth Tuler, Social and Environmental Research Institute
Jeffrey Wickliffe, Tulane University

The group discussed human linkages research conducted prior to the DWH spill. They noted that although research has been conducted, consideration of human linkages is not standard practice in spill response. For example incident command system (ICS) liaison officer positions are responsible for coordinating solely with agencies, not communities. However, over the past decade there has been some progress incorporating human linkages into spill response. For example, during the DWH spill Sea Grant agents from the Gulf states acted as liaisons between responders and the communities.

An extensive list of R&D needs with respect to human linkages within oil spill response was developed. The needs were categorized by topic: risk communications, value of natural resources, social impacts, subsistence and personal use of natural resources, coordination of response and restoration, environmental ethics, and human health. One of the largest deficiencies in the DWH spill response was risk communication. Explaining response decisions to the media and public is crucial to the success of the overall cleanup efforts. While natural resource damage assessment (NRDA) values the loss of natural resources, it does not necessarily consider socio-economic losses. Research should be conducted that investigates practices to incorporate socio-economic losses and social impacts into the spill response framework. Human health was another issue during the DWH spill. Future R&D should address methods for monitoring and surveying public health during potentially harmful spill events. Appendix 3 contains the notes and lists the needs within each of the aforementioned categories. When tasked to prioritize the R&D needs, the group reached consensus on four priority categories:

1. External communications:
    a. Identify perception of risk drivers and how perception translates into action with respect to community engagement, trust, and social media.
2. Investigate regulatory changes to enable the incident command to incorporate human linkages into response and recovery:
    a. Identify regulatory barriers and opportunities to include human linkage issues within the response management system (e.g., incident management, area contingency planning, liability and compensation approaches).
3. Determine methods for rapidly assessing impacts, vulnerability, and resiliency for social, health, and economic impacts on the community and at the family and individual level
4. Integrate human linkages with response and recovery:
    a. Evaluate mechanisms to incorporate local knowledge.

### 3.6 Seafood Safety Monitoring

Seafood safety monitoring is conducted during spill response to protect human health by preventing tainted seafood from reaching the market. Group members included:

Ellen Faurot-Daniels, California Fish & Game
Tracy Floyd, MS Department of Marine Resources
Susan Klasing, California Environmental Protection Agency
Gary Shigenaka, NOAA Office of Response and Restoration (Group Facilitator)
Gina Ylitalo, NOAA Northwest Fisheries Science Center

The state-of-the-art practices for monitoring seafood safety prior to the DWH spill were standardized U.S. EPA and Food and Drug Administration (FDA) risk assessment methods for analyzing polycyclic aromatic hydrocarbons (PAHs) in seafood, including sensory analysis methods. There were no established protocols or practices for analyzing dispersant constituents in seafood. The group identified R&D needs that existed prior to the DWH spill:

- Investigate human health effects from PAHs, including alkylated homologues.
- Gather baseline levels of PAHs and other oil related compounds.
- Investigate the bioavailability and human toxicity of dispersants.
- Develop and validate rapid, cost-effective analytical methods for monitoring PAH and dispersant compounds in seafood.
- Improve public risk communication regarding seafood safety.
- Develop an emergency response seafood sampling plan.

Some of the on-going DWH research related to seafood safety and oil spills addressed these needs. For instance, new rapid screening analytical methods for PAHs were developed, and more robust sampling protocols, and dispersant toxicity criteria and analytical methods were established. However, new R&D needs became apparent during and in the aftermath of the DWH spill. The group prioritized R&D needs for oil spill response into three categories: sampling and analysis; risk assessment; and risk communication. The group also highlighted risk communication as a key element for improving spill response.

Sampling and Analysis:

1. Evaluate and improve analytical and quality assurance methodologies for monitoring seafood safety with respect to oil components and dispersants.
    a. Rapid assessment techniques.
    b. Direct comparison of various analytical methods.
    c. Improved standard reference materials (SRM).
2. Fill background data gaps on levels of oil constituents and dispersant components in seafood.
3. Build response capacity through workshops, and maintain analytical equipment and expertise (the latter by agency contact lists and other reference documents).

Risk Assessment:

1. Conduct toxicity testing on alkylated PAHs and dispersant components.
    a. Investigate other possible constituents of concern.
2. Re-evaluate oil constituents and toxicity endpoints to address public concern.

3. Determine how different organisms metabolize dispersant components to inform sampling decisions.

Reporting and Communication:
1. Identify ways to simplify research findings and survey results on oil and dispersants to make it understandable to the public.
2. Survey the public through direct polling and focus groups to improve outreach.
3. Determine the best ways to communicate the difference between exposure to oil and dispersant components vs. seafood safety.

### 3.7 Acquisition Synthesis and Information Management

The acquisition synthesis and information management group focused on practices and methods for accessing and using remote-sensing data, real-time observational data systems, electronic data collection via field surveys, and geographical information systems (GIS) to improve oil spill response decision-making. Group members included:

Lynn Ford, Alabama Department of Environmental Management
David Gisclair, Louisiana Oil Spill Coordinators Office
Pierre Le Roux, Aerometric
John Murphy, Genwest
Eric Roby, NOAA National Coastal Data Development Center
Rost Parsons, NOAA National Coastal Data Development Center
Sam Walker, NOAA Integrated Ocean Observing System (Group Facilitator)

The state-of-the-art practices prior to the DWH spill, which contribute actionable information during a spill response were:

- Assembled geospatial database capability at local and regional level .
- Environmental Sensitivity Index (ESI) maps.
- National Environmental Satellite, Data, and Information Service (NESDIS) remote sensing acquisition and interpretation protocol.
- High Frequency Radar (HFR) data acquisition protocol.
- Data interoperability and exchange standards (e.g., web services).
- Subsurface observing capabilities (e.g., CTD, gliders, autonomous underwater vehicles).
- Reliable assembly point capability and capacity (e.g., secure FTP sites).
- Shoreline cleanup and assessment team (SCAT) data collection and transmission protocols.
- Common Operating Picture (COP) (e.g., Environmental Response Management Application®).
- Query Manager and SCRIBE for physical samples.
- Standardized data collection protocols (e.g., BOEMRE sampling protocols).
- Quality assurance/quality control (QA/QC) for data products (e.g., range checks).
- Spill trajectory mapping.

While the group identified numerous state-of-the-art procedures, they also acknowledged the R&D needs prior to the DWH spill, these included:

- Develop data interoperability and integration practices.
- Incorporate remotely sensed oil characterization products, including protocols and sensors.
- Define roles (acquisition teams and decision-makers) and training for information management.
- Improve field data transmission methods and communication.
- Integrate National Response Team (NRT) analysis in the decision-making realm.
- Improve advanced ocean observing capability/capacity.
- Maintain and refine existing capabilities (e.g., ESI, SCAT).
- Improve geospatial data management framework.
- Define the uses for distributed vs. centralized data systems in emergency response.
- Improve the calibration of sensors and integrated analysis.
- Integrate and adopt new information technologies within ICS.
- Develop protocols for data formatting and transmission to modeling teams.

Some of these R&D needs have been or are currently being addressed. Table 1 shows what entities are addressing the R&D needs.

Table 1: Acquisition synthesis and data management research and development needs prior to the DWH spill and current activities addressing needs. (No activity exists where fields are blank.)

| Research and Development Issue | Current Activities |
|---|---|
| Data interoperability and integration standards | Being actively addressed through federal and regional partnerships |
| Remotely sensed oil characterization products | Federal and private sectors are addressing this directly |
| Definition of roles and training for information management | |
| Field data transmission and communication | Being addressed for SCAT |
| Common Operating Picture and visualization tools | ERMA is being actively developed for regions. Industry is currently looking at this as well |
| Integration of Near Real Time analysis in the decision-making realm | |
| Advanced ocean observing capability/capacity | Being addressed, in distributed manner, in academic and private sectors |
| Maintain and refine existing capabilities (e.g., ESI, SCAT) | Being addressed, as resources permit, at state level |
| Geospatial data management framework | Being addressed at local/regional scales |

| | |
|---|---|
| Distributed vs. centralized data systems in emergency response realm | Being examined by industry and government |
| Calibration of sensors and integrated analysis | Being addressed, in distributed manner, in academic and private sectors |
| Integration and adoption of new information technologies within ICS | |
| Definition of requirements for field data formatting and transmission to modeling teams | |
| Managing and exploiting high-volume data streams in the national response team (NRT) (e.g., imagery, video, acoustics) | Being addressed through NSF's Ocean Observing Initiative on Cyberinfrastructure |
| Create a comprehensive risk assessment framework | |

Some of the R&D needs prior to DWH are still considered gaps and some new needs became apparent during the spill. The group identified and prioritized five major research and development areas to improve spill response moving forward.

1. Data Standards and Interoperability:
    a. Determine best practices to adopt standards for data collection.
    b. Determine best management of information practices, including QA/QC.
    c. Define requirements for field data formatting and transmission of data to (and from) modeling teams.
2. Oil Identification and Mapping:
    a. Calibration of sensors and integrated rapid analysis.
    b. Remote sensing-based characterization of oil thickness and form.
3. Incident Command System (ICS) Integration:
    a. Determine threshold for initiating an intelligence unit within the ICS framework.
    b. Define roles and training for information management within ICS.
4. Baseline Data and Information Needs:
    a. Create a spatially-enabled comprehensive risk assessment framework.
    b. Investigate advanced ocean observing systems capability and capacity.
5. Training and Awareness:
    a. Reconcile public/private responder awareness and understanding of ICS.
    b. Include information process training in scenario simulations.

**4.0 SYNTHESIS SESSION**

The final day of the workshop was devoted to synthesis and prioritization among all participants. A list of each groups' prioritized R&D needs (Appendix 4) was given to each participant to help facilitate this discussion. Two main questions were posed: (1) Are there any major R&D needs that were omitted or overlooked during the discussion in the previous two days? and (2) Are there any interdisciplinary R&D opportunities?

Participants discussed the need for relevant toxicity testing with oil and dispersant mixtures. These studies should evolve from single constituent testing and towards analyzing the effects from numerous dispersant and oil constituents in various mixtures, at environmentally relevant concentrations. There is also little known about the toxicity of alkyl-homologues and photo-oxidized products.

The group noted that there was a lack of expertise on ecosystem and biological modeling and therefore the modeling group's discussion may be incomplete. Similarly, there was no representation from the FDA in the Seafood Safety Monitoring group and this may have caused omissions in their recommendations. Detection of oil and dispersant constituents in air were not covered in this workshop, but these are major R&D issues in the wake of DWH and should be addressed in future efforts to coordinate research.

Many interdisciplinary or collaborative opportunities were identified that incorporated R&D needs across topics. Risk communication was repeatedly mentioned as an issue that should be addressed in conjunction with multiple research efforts (e.g., seafood safety monitoring, visualization of trajectory models, results of toxicity testing, decision-making regarding dispersants). Another major link exists between detection, dispersant efficacy and modeling. For example, the results from a study investigating droplet size distribution could potentially aid in improving detection methods, hydrodynamic models, and optimizing dispersant application rates and methods. In addition, rapid assessment of potential human impacts and vulnerabilities hinges on data standards and field data transmission and formatting. A full list of links between various R&D needs is included in Appendix 4.

## 5.0 CONCLUSION

While there are obvious links between many of the focus topics, some significant ones identified in the final plenary session were: seafood safety monitoring and human linkages; detection and dispersant efficacy; dispersant efficacy and dispersant effects; and detection, information management, and modeling. One of the major areas for improvement identified by those involved with the response to the DWH incident was risk communication and public perception surrounding response efforts. All groups identified risk communication as a major research area. The links mentioned above, especially the ones between human linkages and other topics, should be considered in future research. Improving the way scientific and engineering information is presented to the public should be a key research area moving forward.

This workshop will inform funding entities and researchers as to needs in order to improve oil spill response. While this workshop and its outcomes are not exhaustive, they provide a focused list of R&D needs that, when accomplished, will greatly advance oil spill response moving forward.

In addition, research results from studies addressing these needs must be translated into practice. There should be ongoing communication between responders and researchers to provide real world conditions and historical and background information. Encouragement for early and immediate academic involvement in response should come from within the regulatory framework. Researchers should attend practitioner conferences (e.g., International Oil Spill Conference (IOSC), Clean Gulf, Arctic and Marine Oilspill Program (AMOP) Technical Seminar) to better understand the spill response conditions.

## 6.0 ACKNOWLEDGEMENTS

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# Coordinating R&D on Oil Spill Response
## in the Wake of Deepwater Horizon

**Louisiana State University**
Lod Cook Alumni Conference Center
3838 W. Lakeshore Drive, Baton Rouge, LA
**March 22-24, 2011**

AGENDA—TUESDAY, MARCH 22

| | |
|---|---|
| 9:30 AM | **Registration/Check-In**<br>*Continental Breakfast (provided)* |
| 10:00 AM | **Welcome**<br>**Background and Workshop Goals & Outcomes**<br>Nancy Kinner, *UNH Co-Director, Coastal Response Research Center* |
| 10:30 AM | **Participant Introductions** |
| 10:50 AM | **Opening Remarks**<br>Tom Coolbaugh, *ExxonMobil*<br>Doug Helton, *NOAA Office of Response & Restoration*<br>Mike Carron, *Gulf Research Initiative*<br>Paul Bishop, *National Science Foundation* |
| 11:10 AM | **DWH Response Perspective**<br>Charlie Henry, *NOAA Office of Response & Restoration* |
| 12:00 PM | **Workshop Structure & Logistics**<br>Nancy Kinner |
| 12:20 PM | **Breakout Session I: Setting the Stage**<br>**Mini Topic Presentation**<br>Group A: Dispersant Effects<br>Group B: Dispersant Efficacy<br>Group C: Detection<br>Group D: Human Dimensions<br>Group E: Seafood Safety Modeling<br>Group F: Modeling<br>Group G: Acquisition, Synthesis & Management of Information |
| *1:00 PM* | *Working Lunch in Breakout Groups (provided)* |
| 3:15 PM | **Group Reports (5-10 minutes each)** |
| 4:30 PM | **Adjourn** |
| *6:00 PM* | *Dinner—Mike Anderson's (provided)* |

## Agenda—Wednesday, March 23

*8:00 AM* *Continental Breakfast (provided)*

8:30 AM **Overview and Review**
Nancy Kinner

8:45 AM **Sea Grant Database**
Steve Sempier, *Mississippi-Alabama Sea Grant Consortium*

*9:00 AM* *Break*

9:15 AM **Breakout Session II: Dialogue Between Responders and Researchers**
Report to assigned group

*12:00 PM* *Lunch (provided)*

12:45 PM **Breakout Session III: Synthesis and Summary**

3:15 PM **Group Reports**

4:30 PM **Adjourn**

*Dinner (on your own)*

## Agenda—Thursday, March 24

*8:30 AM* *Continental Breakfast (provided)*

9:00 AM **Plenary Session IV: Synthesis and Next Steps**

11:00 AM **Closing Remarks**

*11:30 AM* *Lunch (to go)*

**Group A: Dispersant and Dispersed Oil Effects**
**Notes**

Breakout Session I: Tuesday afternoon, 3/22

1) What were the state-of-the-art oil spill response practices with respect to dispersants and dispersed oil, prior to the Deepwater Horizon (DWH)?

-application of dispersants (hose, fire monitor, spray boom, aircraft): applying to surface.
    -Operations and monitoring
    -knowledge and database: databases used by contingency planning groups
    -R&D and testing:-testing of dispersed oil: lab research conducted
        -static vs spiked
        -specific effects on singular species with no real world concentrations
        -define what actue is
        -combination effects of dispersed oil
    -In the DWH subsurface application was applied
    -Even back when there was an agreement for a decision on dispersant use shall be made through net environmental benefit analysis (environmental risk assessment workshops)
-consensus prior was net environmental impact
-standard testing mechanisms are more applicable across the board
-we can forever be trying to perfect: need scientific consensus on dispersed oil and dispersed oil related questions that industry, gov, etc can get past and come up with a suite of tests for environmental assessment
    -comparable data
-Attempting to differentiate problems with each dispersant- more for marketing than scientific advancement.
    -don't focus on making a better dispersant, it has to be on a pre-approved list
    -misleading: haven't focused on the important questions relating to dispersants
-testing mechanisms: organisms, bioassays, exposure time (from field data)
-new questions identified about protocols that weren't appropriately addressed (offshore, marine, high mixing rates)
    -96hr rate is not adequate
    -bracketing toxicity tests
    -dilution factors
-DWH wasted days discussing dispersants and differences when the oil was the primary toxin of concern.
    -tradeoff issues
-quantification of trade-offs: how do you put it in perspective?
    - increase bioavailability with dispersant use, decrease long-term risks
-We can't quantify a greater input of oil in water column vs letting oil coming onshore. It's based on assumptions. Not quantitative.
-How do we truly assess impact of dispersed oil, is it greater than naturally dispersed oil?
-focus on benefit of dispersion
**-scientific tests focused on LC-50s – not helpful in ICS**
**-Field measurements vs lab**

-Most toxicity data was lab based, limited field testing. Some uncontrolled from spill of opportunities, or from very old data.
-relative toxicity between species
-effort for in-situ tox testing during DWH?? –API and TGLO put together on purpose spills and spill of opportunities in estuarine and near shore spills, but it wasn't passed except for with spills of opportunities.
-Labs do not mirror natural environment
**-blanket assumption that dispersed oil was biodegraded sooner than non dispersed**
-Data is helpful for responders- difficult to meet qualification standards for specific tests
    -useful to have some data (e.g., specific concentration will Not harm a species)
-Be as representative as possible
    -isolates out all of the variability in the world
-mechanisms to provide parallel testing
-Need to stop arguing over who's tox data is better
-need methods developed for detection in tissue
-EAP had process to have it on the list for efficacy and tox testing, but did they provide realistic information for decision making? Nope.
-alaska exp- most PAH concentrations from smoked salmon. Judgment call, perspective
-underlying issues as scientists, we can't get too far down underlying issues (save for human dimensions)
-what we know and don't know to determine the path forward
-science then translate into risk communication
-Transparency incorporated into R&D. Public for researchers.
-comparing physically and chemically dispersed oil in all senses, environmental
    -chemically dispersed in sea vs slick in a marsh
    -chemically dispersed oil LC-50s on individual species and compare physically dispersed oil or oil in a marsh

2) What were the research and development needs prior to DWH?
-lacking- synthesis of knowledge as opposed to future needs
-status of protocols
-Didn't know what was in dispersants, didn't have methods for detecting it in seafood samples
-tox levels of concern were huge
- need tracers- have to detect if it is in seafood before they can say it's okay for consumption
    -need method to detect
-seafood safety- driven by public perception
    -protect marketability of product; need testing
-more available data, research, methods
-consolidation of results, methods
-Outside individuals having access to the consensus and central information
    -more systematic
-Lab work where we hold things constant. Can't take one study and use it as a surrogate for the whole
-Variability in the real world
-Not down to the level of precise half-lives
-need information relative for the FOSC

-cloud of uncertainty- need minimum regret. General understanding, continue to collect information then adapt it to new information

-need to admit upfront that we adaptively manage spill response- it's the nature of the response business

-real life levels, highs and lows, actual levels, what type of oil to use
-lab experiments and mesocosm
-always control the environment we're working with in the lab-set up experiment with three different dispersants, test efficacy and/or toxicity. In real world there is more variability factored into it. Keep data in context relative to decision making
-weathered oil
-difficulties with getting oil
-disconnect between industry, government, and university researchers
-Difficult to get oil samples
-field experiments need to recognize actual concentrations in the environment

-concentrations are hard to analyze

-don't extrapolate from things that will never happen in the real world
-Range finder- pilot study. Environmentally relevant study.
-State assumptions in studies
-lifecycle analysis
-design tox tests for emerging factors (e.g., high pressure, low temp)
-representative species

-pick standard set of organisms, set guidelines and fill in data gaps

-you can write up criteria, but technology changes over time

3) How are/were these needs being addressed before or in the wake of DWH?
-challenge- do the experiments

-not homogeneous. Oil not soluble –can't isolate parts of it.
-all microbiology done on soluble hydrocarbons
-data is extrapolated into field spills

-Need that enough reference material (e.g., oils) is available

-EPA did it after Exxon valdez oil spill

-differences between chemically and physically dispersed oil
-Compare one species and the toxicity of oil, dispersant, and dispersed oil to the potential risk of oil on marshes

-lethal and sub-lethal effects

-Model used for making decisions and what science needs to be incorporated to meet questions
-What does science in the future: science developed to answer questions in that model.
-have we always asked the right questions in making trade-off decisions?
-- Need more standardized testing to move toward bigger issues (e.g., NEBA, ecological)

Notes:
-dispersed oil in terminology not just dispersants; the objective is to have the dispersants come into contact with the oil. Thus, the toxicity of dispersed oil is what the focus should be.

Previous research and development needs
-Table 4: 1a. interaction of dispersed oil droplets- ken lee is researching this

-Valid scientific question- delves into near shore effects.
1b. been done
1c. better modeling -valid
1d. quantification of deg kinetics
1e. more of a transport and modeling, but still valid

Table 5 2a.
2b. how do we do it?
2c. valid, improved. Peer reviewed and non peer reviewed literature
2d. species different in near shore, review existing research- has been progress. Note: standard methods may not be appropriate word

**Breakout Session II**: Wednesday morning, March 23

*Dialogue Between Responders and Researchers*

Researchers will have the opportunity to discuss (or provide brief presentation) their projects. Questions are welcome and discussion between responders and researchers will ensue.

1) What are the new R&D needs that have become evident during, or in the aftermath of, DWH?

A) Net environmental benefit analysis (NEBA) and ecological risk assessment (ERA) is the key process for future decision making
    a. Tradeoff analysis: non-action being compared to dispersion (physical dispersion, chemical dispersion, stranded oil, sensitive habitat)
    b. Incorporation of population level ecological models
B) Conduct retrospective net environmental benefit analysis on DWH spill with respect to control and abatement strategies (e.g., quantification of benefits)
C) Evaluate effects of chronic and sub-lethal effects (*e.g.,* reproduction, growth, survival) for varying exposure scenarios and durations
    a. Conduct chemical analysis and characterization of exposure matrix to define the dose and relate the chemical analysis to the toxicity
D) Need chemical methods for detection and quantification of dispersant constituents in environmental samples to assess biodegradation and bioaccumulation

**Subsurface/Deep water**

A) Are the current surrogate species used to evaluate dispersant and dispersed oil toxicity sufficient to evaluate risk at the subsurface?
    - Ecological and incremental effects of naturally dispersed oil versus chemically dispersed oil
B) Need to develop criteria for classification of deep water
    - Substantial stratification
C) Develop test protocols recognizing different exposure regimes in various mixed systems

        - Toxicity
            - Shape of the dose curve
        - Biodegradation
        - Exposure methods
            - Efficiency and concentration data to assess proper exposure duration and concentration
            - Need to develop dispersed oil transport, fate and behavior, and particle size models
        - Validation/test performance of data analysis
    D) Use existing experience of NEBA and ERAs to include discussion about subsea dispersant injection (this is an objective)
    E) Optimal dispersant application rates

**Subsurface dispersant use/ non-deep water**

A) Improved understanding of efficiency of dispersion and plume transport dynamics will inform exposure assumptions for risk assumptions
    a. In the water column
    b. After residual oil spreads on the surface and potential dispersion

B) Evaluate existing toxicity data through ecological risk assessment

**Surface**

A) Need to summarize and make available existing data on the effectiveness of dispersion of surface oil and the toxicity, biodegradation and bioaccumulation of dispersants and dispersed oil (physically and chemically dispersed)
    a. Expert panel for critical review of data and publications
    b. Criteria and review for assembled database and available information
    c. Usable, searchable, peer reviewed database

B) Develop measures of successful dispersant operations (required for NEBA and ERA analysis)

C) Human health and risk communication (a major assessment is being conducted by NIH at present)

D) Potential for bioaccumulation of constituents associated with dispersants

2) How does the current research fill in, or address these issues?

- How will the results from oil spill research affect oil spill response practices? (i.e. How will the findings be put into practice?)
    A) Need more interaction with a larger group of specialists to do comprehensive review of ongoing research (*e.g.*, BP, API, EPA, NOAA, CG, academia)
- Are there potential responder-researcher partnerships that could benefit both parties? (i.e. Can responders act as project liaisons to aid in practicality?)
    A) NEBA needs to be widely distributed in response and research community
    B) Enhance researchers interactions (*e.g.*, ICOPAR, NRT, RRT)

**Breakout Session III**: Wednesday afternoon, March 23

*Synthesis and Summary*

**1)** What are the revised R&D needs incorporating the pre DWH and post DWH needs list?

A) See above

**2)** Prioritize the major gaps: which R&D needs should or have to be addressed first, second, etc.?

1) What are the new R&D needs that have become evident during, or in the aftermath of, DWH?

Note: All of the following are **high priority**, but based on group consensus this was the prioritization

A) Net environmental benefit analysis (NEBA) and ecological risk assessment (ERA) is the key process for future decision making. **Priority 1**
   a. Conduct retrospective net environmental benefit analysis on DWH spill with respect to control and abatement strategies (e.g., quantification of benefits)
   b. Tradeoff analysis: non-action being compared to dispersion (physical dispersion, chemical dispersion, stranded oil, sensitive habitat)
   c. Incorporation of population level ecological models
B) Evaluate effects of chronic and sub-lethal effects (*e.g.,* reproduction, growth, survival) for varying exposure scenarios and durations **Priority 2**
   a. Conduct chemical analysis and characterization of exposure matrix to define the dose and relate the chemical analysis to the toxicity
C) Need chemical methods for detection and quantification of dispersant constituents in environmental samples to assess biodegradation and bioaccumulation **Priority 3**

**Subsurface/Deep water Priority 1**

A) Need to develop criteria for classification of deep water **Priority 1**
   - Substantial stratification
B) Are the current surrogate species used to evaluate dispersant and dispersed oil toxicity sufficient to evaluate risk at the subsurface? **Priority 2**
   - Ecological and incremental effects of naturally dispersed oil versus chemically dispersed oil
C) Develop test protocols recognizing different exposure regimes in various mixed systems **Priority 3**
   - Toxicity
     - Shape of the dose curve
   - Biodegradation
   - Exposure methods
     - Efficiency and concentration data to assess proper exposure duration and concentration
     - Need to develop dispersed oil transport, fate and behavior, and particle size models
   - Validation/test performance of data analysis

D) Optimal dispersant application rates (efficacy issue that relates to test methods) **Priority 4**

**Subsurface dispersant use/ non-deep water Priority 2**

**Both A and B are equal**

A) Evaluate existing toxicity data through ecological risk assessment **Priority 1.5**
B) Improved understanding of efficiency of dispersion and plume transport dynamics will inform exposure assumptions for risk assumptions **Priority 1.5**
    a. In the water column
    b. After residual oil spreads on the surface and potential dispersion

**Surface Priority 3**

A) Need to summarize and make available existing data on the effectiveness of dispersion of surface oil and the toxicity, biodegradation and bioaccumulation of dispersants and dispersed oil (physically and chemically dispersed) **Priority 1**
    a. Expert panel for critical review of data and publications
    b. Criteria and review for assembled database and available information
    c. Usable, searchable, peer reviewed database
B) Develop measures of successful dispersant operations (required for NEBA and ERA analysis) **Priority 2**
C) Human health and risk communication (a major assessment is being conducted by NIH at present) **Priority 3**

**3)** What are additional future studies and collaborations that can fill these gaps, not identified above?

A) In-situ exposure tests

**Group A: Dispersant and Dispersed Oil Effects**

**Overall**

1. Net environmental benefit analysis (NEBA) and ecological risk assessment (ERA)
2. Evaluate effects of chronic and sub-lethal effects for varying exposure scenarios and durations
3. Need chemical methods for detection and quantification of dispersant constituents in environmental samples to assess biodegradation and bioaccumulation

**Subsurface**

1. Need to develop criteria for classification of deep water
2. Are the current surrogate species used to evaluate dispersant and dispersed oil toxicity sufficient to evaluate risk at the subsurface?
3. Develop test protocols recognizing different exposure regimes in various mixed systems
4. Optimal dispersant application rates (efficacy issue that relates to test methods)

**Subsurface (non deepwater)**

1. Evaluate existing toxicity data through ecological risk assessment
2. Improved understanding of efficiency of dispersion and plume transport dynamics will inform exposure assumptions for risk assumptions

**Surface**

1. Need to summarize and make available existing data on the effectiveness of dispersion of surface oil and the toxicity, biodegradation and bioaccumulation of dispersants and dispersed oil
2. Develop measures of successful dispersant operations (required for NEBA and ERA analysis)
3. Human health and risk communication

**Group B: Dispersant Efficacy**

1. Fundamental science to support the development or revisions of operational guidelines for dispersant use
2. Extrapolation of current knowledge and past efforts around surface use of dispersants to other environments such as deep water and arctic, where applicable
3. Correlation of oil and dispersant physicochemical properties with dispersion efficacy
4. Dispersant application optimization

**Group C: Detection**

1. Where is the thick surface and subsurface oil (oil and dispersed oil)?
2. Rapid Data Fusion
3. New Technologies for 24 hr operations
4. Robust optical package to handle surface and subsurface plume identification and false alarms (e.g. multi-channel flourometers, particle analyzers, oxygen sensors, etc.)
5. Better techniques for locating and sampling contaminated sediments

**Group D: Modeling**

1. Droplet size distributions from well heads
2. Stitching together (not nesting) small scale and large scale hydrodynamic models
3. Ensemble modeling and adjoint techniques
4. Can you use observations from DWH to develop observational program for the future?
5. Oil weathering and fate (models): solubilization, emulsification, biodegradation
6. Leveraging and assimilating field observations
7. Easier access to existing hydrodynamic models (people are working on this)

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| **Group E: Human Dimensions/Linkages**<br>1. External communications (12 research topics)<br>    a. Risk perception (identify drivers and how perception translate into action w/r/t community engagement, trust, social media)<br>2. Regulatory changes to enable incident command to incorporate human dimensions into response and recovery (9 research topics)<br>    a. What are the regulatory barriers and opportunities for including human dimensions within the response management system; specific areas of interest include incident management, area contingency planning, liability and compensation approaches<br>3. Assessing human impacts, vulnerabilities, and resiliency (6 research topics)<br>    a. Rapid vulnerability assessment techniques (social, health, economic; community and family/individual)<br>4. Integrating human dimensions w/ response and recovery (15 research topics)<br>    a. Evaluate effective mechanisms to incorporate local knowledge | **Group F: Seafood Safety Monitoring**<br>**Sampling and Analysis**<br>1. Evaluation and improvement of analytical methodologies and quality assurance for oil components and dispersants, including rapid assessment techniques, direct comparison of various analytical methods, and improved SRMs<br>2. Fill background data gaps with regard to levels of oil constituents and dispersant components in seafood<br>3. Build response capacity through workshops, maintenance of analytical equipment and expertise, agency contact lists, and other reference documents<br><br>**Risk Assessment**<br>1. Toxicity testing of alkylated PAHs and dispersant components (are there other constituents of concern or critical effects?)<br>2. To address public concerns, re-evaluate oil constituents and toxicity endpoints<br>3. Determine how different taxa metabolize dispersant components to inform sampling decisions<br><br>**Reporting and Communication**<br>1. Simplify research findings and survey results on oil and dispersants to make it understandable for the public<br>2. Survey the public through direct polling and focus groups to improve outreach materials, press releases, etc.<br>3. Communicate the difference between exposure to oil and dispersant components vs. seafood safety |
| **Group G: Data Management**<br>(1) Data Standards and Interoperability:<br>• Research best practices and develop/adopt standards<br>• Definition of requirements for field formatting/transmission to modeling teams<br>(2) Oil Identification and Mapping:<br>• Calibration of sensors and integrated rapid analysis<br>• Remote sensing based characterization of thickness and form<br>(3) ICS Integration:<br>• Determine threshold for initiating an intelligence/information Section/Unit<br>• Definition of roles and training for information management (a la carte)<br>(4) Baseline Data/Information Needs:<br>• Create a spatially-enabled comprehensive risk assessment framework<br>• Advanced ocean observing capability and capacity<br>(5) Training and Awareness:<br>• Reconciling public/private responder awareness and understanding of ICS<br>• Include information process training in scenario simulations | |

Summary of Day 3 Synthesis and Prioritization Session Discussion

Day 3: Synthesis and Prioritization

1. Have we missed any major R&D needs?

- Group A:
  - Bullet number 3 – need research to identify chemical constituents in oil and dispersed oil responsible for toxicity
    - Not single constituent testing, but testing with mixtures
    - Need chemical and toxicity testing together on entire mixture components
    - Use state-of-the-art technologies
    - Need to know toxicology information on alkyl-homologues and photo-oxidated products
- Group B:
  - Augment main bullets with sub-bullets from presentation
- Group C:
  - Data fusion is rapid collection, interpretation, processing, and distribution
  - Goal is to get the responder and response equipment to the oil
  - Low-tech methods such as social media and human observations
- Group D:
  - Ecosystem or biological modeling
    - No represented expertise
  - Validation and evaluation of oil spill forecast
  - Emergence of new information technologies (social media) and how they can aid models
- Group F:
  - No representation from FDA or sensory assessment
- Group G:
  - Under category 1, first bullet, we also have to look at best management practices to manage information
- Response techniques influence of topic areas
  - Air modeling for human health and safety and response options (e.g., dispersants, in-situ burning)

**a. Have we missed interdisciplinary R&D opportunities?**

- Net environmental benefit analysis (NEBA) for research topics
- Encourage early/immediate academic involvement in response
  - Research must be in regulatory framework of response for it to be successful
- Metabolic or immune system markers used for detection
- Human dimensions and seafood safety monitoring

    - Improve reporting and communication of data and information (e.g. seafood “sniff” tests)
- Studies to understand dilution of surface and sub-surface oil and realistic concentrations for biodegradation
- How do we take information from lab-based toxicity testing and translate them into fishery or ecosystem impacts?
- Link between data management and human dimensions
    - How do we manage data to make decisions?
    - How do we assimilate data in Geoplatform and ERMA to make it available to public?
    - Various stakeholders beside public
    - Focus on communication to appropriate individuals (e.g. media and decision-makers)
- Link between E3 and G4
    - Human terrain analysis – defense intelligence
- Link between C2 and G2, B3, B4, D2, G1
- Link between C3 and E4, B4
- Link between C4 and Modeling, Dispersant efficacy groups and B4, B1, D1, D6
- Linking group F and E to improve risk communication to public
- Regulatory link for human dimensions (already in group G)
- Explore different types of engagement
    - Use of time visualization and animation for public
- Risk communication between modeling and human dimensions
    - Visualization of risk
- Lack of two-way information flow
    - Tools to provide consolidated communication within responders, etc.
- Linking F1 under risk assessment to dispersant effects
- Link between social sciences and all applied research
    - How will they be used as decision-making tools?
- Link between human dimensions, seafood safety, and toxicology
    - How do you approach that issue?
- Public awareness of decision-making processes
- Link between F1 under reporting and communication and G4
- Link NEBA and research
- Instrumentation (e.g. fluorometers) linkages between agencies and academic community
- ITOPF and US response community (e.g. computer modeling) look at ITOPF research priorities and visa versa