Deepwater Horizon Oil Spill

Nancy E. Kinner
Coastal Response Research Center
University of New Hampshire

Southwest Florida Chapter
UNH Alumni Association
February 25, 2012

Coastal Response Research Center (CRRC)

- NOAA's Office of Response and Restoration (ORR)/UNH Spill Partnership in 2004
  - NOAA = National Oceanic & Atmospheric Administration
- THERE WILL BE ANOTHER MAJOR SPILL IN U.S.
- Many Research Needs Exist Regarding Spill Response, Recovery and Restoration
- Expertise to Call Upon During a Spill
  - Independent voice
  - Honest broker

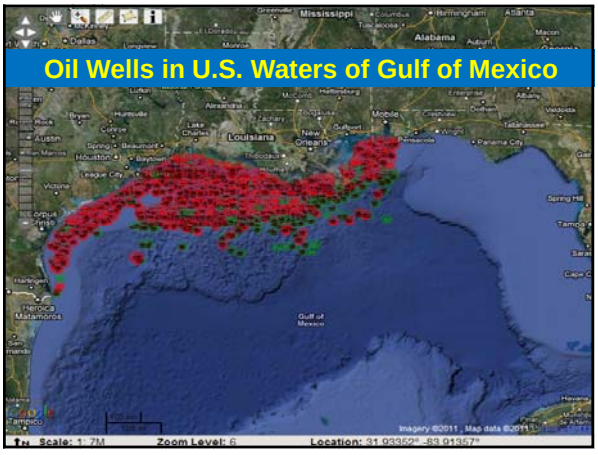
Why UNH?

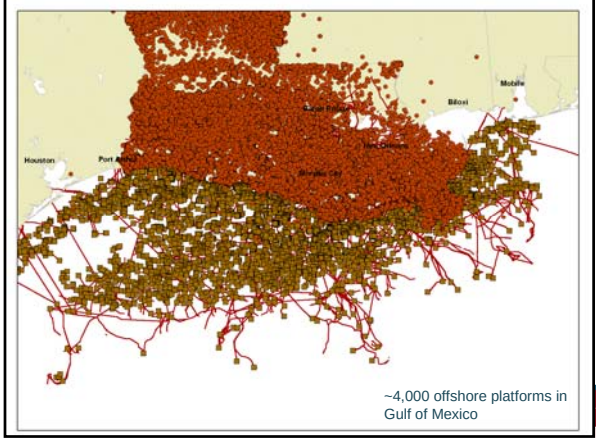
- Marine Science & Environmental Engineering Strengths
  - UNH ranked nationally in both areas
- No Oil = No Oil Politics
- Senator Gregg
  - NOAA Appropriations
    - Center for Coastal and Ocean Mapping
    - Cooperative Institute on Coastal and Estuarine Environmental Technologies
    - Center for Ocean Observing and Analysis
    - Coastal Response Research Center

CRRC Mission

- Conduct and Oversee Basic and Applied Research and Outreach on Spill Response and Restoration
- Transform Research Results into Practice
- Serve as Hub for Oil Spill R&D
- Educate/Train Students Who will Pursue Careers in Spill Response and Restoration

Deepwater Horizon Oil Spill





~4,000 offshore platforms in Gulf of Mexico

Crude Oil Production in U.S.

- Total: 79.8 billion gallons/yr (2009)
- Gulf of Mexico (GOM) produces 23.9 billion gallons/yr (30% of total domestic crude)

Crude Oil Imports into the U.S.

- Total: 10.4 million barrels/day = 159 billion Gallons/Yr (2010)
- Imports Through Louisiana Offshore Oil Port (LOOP) Facility
  - Handles 13% of imported oil = 20.7 billion gallons/yr

Deepwater Horizon Rig

- 33,000 Ton Drilling Rig on Pontoons
  - Built 2001 for $350M
- Derrick = 20 stories above top deck
- Held in position using GPS thrusters
- Crew = 126
- Owner: Transocean

Mississippi Canyon Block 252 (Macondo Site)

- BP Lease Site (MC252)
  - Cost = $34M
- Transocean's Marianas rig started drilling in October 2009
  - Damaged in Hurricane Ida
    - November 9, 2009
  - Drill pipe 5,000 ft of water + 4,000 seabed (9,000 ft total)

Macondo Site Drilling History

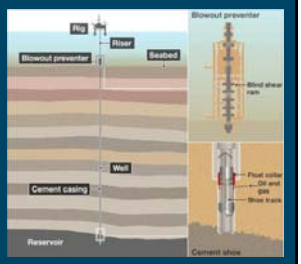
- ~ 9,000 ft more to drill to gas and oil reservoir (~ 18,000 ft total)
- DWH arrives at Macondo site Jan 31, 2010 and starts putting down pipe
  - Estimated cost = $1M /day fee
- BP and partners budgeted 51 days and $96.2M for this well

DWH Well Blowout

- Occurred on April 20, 2010
- DWH Rig had drilled into oil/gas reservoir
- 6 weeks behind schedule and $58M over budget

DWH Well Blowout

- Put in Temporary Cement Plug – 3,000ft Below Top of Well
- Positive Pressure Test
  - Check casing and seals intact
- Negative Pressure Test
  - No fluids should leak into well



DWH Well Blowout (cont'd)

- Positive Pressure Test – Acceptable Results
- Negative Pressure Test
  - Began 5 pm, April 20
  - Pressure repeatedly increased – fluids leaking in?
  - Decided to try again using "kill line" on blowout preventer (BOP)
    - Results ok no pressure increase
    - Likely kill line was not working properly (clogged)
  - Decision – OK to open BOP and replace heavy drilling mud in drill pipe with seawater

DWH Well Blowout (cont'd)

- 9:15 pm Begin Adding Seawater into Bottom of Well (Annulus)
- ~ 9:40 pm Hissing and High-Frequency Vibration
- Then Mud Shooting Out of Gas Buster on Rig
- Then Explosion
- All Saved Except 11 Killed in Explosion

DWH Well Blowout (cont'd)

- 1:30 am (April 21) DWH Rig Listing; Secondary Explosions & Fire
- 2:50 am (April 21) Rig Spins 180°; GPS Dynamic Positioning Dead
  - DWH moved 1600 ft from well
- 3:15 am DWH Listing Heavily, Fire Continues & Fire Boats Spraying Water on Rig
- 1:27 am April 22 DWH Sank Along with 5,000 ft pipe

Overview of DWH Spill

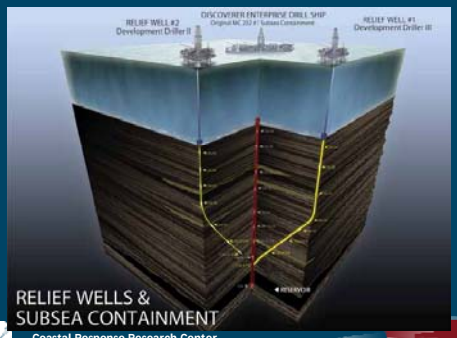
- 87 Days of Continuous Release of Oil and Gas
- Numerous Attempts to Stop Flow
  - No spill response plan for large blowout
- July 15 – Well Killed from Top Ending Release
- Bottom Kill Sept 19, 2010
- Total Oil Release (est.) = 200 Million Gallons
- Biggest Accidental Oil Spill in Recorded History!

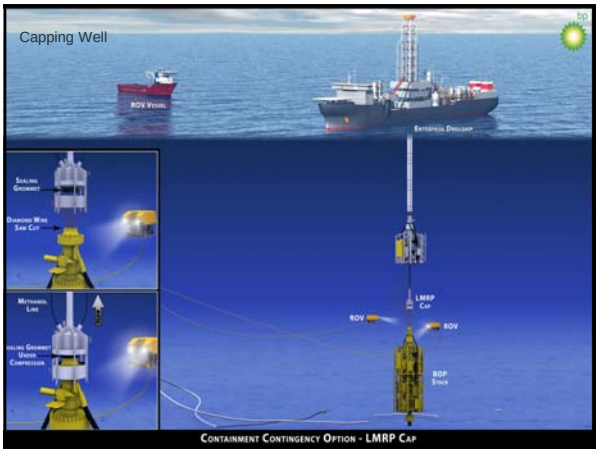
Priority #1 = Stop Fire, Rescue People

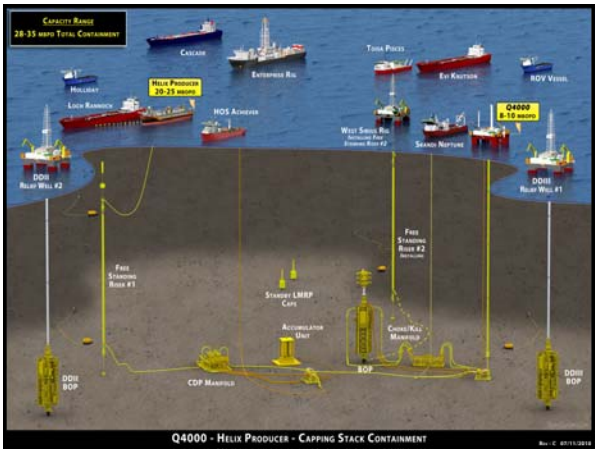
Priority #2 - Stop Source of Leak

- Start Relief Well
- Install "Cap" to Stop Flow
  - High ambient water pressure, cold and dark
    - 2200 psi
  - High exit pressure of oil, hot (212ºF)
    - 6500 psi
  - Well Head ~ 7 inches diameter; 1 mile below water's surface

Relief Wells





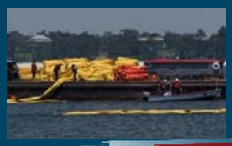


Priority #3 - Identify Natural Resources at Risk

- Crabs, Shrimp, Oysters, Blue Fin Tuna, Charismatic Marine Mammals
- Recreational Beaches
- Commercial Fishing
- Subsistence Fishing

Priority #4 - Minimize Damage to Natural Resources

- Purpose of Response Technology
- Key Is Select Most Appropriate Response Techniques
- Unique to Each Spill



REALITY CHECK!!!!!!!

200 MILLION GALLON SPILL WILL CAUSE DAMAGE

(Exxon Valdez Spill = 11 Million gallons)

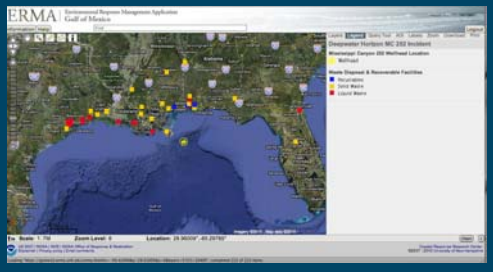
RESPONSE MINIMIZES DAMAGE, BUT THERE WILL BE SIGNIFICANT DAMAGE!!!!!

Satellite Image of Oil Slick

Response: Sorbents

Oily Waste Collected

Landfills and Burned

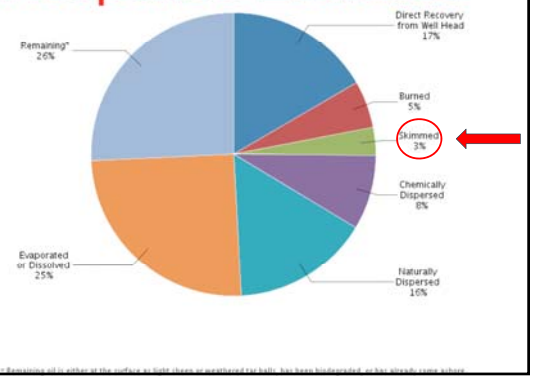


Booms and Skimmers

Capture and Concentrate Oil, Deflect Oil from Critical Area

Deepwater Horizon Oil Budget Through July 14 (Day 86)

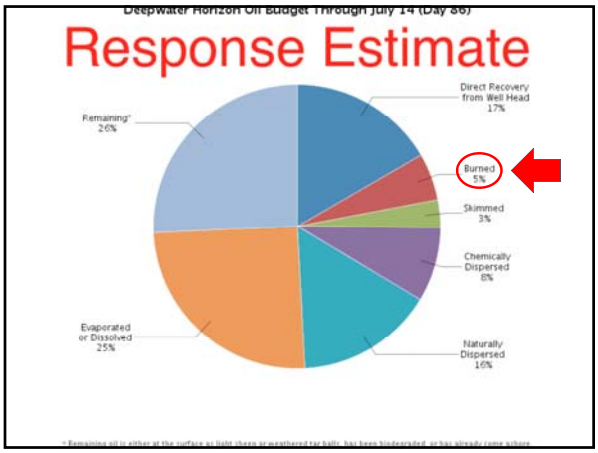
Response Estimate



Response: *In Situ* Burning

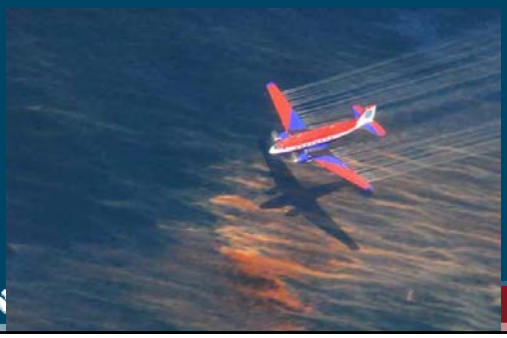
Coastal Response Research Center

36



Response: Chemical Dispersants

Surface Application



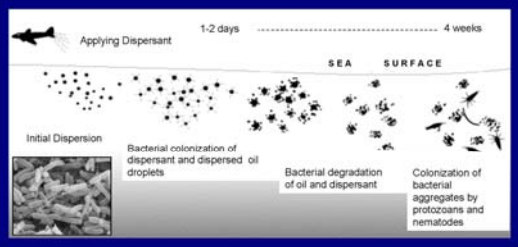
38

Response: Dispersants

Sub-Surface Application

39

Fate of Dispersed Oil Droplets



Source: *http://www.response.restoration.noaa.gov*

Coastal Response Research Center

40

Why Use Chemical Dispersants?

- Wind and Waves Often Too High to Allow Mechanical Removal (Booms & Skimmers) or Burning
- Kept Oil Out of Nearshore Waters and Marshes
  - Where organisms were breeding and juveniles
  - Marshes hard to clean if repeatedly fouled with oil

Coastal Response Research Center

41

Dispersant Controversy

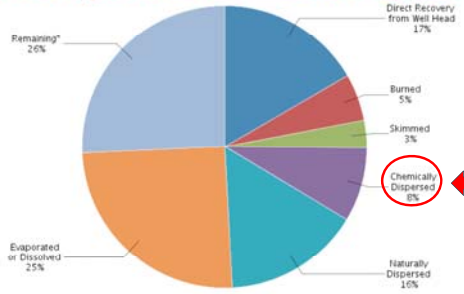
- Exposure/Toxicity of Dispersants to Marine Life, Humans, Seafood
- Exposure of Marine Organisms Below Surface to Dispersed Oil
- Proprietary Mixture
- Where Did Oil Go?

Coastal Response Research Center

42

Deepwater Horizon Oil Budget Through July 14 (Day 86)

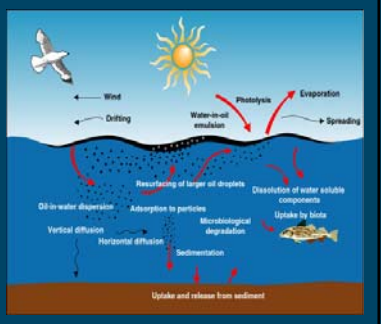
Response Estimate



* Remaining oil is either at the surface as light sheen or weathered tar balls, has been biodegraded, or has already come ashore

Nature's Response

- Function of Environmental Conditions
  - Temperature
    - (H_2O, Air)
  - Wind
  - Oil Type
  - Currents, Tides

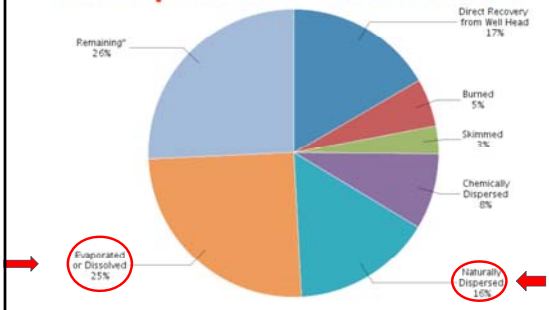


Coastal Response Research Center

44

Deepwater Horizon Oil Budget Through July 14 (Day 86)

Response Estimate

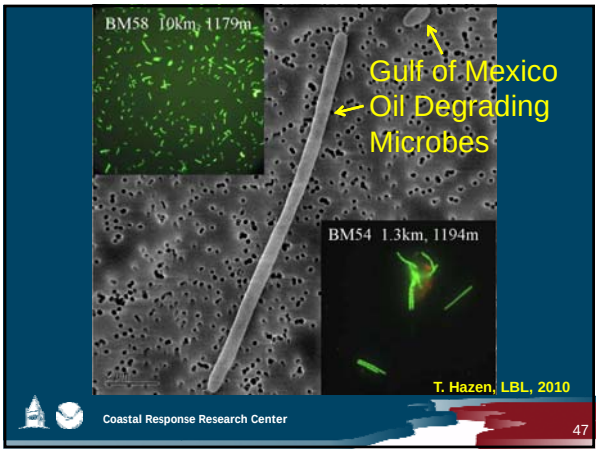


Response: Biodegradation

- Every Year, ~ 20 Million Gallons of Oil Enter GOM from Natural Seeps
- Naturally Occurring Bacteria Live in GOM Use Oil as Food Source
- DWH Oil is More Food
- Takes <10 days to Degrade Oil Mass by Half
  - 10 g ⟶ 5 g

Coastal Response Research Center

46

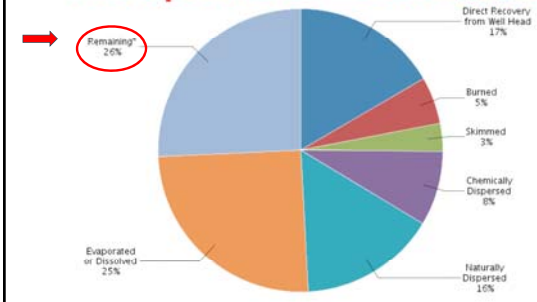


Coastal Response Research Center

47

Deepwater Horizon Oil Budget Through July 14 (Day 86)

Response Estimate

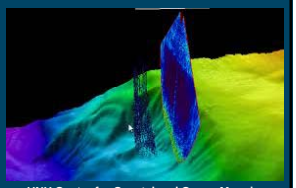


* Remaining oil is either at the surface as light sheen or weathered tar balls, has been biodegraded, or has already come ashore

UNH Innovations During DWH Spill Response

DWH: State-of-the-Art Monitoring Oil

- Detection of Subsurface Oil
  - Measuring for leaks and natural seeps
  - Holographic detectors from biological oceanography
- UNH Center for Coastal and Ocean Mapping



UNH Center for Coastal and Ocean Mapping

DWH: State-of-the-Art Managing Spill Response

- Common Operating Picture
  - All responders see same, detailed information
  - Overlay layers of information to help make decisions
    - Where beaches located?
    - Where floating oil?
    - Decide boom placement to protect beaches at risk

DWH: State-of-the-Art Managing Spill Response

- Environmental Response Management Application
  - ERMA® - UNH/NOAA trademark
  - Developed by UNH Research Computing Center
  - Partnership with NOAA
- www.geoplatform.gov Has Hundreds of Layers of Data to Overlay

www.geoplatform.gov/gulfresponse

Phases of Oil Spill

- Emergency Response
  - Immediate to few years after
- Natural Resource Damage Assessment (NRDA)
  - Determine damage to and compensation of natural and human resources by responsible parties (RPs)
    - Not civil suits
- Restoration/Recovery
  - Months to years funded by RPs

Biological Impacts of Spill

Key Biota in DWH Spill

- Coral
- Oysters
- Shrimp
- Crabs
- Blue Fin Tuna
- Intertidal/Marsh Vegetation (Marsh as Nursery Grounds)
- Biota That Cannot Swim Away Are Most Impacted

Biological Impacts of Spill

- What Are the Biological Impacts of this Spill?
  - GOM: 100's of spills per year
  - Lethal (acute) vs. Sublethal (chronic) effects
- When Has Complete Recovery Occurred (if ever)?
- Is Recovery to Organisms and Community Before Spill?
  - How Clean is Clean Enough?

All Compared to Natural Variation

Impact of Deepwater Horizon on Gulf of Mexico

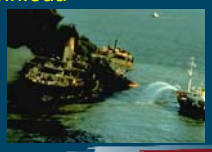
- Short Term, Acute Toxicity (Immediately Lethal) = Lower Than Expected
  - (>4,000 birds DWH 200M gal vs. >100,000 birds in Exxon Valdez 11M gal)
- Long Term, Chronic Toxicity = ????
- Only Time Will Tell
  - Months to years of data needed

Cuban Oil Drilling

Cuban Drilling

- Started 18 Miles Off Havana
  - Arrived in January
  - Drilling started this month
- Spanish Company – Repsol
- U.S. Coast Guard Has Contingency Plans for Spill
  - Oil spill response companies Will Be Activated in case of spill

CRRC Website:
www.crrc.unh.edu
nancy.kinner@unh.edu



Coastal Response Research Center

61