



Oil Spill Response



Bridging Science & Response (Americas)

ITAC 2017
Plymouth, England

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OIL SPILL!!!

Natural Science informs Preparedness, Response & Restoration
Social Science informs the ways people react



*Emotional (sad/mad), Anger, Disappointment,
Shock, Depression, Critical, Opportunistic,
Political, Economic, etc.*

Tier 3 Response Toolbox

- ▶ Surveillance & Monitor Only
- ▶ Containment & Mechanical Recovery
- ▶ Shoreline Protection/Clean-up
- ▶ Aerial & Surface Dispersants
- ▶ In-situ Burning
- ▶ Subsea Intervention (Capping, Containment)
- ▶ Subsea Dispersant Injection
- ▶ Trained Personnel/SMEs
- ▶ Good Practice Guides

Outreach & Communications (Americas)

- Methods/Tools Employed Scenario & Science Dependent
- #1 Priority: Health & Safety of Responders & Community
- Feasibility: Weather, Geography
- Type & Fate of Spilled Oil
- Resources at Risk & Environmental Sensitivities
- Priorities of Stakeholders (PEAR)
- Available Response Resources & Logistics
- Realistic Expectations, Political Considerations
- Net Environmental Benefit Analysis (NEBA/SIMA)

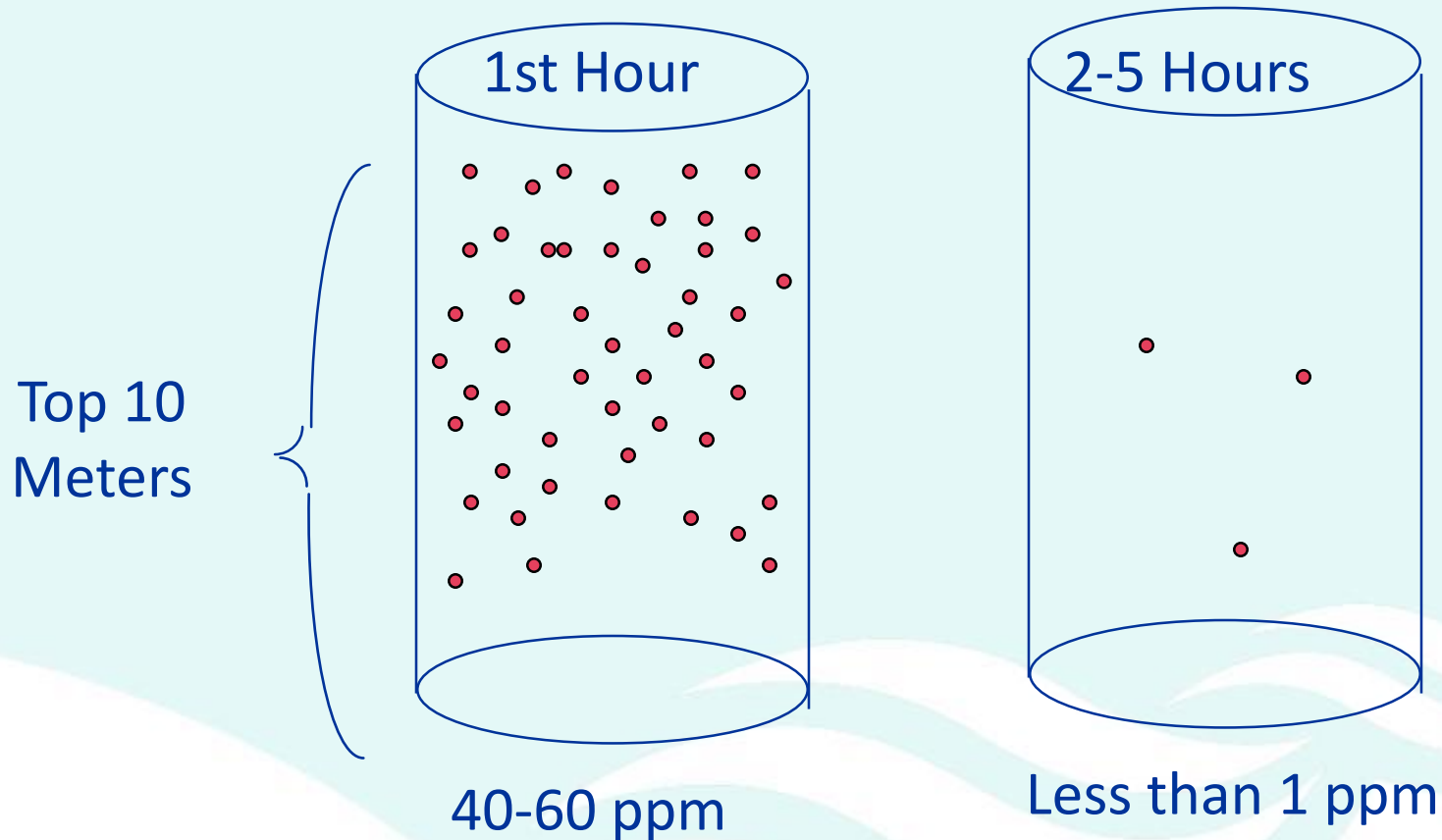
ITAC 2017 Take Home (Scott, MNZ)

- Professional
- Evidence-based
- Intelligence-led
- Regulatory Compliant
- Explore New Ways of Responding
- Focus on Research, Science & Technology

Assessing Dispersant Science (Science Literate perspective)

- ▶ Toxicology
 - Realistic Concentrations
- ▶ Relevance & Scale
- ▶ Bio-availability
- ▶ Does it holistically apply to NEBA/SIMA
- ▶ Does it inform decision-making
- ▶ Does it appropriately impact the “Response Toolbox”

Dispersion Effect-Pulse Exposure



Water Currents Distribute Oil Over Wide Area
Reduce Concentrations Before Adverse Effects Occur

Maximum Calculated Concentrations Dispersed Oil at Various Water Column Depths

Numerical Maximum Concentrations of Dispersed Oil (.1mm and .2mm) into Various Water Column Depths

| | .2mm thickness (in 1m ² area) | .1mm thickness (in 1m ² area) |
|-----------------------------------|---|---|
| Surface (only) Volume | 0.2 L | 0.1 L |
| | (1,000,000 ppm) | (1,000,000 ppm) |
| Water Column Dispersion Depth (m) | Concentration mg/L (ppm) | Concentration mg/L (ppm) |
| 1m | 200 | 100 |
| 2m | 100 | 50 |
| 3m | 66 | 33 |
| 5m | 40 | 20 |
| 10m | 20 | 10 |

Oil Spill Science/Research

- ▶ Gulf of Mexico Research Initiative (GoMRI)
 - BP \$500 million/10 years
 - Consortium Advisory Committee (CARTHE II)
 - Research Board Liaison
 - Relevance of Science, Research Protocols (Concentrations & Toxicity)
 - Synthesis
 - Participate in Research (Responder Perspective)
 - GoMRI Scientists at ITAC
 - GoMRI Track at IOSC 2017
 - OSR 201 @ GOMOSES 2018

Science Culture (pure/applied)

- Objective: Understand Effects
- Grant \$\$\$ Driven
- Highly Specialized
- Micro View
- Work Environment:
 - High Control, Lab or Field
- Rigorous Peer Review, Replicable
- Make the dots,
- Synthesis Lacking/Pending
- Employs Social Media
- Audience: Other Scientists, Researchers
- End: “more studies need to be done”
- Publish or Perish

Responder Culture (applied)

- ▶ Understanding...as it Informs Preparedness, Response, Operational Decision-making
- ▶ Issue Driven
- ▶ Macro view
- ▶ Holistic
- ▶ Work Environment:
 - Field, High Uncertainty
- ▶ Act on Observations, not peer reviewed, not always replicable (SSDI)
- ▶ Connect the dots, Conclusions for OSPR
- ▶ High Pressure, High Stakes “What is the best action?”
- ▶ Audience: Decision-makers, Public

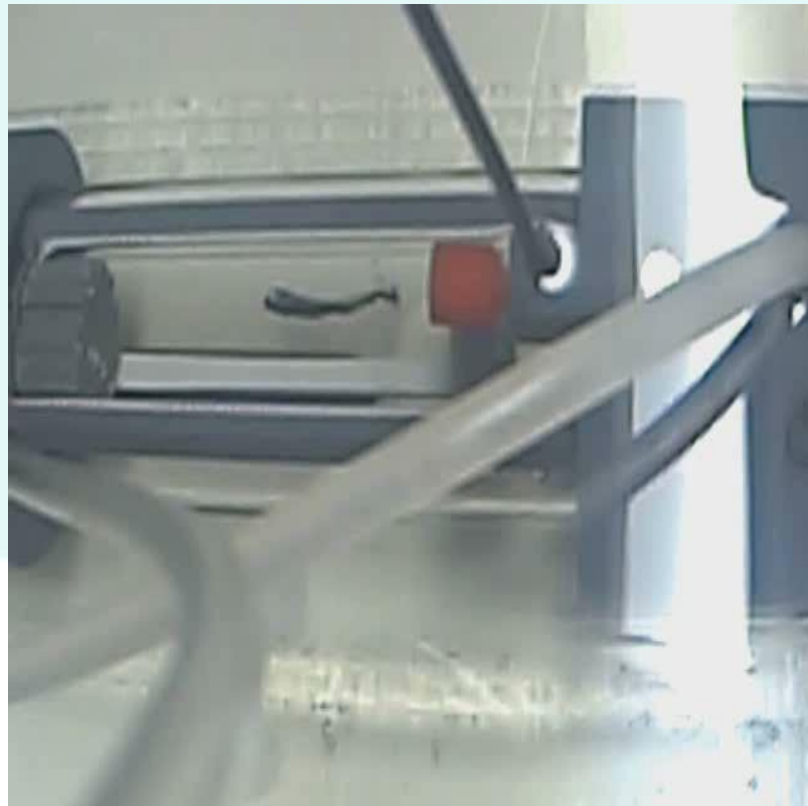
DLR SAR-2 Calibration



University of Miami

Impacts on juvenile and adult Mahi Mahi swim performance

SWIM TUNNEL RESPIROMETRY



Other US Research

- ▶ Parallel and After GoMRI
 - NOAA NRDA Data Sets
 - BSEE, NOAA
 - US Government: ICOPAR
 - Gulf Research Program (NASEM)
 - API

National Academy of Science

- ▶ Dispersant Efficacy & Effectiveness Committee
 - 1989, 2005
- ▶ Oil Spills & Public Health & Well-Being



Critical Review of Aquatic Toxicity of Dispersants

► Phase I:

- Unpublished data sets released by BP
- Peer-reviewed papers by PIs

► Phase II:

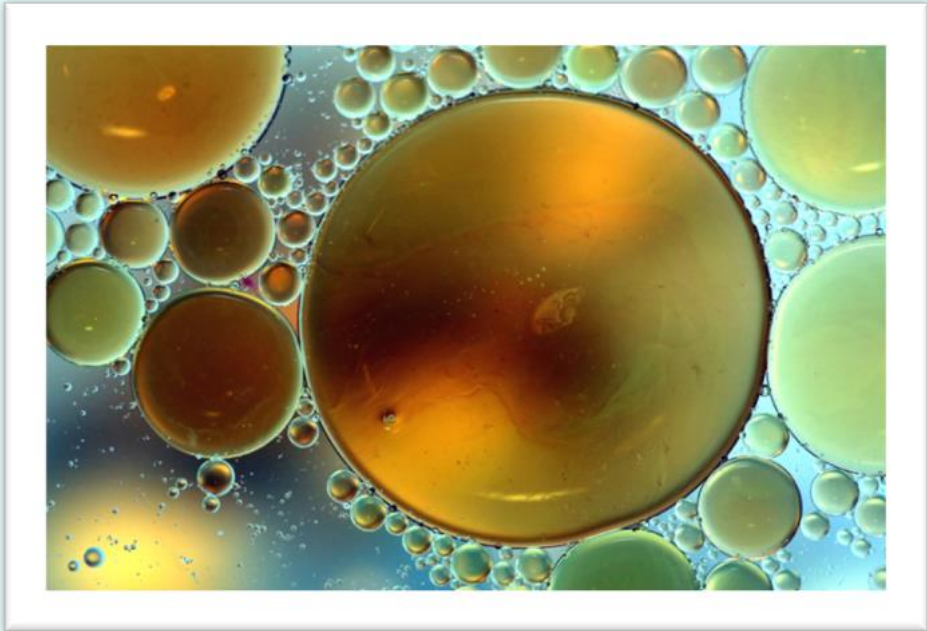
- “Critical Review” of all Dispersant Toxicity Studies
- Chevron data/studies added

► Provide final work to NASEM Dispersant Committee (Jan/Feb 2018)

Water Column Monitoring White Paper

- ▶ OSRL – IBP Forum in Rio (Aug 2017)
 - “Responding to a Subsea Incident”
- ▶ Monitoring Protocol inputs from Environmental Agency
- ▶ White Paper by CSA

Understanding Dispersants in Oil Spill Response



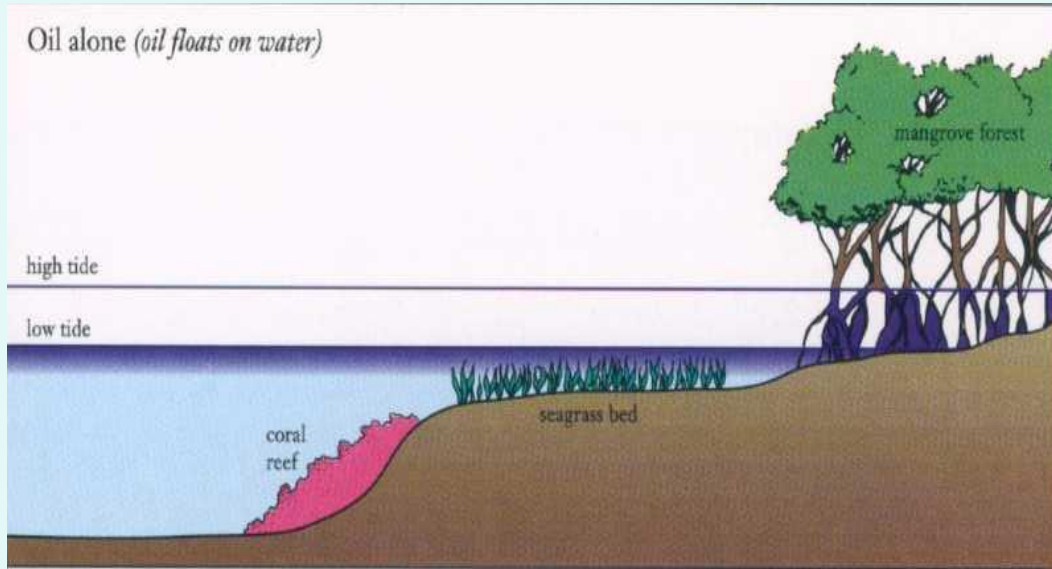
Conducting Oil Spill Research

- ▶ **TROPICS (1984 - July 2016)**
Tropical Oil Pollution Ivestigations in Coastal Systems
- ▶ Long-term Field Study of “relative” effects of crude oil and dispersed crude oil on tropical marine communities: Mangroves, Seagrass and Coral community
- ▶ Application:
 - Basis for Net Environmental Benefit Analysis
 - Use of dispersant in near shore response
- ▶ **32 Year Visit:**
NSUOC, Texas A&M, NOAA, CEDRE, CCA/OSRL

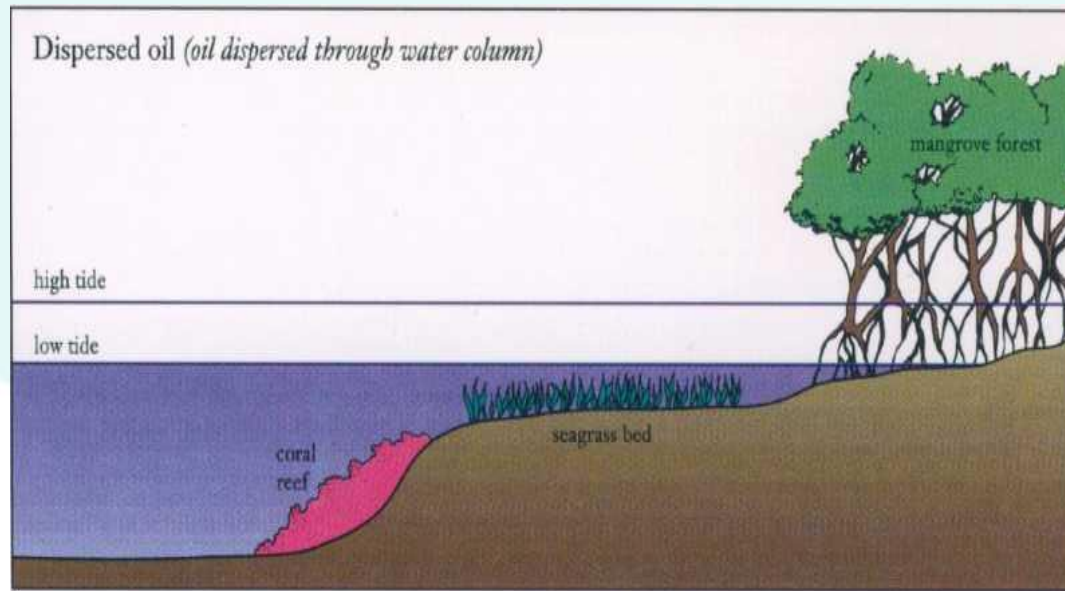


Dispersed Oil Site, April 04

Oil alone (*oil floats on water*)



Dispersed oil (*oil dispersed through water column*)



Non-treated Oil Site, June 2001



Dispersed Oil Site, June 2001



Oil Test Site, Aug 2004

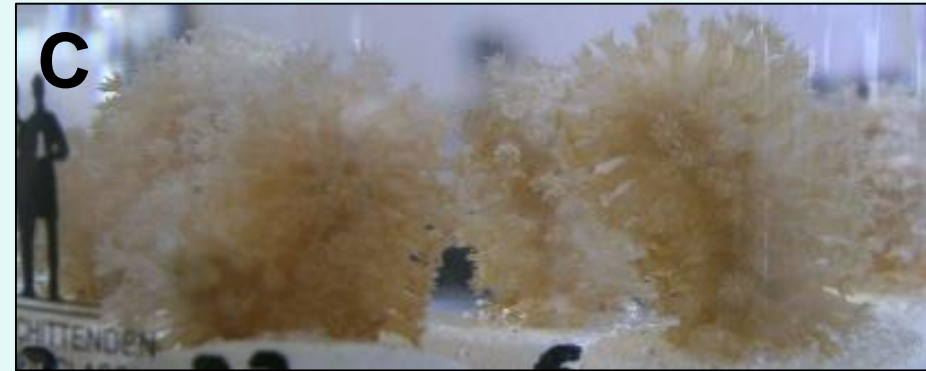
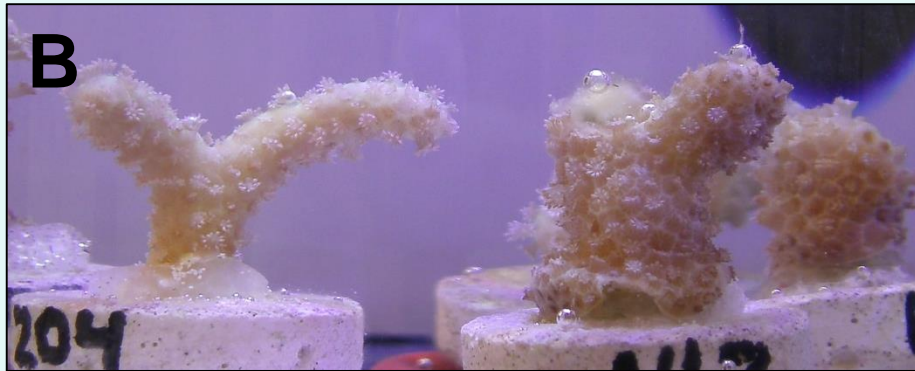




SUMMARY CONCEPTS

- ▶ The habitat - mangrove, seagrass, coral - is more important for ecosystem recovery in the long-term than the organisms themselves.
- ▶ Organisms can repopulate if the habitat is preserved.
- ▶ Untreated oil (PAHs) can remain entrapped in substrate and affect the habitat for a very long time.

Coral Toxicity Study (3+ Years)



Quantifying Hydrocarbon Toxicity to Shallow-water Corals: Improving NEBA for Dispersant Decision-Making

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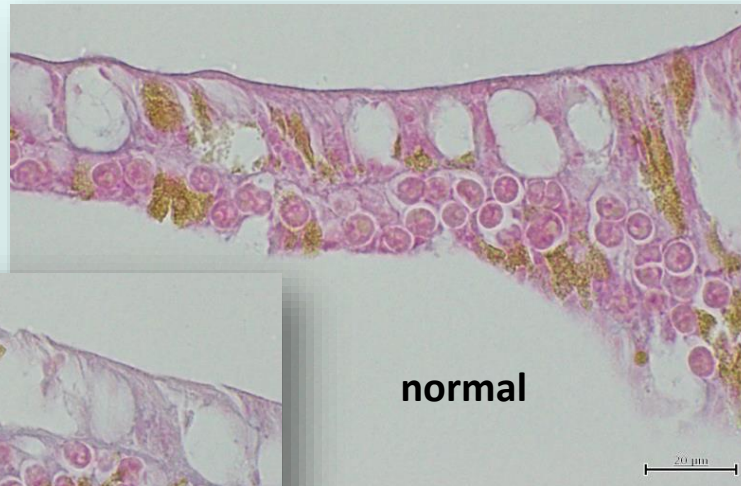
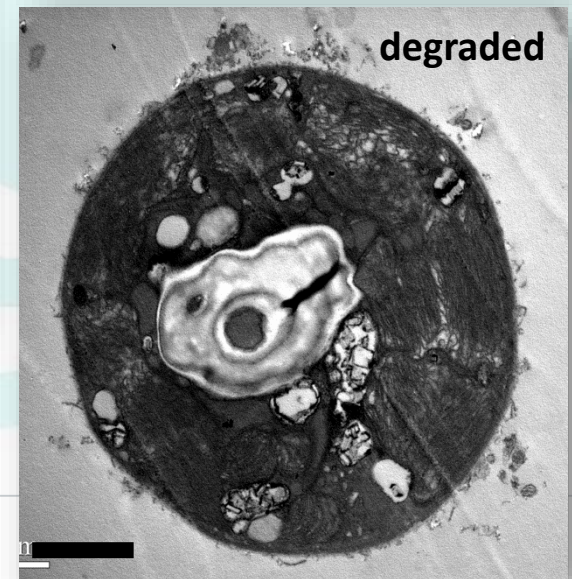
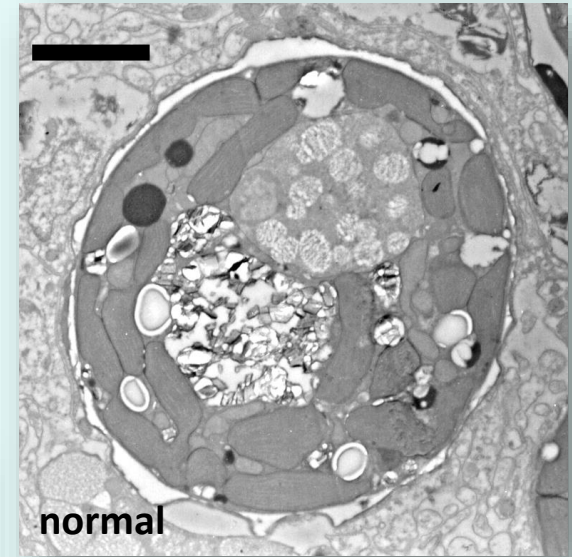
Design Objectives

- Designed with the end (not results) in mind!
- Cutting edge Toxicology, dosing methodology
- Output coral toxicity data input into NOAA CAFÉ
- Possible model real oil concentrations vs. toxicity thresholds
- Decision-making



Histological evaluation:

- Quantitative changes in tissue characteristics and cell types.
- Degeneration of tissues and symbiotic zooxanthellae.
- Gain or loss of zooxanthellae.
- Ultrastructural: sub-cellular changes (degradation of cell walls, mitochondria, zooxanthellar organelles).



CTLBB - Critical Target Lipid Body Burdens Comparisons

| Species | Common Name | Habitat | CTLBB |
|---------------------------------|-------------------|--------------|-------|
| <i>Rhepoxyinus abronius</i> | Amphipod | Infauna | 31.2 |
| <i>Mysidopsis bahia</i> | Mysid | Epibenthic | 34.3 |
| <i>Eohaustorius estuarius</i> | Amphipod | Infauna | 41.4 |
| <i>Leptocheirus plumulosus</i> | Amphipod | Infauna | 43.1 |
| <i>Portunus pelagicus</i> | Sand Crab | Epibenthic | 53.3 |
| <i>Ampelisca abdita</i> | Amphipod | Infauna | 53.8 |
| <i>Palaemonetes pugio</i> | Grass Shrimp | Epibenthic | 57.3 |
| <i>Jordanella floridae</i> | American Flagfish | Water Column | 67.1 |
| <i>Cyprinodon variegatus</i> | Sheepshead Minnow | Water Column | 114 |
| <i>Oithona davisae</i> | Copepod | Epibenthic | 142 |
| <i>Meanthes arenaceodentata</i> | Annelid Worm | Infauna | 182 |
| <i>Artemia salina nauplii</i> | Brine Shrimp | Water Column | 194 |
| <i>Menidia beryllina</i> | Inland Silverside | Water Column | 292 |
| <i>Porites divaricata</i> | Thin Finger Coral | Benthic | 356 |

San Jose, Guatemala (2003)



Clear, Consistent Messaging

Drinking vodka over ice can give you kidney failure,
Drinking rum over ice can give you liver failure,
Drinking whiskey over ice can give you heart problems,
Drinking gin over ice can give you brain problems,
Apparently ice is really bad for you!

... and dispersants?

18 Years Later
