Gulf Oil Spill – Seafood Testing

Presented by:

Jason M. Behrends, Ph.D., CCS

June 2011

RMC – Manhattan, KS

Outline

- Review
- Food Safety Concerns
- Testing
- Where we were to where we are…

Review

- Explosion on April 20, 2010
- Rig Capsizes on April 22, 2010
- Water contaminated with millions of barrels of oil
- Dispersant used to help eliminate oil
- Sensory and analytical testing used to evaluate safety of product

Review

- Multiple attempts to cap and contain oil
- July 13, 2010 – Leak from well is capped and oil has stopped flowing into the Gulf of Mexico
- Continued cleanup of oil in the Gulf of Mexico

Review

- Prompt information and assistance during oil spill response can prevent unnecessary restriction on seafood harvest
- Order of concern
  - Mullusks/oysters
  - Crabs
  - Shrimp
  - Finfish

Food Safety

- Two risks of oil contamination
  - The presence of petroleum taint that renders seafood unfit for human consumption
  - The presence of polycyclic aromatic hydrocarbons (PAHs)

Food Safety Concerns

- Polycyclic aromatic hydrocarbon (PAH)
  - Criteria for shellfish ranges from 5 to 120 parts per billion (ppm) benzo[a]pyrene equivalents

- Seafood marketability has more often been impacted, due to petroleum taint (off-odor or off-flavor)

Food Safety Concerns

- PAHs
  - Potential carcinogenicity of PAHs accounts for most of the human health concern associated with petroleum compounds
  - Benzo[a]pyrene is the most easily characterized toxicologically than any other carcinogenic PAHs and other compounds are usually weighted relative to benzo[a]pyrene

Yender et al., 2002 – National Oceanic and Atmospheric Administration

Food Safety Concerns

- Several Factors for Cancer Risk Equation.
  - **Acceptable carcinogenic risk level** – the risk level is the maximum level of individual incremental lifetime carcinogenic risk that is considered acceptable or tolerable (1×10^{-4} - 1×10^{-6})
  - **Body weight of population** – 80 kg (177 lbs)
  - **Exposure duration** – Time one is exposed
  - **Seafood consumption rate** – based on high level consumers
    - Shrimp and crab (13 g/day)
    - Oyster (12 g/day)
    - Finfish (49 g/day)
  - **Benzo[a]pyrene cancer slope or cancer potency factor** – conservative estimate of potential cancer risk of a contaminant
  - **Averaging time** – average human lifetime

Food Safety Concerns

- Dark brown crude oil found in harvesting areas
- Infected fish/seafood
- Blue crabs, oyster, shrimp can retain contaminants longer than fish
- Contaminants PAHs
  - Associated with carcinogens
  - Smoked fish was found to have higher concentrations of PAH than fish from contaminated waters of the Exxon Valdez spill of 1989.

Food Safety Concerns

- Dispersant
  - Information indicates that the dispersant used does not appear to accumulate in seafood
    - Little public health concern
    - Sensory testing and further work to identify component compounds In known exposed fish were conducted for the dispersant.

Food Safety Concerns

- Complaints about dispersants - chemicals used to break up the oil spill so it can be eliminated faster.
  - Based on current science, the dispersants used during the Deep water Horizon response have a low potential to bio-accumulate in seafood and are low in human toxicity, therefore there was likely little public health risk associated with consuming seafood that has been exposed to them.
  - Nonetheless, as a precaution, the U.S. government continues to monitor the use of dispersants and test seafood that may have been exposed to them. It is possible for the dispersants to “taint” seafood with a chemical smell.
  - Even though the dispersant “taint” may not be harmful, seafood possessing the chemical smell is considered adulterated and not permitted for sale.
  - US Environmental Protection Agency
    - Low toxicity.
    - Not danger to humans

Boosting Consumer Confidence

- President Barack Obama publicly ate Gulf seafood in Mississippi only a short time after oil spill
  - Boosting consumer confidence in seafood safety from the Gulf

- Gulf provides us with a significant proportion of the seafood consumed in the US
  - Vast majority of:
    - Shrimp
    - Oysters

Boosting Consumer Confidence

- According to the Commissioner of the FDA, Dr. Margaret Hamburg
  - The US government did everything possible to make sure that any seafood that comes from the Gulf of Mexico off the US coast is safe before any harvests can be made.
  - The governor of Louisiana also told the media that due to new programs coming into effect after this spill the seafood from the Gulf of Mexico will end up being the safest anywhere in the world.
  - Finfish are especially likely to be safe since they are able to out maneuver any toxic chemicals much more easily.

Verification (CCP – Receiving)

- Sensory screening for every lot
- Periodic analytical screening of samples
- Sensory and analytical screening are safety measures
  - That can be used in addition to the recommendations and guidance provided in FDA's 2001 Fish & Fisheries Products Hazards and Control Guide, Chapter 9-Environmental Contaminants & Pesticides.
  - **Use of these extra measures would be appropriate during periods of concern for possible contamination from oil spills**

Overview of Testing Protocol

- **How oil can make seafood unfit for consumption: (Previously discussed)**
  - Certain levels of chemicals (PAHs)
  - Petroleum Taint “adulteration”
- **How dispersants can make seafood unfit for consumption:(Previously discussed)**
  - Low toxicity
  - Not danger to humans

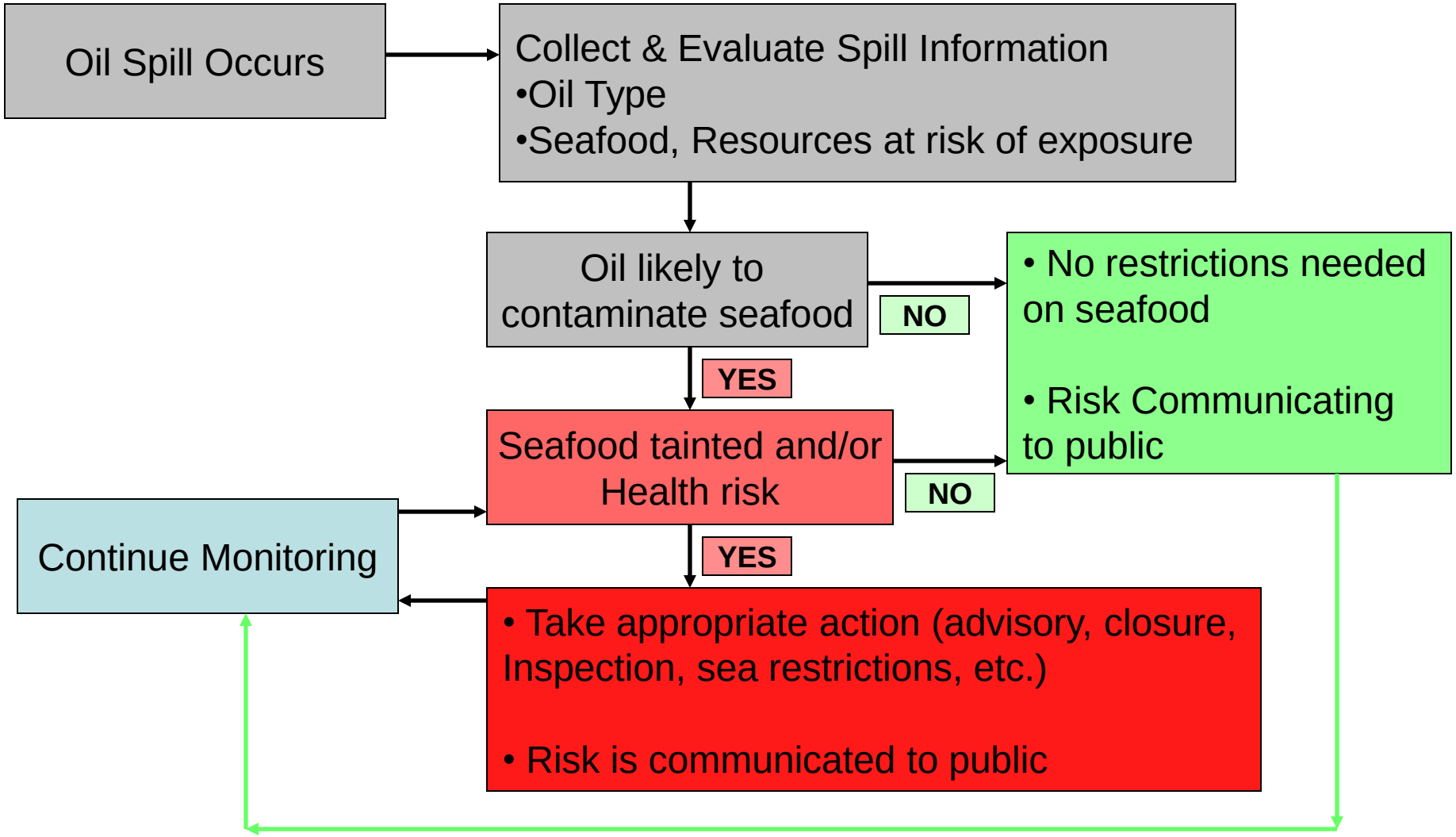
Overview of Testing Protocol

- **Protocol for sampling, testing, and re-opening closed harvest waters:**
  - **Re-opening fishing waters that were closed, but which were never actually exposed to oil.**
    - Harvest area closures include buffer zones around the contaminated areas as a precaution to account for any uncertainty about the exact location of the oil from day to day.
    - There are also areas which federal and state officials closed in anticipation that oil would enter, but it never did enter.
    - If it can be confirmed (e.g., through water quality sampling, aerial surveillance, and/or satellite imagery) that a harvest area was never exposed to the oil, that area may be re-opened without first testing seafood samples.

Overview of Testing Protocol

- **Protocol for sampling, testing, and re-opening closed harvest waters:**
  - **Re-opening harvest waters that were exposed to oil.**
    - The first criterion to be met before harvest waters exposed to oil are re-opened is that the water be free of oil from the spill.
    - Once the oil has dissipated, re-opening of harvest waters may be performed on a species by species basis; that is, areas may be open to the harvesting of certain types of seafood, like finfish, but not others.
    - For a closed area to re-open for harvesting of a given species, samples of the species taken from the waters must successfully pass both a sensory examination and chemical analysis in an approved laboratory.
    - Testing will be performed on finfish, shrimp, crabs, and mollusks (e.g. oysters/mussels).

Decision Process



Yender et al., 2002 – National Oceanic and Atmospheric Administration

Sensory Testing

- Four Principles to establish protocol:
  - NOAA/FDA – worked with other federal and state agencies to protect consumers and economic impact
  - Oil or chemical contaminants observed on surface – recommended that fishery be closed
    - Subsequent testing required to confirm safety
  - After initial fishery closure – the best approach to insure safety and acceptability involves organoleptic analysis → followed by chemical analysis
  - Fishery closure area include areas that NOAA projects will have surface oil and a precautionary buffer zone around known contaminated waters
    - After it has been determined that oil did not enter an area it can be re-opened

Sensory Testing

- Response to the BP Oil Disaster in April 2010.
  - Debate on what is deemed safe levels
  - Expense of analytical vs sensory testing/training
  - Specialists with NOAA train their noses to detect contaminated seafood.
  - Training sessions in several coastal locations including Mississippi, Louisiana, Alabama, and Florida
- Many of the coasts of Mississippi, Louisiana, Alabama and other states reopened quickly due to the testing
- Media tended to report more of the shock, playing on the human emotions. This may have actually hindered the recovery of the Gulf Coast Seafood market

Sensory Testing

- Protocol for interpretation and use of sensory testing and analytical chemistry results for re-opening oil-impacted areas closed to seafood harvesting due to deepwater Horizon oil spill.
  - June 2010
  - Updated November 2010

http://www.fda.gov/food/ucm217601.htm

Sensory Screening

- Sensory Screening ‘obvious taint’ in seafood harvested from open waters
  - Training – exposure to actual Gulf seafood samples spiked with potential petroleum samples (taint)
  - Certification – Training documented per persons and firms completing the formal courses for implementation of monitoring and verification procedures in the special HOW (Harvest from Open Water) program for Safe Gulf Seafood

Sensory Testing

- **Criteria for sensory trained testing:**
  - Up to 6 sub-samples per seafood type (3 sub-samples for oysters) from each sample location
    - » A sub-sample consist of an individual organism for legal size finfish and multiple organisms for shrimp and shellfish, depending on the intact animal type (e.g. 6 blue crabs, 10 oysters, 0.5 lb shrimp)
  - Sufficient material to analyze both the raw and cooked odor state and to assess the cooked flavor
  - Samples evaluated by a panel of a minimum of 7 expert assessors in raw and cooked state

Sensory Testing

- **Criteria for sensory trained testing:**
  - Samples were evaluated in the following order
    1. Raw odor
    2. Cooked odor
    3. Cooked flavor
  - If at any time the analyst finds detectable petroleum or dispersant, the analyst will not further evaluate the sample
  - For consideration for reopening the following criteria must be met
    - » Minimum of seventy percent (70% – 5 out of 7) of expert assessors must find NO detectable petroleum or dispersand odor or flavor from each sub sample
    - » If any sub-sample fails, the sample location fails
    - » All contiguous stations or sample locations must pass for an area to be open


Picture from NOAA

Sensory Testing

- Panelist evaluate samples in a glass container with glass lid
- Trained panelist able to detect 5 ppm (sniff test)
- 10 ppm is approximately
  - 1 drop of oil in 1 gallon of water
- Pass or Fail
- Fail – must rank
  - F1 – F4 (Slight to Strong)

Steve Wilson – Chief Quality Officer for Seafood Inspection Program at the NOAA Evaluates samples (picture from NOAA)

Sensory Testing

- Concerns with Organoleptic Training
  - Media have raised concerns of organoleptic testing.
  - The federal government of the United States has researched and fish are being regularly sensory tested to make sure they are safe for human consumption.
  - Some in the media have laughed off the idea of organoleptic “scent” based testing, but scientists in toxicity have stated that not only is it a highly effective means of testing for contaminants that could be dangerous to people
  - It is more cost effective

Sensory Testing

- Certification Program (Steve Otwell – University of Florida)
  - The nose provides a safety hurdle
  - Organoleptic “Oil Sniffing” Program – Adds one more layer of protection to complement extensive government sampling and chemical analysis
  - Over 200 companies from every Gulf state have participated
  - Sniffing program originally designed to help seafood processors know what to smell for as fish arrives on their dock
  - Grocery store and restaurant owners also are participating in the program
  - Full recovery of the Gulf is unknown
  - Seafood workers trained how to sniff oil in an effort to battle what they regard as the industry’s biggest challenge.

Sensory Testing

- Certification Program
  - Extension conducted courses to help train and identify contamination through organoleptic sensory testing
  - Scientists from several government agencies has reported that testing has consistently shown that Gulf fish are safe.
  - The National Oceanic and Atmospheric Administration reopening more than 4,000 square miles of closed Gulf fishing areas off western Louisiana due to testing verifications shortly after the release of oil

Analytical Testing

- Periodic Analytical Screening for route, practical verification per harvest from open waters & approved fisheries
  - Training – Directions for sampling, packing and identifying fish products for subsequent analytical verifications
  - Chemical Analysis – Services utilizing recognized routine analytical screening procedures for samples of harvest from open waters as provided by certified primary processors
  - The FDA is coordinating the testing program in collaboration with the National Oceanic and Atmospheric Administration.

Faculty member Robert Poppenga, a veterinary toxicologist, handles samples of seafood in the California Animal Health and Food Safety Laboratory.

Analytical Testing

- **Criteria for chemical testing:**
  - The federal surveillance program will rely on two levels of testing.
  - If all tested samples of a given species from a collection site pass the sensory criteria, additional samples will undergo chemical analysis to determine if harmful levels of PAHs are present.
  - If harmful levels of PAHs are found in the samples, the site from which the sample was collected fails and remains closed.
  - If the levels of PAHs in the seafood samples do not pose a health concern the site will be considered eligible for re-opening.
  - All contiguous sites must pass both sensory and chemical testing for an area to re-open.

Analytical Testing

- Participating labs are part of the Food Emergency Response Network (FERN) – a group of local, state and federal laboratories that are equipped to test for food contamination.

- UC Davis
  - The California Animal Health and Food Safety Laboratory at UC Davis School of Veterinary Medicine is one of eight state and federal laboratories nationwide
    - Chosen by the federal government to monitor seafood from the Gulf of Mexico for toxins related to the Gulf oil spill.
    - Seafood from the oil spill began arriving for testing in early August 2010.
  - The other participating labs are located in Colorado, Arkansas, Georgia, Missouri, Arizona, Wisconsin and Florida.

Analytical Testing

- UC Davis: Dr. Poppenga - “Petroleum crude oil is a very complex mixture of chemicals, and some of the chemicals within that mixture are potential cancer-causing agents,” “So we’re going to focus on those that are of primary concern to human health.”
  - Of interest is a group of chemicals known as polyaromatic hydrocarbons (PAHs) such as
    - Benzene,
    - Naphthalene
    - Fluorine
    - Anthracene
    - Pyrene
    - Benzo(a)pyrene
    - Others - baseline levels for some petroleum compounds that are commonly found at very low levels in most indoor environments.

Analytical Testing

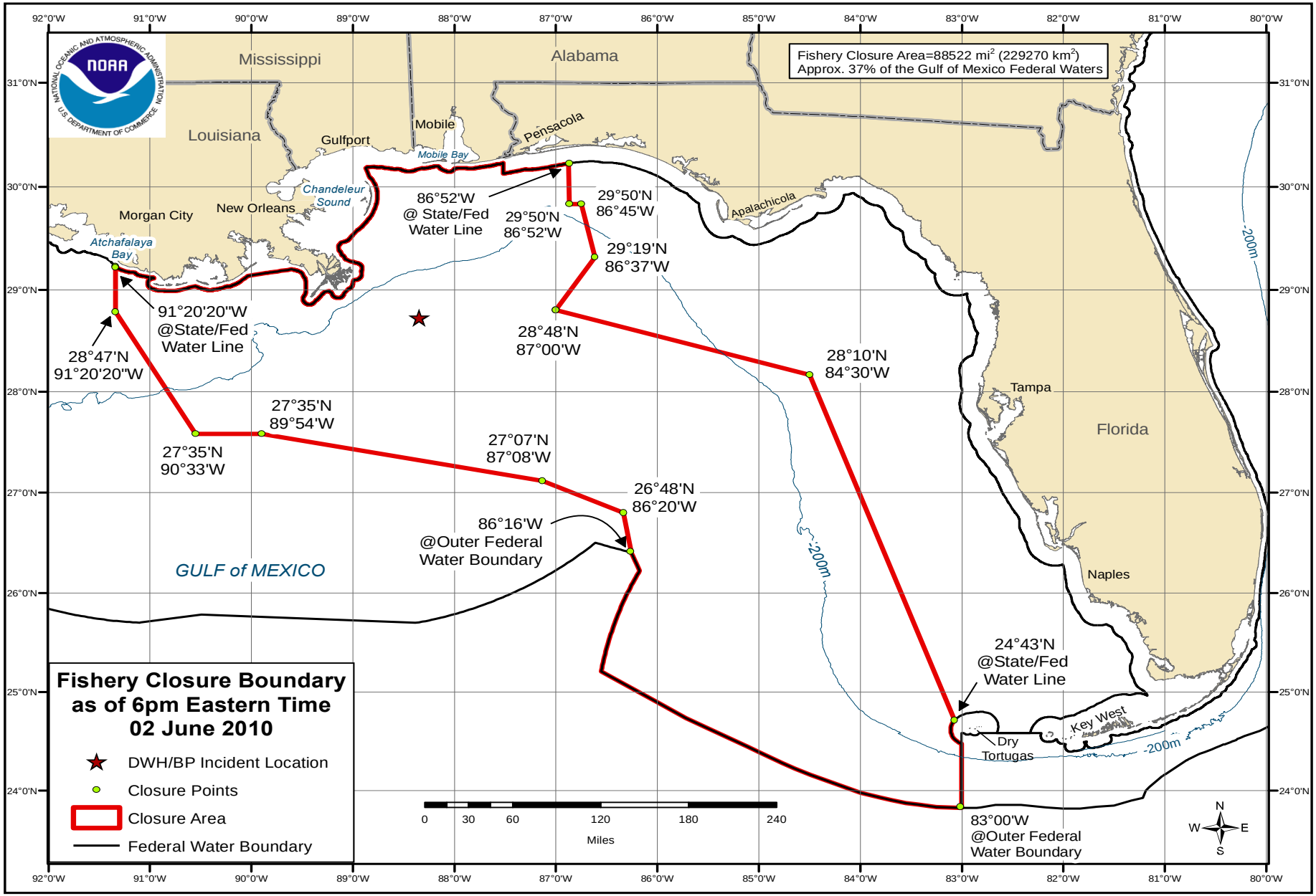
- Chemicals examined for contamination down to the parts-per-billion level
- Takes four to five days to process each seafood sample.
- All data from the tests reported back to the FDA.
- The results are used to determine which areas of the Gulf of Mexico have oil-contaminated seafood and which areas can be reopened to commercial fishing.

Summary of Testing

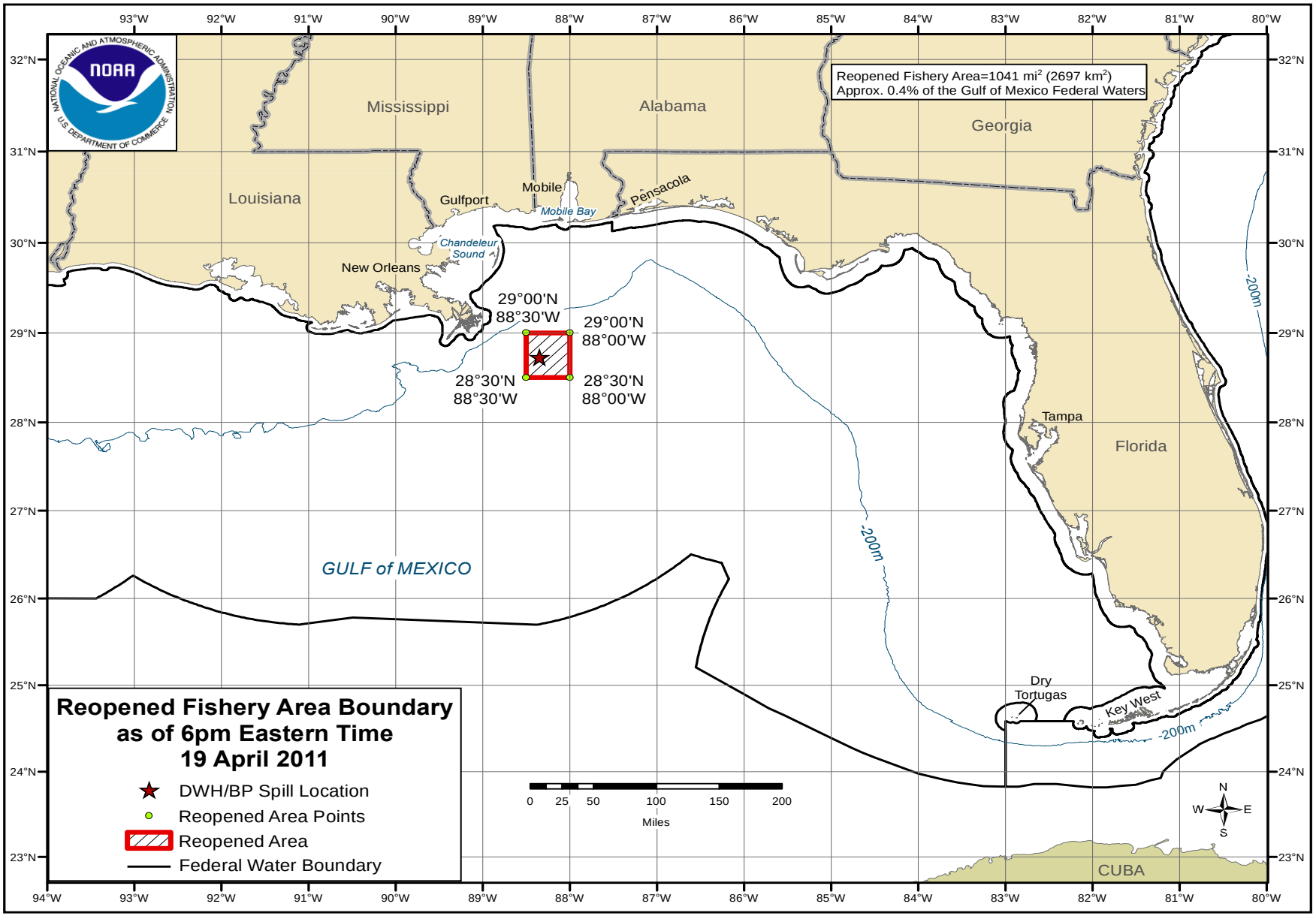
- After an oil spill
  - Seafood suspected of oil contamination can only be brought into interstate commerce when it passes both
    - Sensory testing for petroleum taint
    - Chemical analysis for PAHs

Specialists with NOAA train their noses to detect contaminated seafood at the NOAA center in Pascagoula, MS. © BP p.l.c.

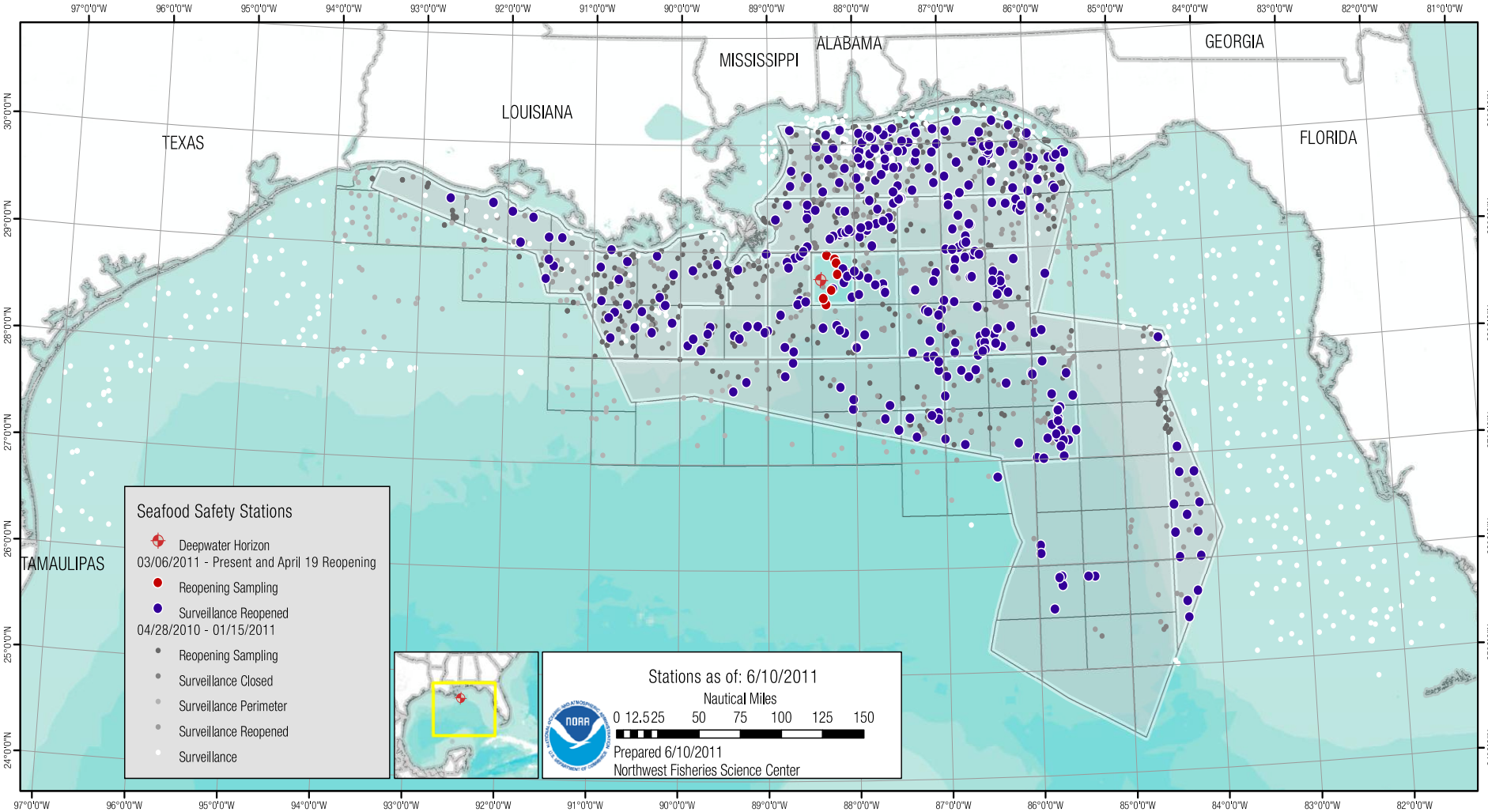
Where we were…



Were we are…


Reopened Fishery Area=1041 mi² (2697 km²)
Approx. 0.4% of the Gulf of Mexico Federal Waters
Mississippi
Alabama
Georgia
Louisiana
Florida
Gulfport
Mobile
Mobile Bay
Pensacola
Chandeleur Sound
New Orleans
Tampa
Dry Tortugas
Key West
GULF of MEXICO
CUBA
29°00'N 88°30'W
29°00'N 88°00'W
28°30'N 88°30'W
28°30'N 88°00'W
-200m
0 25 50 100 150 200
Miles
N
S
E
W
Reopened Fishery Area Boundary as of 6pm Eastern Time 19 April 2011
DWH/BP Spill Location
Reopened Area Points
Reopened Area
Federal Water Boundary

Where we are…


TEXAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
TAMAULIPAS
Seafood Safety Stations
Deepwater Horizon
03/06/2011 - Present and April 19 Reopening
Reopening Sampling
Surveillance Reopened
04/28/2010 - 01/15/2011
Reopening Sampling
Surveillance Closed
Surveillance Perimeter
Surveillance Reopened
Surveillance
Stations as of: 6/10/2011
Nautical Miles
0 12.5 25 50 75 100 125 150
Prepared 6/10/2011
Northwest Fisheries Science Center

Where we are…

- All waters have been open
- Testing continues
- Waters may be temporarily closed periodically if oil is spotted


QUESTIONS