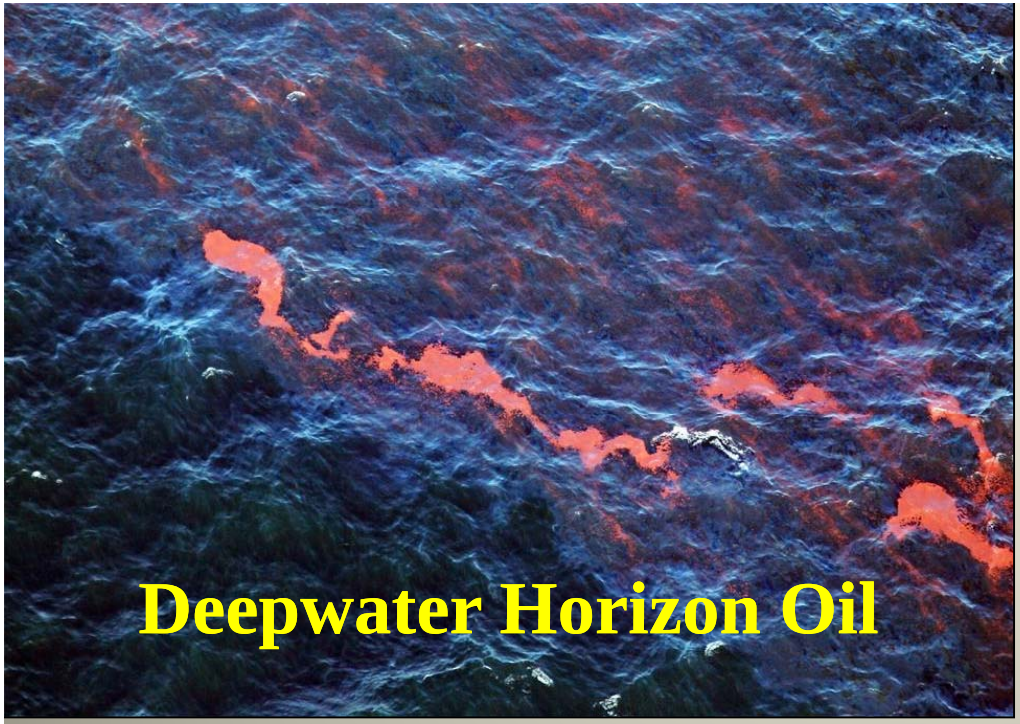
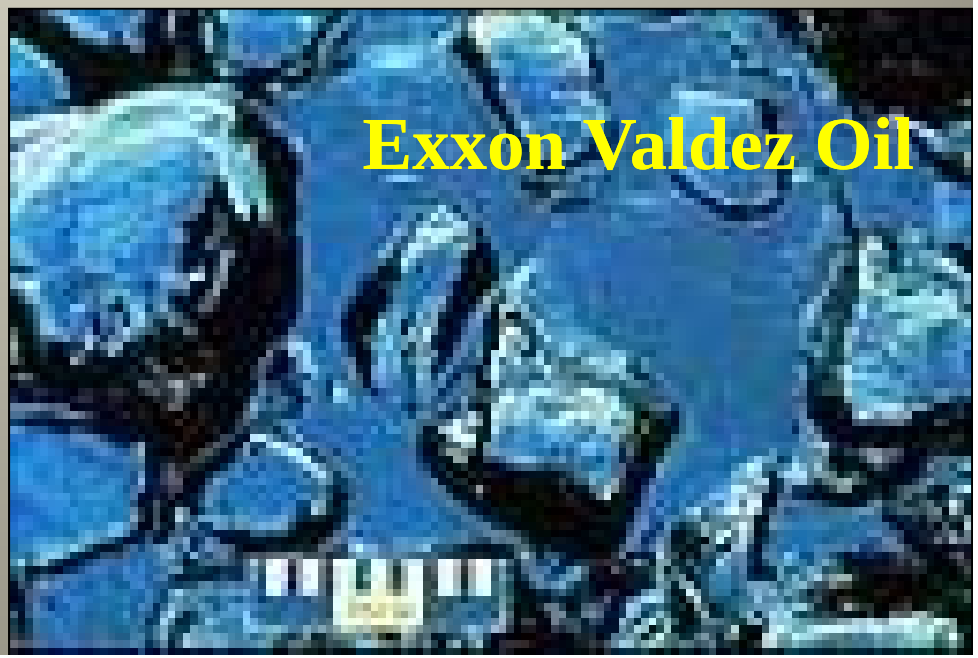


Oil Spill Overview and Recommendations for Moving Forward

Edward B. Overton, Ph.D.
Professor Emeritus
Dept of Environmental Sciences
School of Coast and Environment
Louisiana State University
Baton Rouge LA 70803

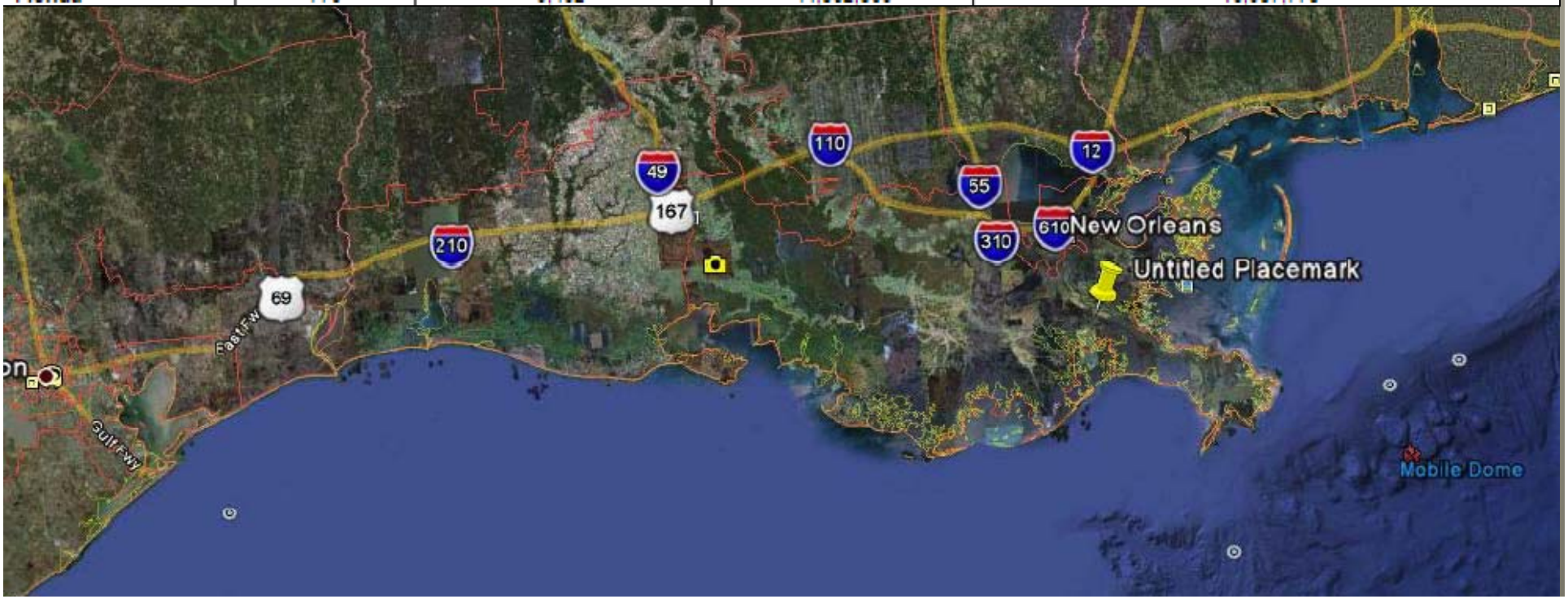


Deepwater Horizon Spill

Overview of the Spill

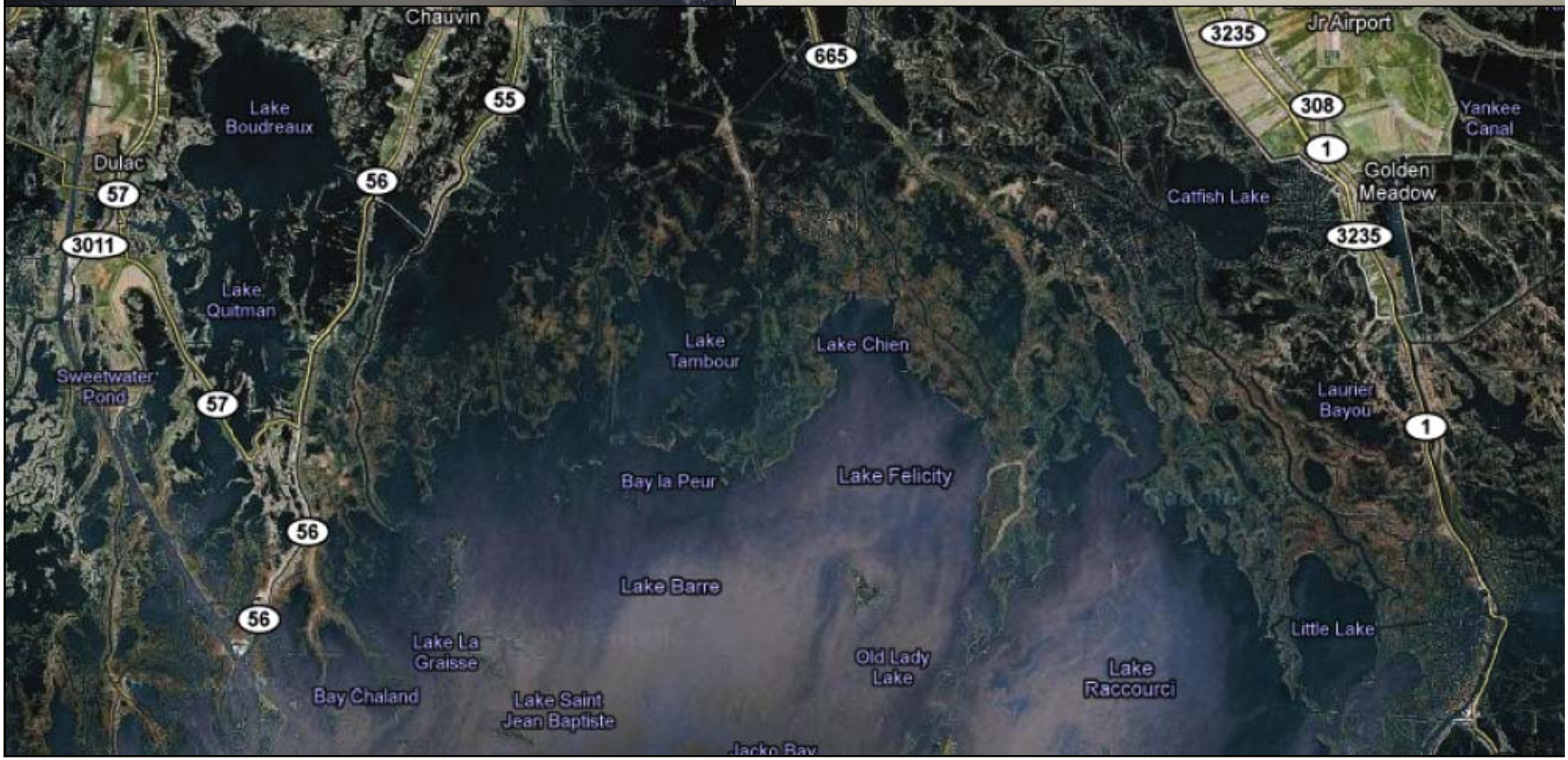
- **Began April 20, 2010 with the explosion of the Deepwater Horizon drilling platform in the Gulf of Mexico, 11 people perished**
- **Capped on July 15, 2010**
- **Estimates of 35,000-60,000 barrels of crude oil flowed from the well per day, covering 2,500 square miles**
- **>200M gallons of oil spilled – Largest spill in US history**
- **Volume of spill = <1/4 Superdome** (Superdome would hold 750M ga**l,** Gulf of Mexico 500M superdomes of water, or 0.4MMM gals)
- **>1.8M gallons of dispersant used at depth and on the surface**
- **Impact possible to: people, environment, economy, and geology**
- **Some impacts will be seen in coming years, most impacts will be short lived**

STATE	Total Coastline (miles)	Tidal Shoreline (miles)	Tidal Shoreline (feet)	Threatened Shoreline (within 350 miles of incident site)
Louisiana	397	7,721	40,766,880	40,766,880
Mississippi	44	359	1,895,520	1,895,520
Alabama	53	607	3,204,960	3,204,960
Florida	770	8,402*	44,362,560	16,857,773

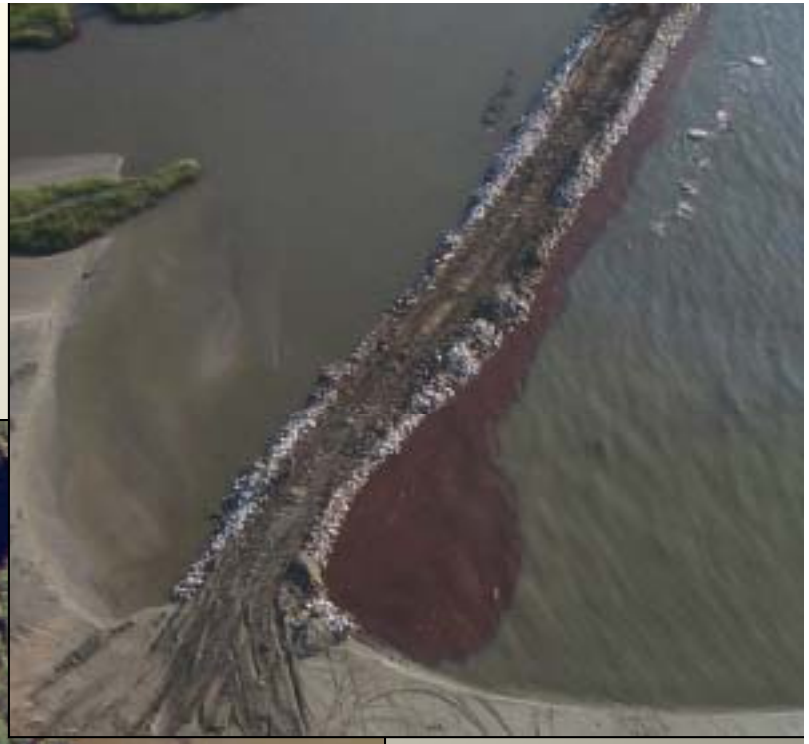


7721 miles

of coastline in Louisiana



On Shore Oil

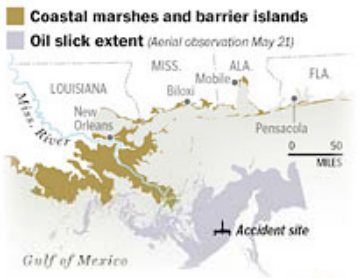


What oil does to a salt marsh

As sheets of oil from the BP spill enter marshes in the Gulf of Mexico, you will see heart-breaking images of graceful birds and their grassy habitats coated with sludge. Even more disturbing might be images that could be taken this time next year, when the same marshes may be struggling for life, if they exist at all.

Why do we need marshes?

Coastal wetlands buffer the mainland against tidal surges and erosion, incubate much of our seafood and absorb greenhouse gases and excess nutrients that cause "dead zones" in the ocean.



Cordgrass

The grass, mostly Spartina, provides the structure of a salt marsh. It grows in clumps, with stalks rising a few feet out of the water. Marsh periwinkle snails patrol the stalks, munching algae and microcrustaceans. Fish and shrimp live in channels, ponds and inlets formed by water among the patches of grass. Small mudflats host Fiddler crabs and shelter nesting birds.

Dragonflies

Among the few insects that can tolerate the high salt content of the outer Louisiana marshes are dragonflies, mosquitoes and gnats.

Brown pelicans

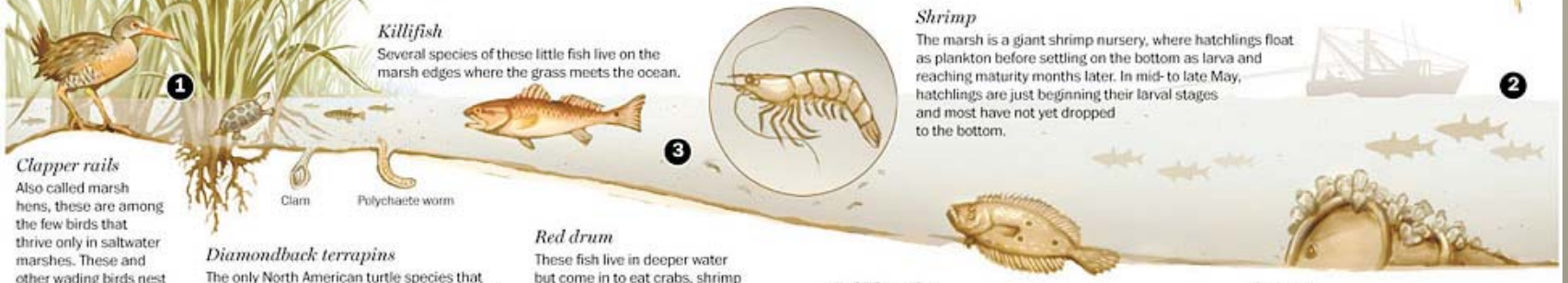
Pelicans and other diving birds follow schools of fish, such as mullet, that approach the coast.

Killifish

Several species of these little fish live on the marsh edges where the grass meets the ocean.

Shrimp

The marsh is a giant shrimp nursery, where hatchlings float as plankton before settling on the bottom as larva and reaching maturity months later. In mid- to late May, hatchlings are just beginning their larval stages and most have not yet dropped to the bottom.



Clapper rails

Also called marsh hens, these are among the few birds that thrive only in saltwater marshes. These and other wading birds nest on flats and feast on crustaceans, fish and insects.

Diamondback terrapins

The only North American turtle species that spends its life in saltwater (although usually in interior marshes, which are more brackish) mates and nests at this time of year.

Red drum

These fish live in deeper water but come in to eat crabs, shrimp and killifish. They'll swim into such shallow water that their backs and tails will stick out.

Gulf flounder

Plate-size flounder that live on the muddy seabed come into the marshes at night and will even swim into rivers.

Oysters

The oil pipes and equipment that crisscross the marshes make fine places for oyster beds.

One thread in the food web

- Decaying cordgrass is the most important nutrient source for a marsh.
- Micro-organisms colonize the debris and form a film on it.
- The film provides perfect nourishment for baby shrimp and other tiny invertebrates.
- Worms, snails, oysters, small fish, shrimp and crabs feast on the small invertebrates.
- Large fish, birds and mammals (including humans) eat the biggest of the fish and shellfish.

Oil's effect | When oil enters a marsh, the species that can flee will move elsewhere. Those that can't will likely die or become ill.

1 In the grass

Fresh oil prevents leaves from "breathing," so they yellow and die. It can foul underground stems, stunting future growth, or smother the roots, killing the plant. Microrganisms on the grass will die on contact. Snails will try to avoid oil, but if it reaches them, they will die. The soil may stay contaminated for years.

2 On the surface

Heavily oiled birds can't fly, and oiled fur and feathers cannot regulate body temperature. Oil ingested when turtles surface or birds preen may not be instantly fatal but can damage kidneys, liver and lungs. A drop of oil on an egg will kill an unhatched bird or turtle. Oil kills many insects; it can suffocate a dragonfly by clogging its respiratory channels.

3 In the water

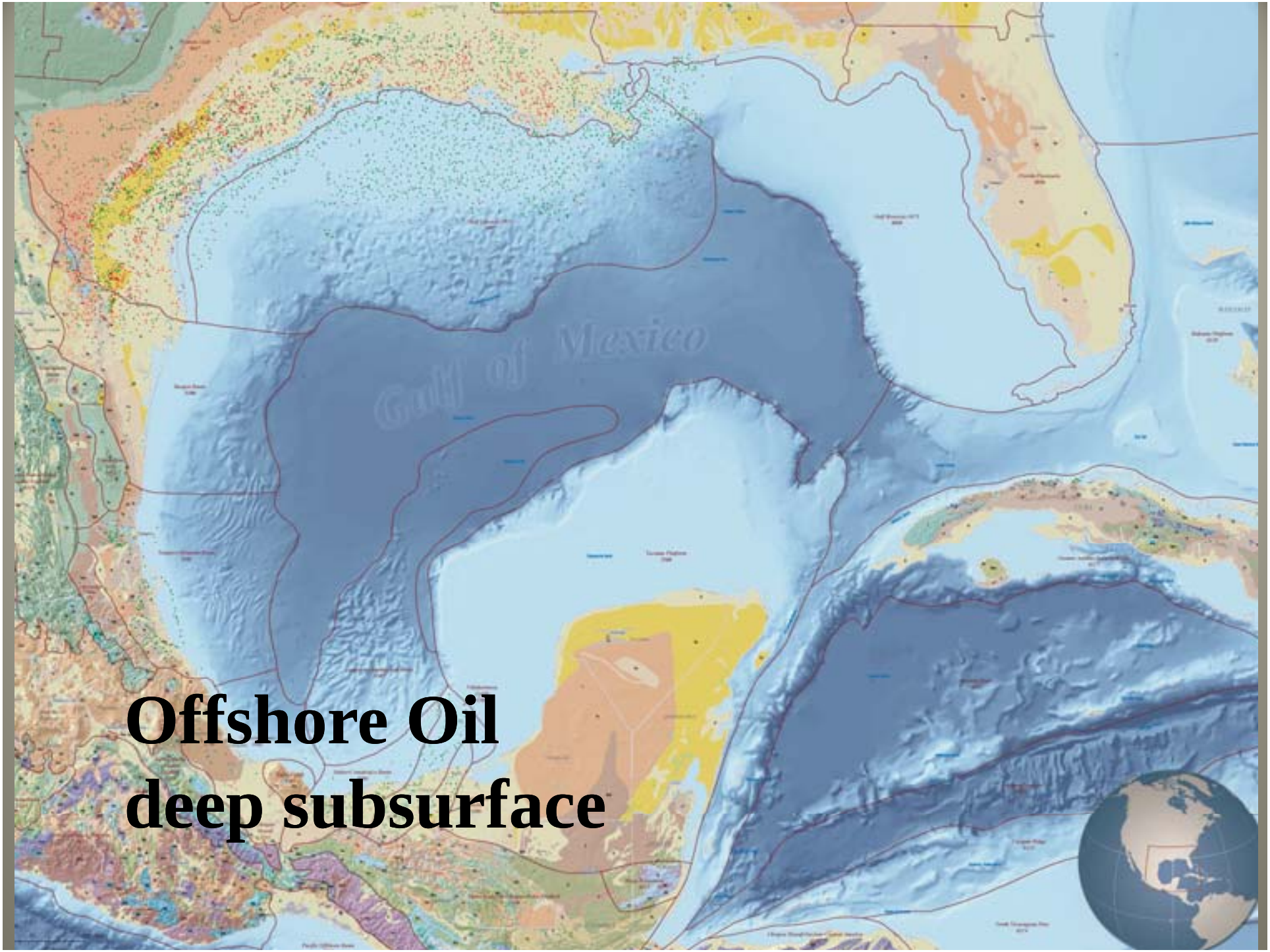
The nutrient-rich detritus will become poisonous. The youngest shrimp and other plankton in the water column have no defenses and will die on contact. Oysters, clams and older shrimp may survive but would be contaminated. Oil and some dispersants are fatal to fish if they contact skin or enter gills.

4 In the food web

This is where some of the most devastating effects may appear. An oil molecule ingested by one tiny crustacean may not kill it, but the effect will be multiplied in the fish that eat hundreds of crustaceans and in the reptiles, birds and mammals that feast on tainted fish. Any break in the food web can topple the carefully balanced system.

How do we clean marshes? We don't. The marsh ecosystem is too delicate for common oil cleanup methods such as high-pressure spraying and dispersants. In general, the marsh must be left to heal itself.

Offshore Oil near surface



Offshore Oil
deep subsurface

Three Scenarios

what's going to happen?

Best Case

- No further leaks with little or no permanent effect to the environment and food chain
- Nature cleans environment with limited human intervention

Worst Case could encompass one or more of the following:

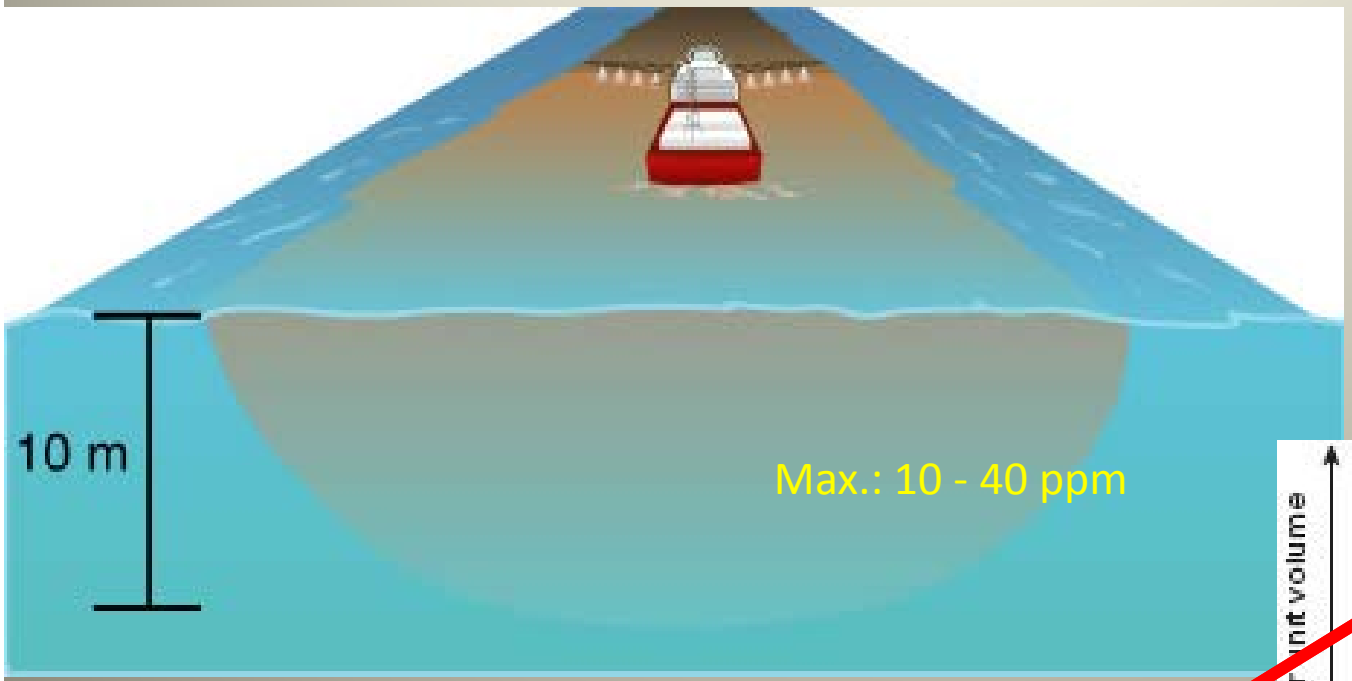
- Further substantial leakage
- Long term changes to food chain
- **Toxicity and oxygen depletion**

Most Likely Outcome

- Gulf spill follows the scenario set by the Valdez spill (gradual return 3-5 yrs)
  - Variables:
    - Environmental (temperature and weather) conditions
    - Greater use of dispersants and ISB
    - Depth of spill and dispersant use at depth
    - Danger of over-remediation

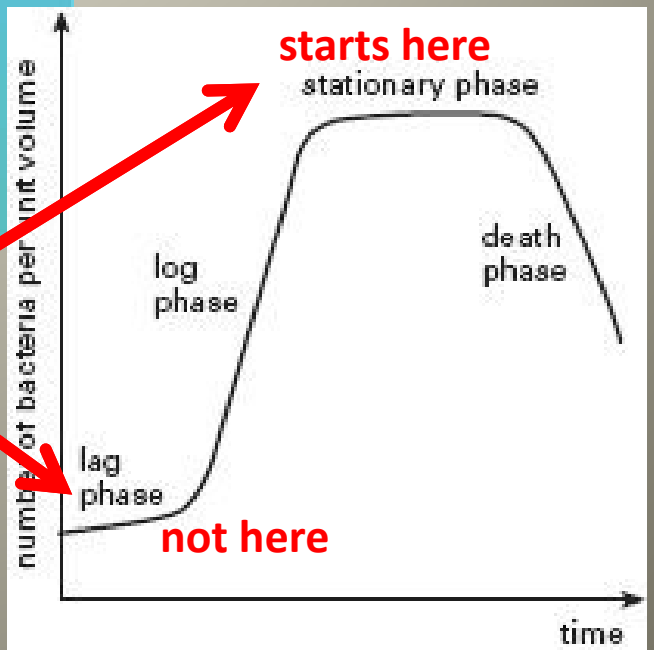
Oil concentrations measured in the field

- Maximum: 10-40 ppm oil (upper 0-3 m) few minutes after treatment.
- Rapid dilution in the water column (0-10 m): → < 1-10 ppm few hours after treatment



The dispersed oil does not sink to bottom

Bacterial Degradation

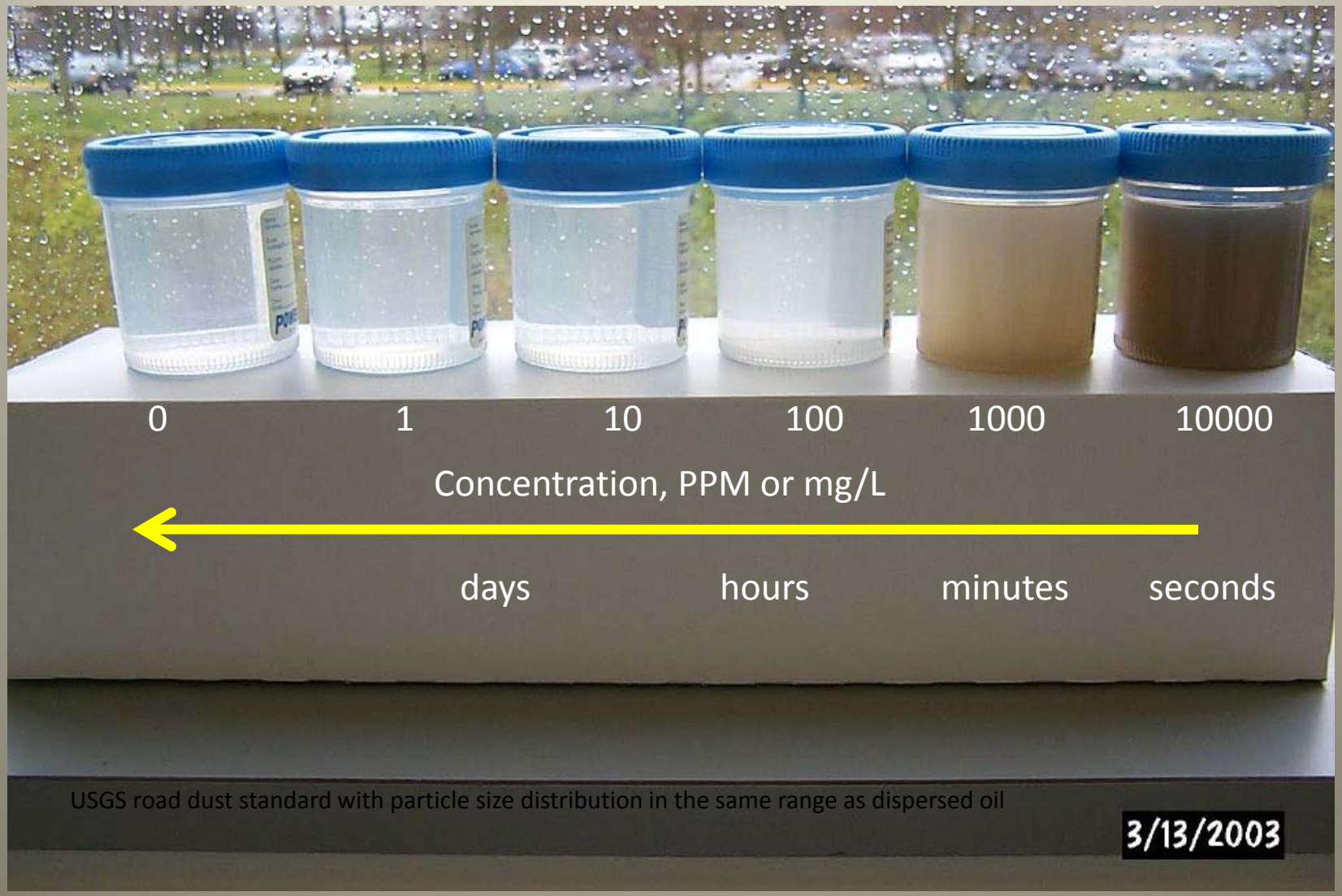



2010/ 6/12
W:088°36'24.11"
N:028°43'58.91"


Close-up of streamer of dark orange emulsified product prior to chemical dispersion.
Thick, skimable, dispersible oil

Oil after dispersant application

…dispersed particles mix rapidly with adjacent clean water, the rate depending on wave action or other sources of diffusion.



Source oil

- oil at depth
- oil on surface
- dispersed oil at depth
- dispersed oil on surface

Weathered oils

- dissolved and modified oils at depth
- dispersed weathered oils on surface
- dispersed dissolved and modified oil at depth
- dispersed weathered oil on surface

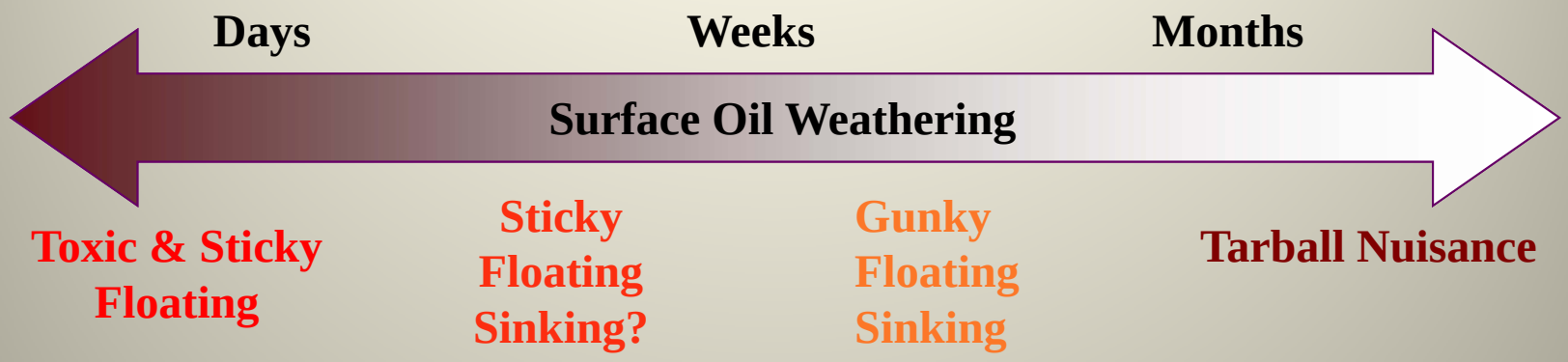
Dispersed

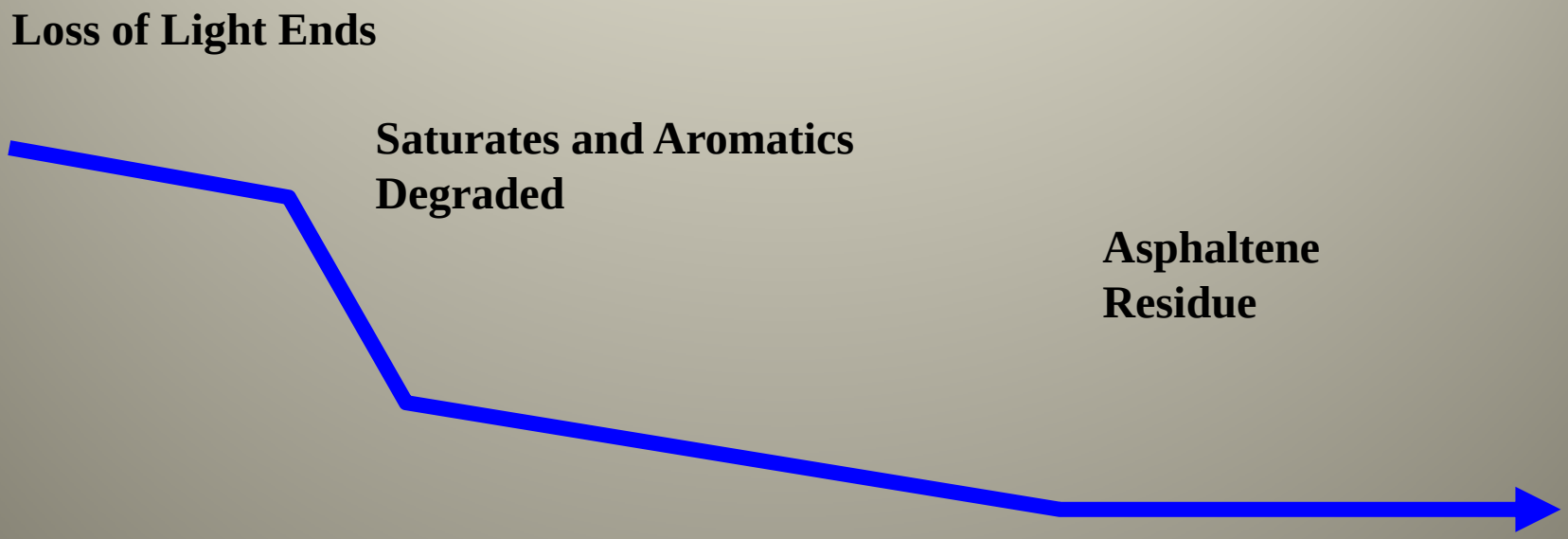
Source

Impacts

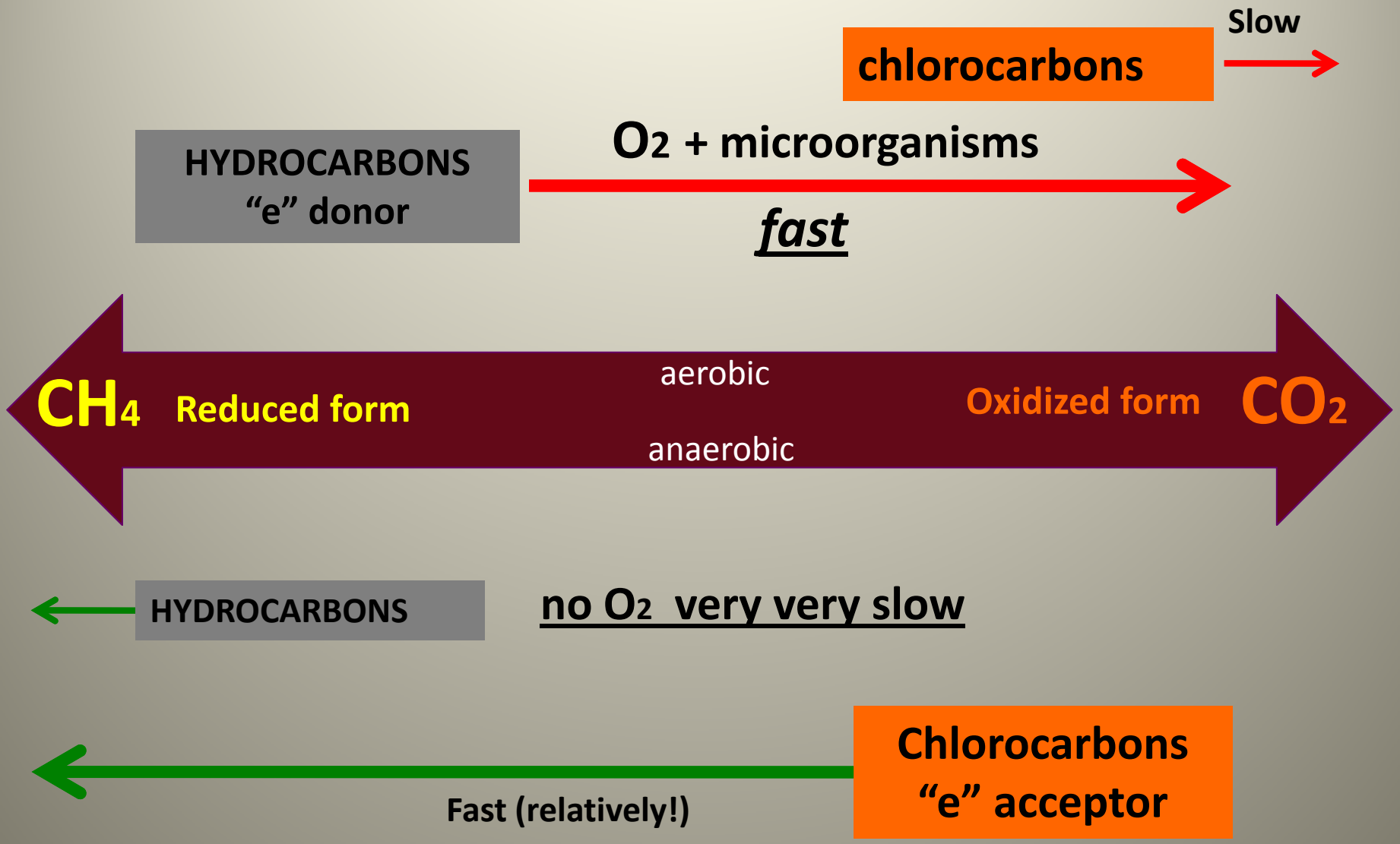
- Ecological
  - Geological
    - Economic
      - Sociological

The Effects of Weathering on Spilled Oil





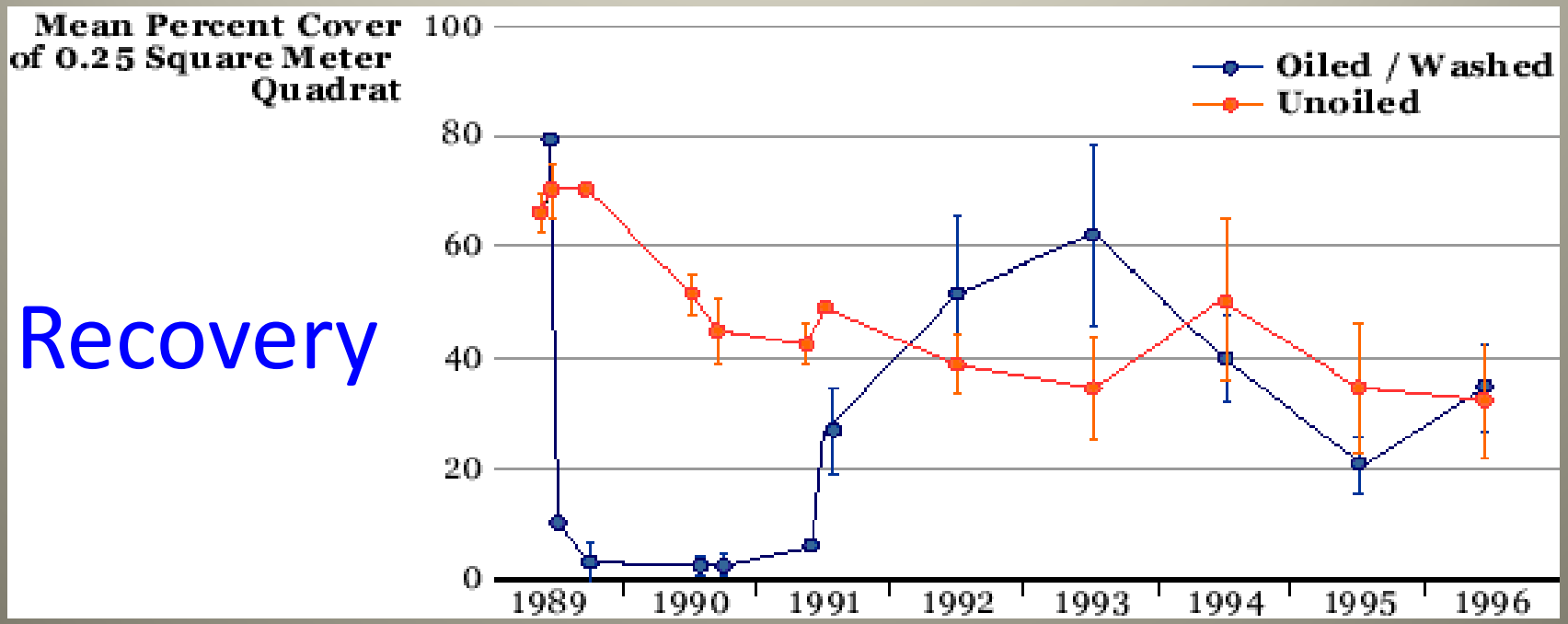
Oxidation-replace H with more electronegative element
Reduction- replace electronegative element with H



Valdez/Ixtoc1 and other oil spills lessons learned:

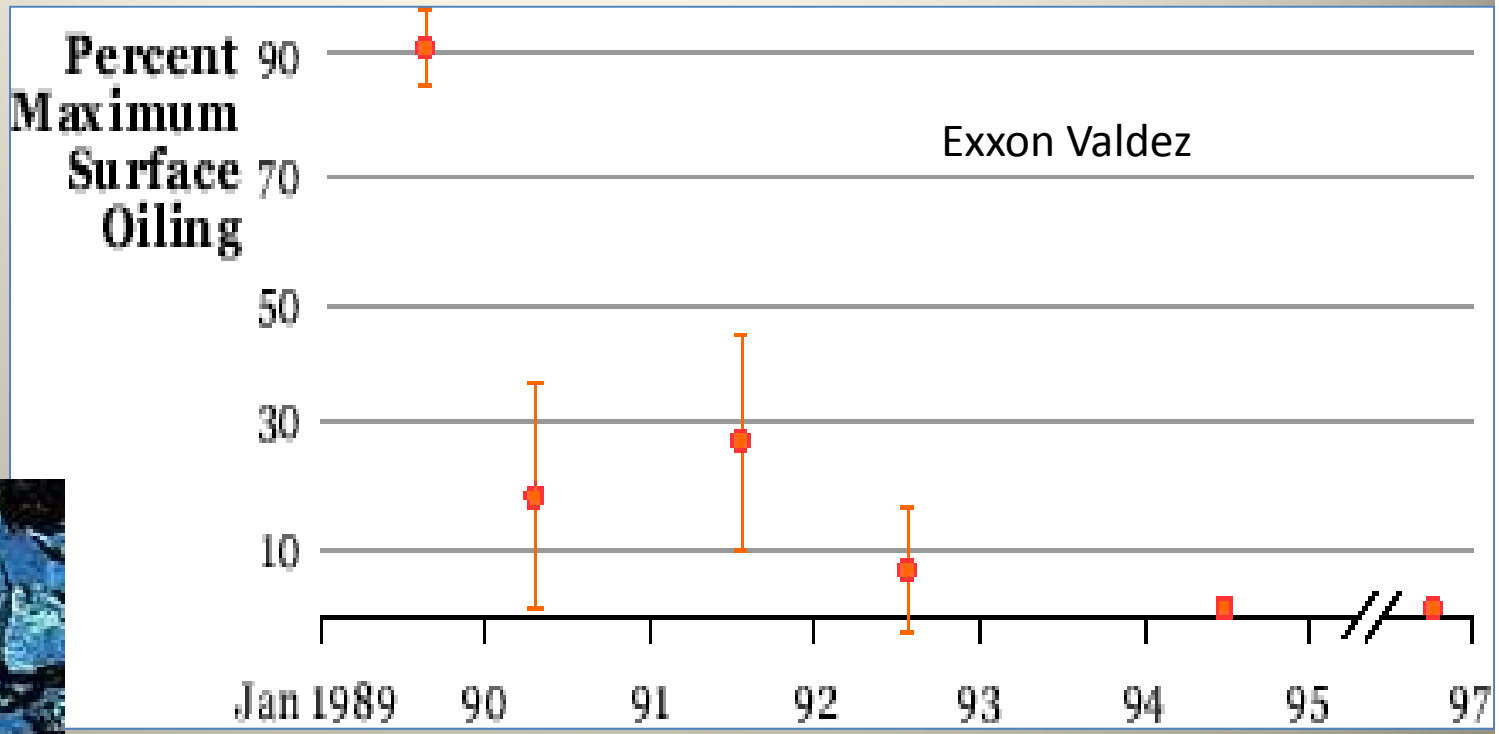
- **Most but not all environmental indicators return to normal in 3-5 annual cycles.**
- **Oil Spills are acute events, not a chronic events**
- **DH Spill different, environment better acclimated for degradation (seeps, temperature, oil)**

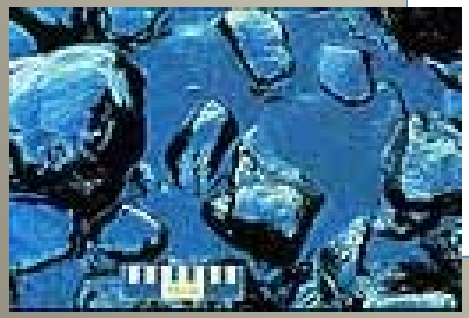
Exxon Valdez Oil Spill



Recovery

Oil Weathering



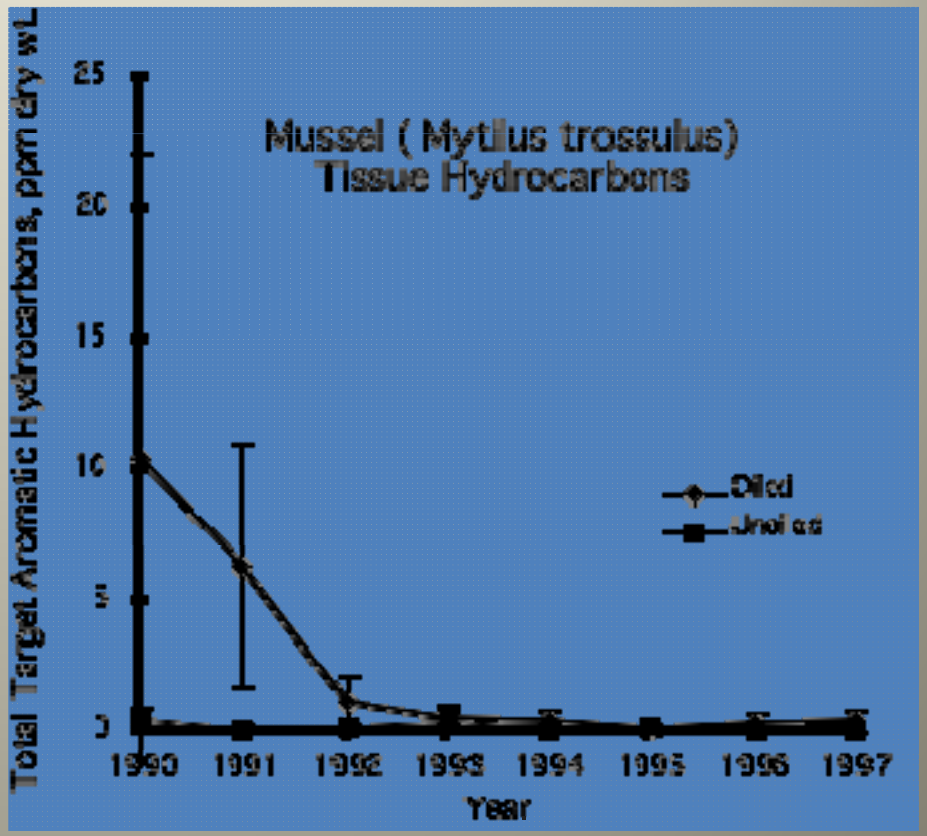


oil weathering

Toxic & sticky **sticky** **Tarball nuisance**

Chemical Contamination EV

Most of the oiled mussels were as clean as unoiled mussels by 1992-93 (3-4 years)



Oil Removal Options: 3 tools in Toolbox:

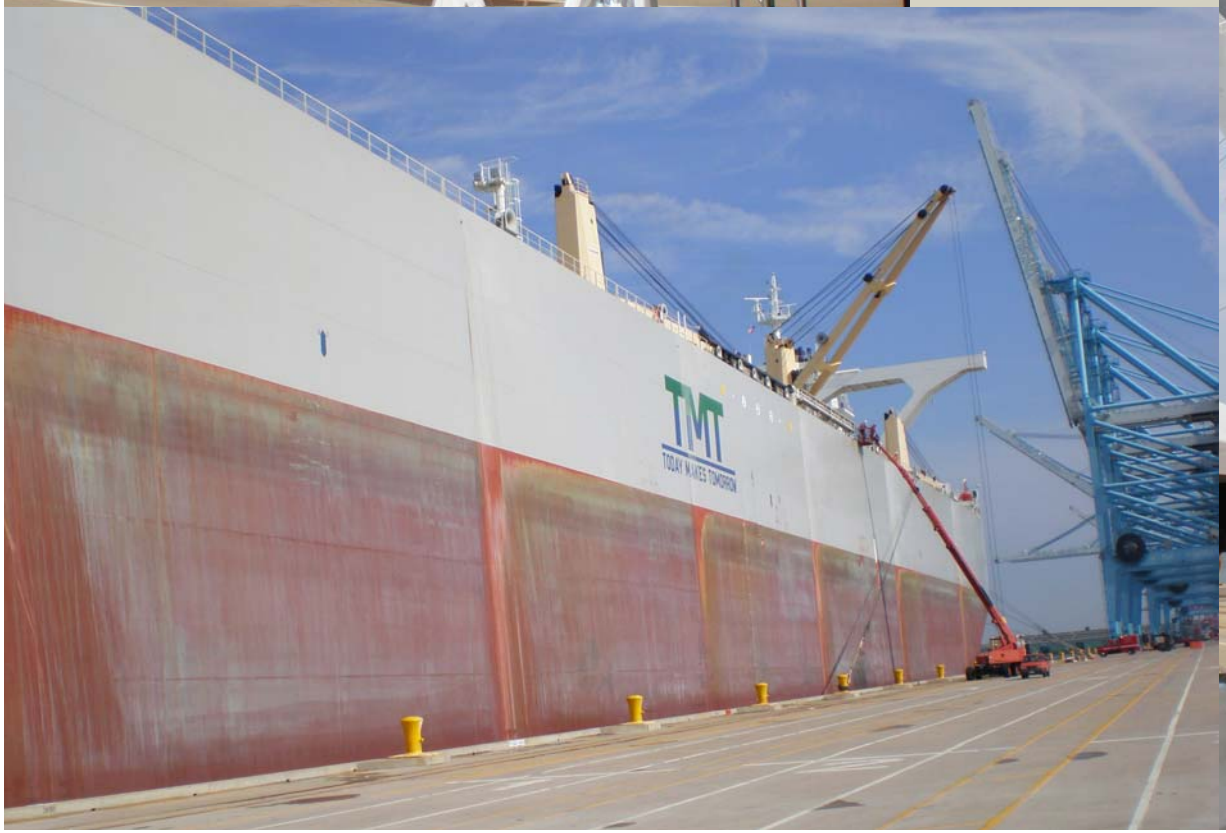
- **Chemicals (dispersants)**
- **Mechanical (skimming and sucking)**
- **In-situ burning**

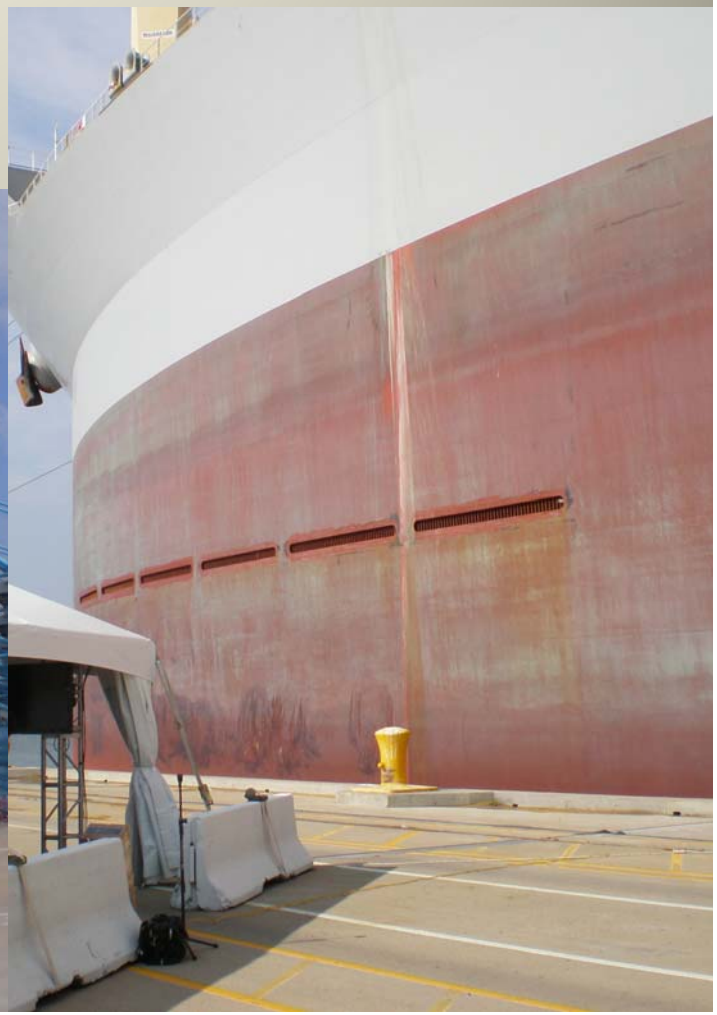

ISB

Areal Dispersant Application

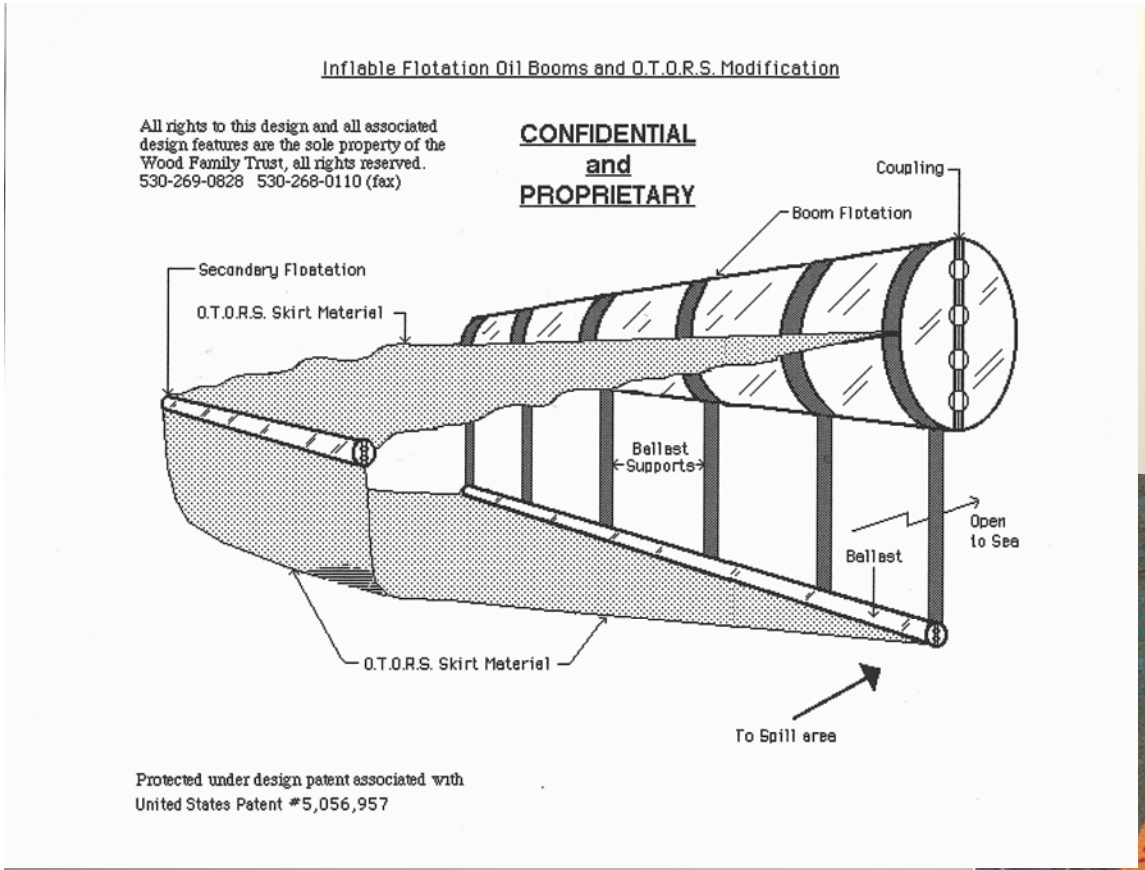
Near shore skimmers

A Whale
Ocean Skimmer?





Deeboom



Jack Wood, Trustee
The Wood Family Trust
21859 Angeli Place
Grass Valley, CA 95949
530-320-7200 (Cell)

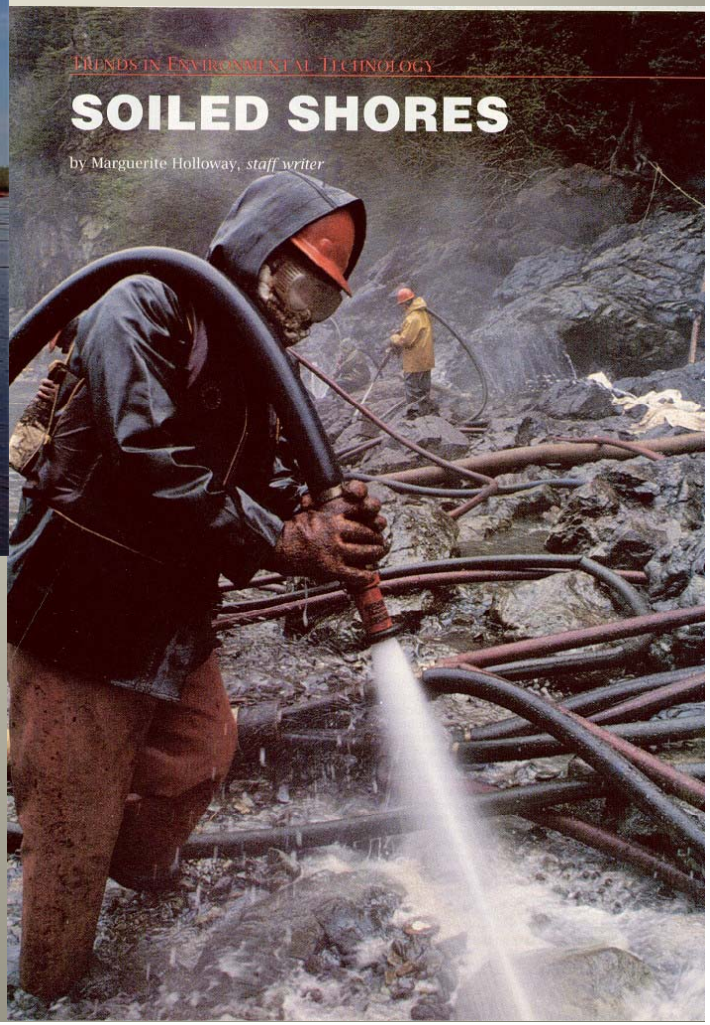
What do you do with this?

Gulf Shores/Orange Beach
July 17, 2010

Sand Berms

Human Health Exposures

- Toxicity of semivolatiles?
- Routes of exposure
- Consumption of seafood?



Conclusions:

- Hope containment holds, relief wells provide final plugging
- Remove as much residual oil as possible off the surface
- Natural recovery processes are in full swing in a highly acclimated natural bio treatment system offshore
- Use portion of royalty income to partially support response and production technologies
- Enforce “talk the talk, walk the walk” as far as environmental health and safety is concerned
- Develop a sensible energy policy for the US

Some Future Recommendations

- Develop transparent information management criteria/protocols in the age of Google
- Understand ecology and impacts of releases at-depth
- Catalogue and contact area experts in marine and coastal ecology, oceanography
- Evaluate the tradeoff for offshore verses near-shore impacts
- Evaluate the efficacy of offshore cleanup options
- Have in place a public cleanup technology review and evaluation system

- **Develop a catalog of oil weathering properties for all production zones**
- **Understand the chemistry of various oils and their weathered products**
- **Develop remote sensing for accurate detection of spreading oil patches**
- **Develop contamination free at depth sampling and monitoring capability**
- **Develop human health exposure risk for response and cleanup workers**
- **Develop an understanding of impact on seafood and duration of seafood impacts**
- **Develop rapid response seafood impact detection capability**

- **Develop capability for 24 hour cleanup operations**
- **Develop cleanup skimming technology for offshore, near-shore and on-shore**
- **Develop response technology use paradigms (skimming, dispersing, ISB)**
- **Develop dispersing efficacy and impacts criteria**
- **Understand impacts of dispersant use at depth and on the surface**
- **Re-examine and re-engineer the safety features for well shutdown**
- **Examine and evaluate Incident Command Structure**
- **Keep incident response technical/scientific based, not political**