

Assessing ecological effects following environmental disasters, and data needs

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Environmental Disasters Data Management Workshop

National Conservation Training Center
Shepherdstown, WV

September 16, 2014

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Since 'retiring' from NWFSC in 2010, I've been a science advisor to NOAA's Oceans and Human Health Initiative, a technical advisor to NOAA's marine mammal and sea turtle TWGs for the DWH NRDA, and have been informally liaising with NIEHS on their DWH long-term human health study (GuLF).

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

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Water chemistry

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Air chemistry

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Chemicals in biota

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Biological measures in individuals

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Population metrics

New research on petroleum in the water column is raising concerns for eggs and larvae

Oil spills and fish health: exposing the heart of the matter

JOHN P. INCARDONA^a, TRACY K. COLLIER^b AND NATHANIEL L. SCHOLZ^a

^aEnvironmental Conservation Division, Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Seattle, Washington, USA

^bOceans and Human Health Initiative, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA

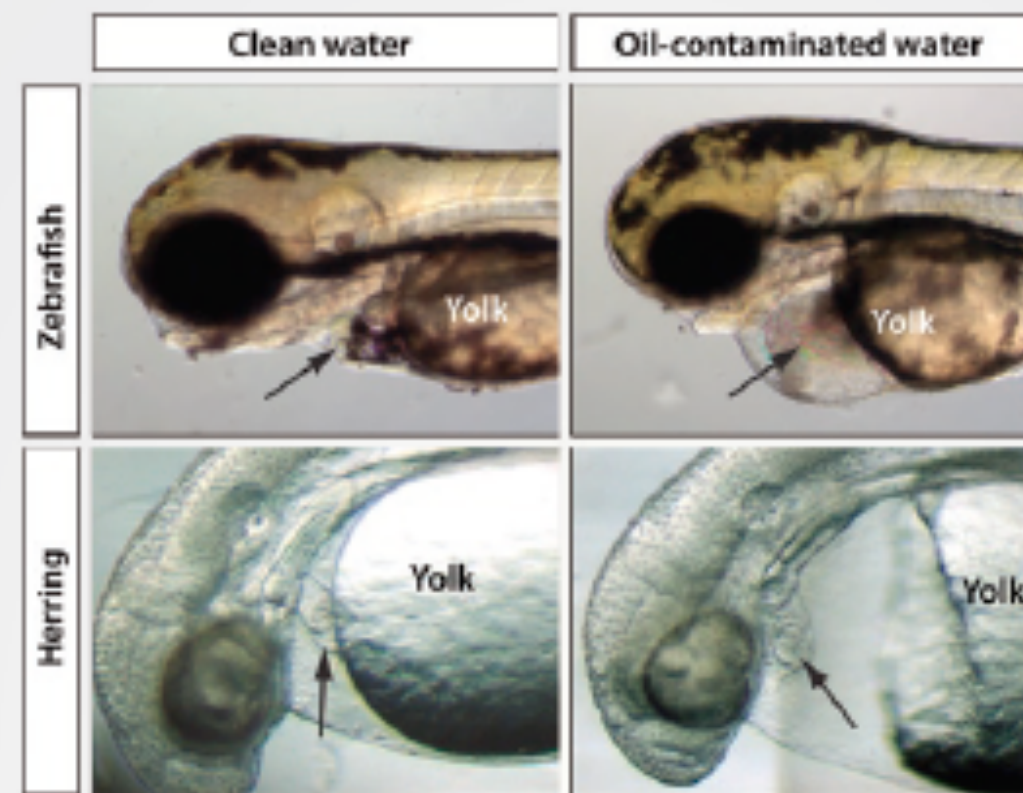
Address all correspondence to john.incardona@noaa.gov

Journal of Exposure Science and Environmental Epidemiology published online 10 November 2010;
doi:10.1038/jes.2010.51

The chemical complexity of crude oil and its fuel products poses many important challenges for exposure science in marine ecosystems that support productive fisheries throughout the world. Meeting these challenges will enable better decisions on approaches to protecting and restoring these ecosystems.

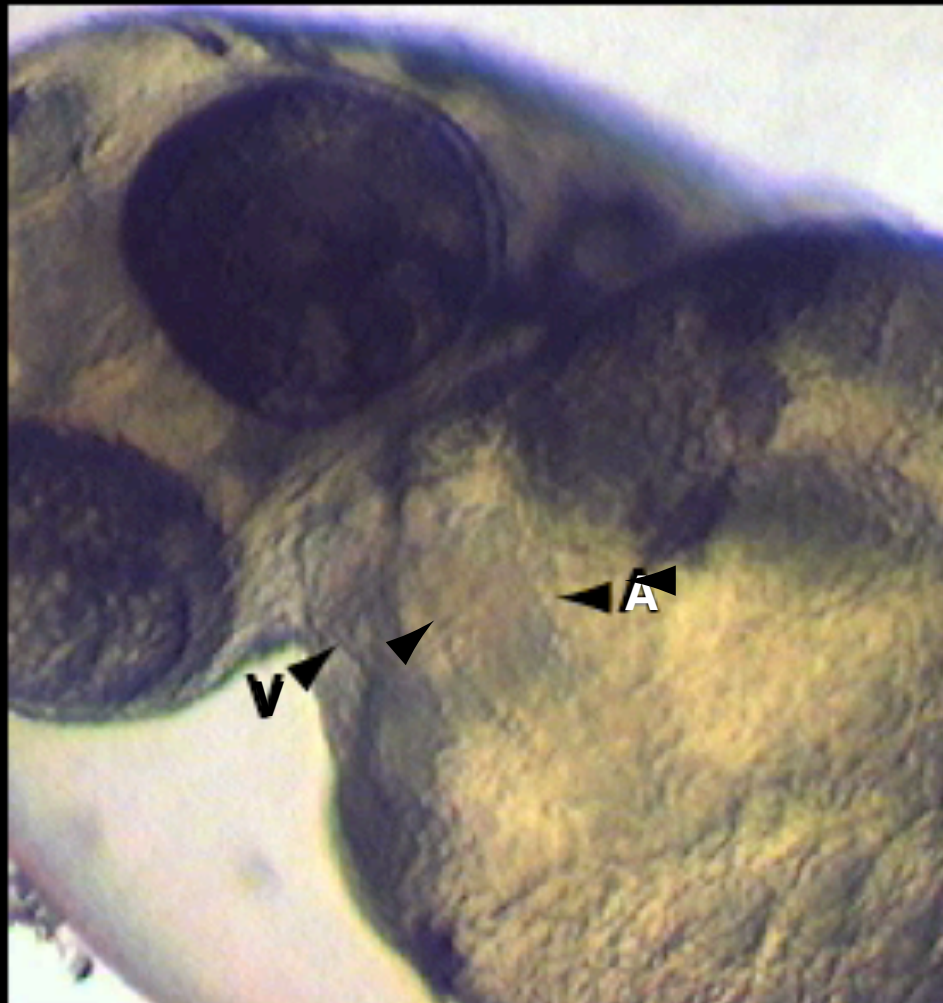
BACKGROUND

Major oil spills typically trigger heightened public concern for highly visible species such as birds and marine mammals. However, because these events do not occur every day and are difficult to study, we know much less about the unseen and more subtle effects of oil exposure in marine ecosystems. Consequently, academic



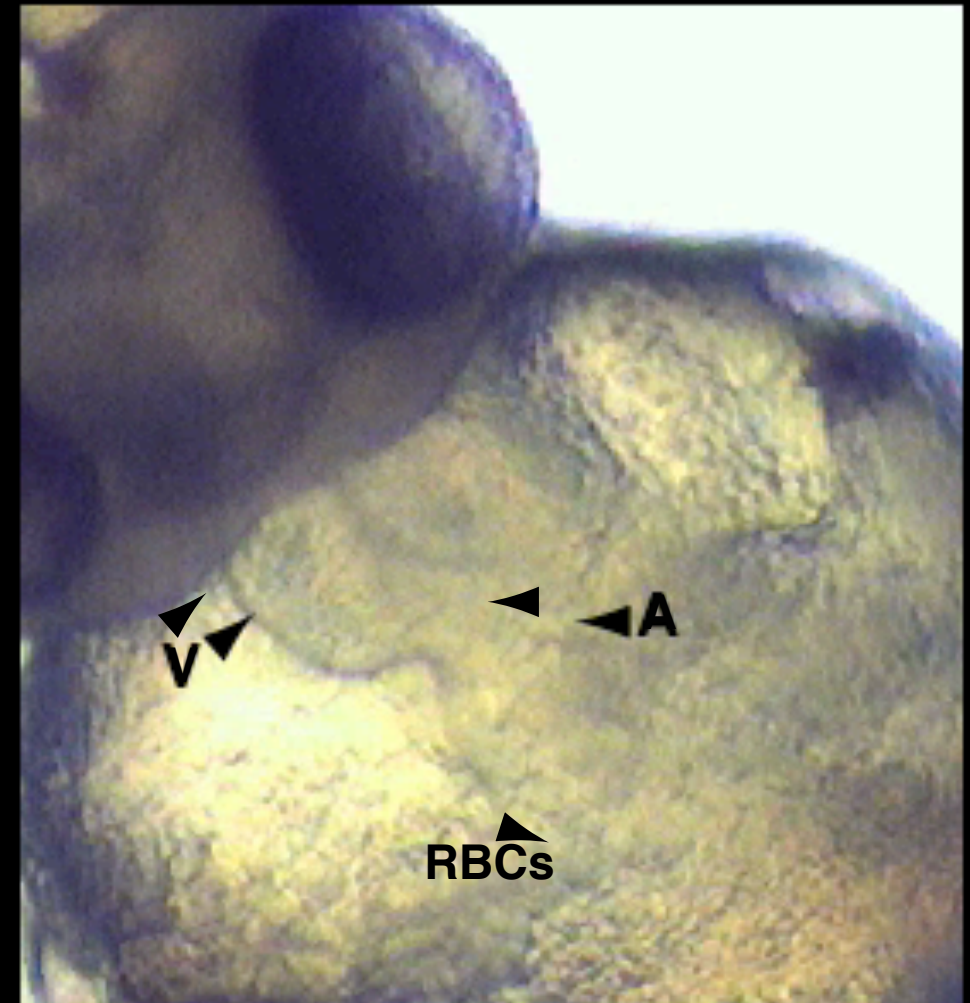
As we learn more about exposure and effects of oil spills, many assumptions are being proven wrong and more unknowns are

Cardiac dysfunction from exposure of fish embryos to very low levels of weathered crude oil



control 39 hpf

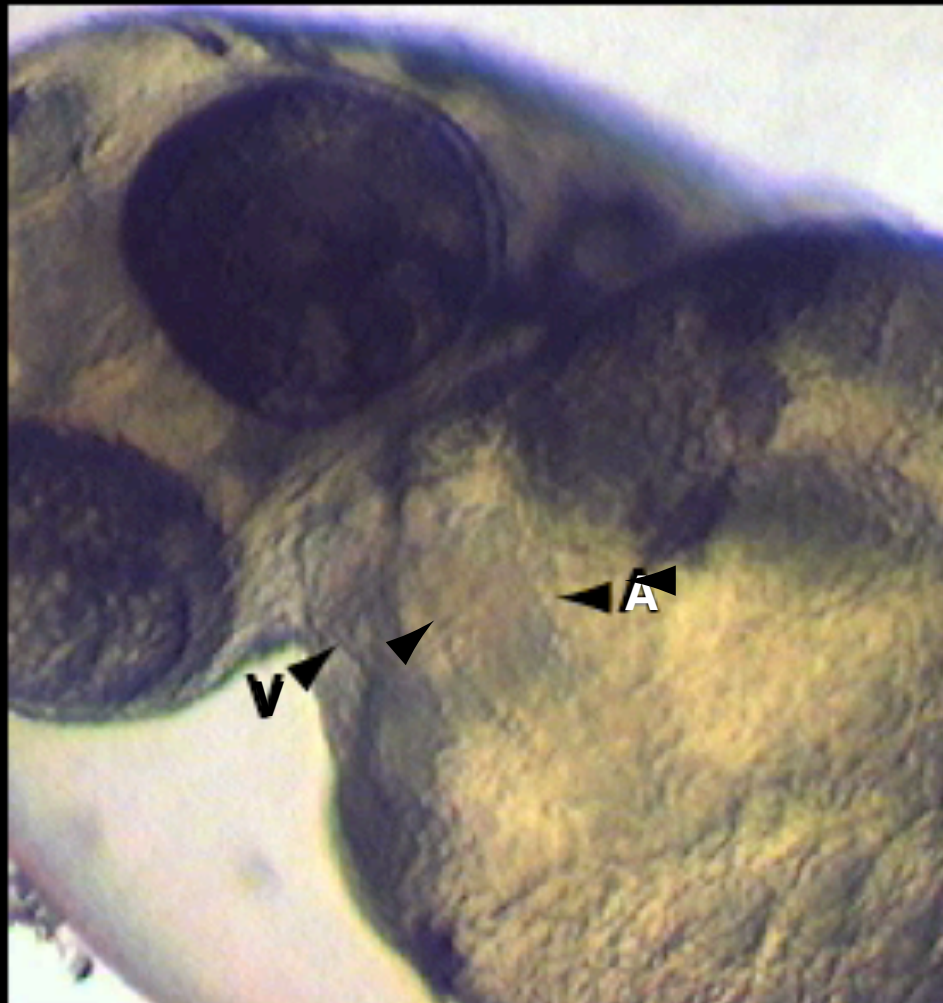
HR @ 56 hpf = 189 ± 8



weathered ANS crude 39 hpf

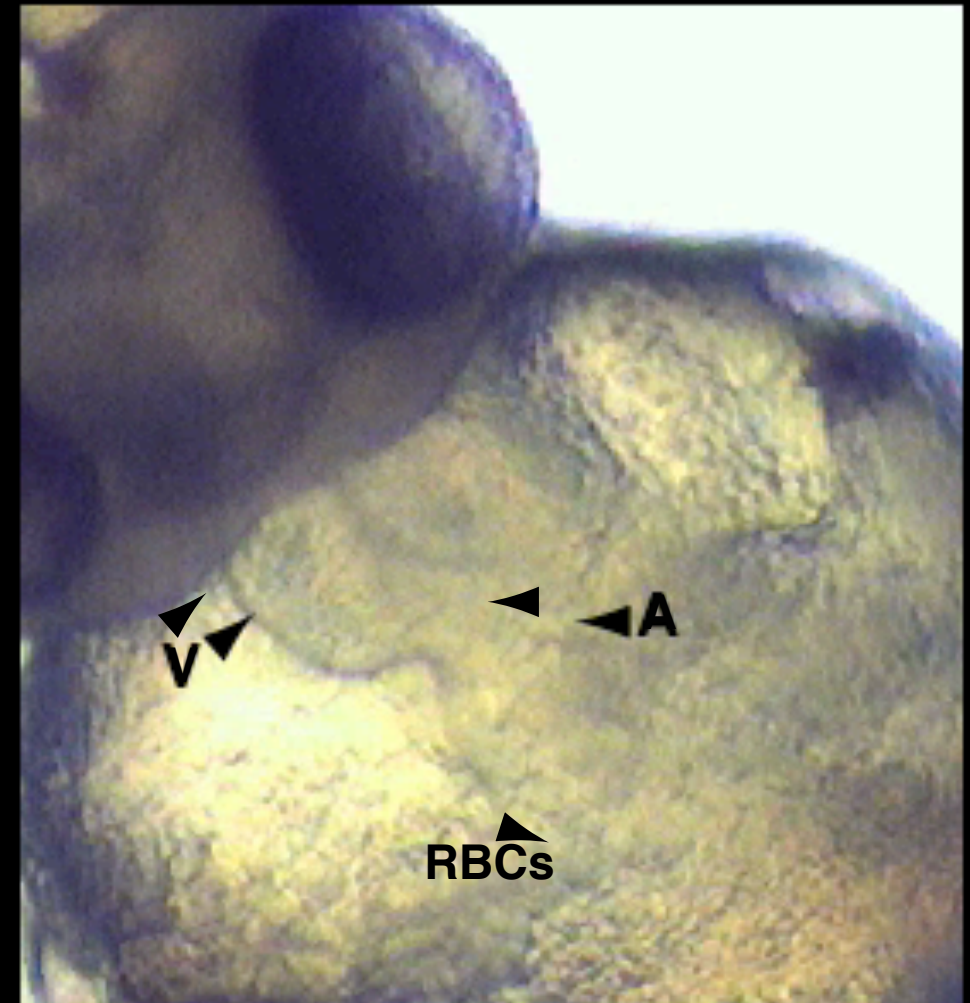
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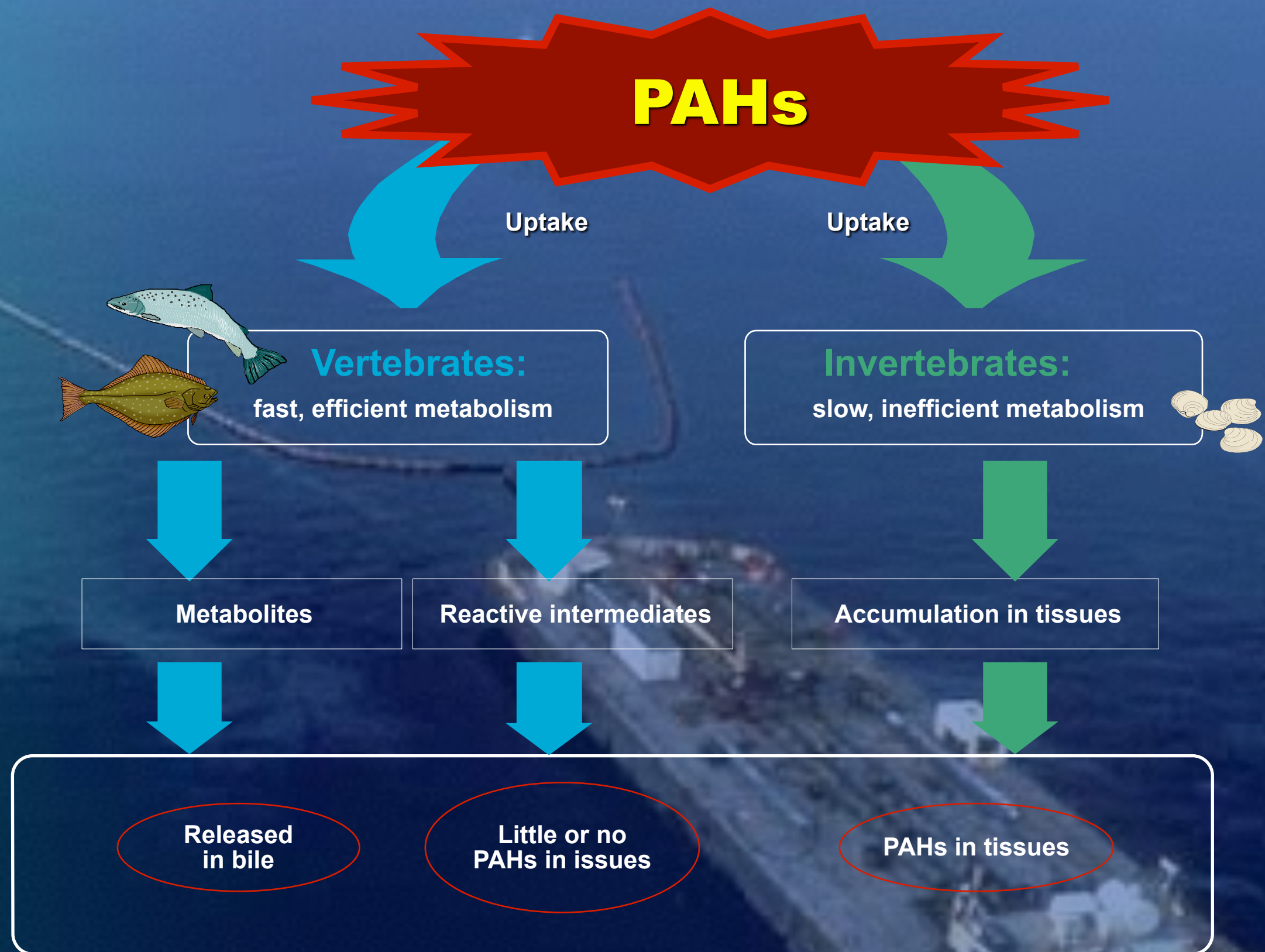
The toll free number is 1-855-NIH GULF.
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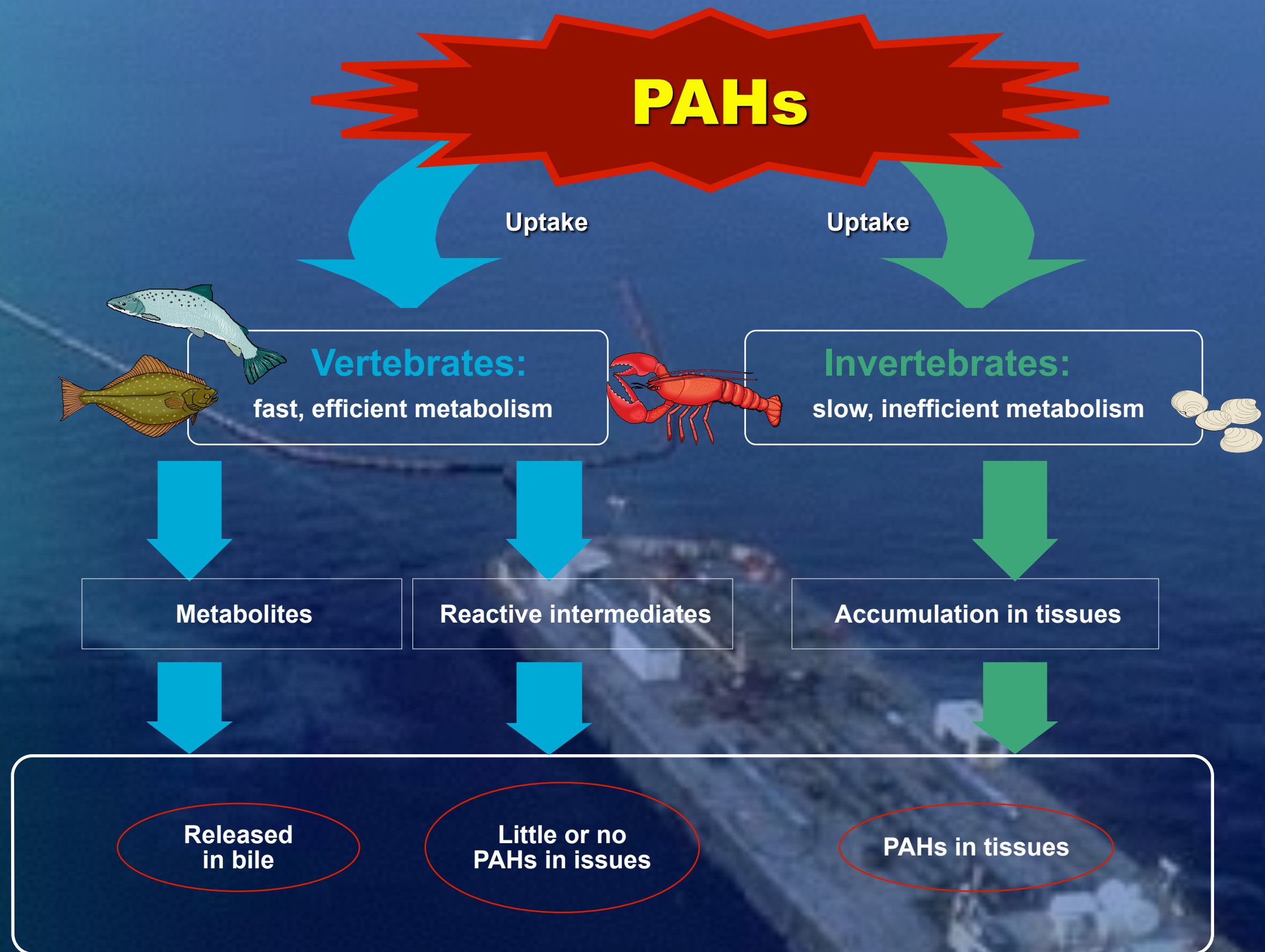
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The fate of chemicals in biota after oil spills



The fate of chemicals in biota after oil spills



Sampling
bile from
herring
using a
syringe

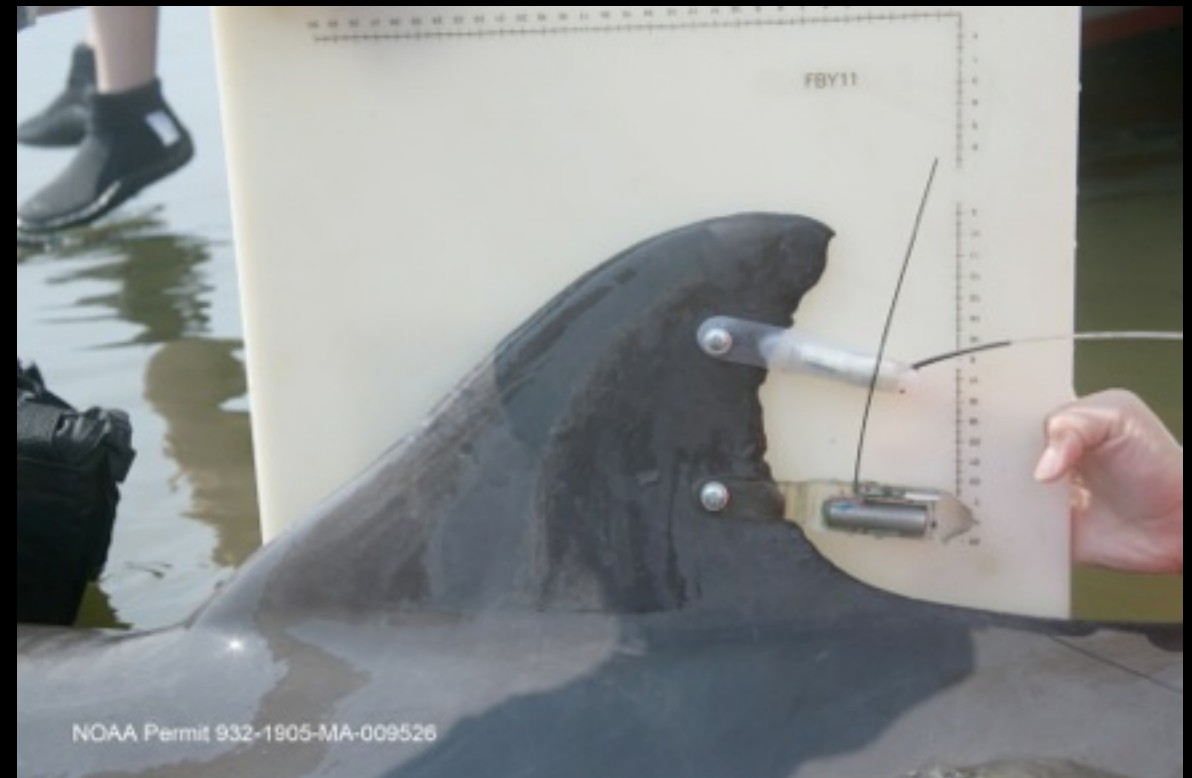


Biological measures in individuals, taken during dolphin health evaluations



Biological measures in individuals, taken during dolphin health evaluations

- Physical exam & ultrasound
- Blood, urine samples
 - CBC, serum chemistry
 - endocrinology, immunology, serology
 - urinalysis
 - chemical analysis
- Blubber biopsy
- Satellite/VHF tagging



Biological measures in individuals, taken during dolphin health evaluations

Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill

Lori H. Schwacke,^{†,*} Cynthia R. Smith,[‡] Forrest I. Townsend,[§] Randall S. Wells,^{||} Leslie B. Hart,[†] Brian C. Balmer,^{||} Tracy K. Collier,[⊥] Sylvain De Guise,[#] Michael M. Fry,[▽] Louis J. Guillette, Jr.,[○] Stephen V. Lamb,[◆] Suzanne M. Lane,[†] Wayne E. McFee,[†] Ned J. Place,[◆] Mandy C. Tumlin,[¶] Gina M. Ylitalo,⁺ Eric S. Zolman,[†] and Teresa K. Rowles[★]

[†]National Centers for Coastal Ocean Science, National Oceanic and Atmospheric Administration, 331 Fort Johnson Road, Charleston, South Carolina 29412, United States

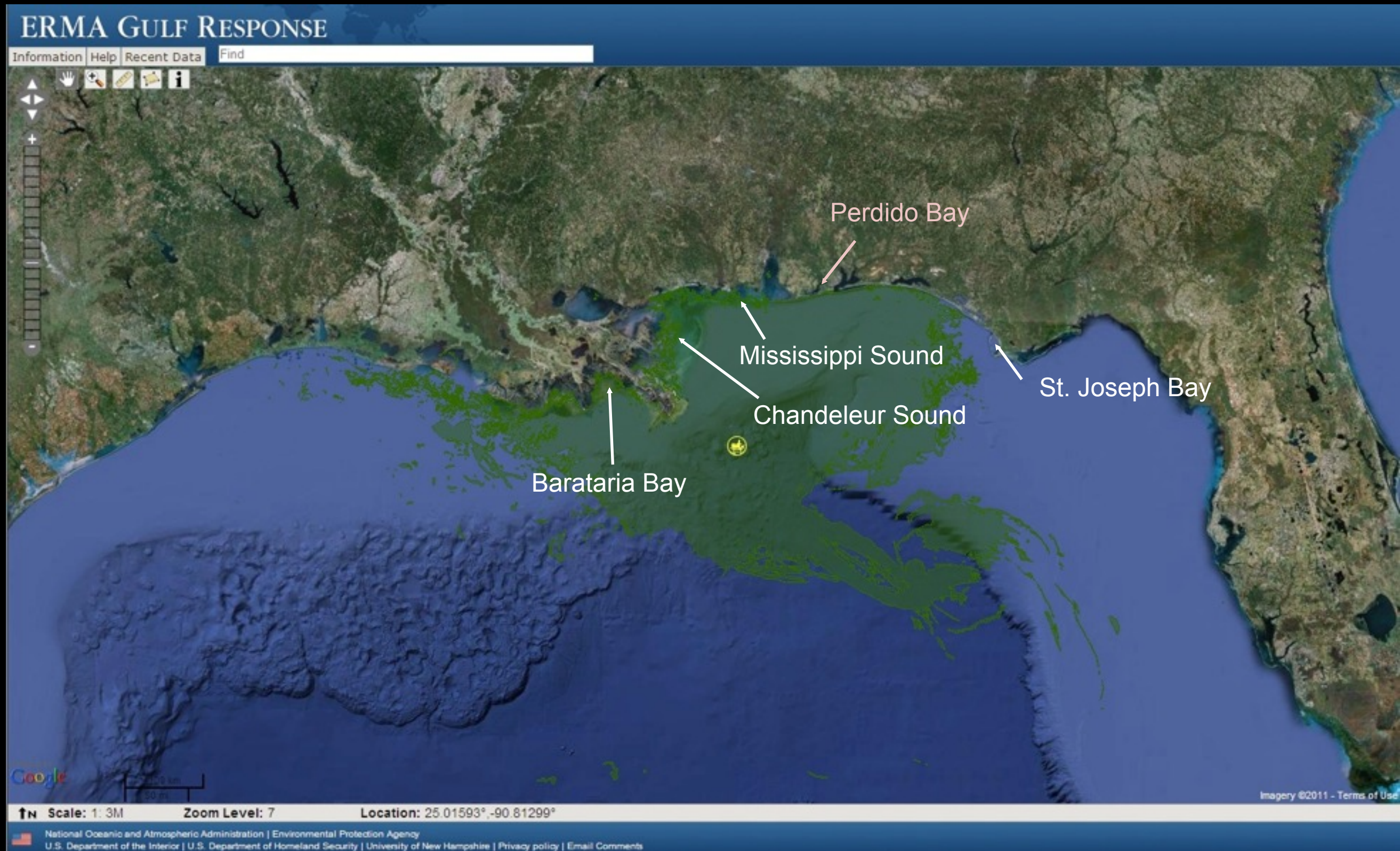
[‡]National Marine Mammal Foundation, 2240 Shelter Island Drive, Suite 200, San Diego, California 92106, United States

[§]Bayside Hospital for Animals, 251 Racetrack Road NE, Fort Walton Beach, Florida 32547, United States

^{||}Chicago Zoological Society, c/o Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236, United States

[⊥]Joint Office for Science Support, University Corporation for Atmospheric Research, 3300 Mitchell Lane, Boulder, Colorado 80301, United States

Focus Sites for *Tursiops* Nearshore Assessments



Longitudinal Vessel-Based Surveys of Dolphin Populations

- Remote biopsy tissue sampling
- Photo-identification for mark-recapture
 - Robust Design
 - Estimate abundance for each primary session
 - Estimate survival rates across primary sessions
 - Document calving events



Photo: NOAA, B. Rone

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

Water chemistry

Air chemistry

Chemicals in biota

Biological measures in individuals

Population metrics

Types of data useful for determining ecological effects of oil spills, focused on fish and higher vertebrates

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Air chemistry

"Other"

Chemicals in biota

Biological measures in individuals

Population metrics

Based on my involvement in and observations of the Deepwater Horizon oil release, and previous experience with EXXON Valdez, North Cape, New Carissa, Prestige, Hurricane Katrina, and Cosco Busan, in 2012 I told a group of European response specialists (PREMIAM—POLLUTION RESPONSE IN EMERGENCIES: MARINE IMPACT ASSESSMENT AND MONITORING) that there are pressing needs in the following areas, regarding pollution emergencies:



Science, Service, Stewardship



NOAA Fisheries' Seafood Safety Response to the Gulf Oil Spill

Aquaculture America 2012

Las Vegas, NV

Calvin C. Walker and Cheryl L. Lassitter
National Seafood Inspection Laboratory
Office of Sustainable Fisheries
Pascagoula, MS

**NOAA
FISHERIES
SERVICE**

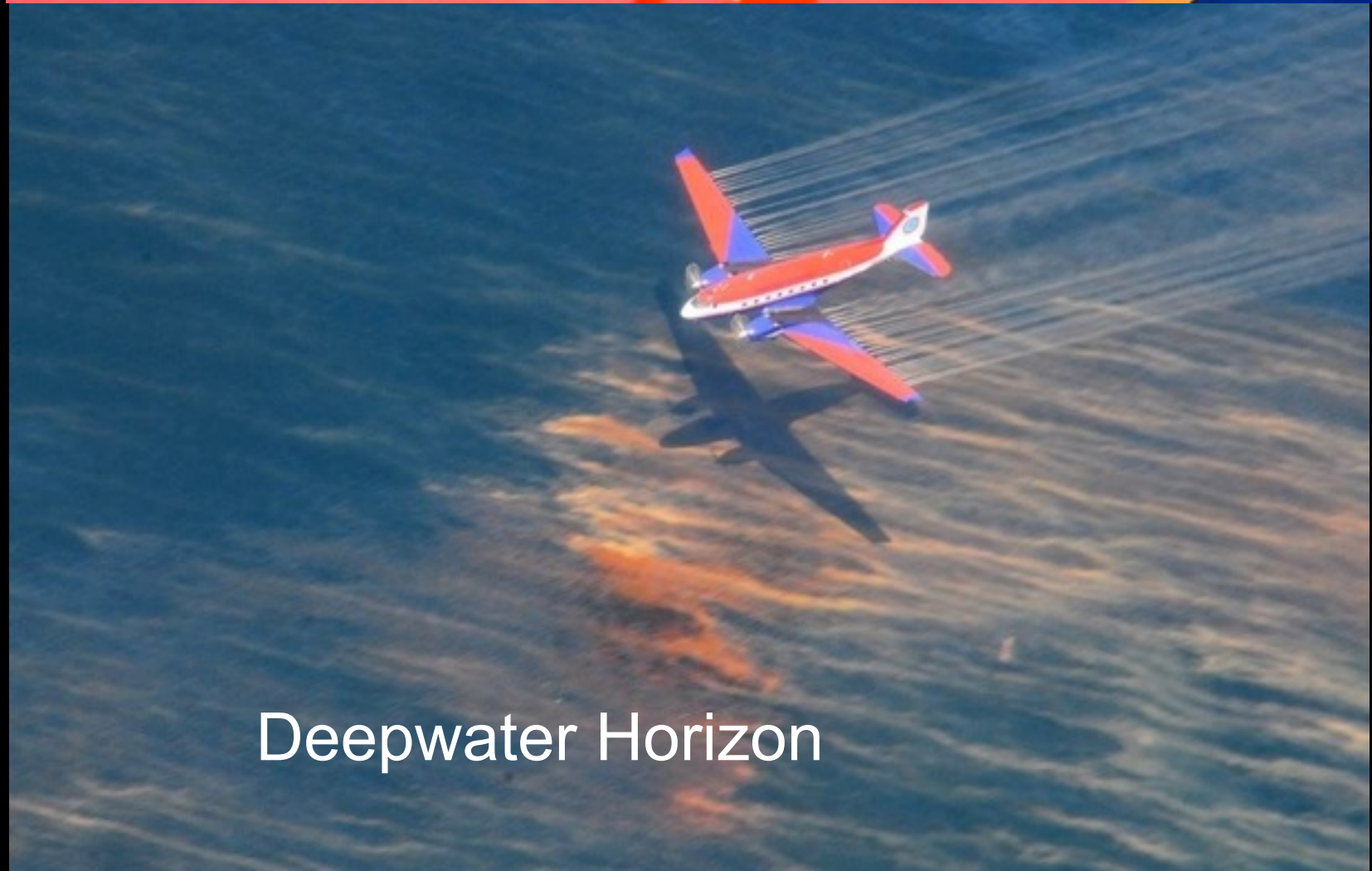
The use of dispersants

Montara



EVOS Trustee Council

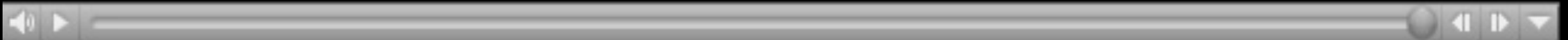
Deepwater Horizon



The effects of oil exposure on human health

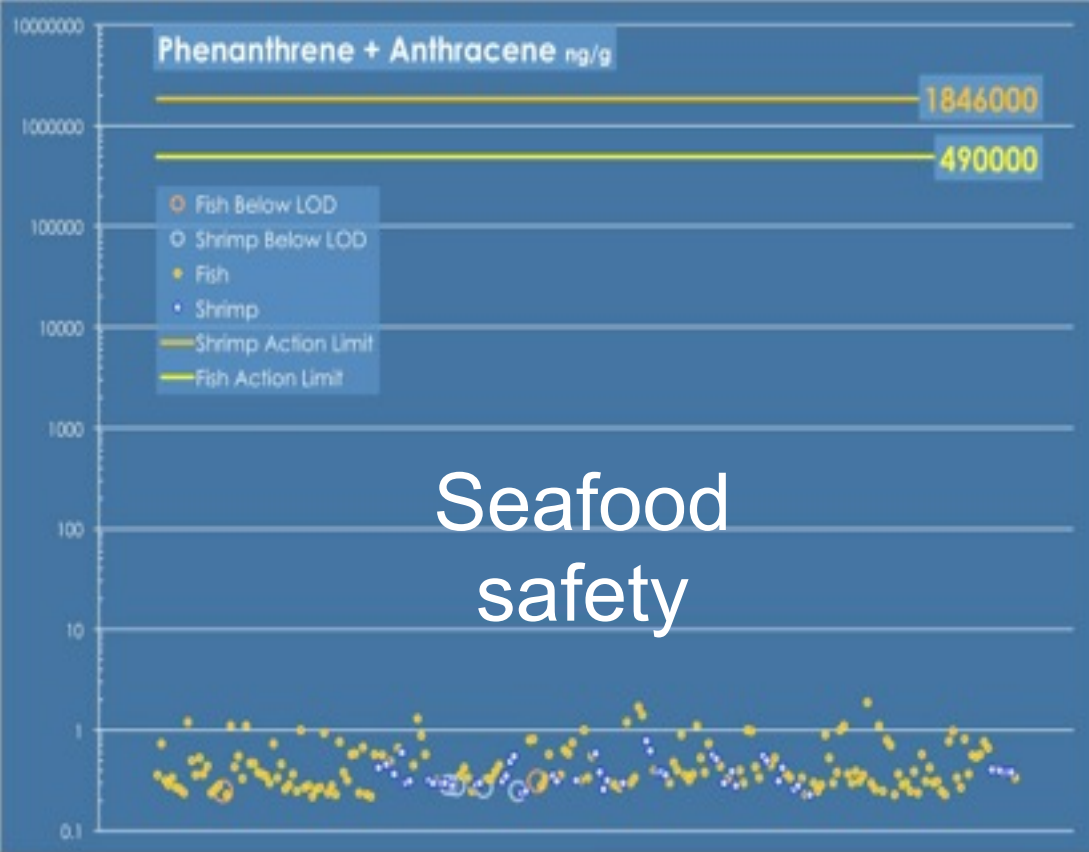


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Assessing the effects of oil spills on threatened and endangered species





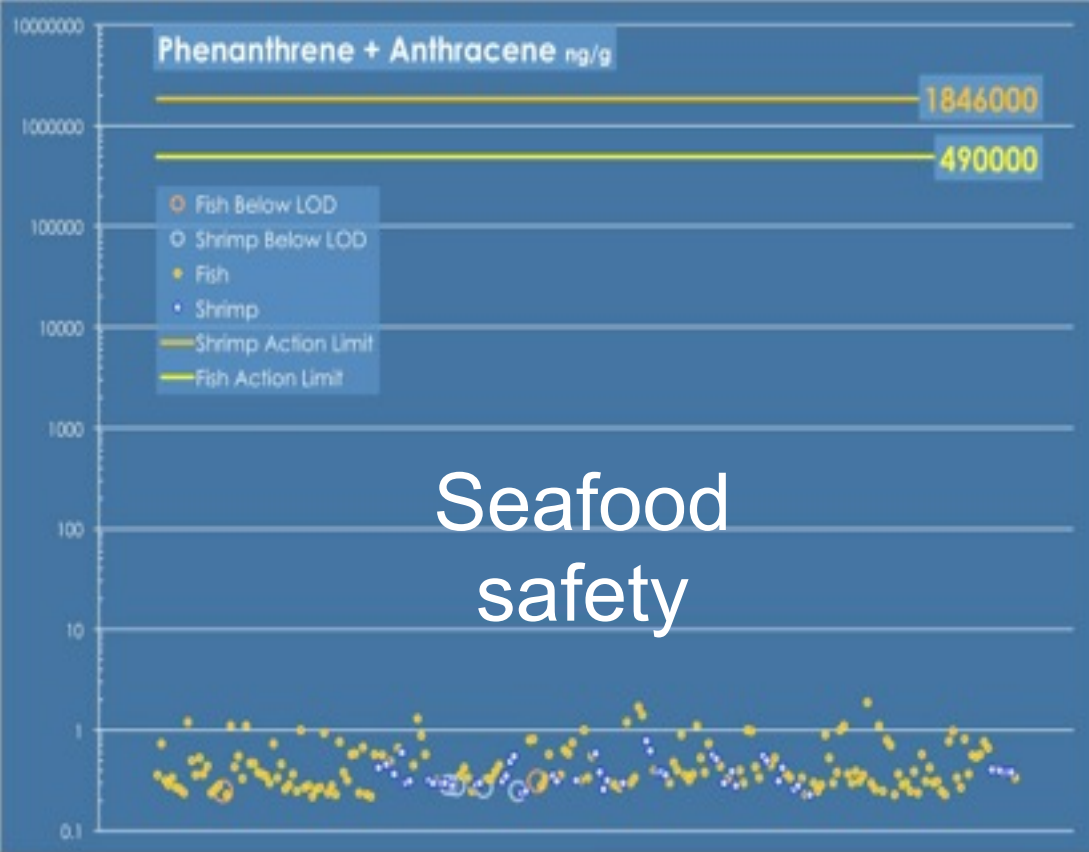
GuLF STUDY

1-855-NIH GULF 4853

Human health

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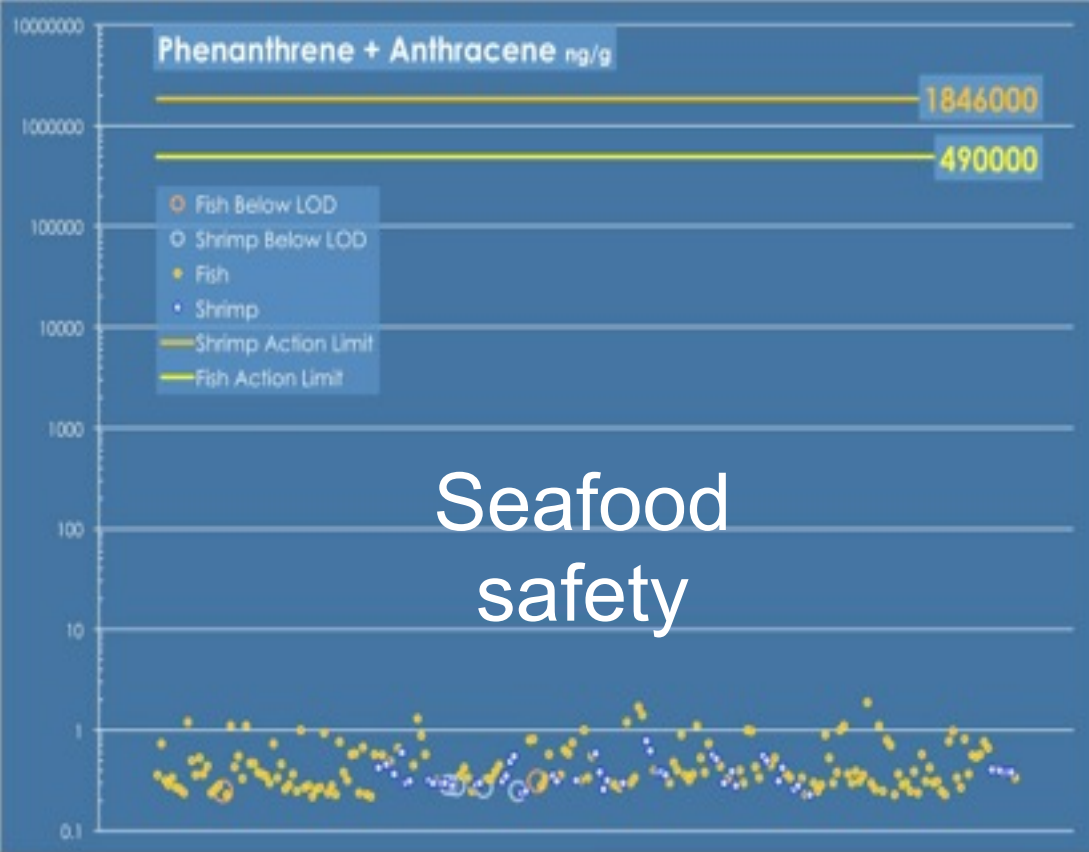
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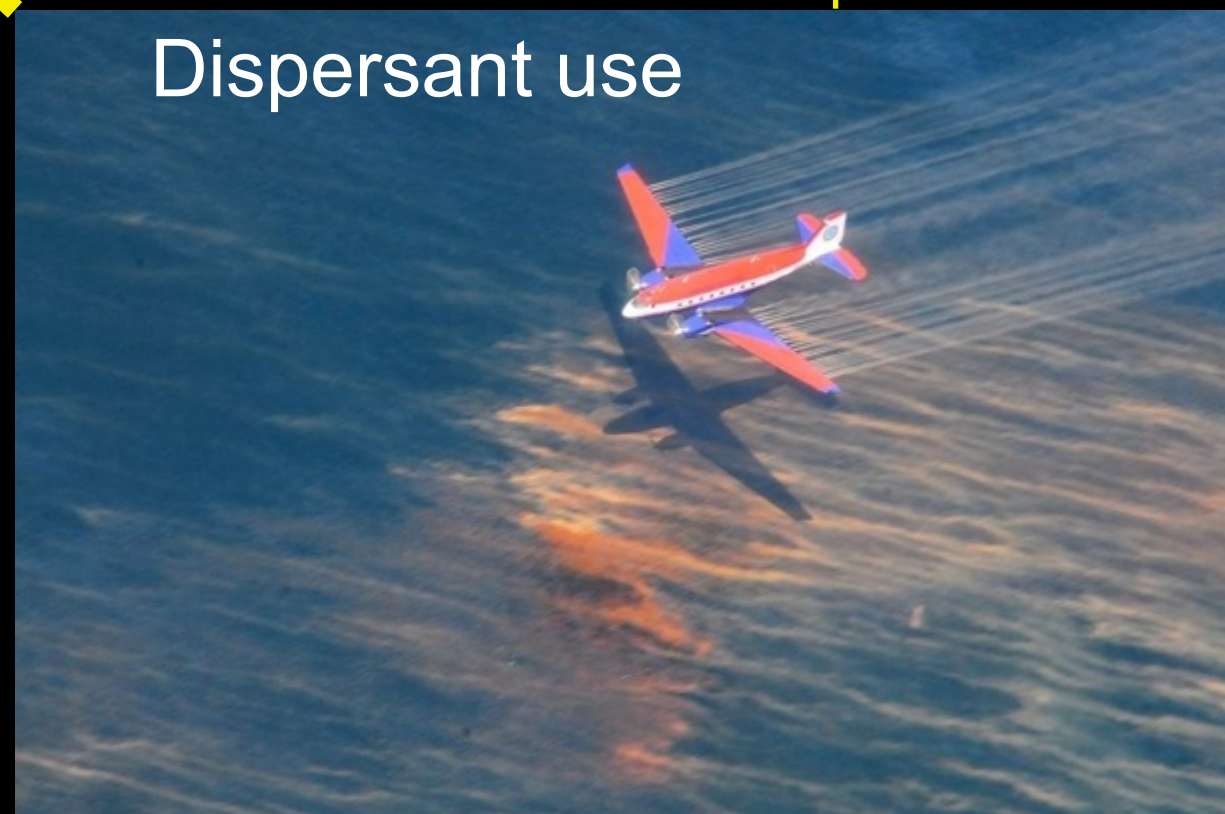


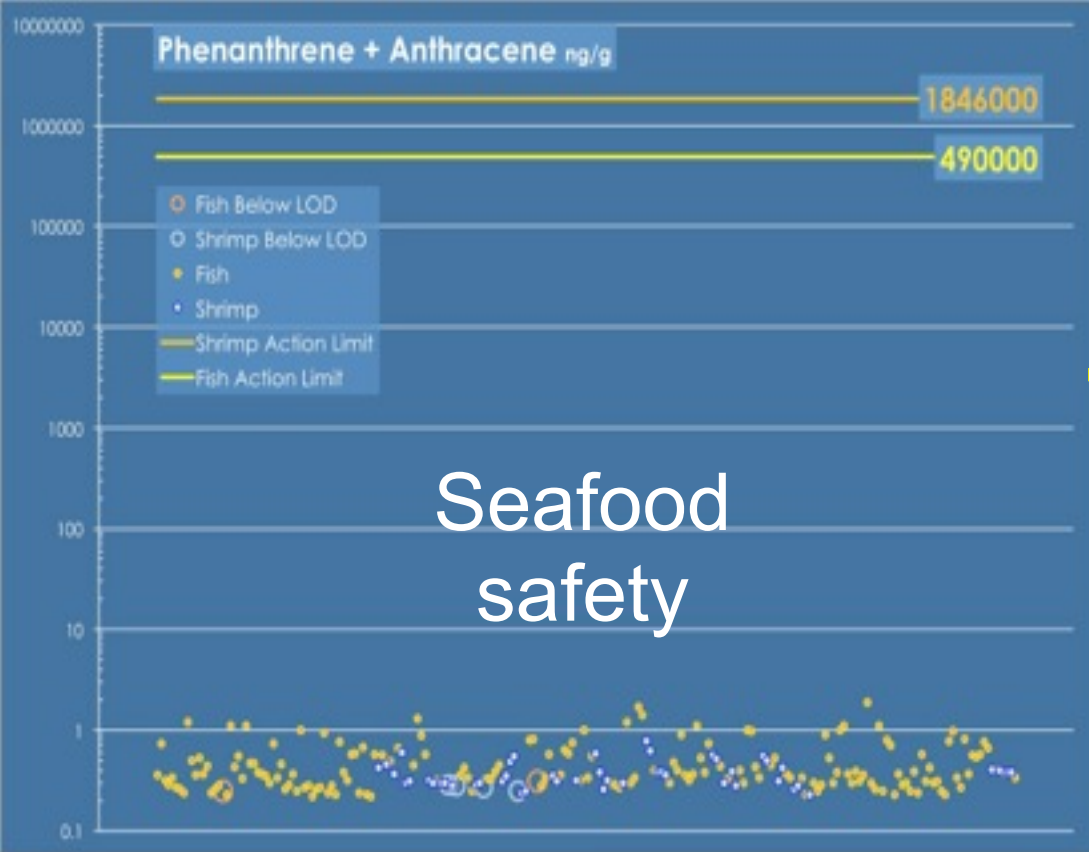
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1-855-NIH GULF 4853

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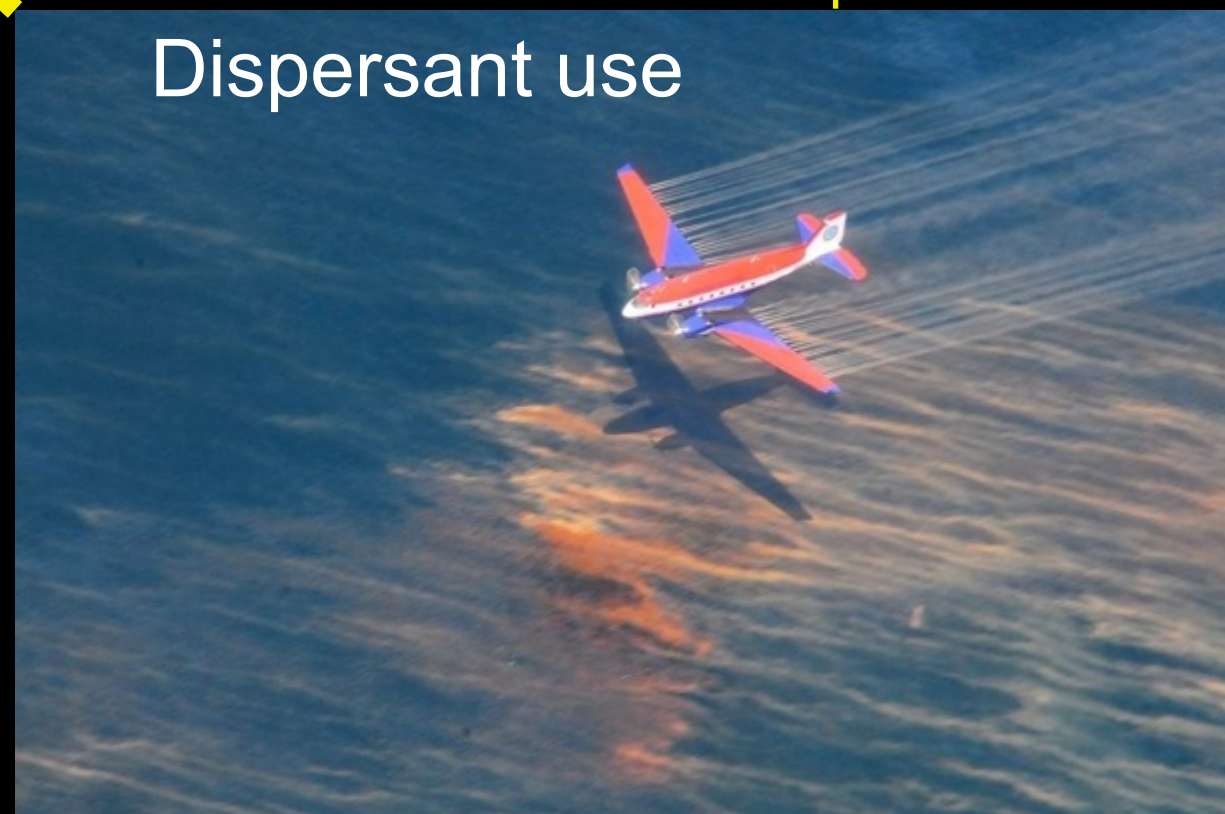
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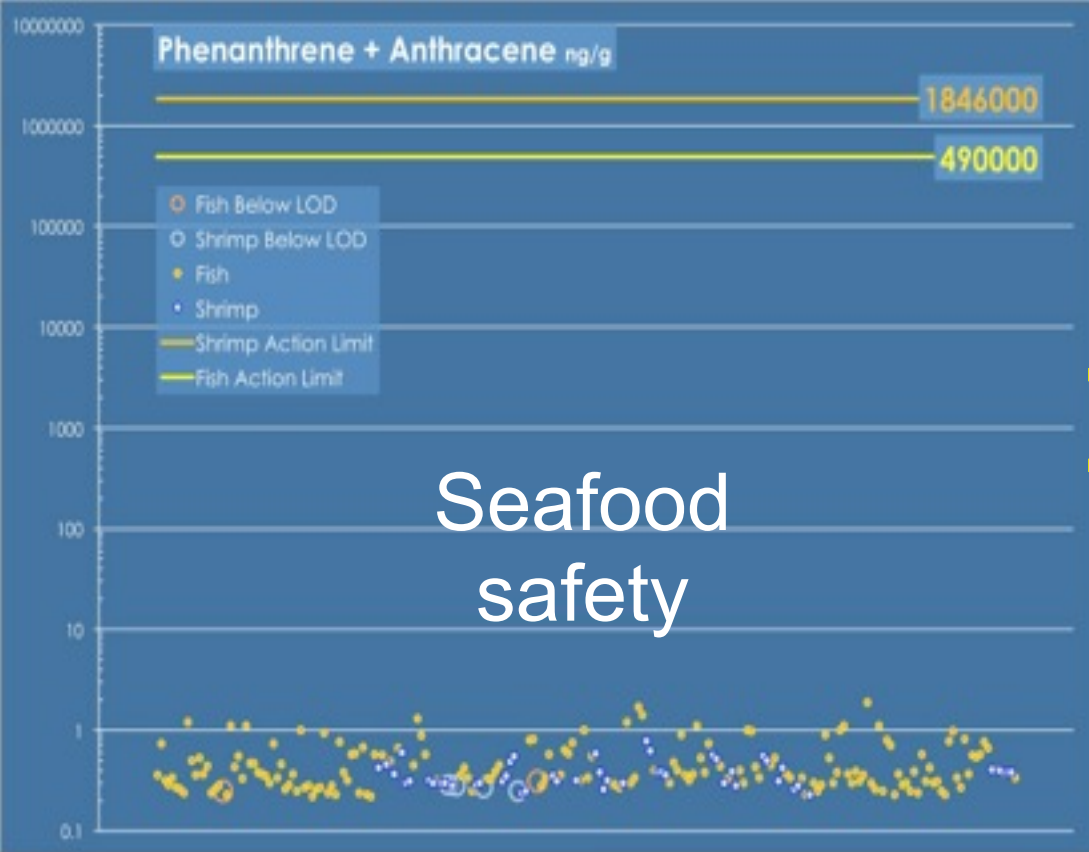
1-855-NIH GULF 4853

Human health

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Video player controls: play, pause, stop, volume, and progress bar.



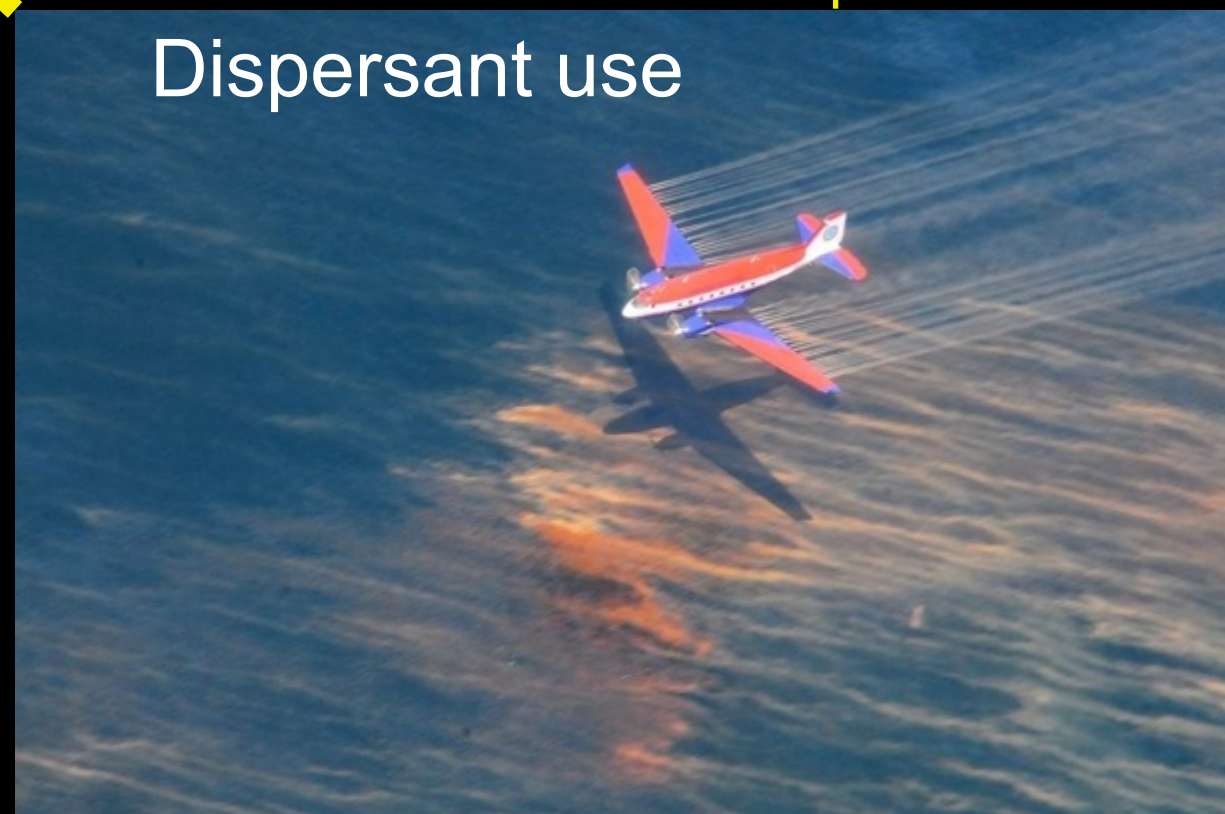


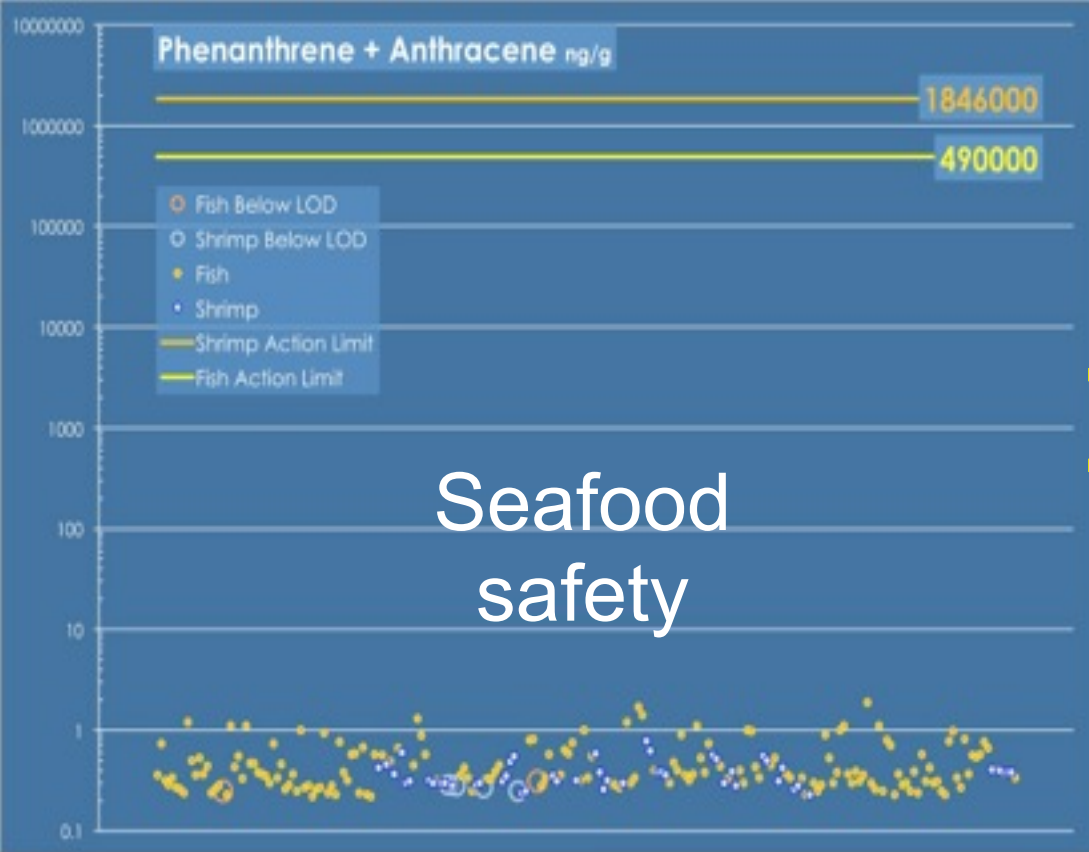
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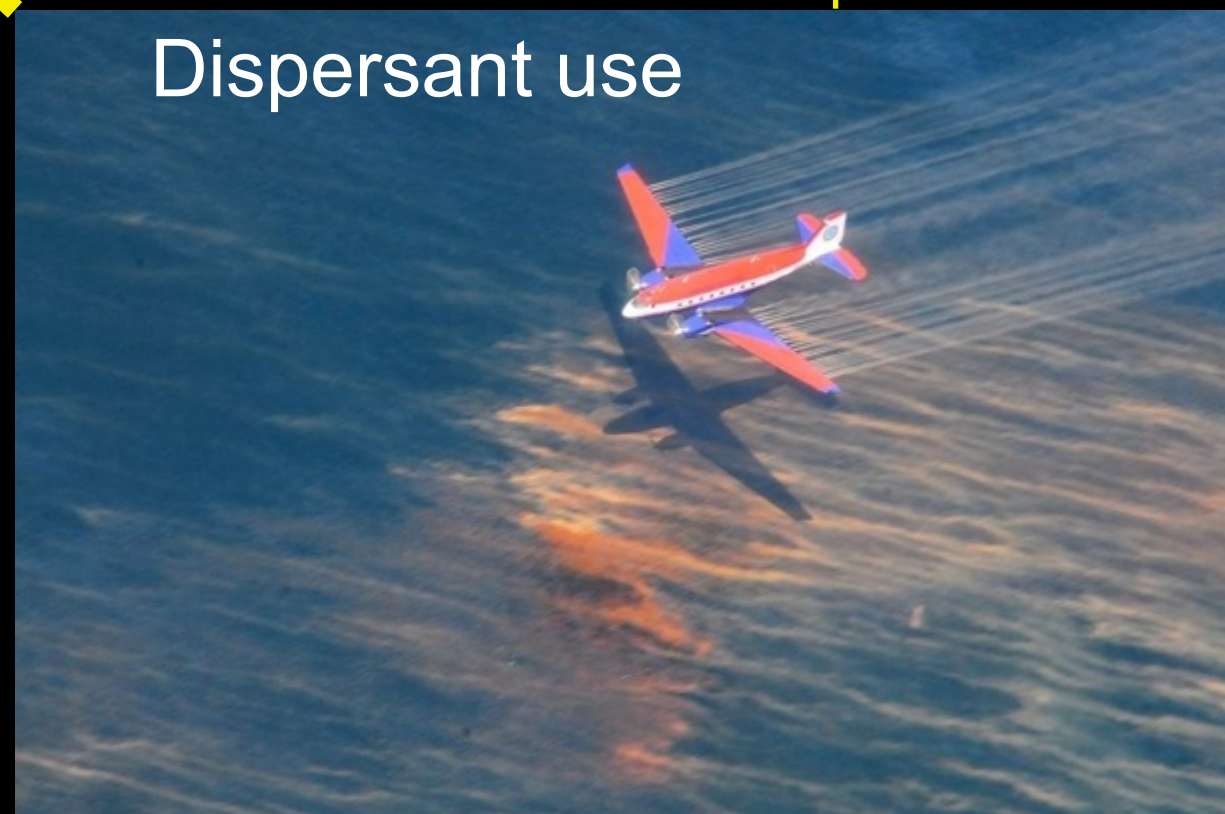
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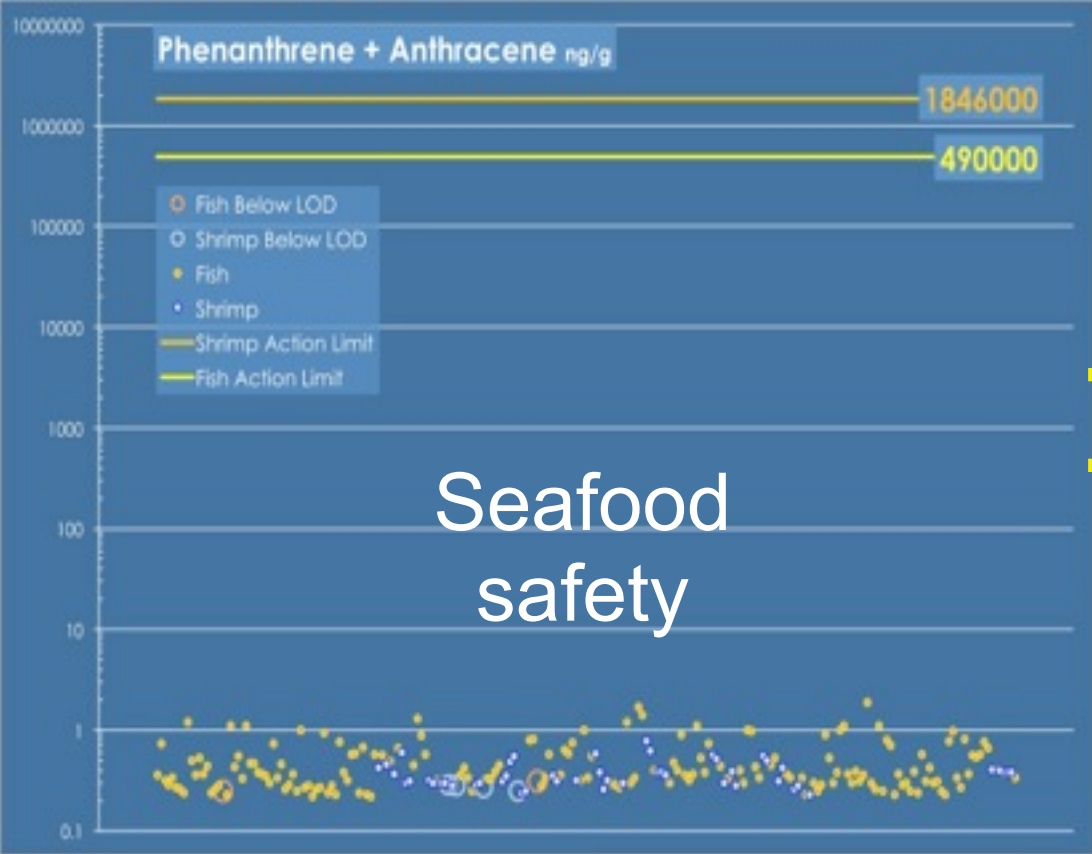
1-855-NIH GULF 4853

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The image shows the GuLF STUDY logo, which features a stylized figure inside a drop shape. Below the logo is the text 'GuLF STUDY' in large, bold letters, followed by the toll-free number '1-855-NIH GULF 4853'. A large play button icon is overlaid on the text. Below the text is a video player interface with a progress bar and control buttons.





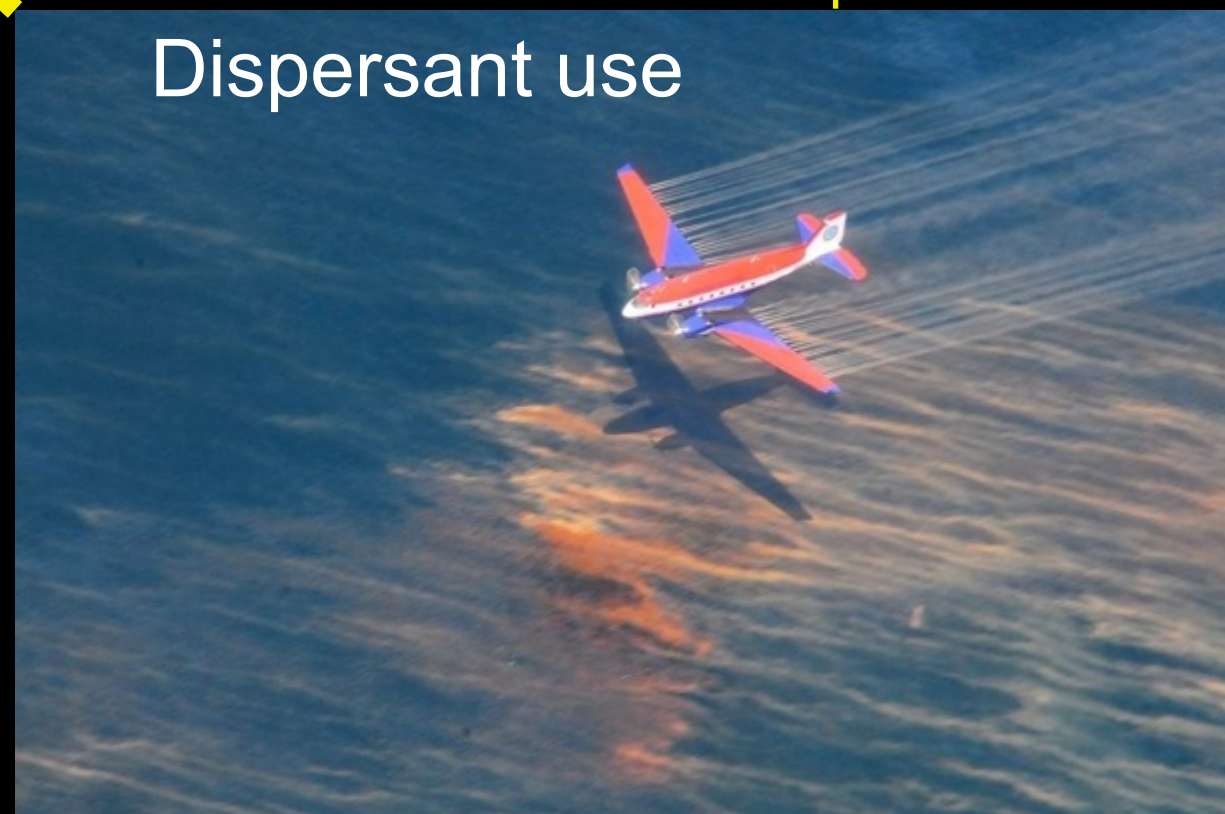
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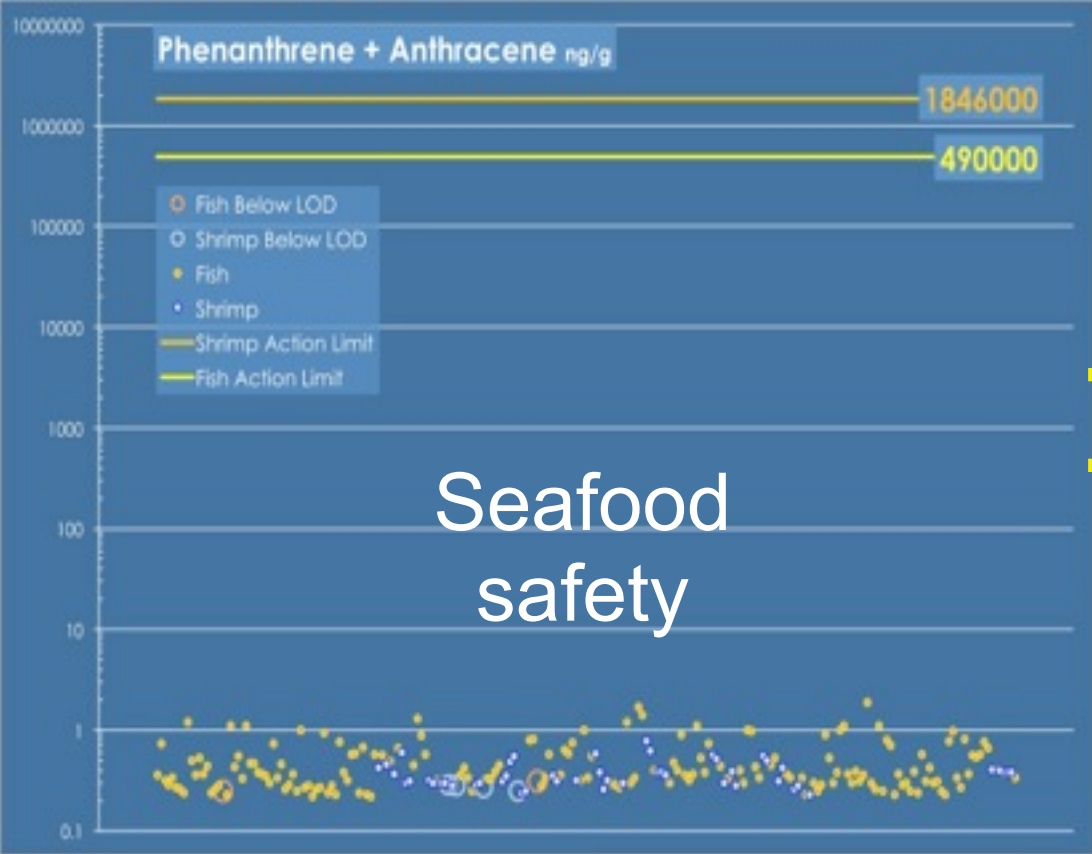
1-855-NIH GULF 4853

Human health

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That's 1-855-644-4853.

The top section features the Gulf Study logo, which includes a stylized figure inside a drop shape. Below the logo is the text 'GULFSTUDY' and the toll-free number '1-855-NIH GULF 4853'. A large play button icon is centered over the text. Below this is the text 'Human health'. At the bottom, a video player interface is visible, showing a progress bar and control buttons.





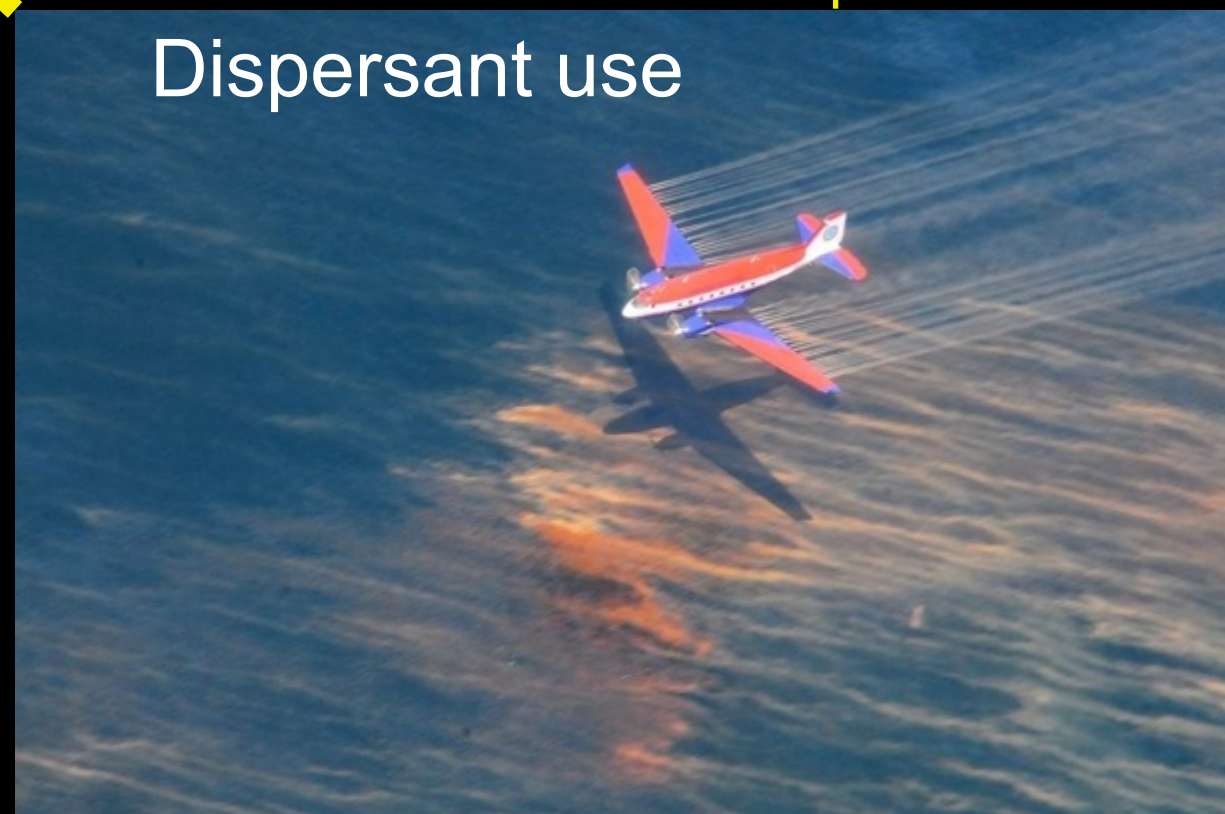
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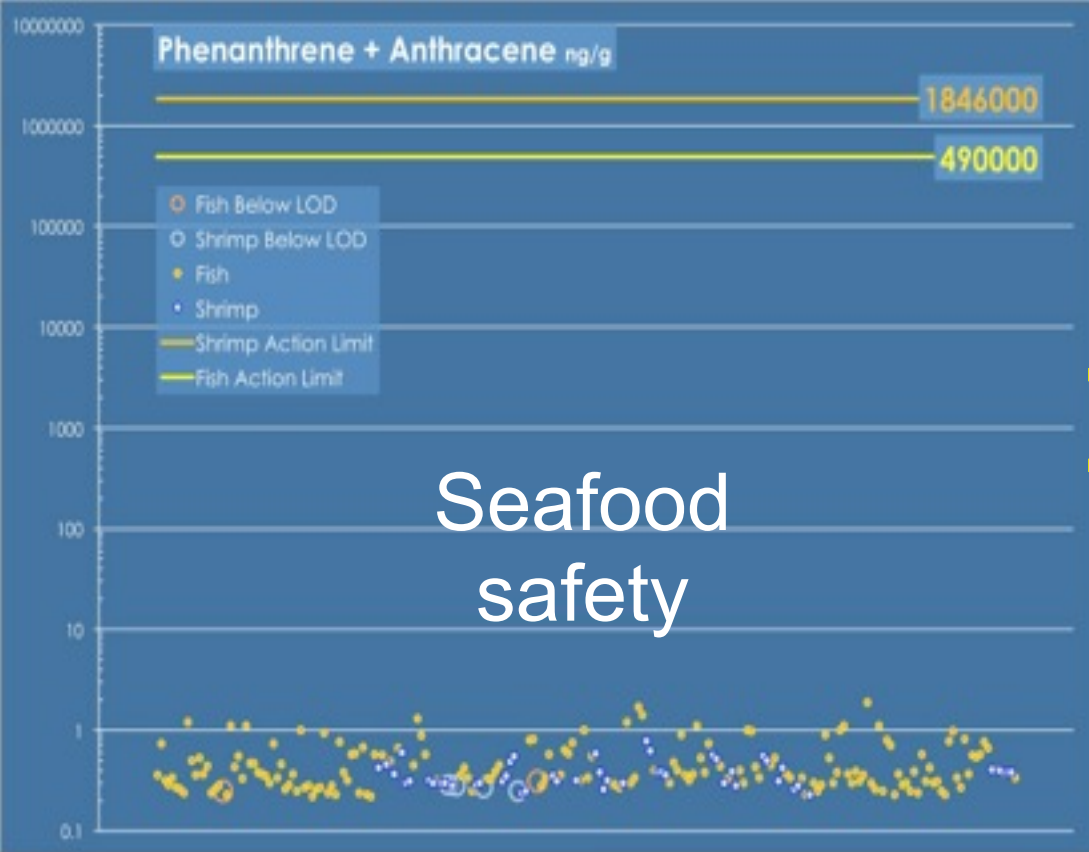
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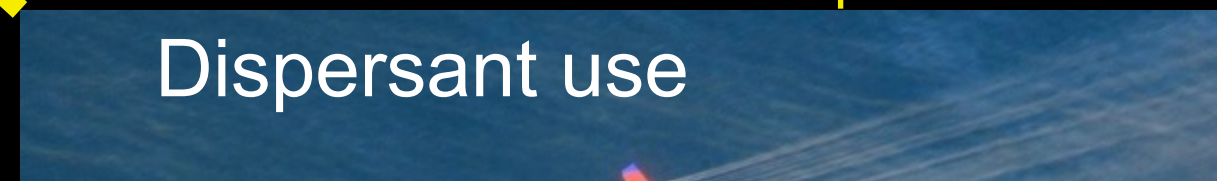


GULFSTUDY

1-855-NIH GULF 4853

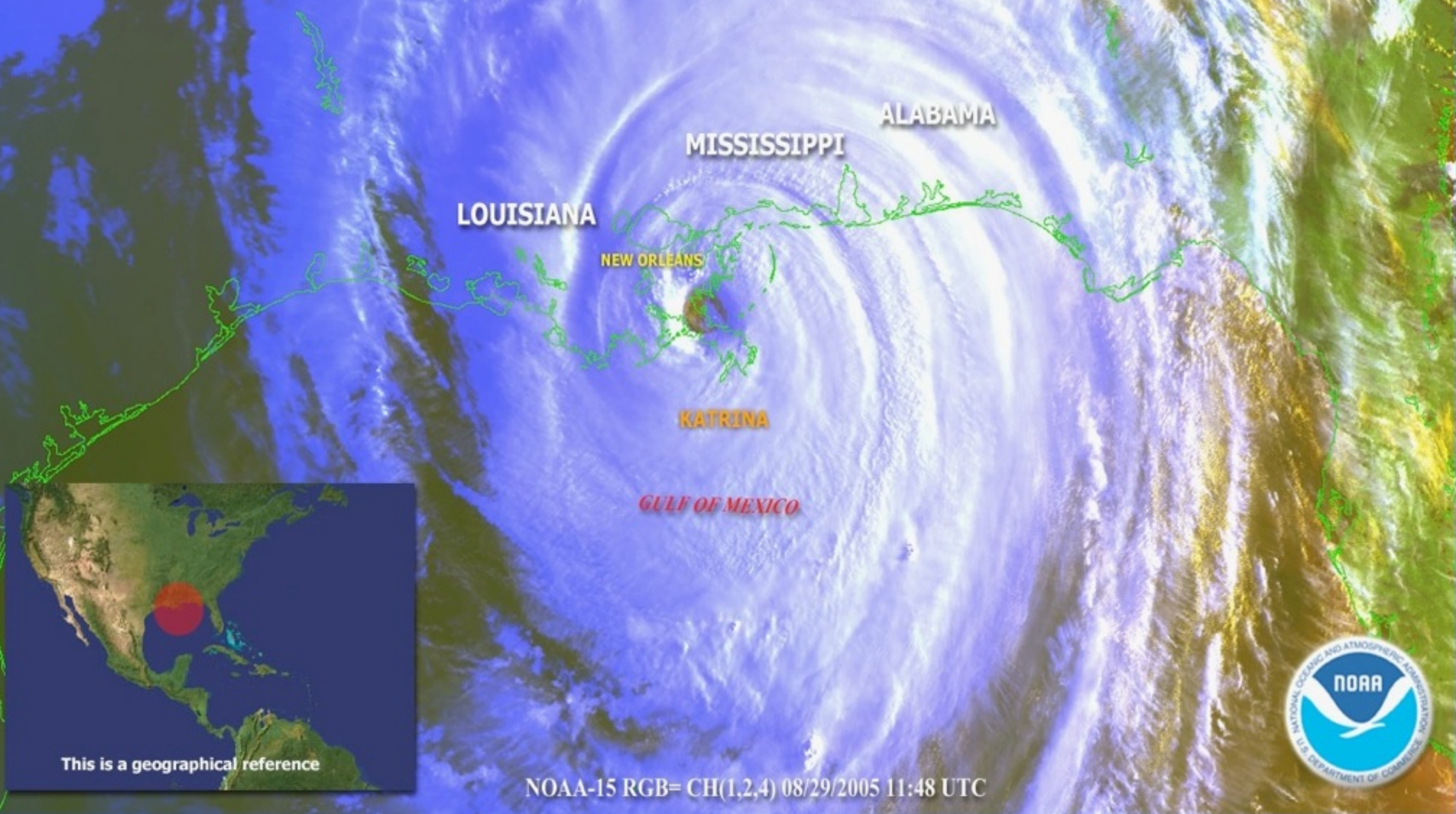
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While each of these areas requires their own advance planning, response, and monitoring capabilities, interconnections mean that we need to crosswalk between them in developing strategies for handling pollution emergencies, and especially for **sharing data**

Hazardous chemical releases associated with Hurricanes Katrina and Rita, and assessment of seafood safety



30,000 chemicals in commerce

- 400 estimated to be persistent
- 4% routinely analyzed
- 75% unstudied
- Many are designed to kill (pesticides)
- Unanticipated (side) effects (e.g. flame retardants)
- Pharmaceuticals in sewage treatment discharge
- Petroleum = thousands of unstudied chemicals

The research vessel *Nancy Foster* has been sampling the Gulf of Mexico to gauge flood pollution.



After Katrina: tracking the toxic flood

BATON ROUGE

Three weeks after Hurricane Katrina ravaged the coasts of Mississippi and Louisiana, marine researchers are starting to assess the safety of fish and shellfish exposed to toxic flood waters in the Gulf of Mexico.

The flood waters are teeming with *Escherichia coli* bacteria and a wide range of chemicals (see *Nature* 437, 301; 2005). And engineers are pumping the toxic mix out of the city towards the Gulf coast. With its shrimp, oyster, crab and flat-fish stocks valued at around \$3.1 billion, the coast is one of the richest fishing grounds in the United States.

Shailer Cummings of the National Oceanic and Atmospheric Administration led a food-safety team into the Gulf last week for a three-day expedition on board the research vessel *Nancy Foster*. Until then the boat was being used to check the safety of the region's major ports, doing soundings to check for obstructions under the water, among other tasks.

Cummings had just two days to organize the expedition — a huge challenge under normal circumstances and more so as personnel were in such short supply. "When you try to get a research team from a distressed area they are hungry, stressed and looking for their family like everyone else," he says. So he recruited a team from the Northwest Fisheries Science Center in Seattle, Washington.

His team of some 15 scientists collected shrimp, oysters and Atlantic croakers — a

common ground fish — and sent them to a Seattle laboratory to be tested for bacterial contamination and pollutants. Aware of the risk of a second public-health disaster in the wake of the hurricane, the researchers worked around the clock. "Nobody sleeps," Cummings told *Nature* after three tough days aboard the *Nancy Foster*. "We're doing this to make sure the food supply is safe."

On their tour through the Gulf, the crew took samples from the muddy plume that has spread from the Louisiana coast over hundreds of square kilometres. Katrina muddied the water by washing sediments from the Mississippi into the sea, explains Cummings. And the fresh water is sitting on top of the salty water, spreading "like tea on a tabletop".

So far, the team has seen no evidence of the algal bloom that might result from the fresh-water influx, and the circulation pattern of the water seems normal. But "we don't know what's in the water," says Cummings.

As well as sampling water and sediment for pathogens and chemicals, the researchers dissected, prepared and labelled fish samples for storage until they could be tested back in Seattle. It was close, feverish and smelly work. The liver and bile will be tested for fat-based contaminants such as polycyclic aromatic hydrocarbons. The gut and gill will be tested for pathogens, and the muscle will be tested

for mercury and other contaminants.

"It's an unprecedented situation," says Tracy Collier, head of the ship's wet lab and director of Environmental Conservation at the Northwest Fisheries Science Center. "We're trying to sample as broadly as we can," he explains, to detect anything that might harm people.

The results will not be ready until the end of September. But it is unlikely anyone will get ill in the meantime, says Bo Boehringer of the Louisiana Department of Wildlife and Fisheries, because no fishing is likely to take place for many weeks. Katrina has brought the fishing community in the region to a standstill. Boats and piers have been destroyed, ice houses smashed and fish-processing centres damaged. US authorities estimate that about 4,800 fishermen in the area are now out of work.

Although serious attention is being paid to food safety, there is also concern that Katrina has damaged fish and shellfish stocks. Flood water has covered oyster beds along a stretch of inland bays with up to a metre of mud, and the oysters have suffocated.

Some wildlife seems to be bouncing back, however. Biologist Melody Baron was on board the *Nancy Foster* to watch for marine mammals in distress. On her third 12-hour shift she said she had seen turtles and dolphins behaving normally.

Adrianne Appel

"We're making sure the food supply is safe."

NATURE 437, 22 Sept. 2005

The toxic flood

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Chemicals in Our Waters

fossil fuels

metals

pesticides

other commercial chemicals

