# CARIBBEAN DISPERSANT WORKSHOP

# ST. CROIX, U.S. VIRGIN ISLANDS

## 16-19 SEPTEMBER 2008

## WORKSHOP SUMMMARY

**National Park Service**
**1201 Oakridge Drive**
**Fort Collins CO 80521**

**April 2009**

# EXECUTIVE SUMMARY

A Dispersant Use Workshop was held during the week of September 15, 2008. The National Park Service (NPS) initiated this cooperative effort in order to increase NPS participation in Caribbean Regional Response Team activities. The *Policy for Dispersant Use in Oceans and Coastal Waters of the Caribbean* is in need of revision, and this workshop was a valuable opportunity for Trustee Agency input. The following issues necessitated the revision:

- Additional species have since been listed as threatened and endangered and critical habitat has been designated or proposed.
- The Magnuson-Stevens Act requires consultation with regards to essential fish habitat (EFH).
- Areas with specific management authorities have been expanded or created. These include areas managed by the National Park Service, National Oceanic and Atmospheric Administration, the Territory, and the Commonwealth.

Government and industry experts presented the best available data concerning fate of dispersed oils in the environment. The general consensus of natural resource managers participating in this workshop was that it is important to have the option for application of chemical dispersants in the event of an oil spill. Participants also agreed that likely impacts from dispersant use are not as adverse as once thought, and use of dispersants may actually reduce the level of harm to important and sensitive aquatic resources.

The proposed revision to the policy for use of dispersants in waters of the Caribbean will not prohibit application in any areas based solely on management authorities. Areas with specific management authorities, including NPS units, will be classified as areas where dispersant use must be evaluated and approved on a case-by-case basis.

A list of prioritized recommendations from workshop participants is included in this report.

## ACKNOWLEDGEMENTS

The Caribbean Dispersant Workshop was sponsored by the National Park Service and coordinated by Dave Anderson and Lindy Nelson. Zandy Hills-Starr is thanked for her local NPS support, including hosting the workshop for days three and four. Sloan Schoyer and others at HOVENSA are acknowledged for their whole-hearted support of the workshop, including hosting the first two days of the workshop and the tour of the facility. Jacqueline Michel of Research Planning, Inc. was the workshop facilitator. Alan Mearns of the National Oceanic and Atmospheric Administration is thanked for his contributions, including the generation and presentations on the modeling analyses used during the workshop. All of the presenters are thanked for sharing their time and knowledge. All of the participants are thanked for their contributions, which made the workshop very successful.

Suggested citation:

National Park Service. 2009. Caribbean Dispersant Workshop: St. Croix, U.S. Virgin Islands. National Park Service, 1201 Oakridge Drive, Fort Collins, CO. 23 pp.

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# CARIBBEAN DISPERSANT WORKSHOP

## INTRODUCTION

The workshop was a cooperative effort of the U.S. National Park Service (NPS), National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency (USEPA), Department of Interior (DOI), U.S. Coast Guard (USCG), U.S. Virgin Islands government, and HOVENSA.

## STATEMENT OF PURPOSE

The purpose of the workshop was to promote spill response preparedness in general and specifically address the existing Caribbean Regional Response Team (RRT) Dispersant Use Policy.

### Goals

1. Promote better understanding of potential Dispersant applications amongst oil spill response partners in the Caribbean. This will include operational challenges, fate and transport of dispersed oils, and environmental affects.
2. Enhance spill response preparedness for oil spill response partners by working through the environmental trade-off evaluation process of dispersant application.
3. Coordinate Trustee review of proposed updates to the Caribbean RRT Dispersant Use Policy.
4. Provide an opportunity for continued coordination and Caribbean spill response community preparedness.
5. Better integrate the National Park Service into the Caribbean RRT.

The result and updates to the policy will then be posted on the Caribbean RRT website.

### Objectives

1. Produce a brief report summarizing discussions and proposed changes to the existing Caribbean RRT Dispersant Use Policy.
2. Identify a list of conditions that may allow for pre-approved use of dispersants.
3. Identify a list of conditions that allow for case by case evaluation and approvals of dispersants.
4. Identify a list of conditions that may preclude dispersant use.
5. Reach workshop participant consensus on updates to the Caribbean RRT Dispersant Use Policy, pending “decision maker” approval.

**WORKSHOP AGENDA AND SPEAKERS**

**Day 1: 16 September, HOVENSA**

8:00-8:30 HOVENSA Security/Visitor Right to Know/Welcome– *S. Schoyer*

8:30-8:45 Introductions and Objectives of the Workshop – *D. Anderson*

Quick intro to the spill scenario – *A. Mearns*

8:45-9:15 Oil Types and Behavior/Fate – *J. Michel*

9:15-10:30 Dispersant Resources in the Caribbean – *OSRO (NRC, MSRC, CCA)*

10:30-12:00 Dispersants – *J. Michel*

- What are They? How They Work
- Factors that Affect Dispersant Effectiveness
- Window of Opportunity for Effective Use of Dispersants

12:00-1:00 Lunch

1:00-2:00 Dispersant Operational Requirements – *Clean Caribbean Americas*

2:00-2:30 Review of the Current Caribbean Dispersant Use Policy – *G. Hogue*

2:30-3:00 Monitoring Methods (SMART) – *B. Benggio*

3:00-4:00 Impacts, Cleanup, and Recovery Rates of Oiled Tropical Shoreline Habitats of Concern – *J. Michel*

- Mangroves
- Sand and Gravel Beaches
- Rocky Shores

4:00-5:00 Hands-on introduction to response equipment at HOVENSA *(NRC)*

**Day 2: 17 September, HOVENSA**

8:00-8:30 Caribbean Dispersants Operations Plan – *B. Benggio*

8:30-10:00 Toxicity of Dispersants and Dispersed Oil – *N. Rutherford*

10:00-10:45 Case Histories of Dispersant Applications/Studies – *J. Michel*

- TROPICS Field Experiment
- T/V *Sea Empress* Case Study

10:45-11:15 Tri-State Bird: Wildlife Rescue and Rehabilitation

11:15-12:00 Resources at Risk/Endangered Species of Concern – *F. Lopez, Z. Hillis-Starr, R. Boulon*

12:00-1:00 Lunch

1:00-2:00 Overview of the ERA Elements and Process – *A. Mearns*

2:00-2:30 Summary of Past Caribbean ERA Workshops – *B. Benggio*

2:30-5:00 Model and Scenario Presentation and Discussion – *A. Mearns*

**Day 3: 18 September, National Park Service**

8:00-9:00 Review of Scenario Results – *A. Mearns*

9:00-11:00 Small Breakout Group Discussions – Natural Recovery

11:00-12:00 Breakout Reports and Risk Scores – Natural Recovery

12:00-1:00 Lunch
1:00-2:00 Small Breakout Group Discussions – Dispersants
2:00-3:00 Breakout Reports and Risk Scores – Dispersants
3:00-4:30 Small Breakout Group Discussions – Mechanical On-Water Response

**Day 4: 19 September, National Park Service**

8:00-9:30 Breakout Reports and Risk Scores – Mechanical On-Water Response
9:30-10:30 Review and Discussion of Additional Scenarios – *A. Mearns*
10:30-12:00 Develop Recommendations for Updating the CRRT Dispersant Use Policy
12:00-1:00 Round Table Discussion on CRRT/DOI/NPS Dispersant Use Policies – *D. Anderson will facilitate with participation from DOI, EPA, USCG, NOAA*

## SPILL SCENARIO AND MODELING RESULTS

The workshop was conducted using the comparative risk methodology to provide training about oil spill response options developed by the U.S. Coast Guard (USCG) and described in the document entitled "Developing Consensus Ecological Risk Assessments: Environmental Protection in Oil Spill Response Planning: A Guidebook," available at http://www.ecosystem-management.net/ c/7/project-reports. This methodology is designed to help decision makers compare the ecological consequences of response options, especially in the protection of tropical ecosystems. This is particularly important for consideration of dispersants, which present difficult ecological trade-off issues when comparing impacts to sensitive habitats that include mangroves, seagrasses, and coral reefs. The approach includes comparison and ranking of the potential impacts to key resources and habitats of concern using a set of scenarios. This process is consistent with the U.S. Environmental Protection Agency Ecological Risk Assessment (ERA) guidelines, but emphasizes development of group consensus among stakeholders. The results are not to be used during an actual oil spill. The knowledge gained by participants in the process, however, will facilitate real-time decision-making.

The oil spill scenario was the basis for discussions of environmental tradeoffs associated with different response options. Dr. Alan Mearns of the National Oceanic and Atmospheric Administration (NOAA) presented the oil spill scenario and results of the 3D modeling of the oil trajectory using the NOAA GNOME model. The scenario was:

- The vessel had grounded on 15 September (a day prior to oil release, so that the issue of dispersant availability would not be a consideration)
- 5,000 barrels of Venezuelan Recon crude oil released at 6:00 am on 16 September
- For the no dispersant scenario, natural dispersion as predicted by the model occurs
- For the chemical dispersant scenario, dispersants were applied for 2 hours, from 10:00 until 12:00, and it was assumed that the dispersant application was 50% effective, in that 50% of the oil on the water surface at that time was dispersed into the water column

Figures 1 and 2 show the spill location and the snapshots of the trajectories for the *no-dispersant scenario* over time that were used by the breakout groups during their evaluations of the different response options. Figures 3 and 4 show the snapshots of the trajectories for the *with dispersant use scenario*. Figure 5 shows the oil budget for the two scenarios. Tables 1 and 2 show the predicted shoreline oiling for both scenarios. Table 3 shows the list of habitats and associated resources used during the workshop.

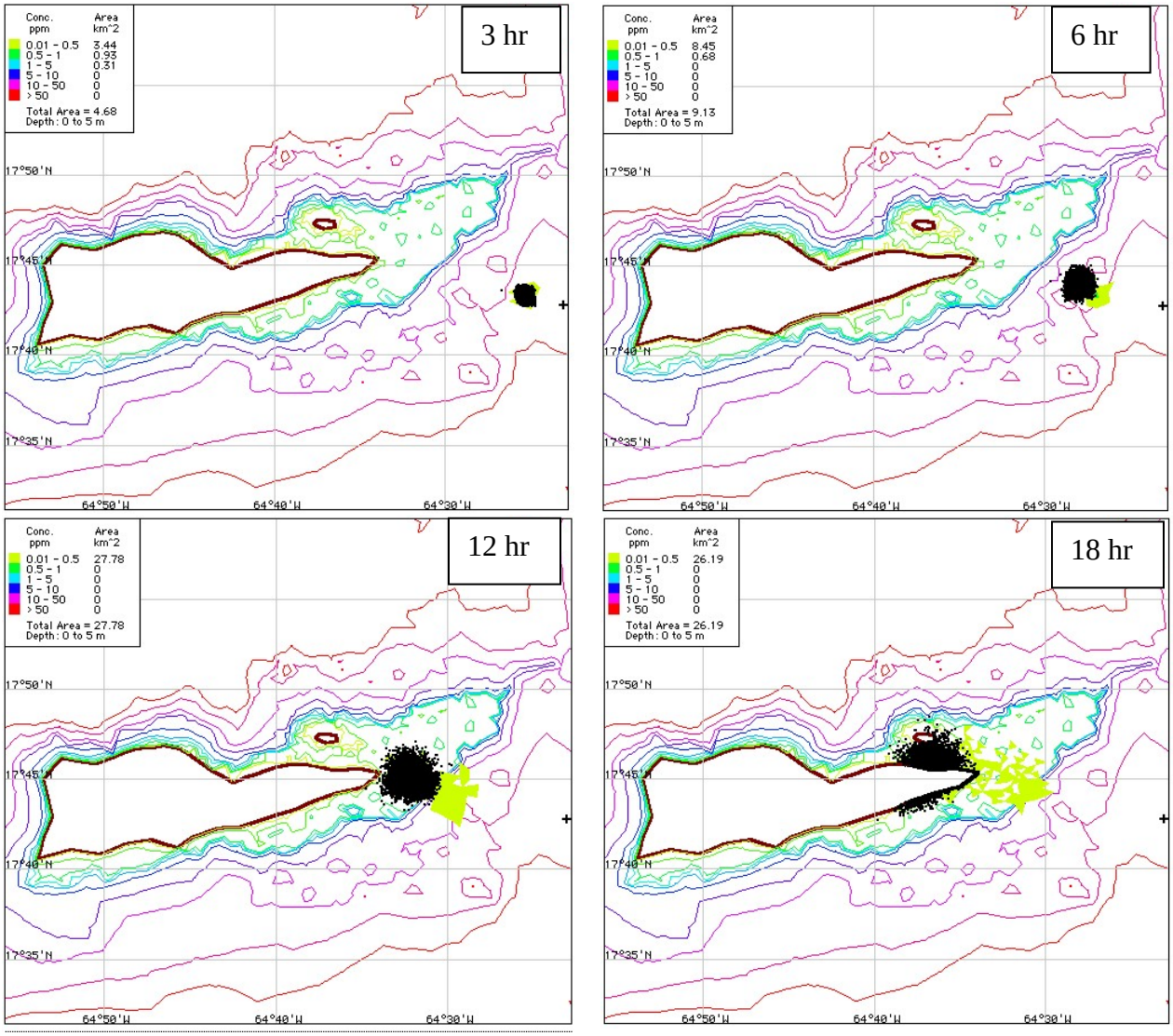



**Figure 1.** Oil spill trajectory for the scenario with no use of chemical dispersants and only natural dispersion, for 3, 6, 12, and 18 hours after the oil release.

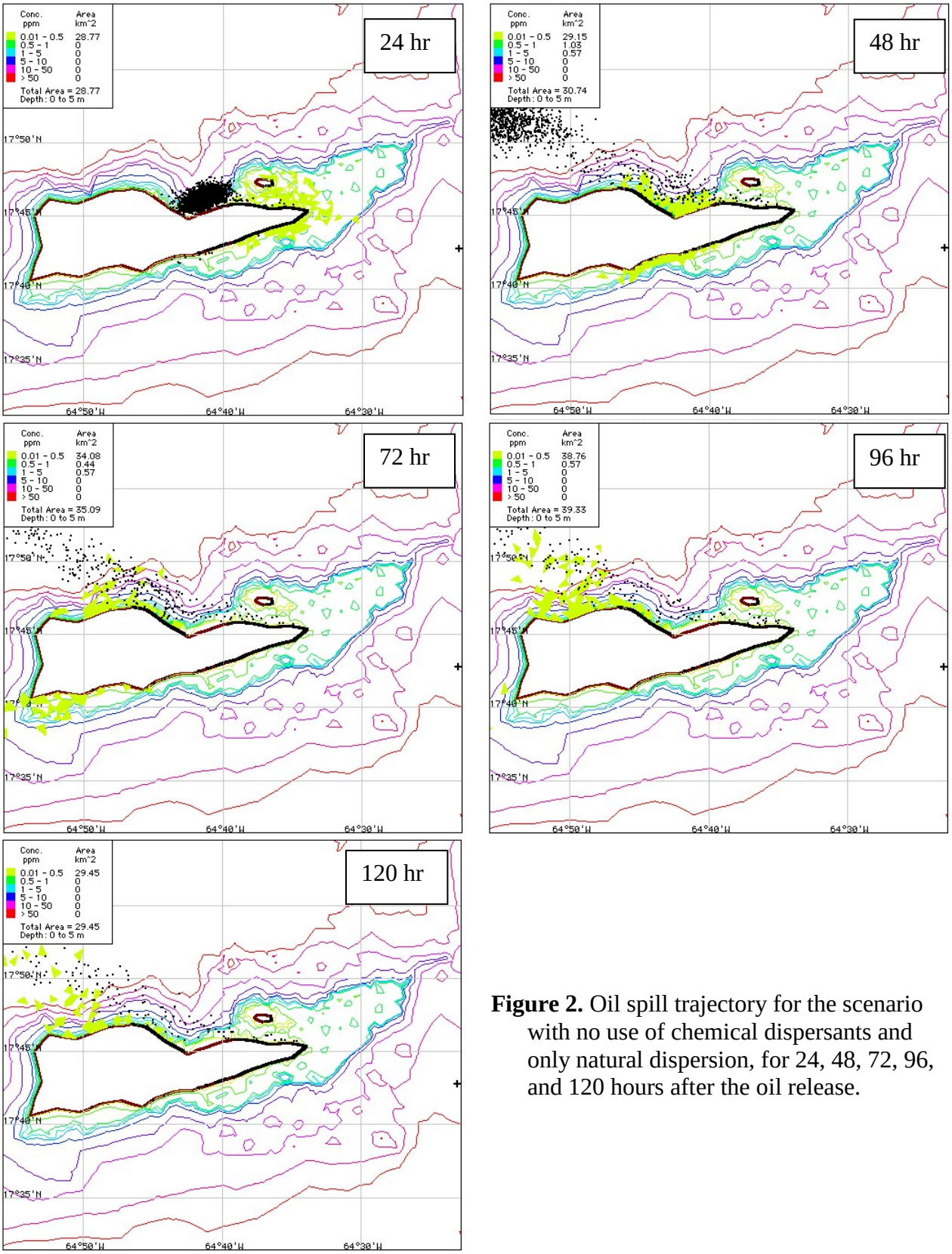



**Figure 2.** Oil spill trajectory for the scenario with no use of chemical dispersants and only natural dispersion, for 24, 48, 72, 96, and 120 hours after the oil release.

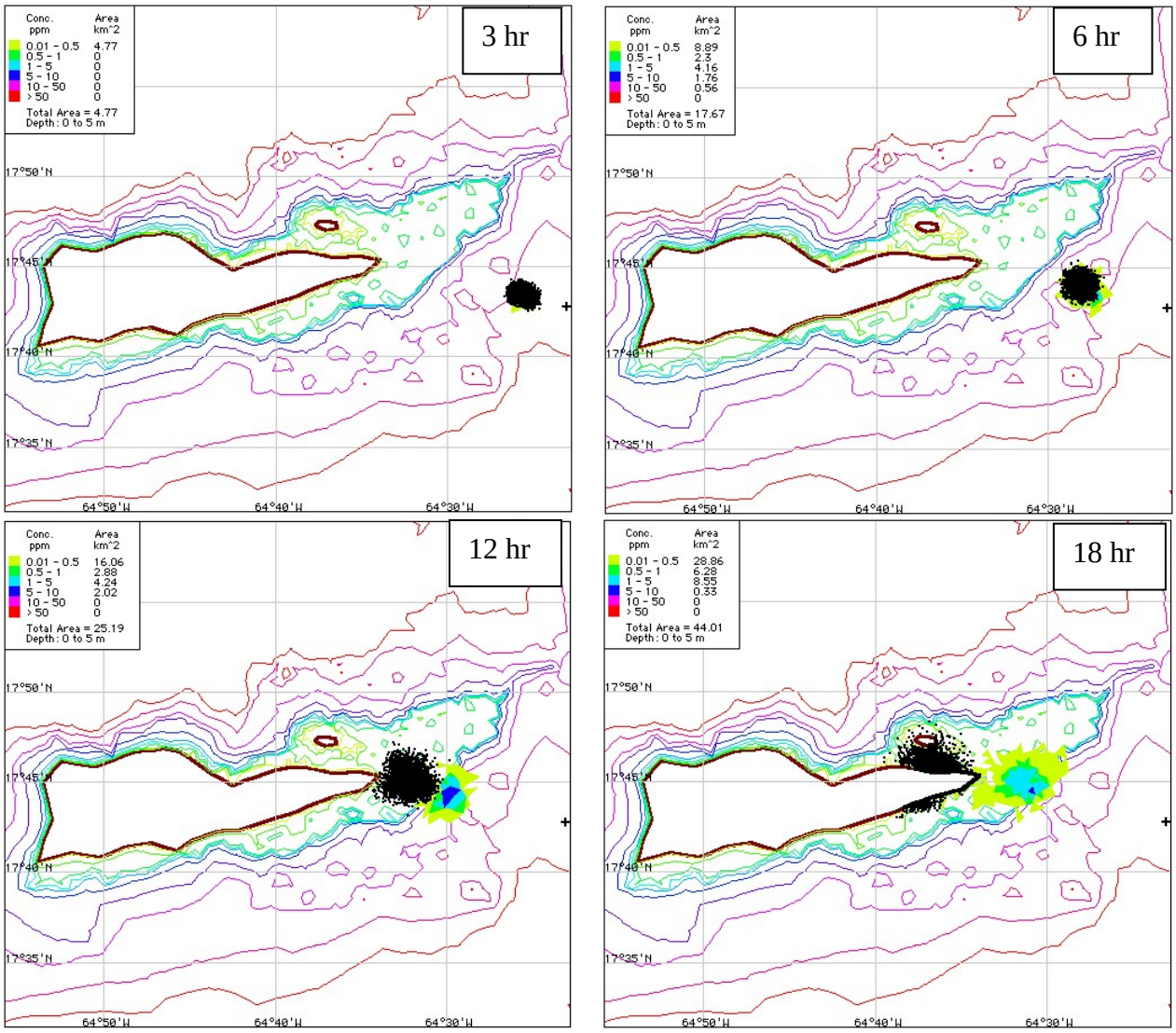



**Figure 3.** Oil spill trajectory for the scenario with chemical dispersants at 50% effectiveness for 3, 6, 12, and 18 hours after the oil release.

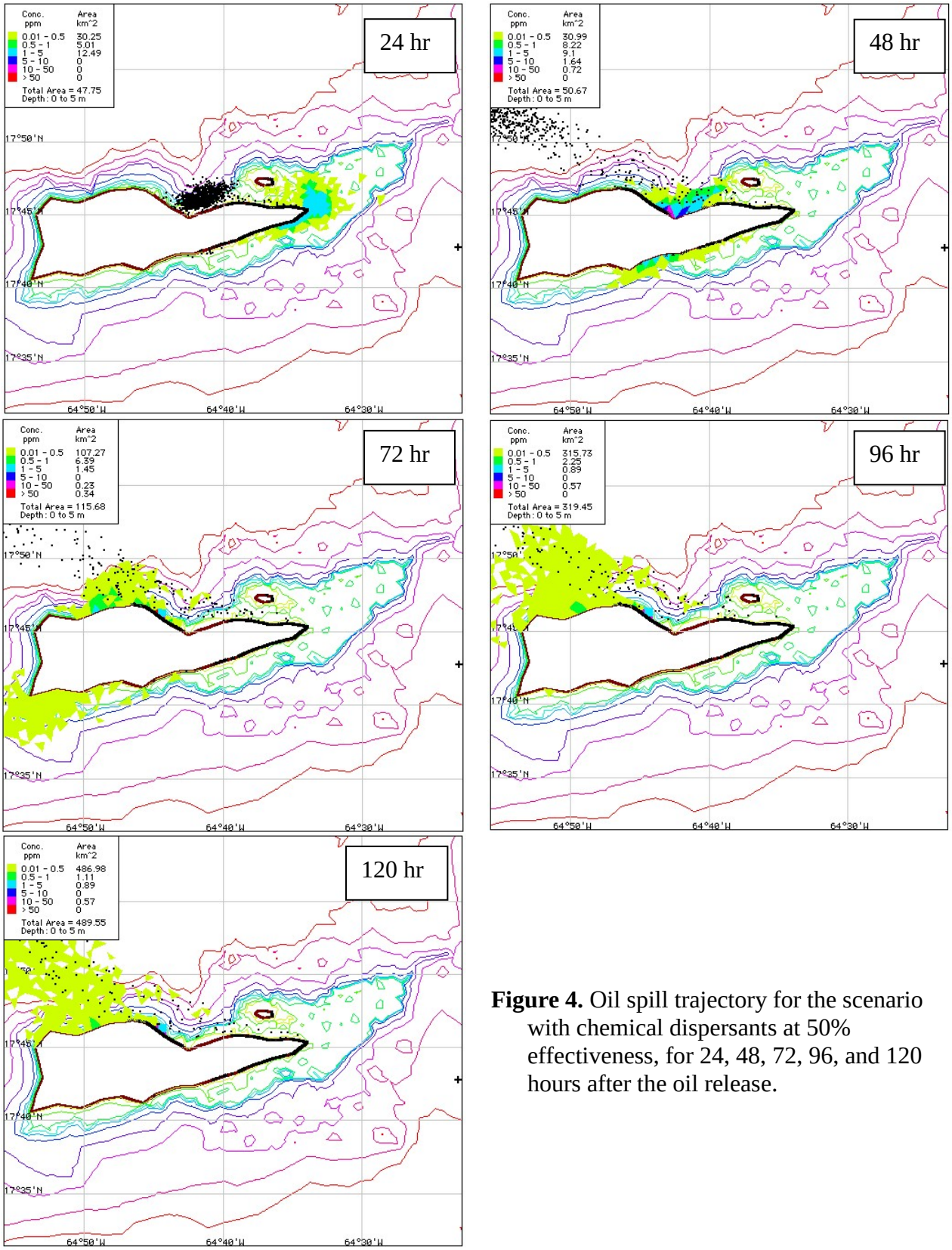



**Figure 4.** Oil spill trajectory for the scenario with chemical dispersants at 50% effectiveness, for 24, 48, 72, 96, and 120 hours after the oil release.

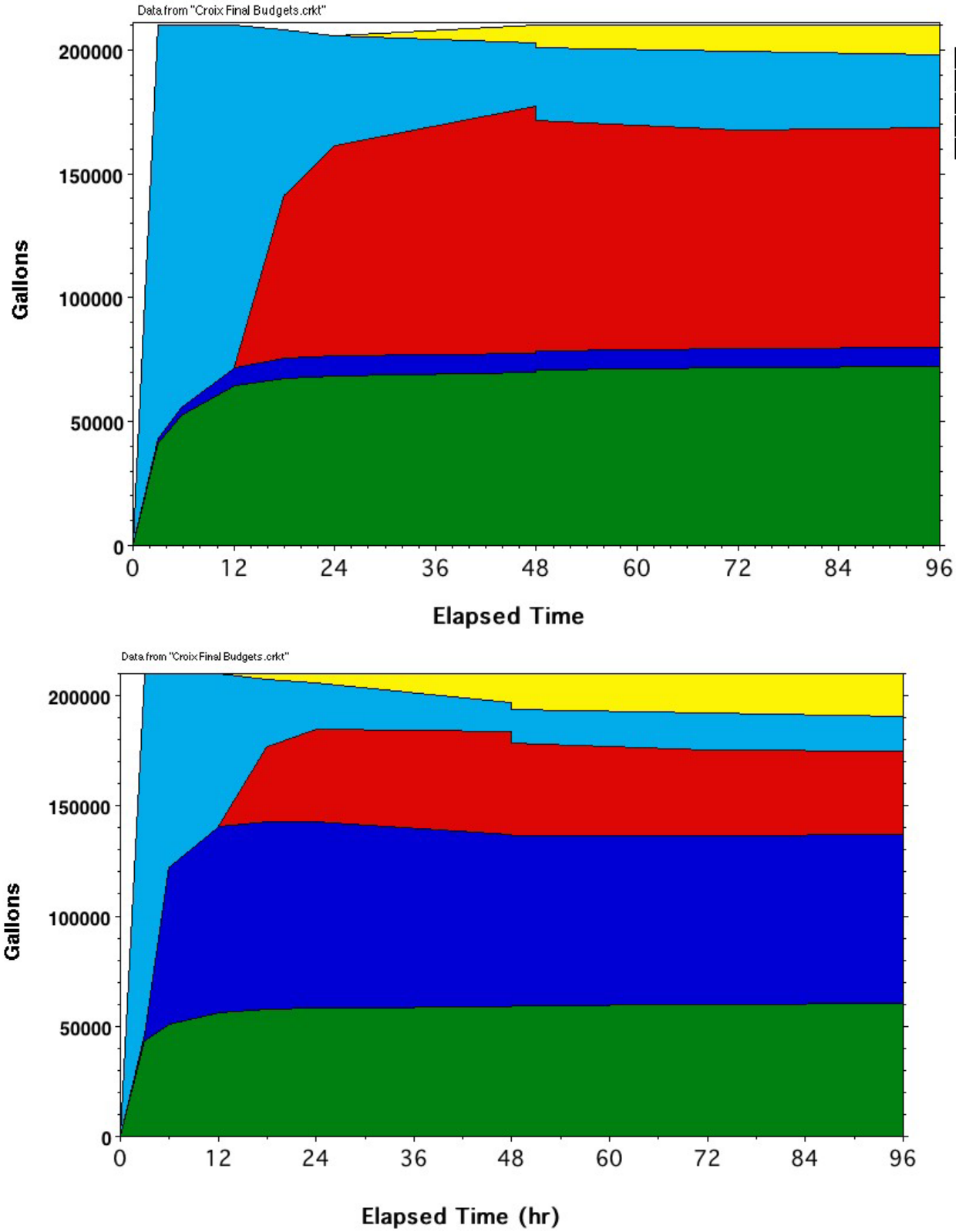



**Figure 5.** Oil budgets for no dispersants (top) and with dispersants (bottom) at 50% effectiveness. Green = evaporated; purple = dispersed; red = beached; blue = floating; yellow = off map.

**Table 1.** Shoreline oiling without use of dispersant.

| AREA | Miles | Miles Oiled | Gallons | Gal/ft | SCAT |
|---|---|---|---|---|---|
| | | | | | |
| Buck Island | 3.3 | 2.05 | 1218 | 0.134 | Light |
| | | | | | |
| Baron Bluffs to Christansted | 5.1 | 5.11 | 18837 | 0.775 | Medium |
| | | | | | |
| Christiansted to Pull Point | 3.7 | 3.73 | 861 | 0.044 | Light: Can't Clean |
| | | | | | |
| Pull Point to Tague Bay | 2.9 | 2.89 | 10353 | 0.659 | Medium |
| | | | | | |
| Tague Bay to Point Udall | 3.0 | 2.98 | 11445 | 0.707 | Medium |
| | | | | | |
| Point Udall to Hughes Point | 1.4 | 1.44 | 37989 | 4.802 | Heavy |
| | | | | | |
| Hughes Point to Mt. Fancy | 4.5 | 4.52 | 15645 | 0.658 | Medium |
| | | | | | |
| Mt. Fancy to Manchenil Bay | 3.8 | 3.80 | 1470 | 0.079 | Light |
| | | | | | |
| Manchenil Bay to Rota Island | 3.0 | 2.96 | 231 | 0.015 | Very Light |
| | | | | | |
| TOTAL | 30.7 | 30 | 98049 | | |

**Table 2.** Shoreline oiling with use of dispersant at 50% effectiveness.

| AREA | Miles | Miles Oiled | Gal | gal/ft | SCAT |
|---|---|---|---|---|---|
| | | | | | |
| Buck Island | 3.3 | 2.14 | 546 | 0.060 | Light, Can't Clean |
| | | | | | |
| Baron Bluffs to Christanste | 5.1 | 5.11 | 9786 | 0.403 | Medium |
| | | | | | |
| Christiansted to Pull Point | 3.7 | 3.73 | 861 | 0.025 | Very Light |
| | | | | | |
| Pull Point to Tague Bay | 2.9 | 2.89 | 4536 | 0.285 | Light |
| | | | | | |
| Tague Bay to Point Udall | 3.0 | 2.98 | 6300 | 0.393 | Lt-Medium |
| | | | | | |
| Point Udall to Hughes Point | 1.4 | 1.44 | 19677 | 2.495 | Heavy |
| | | | | | |
| Hughes Point to Mt. Fancy | 4.5 | 4.52 | 7770 | 0.328 | Lt-Medium |
| | | | | | |
| Mt. Fancy to Manchenil Bay | 3.8 | 3.80 | 714 | 0.036 | Light |
| | | | | | |
| Manchenil Bay to Rota Isla | 3.0 | 1.99 | 84 | 0.008 | VeryLight |
| | | | | | |
| TOTAL | 31 | 27.8 | 49896 | | |

**Table 3.** Habitat table used during the Caribbean dispersant workshop.

| Habitat | Subhabitat | Resource Category | Example Organisms |
|---|---|---|---|
| Water Surface | | Marine Mammals | West Indian manatee, cetaceans |
| | | Birds | frigatebird, tropicbird, brown pelican, diving birds, rafting birds |
| | | Fish | pelagic fish |
| | | Aquatic Arthropods | N/A |
| | | Molluscs | pteropods |
| | | Reptiles | sea turtles |
| | | Plankton | phytoplankton, fish eggs and larvae, copepods, coral larvae |
| Terrestrial | | Mammals | bats |
| | | Birds | osprey |
| | | Reptiles | geckos, iquanas, boas, anoles |
| Intertidal | Mangrove Forest | Vegetation | red, white and black mangrove, macroalgae |
| | | Mammals | West Indian manatee |
| | | Birds | great blue heron, willet, brown pelican, egret, shorebirds |
| | | Fish | bonefish, crevalle jack, mullet, sheepshead, killifish, snook, tarpon, snapper, juveniles |
| | | Aquatic Arthropods | barnacles, amphipods, grass shrimp, juvenile lobster |
| | | Molluscs | clams, oysters, mussels, snails |
| | | Epifauna | algae, sponges, bryozoans |
| | Rocky Shores | Vegetation | macroalgae, buttonwood tree |
| | | Birds | boobies, terns, frigate birds, tropic birds, shorebirds, brown pelican |
| | | Aquatic Arthropods | crabs |
| | | Molluscs | topshell, mussels |
| | | Epifauna | sponges, sea urchins, sea squirts |
| | Sand Beach | Birds | shorebirds, terns, gulls, brown pelican |
| | | Reptiles | sea turtles |
| | | Infauna | Donax clams, ghost crab |
| | Coral/Cobble Beach | Birds | shorebirds, terns, gulls, pelican |
| | | Reptiles | sea turtles, ground lizards |
| | | Infauna | crabs, snails, etc. |
| Intertidal | Reef Flats | Vegetation | macroalgae, seagrasses |
| | | Birds | shorebirds, wading birds, osprey |
| | | Fish | bonefish, mullet, tarpon, snook, other juvenile fish |
| | | Aquatic Arthropods | crabs, barnacles, lobster, shrimp |
| | | Coelenterates | cup coral, fire coral, star coral, anemones |
| | | Molluscs | conch, snails, clams, mussels, octopus |
| | | Epifauna | sponges, sea urchins, sea squirt |
| | Salt Ponds | Vegetation | mangrove, herbaceaous |
| | | Birds | shorebirds, wading birds, others |
| | | Fish | juvenile fish |
| | | Aquatic Arthropods | juveniles |
| | | Molluscs | gastropods |
| | | Epifauna | macroalgae, others |

**Table 3.** Cont.

| Habitat | Subhabitat | Resource Category | Example Organisms |
|---|---|---|---|
| Subtidal Benthic Habitat | Submerged Aquatic Vegetation | Plankton | fish/invertebrate eggs and larvae, copepods, diatoms, green algae |
| | | Vegetation | turtle grass, shoal grass, Halophila, manatee grass |
| | | Marine Mammals | West Indian manatee |
| | | Birds | heron, brown pelican, terns |
| | | Fish | snappers, grunts, barracuda, grey snapper, gobies, pipefish, eel, spot |
| | | Aquatic Arthropods | pink and grass shrimp, spiny lobster, amphipods, blue crab |
| | | Coelenterates | cup coral, anemones, Porites |
| | | Molluscs | queen conch, snails, clams, mussels, octopus |
| | | Reptiles | green, loggerhead, hawksbill sea turtle |
| | | Epifauna | algae, sponges, bryozoans, algae, snails, sea urchins, sea stars |
| | Sand Plain | Infauna | eels, fish |
| | Haystacks | Plankton | fish and invertebrate eggs/larvae, copepods, diatoms, green algae |
| | | Vegetation | macroalgae |
| | | Birds | diving birds |
| | | Fish | snappers, grunts, barracuda, reef shark, butterfly fish, wrasses, parrotfish |
| | | Aquatic Arthropods | spiny lobster, snapping shrimp, amphipods, crabs |
| | | Coelenterates | elkhorn coral, fire coral, star coral, staghorn coral, brain coral |
| | | Molluscs | snails, clams, octopus |
| | | Reptiles | green, loggerhead and hawksbill sea turtle |
| | | Epifauna | algae, sponges, bryozoans, algae, snails, sea urchins, sea stars |
| | Shallow Coral Reef Community (<5m) | Plankton | fish and invertebrate eggs and larvae, copepods, diatoms, green algae |
| | | Vegetation | macroalgae |
| | | Birds | diving birds |
| | | Fish | snappers, grunts, barracuda, reef shark, butterfly fish, wrasses, parrotfish |
| | | Aquatic Arthropods | spiny lobster, snapping shrimp, amphipods, crabs |
| | | Coelenterates | elkhorn coral, fire coral, star coral, staghorn coral, brain coral |
| | | Molluscs | snails, clams, octopus |
| | | Reptiles | green, loggerhead and hawksbill sea turtle |
| | | Epifauna | algae, sponges, bryozoans, algae, snails, sea urchins, sea stars |

**Table 3.** Cont.

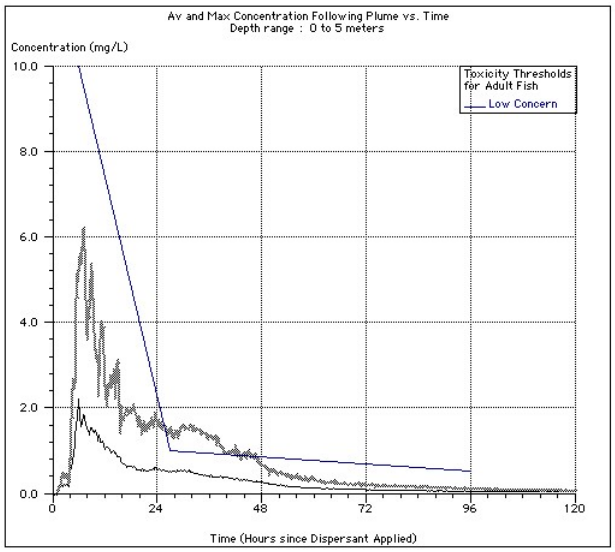
| Habitat | Subhabitat | Resource Category | Example Organisms |
|---|---|---|---|
| Subtidal | Deep Coral Reef Community | Plankton | fish and invertebrate eggs and larvae, copepods, diatoms, green algae |
| | | Vegetation | macroalgae |
| | | Fish | snappers, grunts, barracuda, reef shark, butterfly fish, wrasses, parrotfish |
| | | Aquatic Arthropods | spiny lobster, snapping shrimp, amphipods, crabs |
| | | Coelenterates | elkhorn coral, fire coral, star coral, staghorn coral, brain coral |
| | | Molluscs | squid |
| | | Reptiles | green, loggerhead, leatherback and hawksbill sea turtle |
| | | Epifauna | algae, sponges, bryozoans, algae, snails, sea urchins, sea stars |
| Water Column | Shallow Water (<5m) | Plankton | fish/invertebrate eggs and larvae, copepods, diatoms, green algae |
| | | Marine Mammals | West Indian manatee |
| | | Birds | brown pelican, terns, frigate bird |
| | | Fish | snappers, grunts, barracuda, eel, seatrout, spot, snappers, grunts, sharks, butterfly fish, wrasses, parrotfish |
| | | Aquatic Arthropods | pink shrimp |
| | | Molluscs | squid |
| | | Reptiles | green, loggerhead, hawksbill, leatherback sea turtle |
| | Deep Water (>5m) | Plankton | fish/invertebrate eggs and larvae, copepods, diatoms, green algae |
| | | Marine Mammals | bottlenose dolphins, Risso's dolphins, West Indian manatee, humpbacks, sperm, pilot, ORCA |
| | | Birds | Pelagic seabirds |
| | | Fish | snappers, grunts, barracuda, eel, seatrout, spot, snappers, grunts, sharks, butterfly fish, wrasses, parrotfish, billfish |
| | | Aquatic Arthropods | pink shrimp |
| | | Molluscs | squid |
| | | Reptiles | green, loggerhead, leatherback, hawksbill sea turtle |

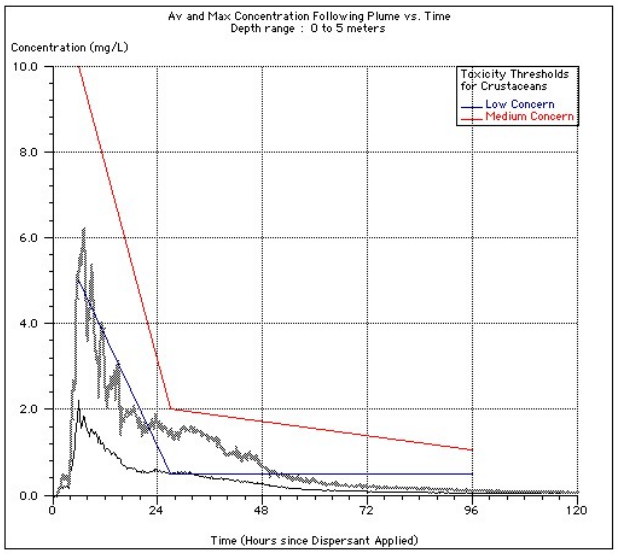
The 3D GNOME model output includes the following kinds of plots that were used by the participants to evaluate the potential impacts associated with each response option:

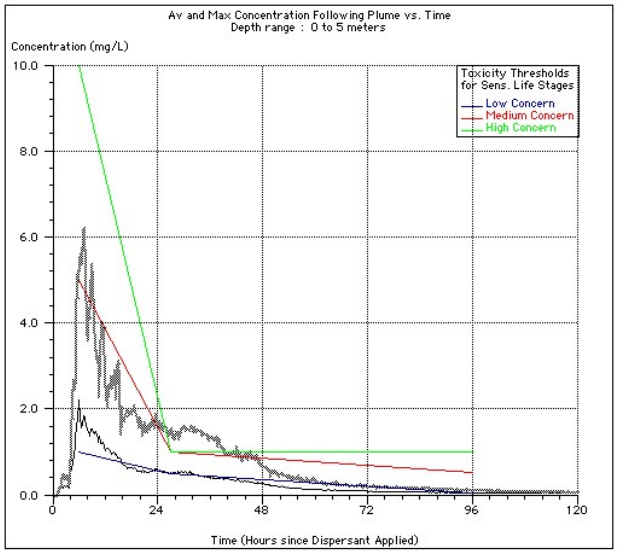
- Maximum and average dispersed oil concentrations at selected depths over time, representing the exposure to organisms that are entrained in the plume, such as plankton. Figure 6 shows example plots with the concentrations compared against "levels of concern" for different groups of organisms. These levels of concern are expressed at the oil concentration at parts per million (ppm) for different durations of exposure (i.e., 3 hours, 24 hours, and 96 hours). The groups were: adult fish, crustaceans, plankton, coral eggs, and seagrass.

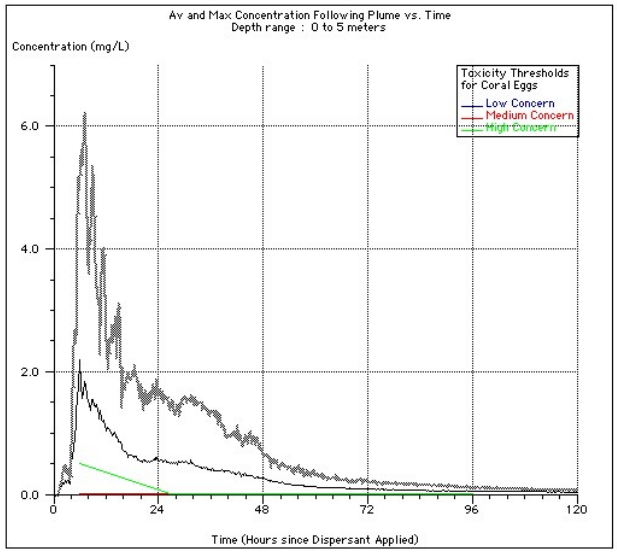
- Concentrations that a fixed feature on the seafloor would be exposed to the dispersed oil plume as it passed by the feature, such as a coral reef. Figure 7 shows example plots for a location just east of Buck Island.

- Depth profiles at different times and locations. Figure 8 shows example plots used by the breakout groups during their evaluations.



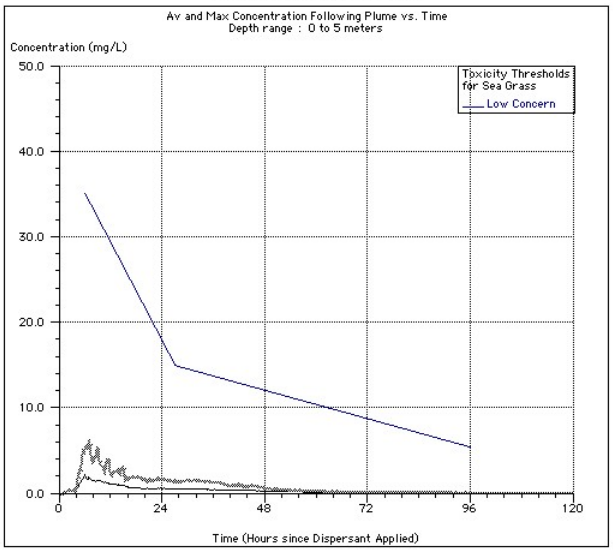




**Figure 6.** Average and maximum dispersed oil concentrations following the plume in 0-5 meters of water for 96 hours after use of chemical dispersants at 50% effectiveness. These concentrations are compared with low, medium, and high "levels of concern" for fish, crustaceans, plankton, coral eggs, and seagrass. These levels of concern are expressed as the oil concentrations for different exposure periods of 3, 24, and 96 hours.

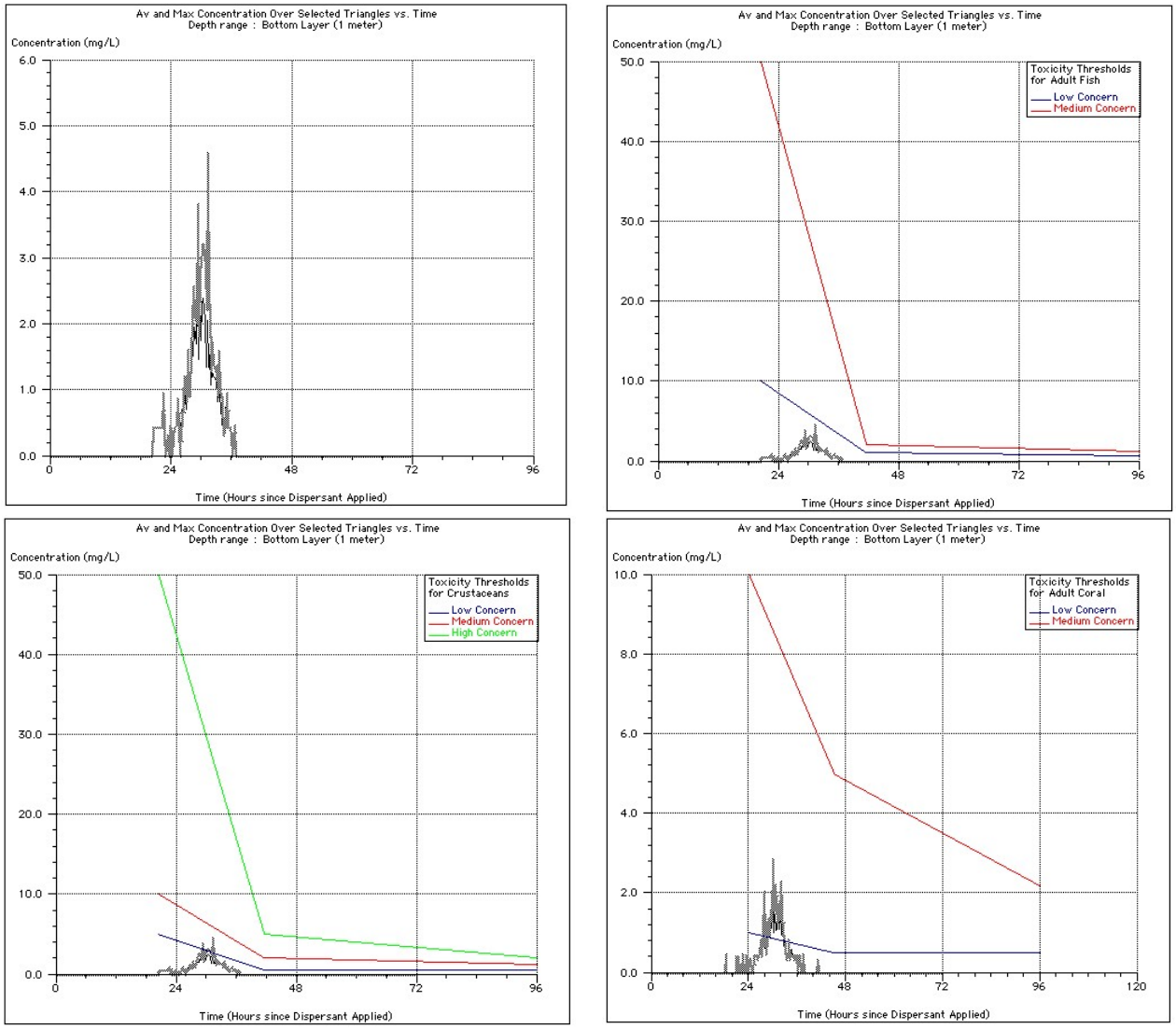



**Figure 7.** Plot of the average and maximum dispersed oil concentrations after use of chemical dispersants at 50% effectiveness over time on the seafloor (0-1 meters above the seafloor) at a location just east of Buck Island (top left). The other three plots also include the levels of concern for adult fish, crustaceans, and adult coral.

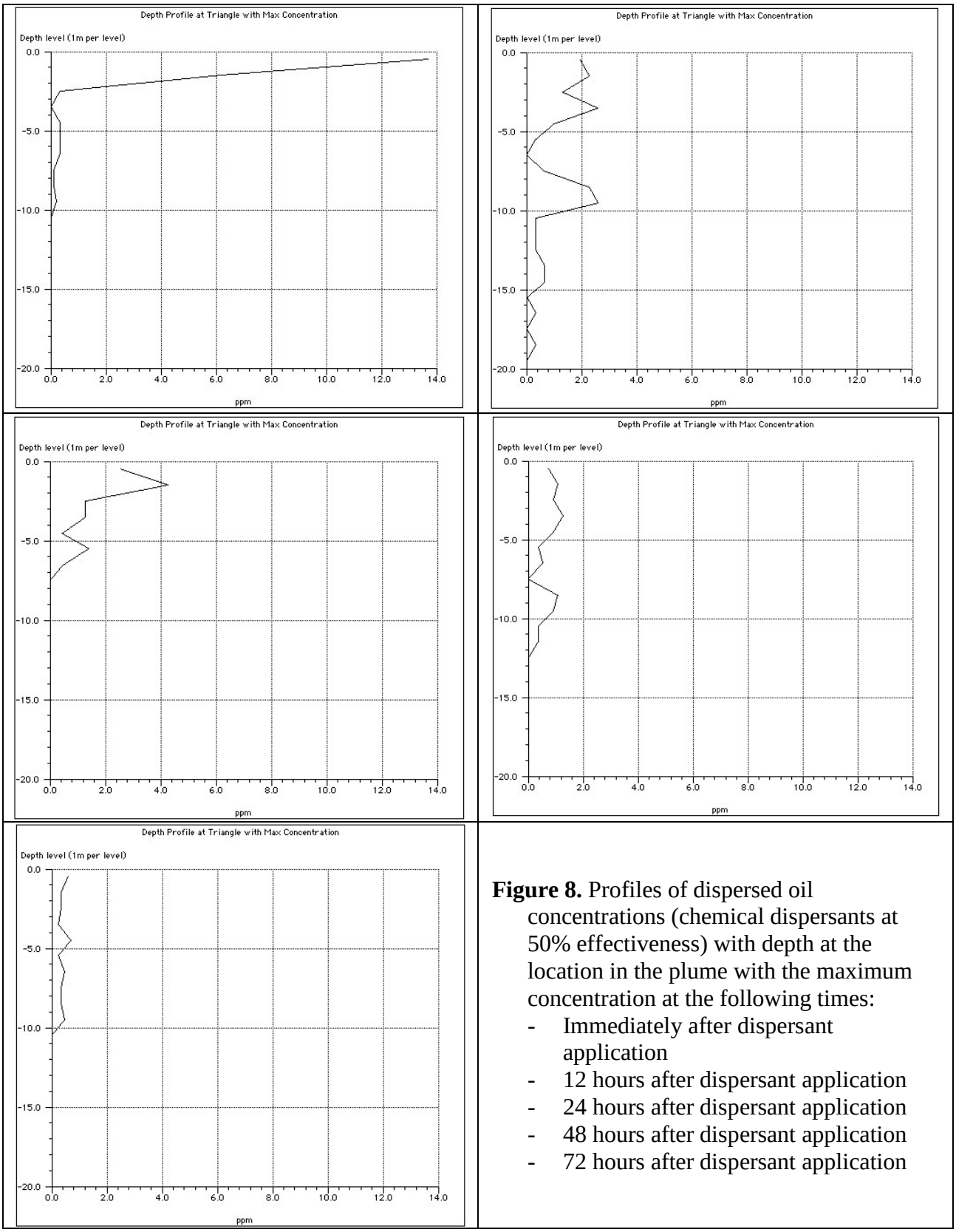



**Figure 8.** Profiles of dispersed oil concentrations (chemical dispersants at 50% effectiveness) with depth at the location in the plume with the maximum concentration at the following times:

- Immediately after dispersant application
- 12 hours after dispersant application
- 24 hours after dispersant application
- 48 hours after dispersant application
- 72 hours after dispersant application

## RISK RANKINGS FOR THE DIFFERENT RESPONSE OPTIONS

The next step in the ecological risk assessment process is to assign risk rankings to the different scenarios. The general risk matrix developed by Aurand et al. (2000) was used as the starting point. The workshop members together discussed the appropriate intervals for both the % of resources affected and the recovery intervals for the resources at risk in the Caribbean region. The individual risk ranks (alphanumeric codes) were then grouped into three overall "levels of concern" defined as high, moderate, and low. These levels of concern and color-codes are useful for summarizing the more detailed risk assessment matrices for each scenario. The risk analysis matrix used by the breakout groups is presented in Figure 9.

| | RECOVERY | | | | |
|---|---|---|---|---|---|
| | > 10 yrs (1) (VERY SLOW) | 5-10 yrs (2) | 3-5 yrs (3) | 1-3 yrs (4) | < 1 yr (5) (RAPID) |
| > 50% (A) | 1A | 2A | 3A | 4A | 5A |
| 30-50% (B) | 1B | 2B | 3B | 4B | 5B |
| 10-30% (C) | 1C | 2C | 3C | 4C | 5C |
| <10 % (D) | 1D | 2D | 3D | 4D | 5D |

**Figure 9.** Risk matrix developed during the workshop. Red cells represent a "high" level of concern, yellow cells represent a "moderate" level of concern, and green cells represent a "limited" level of concern.

Each breakout group reviewed the scenarios, the modeling results, information on exposure and sensitivity to oil and dispersed oil, and basic life history and distribution information to estimate the percent of each resource category affected and the time of recovery for the different response options. Each breakout group used the appropriate alphanumeric codes to rate the level of concern. Figure 10 shows the detailed matrix with the risk rank values and color codes for the four breakout groups for the response option of dispersants at 50% effectiveness.

| Habitats | Water Surface | | | | | Terrestrial | | | Intertidal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Subhabitats | | | | | | | | | Salt Ponds | | | | | | Mangroves | | | | | | Rocky Shores | | | | | Coral/ Cobble Beach | | | Sand Beach | | | Reef Flats | | | | | | | |
| Natural Recovery | Mammals | Birds | Fish | Plankton | Reptiles | Birds | Reptiles | Mammals | Vegetation | Birds | Fish | Aquatic Arthropods | Molluscs | Epifauna | Vegetation | Birds | Fish | Aquatic Arthropods | Molluscs/Epifauna | Mammal | Vegetation | Birds | Aquatic Arthropods | Mollusks | Epifauna | Birds | Infauna | Reptiles | Birds | Infauna | Reptiles | Vegetation | Birds | Fish | Aquatic Arthropods | Coelenterates | Molluscs/Epifauna | | |
| Habitat Scaling | R | L | R | L | R | L | L | L | | | | | | | L | L | L | L | L | L | L | L | L | L | L | L | L | R | L | L | R | L | L | L | L | L | L | R |
| Group 1 | 4D | 4D | - | 5D | 1D | 3C | 2C | 3D | | | | | | | 2D | 4D | 4C | 5C | 5C | - | 5C | 2D | 4C | 4C | 4C | 3D | 5D | - | 3D | 3D | 1D | 5D | 4D | 5A | 5B | 1C | 4C | - | |
| | | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Habitat Scaling | R | L | R | L | R | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | R | L | L | R | L | L | L | L | L | L | R |
| Group 2 | 5D | 2D | 5D | 5D | 1D | 5D | - | - | 1D | 5D | 5D | 5D | 5D | 5D | 1C | 2D | 5D | 5C | 5C | - | 5D | 3C | 5D | 3A | 4D | 3C | 5C | 4A | 3D | 5B | 1A | 5C | 3C | 5D | 5C | 1C | 5D | 5D | |
| Habitat Scaling | R | L | R | L | R | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | R | L | L | R | L | L | L | L | L | L | R |
| Group 3 | 1D | 2D | 3D | 5C | 1D | 4D | 5D | 5D | 2D | 3D | 5D | 4D | 4D | 4D | 2C | 3D | 3D | 4D | 3C | - | 2D | 2D | 4D | 4C | 4D | 2D | 4C | 1D | 2D | 4C | 1C | 4C | 3D | 4D | 5D | 4D | 4D | 3D | |
| Habitat Scaling | R | L | R | L | R | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | R | L | L | R | L | L | L | L | L | L | R |
| Group 4 | 1D | 2D | 4D | 5D | 1B | 4D | 1C | - | | | | | | | 1B | 2B | 1B | 1B | 1B | 1B | 4B | 1D | 4A | 3B | 3A | 2D | 4B | 1D | 3D | 3C | 1A | 4C | 2C | 3B | 4A | 2A | 3A | - | |
| | | | | | | | | | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Shaded Area = Habitat Scaling  L=Local (General vicinity of trajectory)  R=Regional

**Figure 10**. The detailed matrix showing the risk ranks for all resource categories within each subhabitat for the water surface, terrestrial, and intertidal habitats as completed by the four breakout groups for the response option of dispersants at 50% effectiveness. The variation in the risk ranks among the breakout groups reflects the variability and uncertainty in the risk assessment process and in the real world during spill response and decision making.

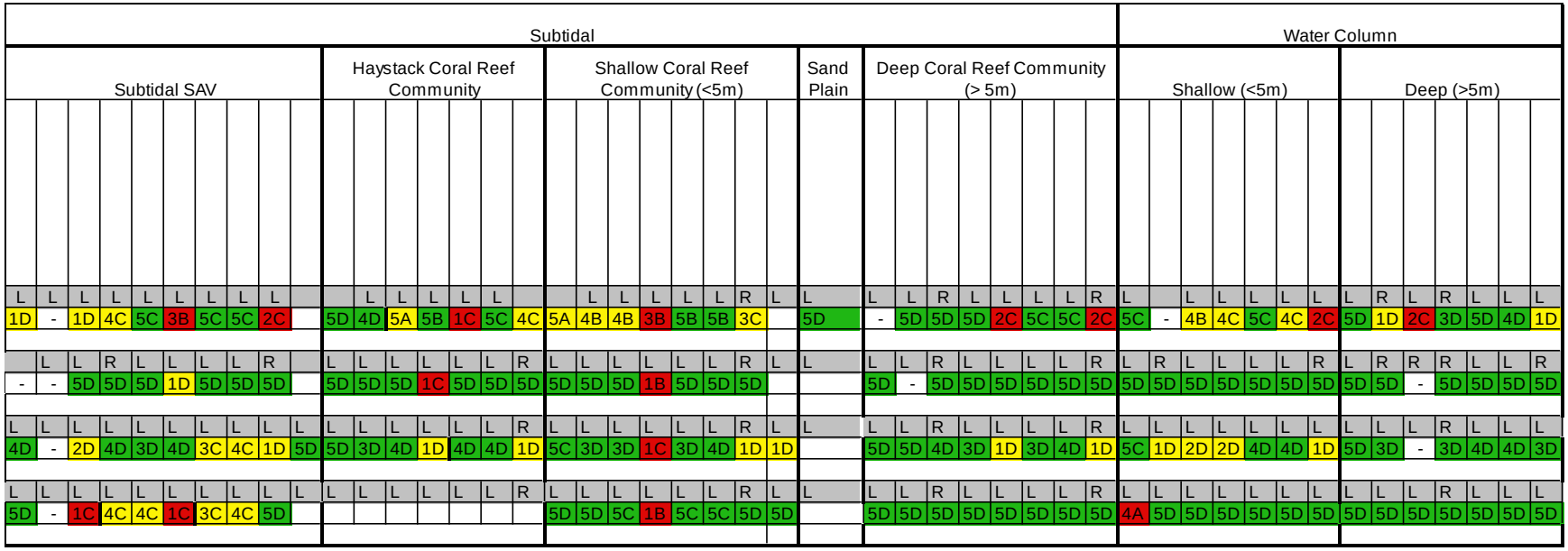



**Figure 10**. Continued.

The risk ranks from each breakout group were summarized by habitat and subhabitat for each response option, as shown in Figure 11. Many of the resources were ranked as having high levels of concern for all response options. Because of the relatively small size of the islands, spills can have significant impacts on the local and regional resources. It was clear during the discussions at the workshop that more information is needed to make more informed decisions during spill emergencies.

| Response Options | | | | Intertidal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mangrove Forest | | | | | | | | Sand Beaches | | | | Coral/Cobble Beaches | | | | Reef Flats | | | | Salt Ponds | | | | | | | | | | |
| Natural Recovery | 1D | 1C | 1C | 3D | 2B | 5D | 3D | 1C | 2D | 1B | 1B | 1A | 2D | 3A | 3C | 4A | 1C | 1A | 1A | 2A | 3D | 4A | 2C | 2D | 3C | 1D | 3D | 3B | - | 1C | 4D | - | | |
| Mechanical Recovery | 1D | 1C | 1C | 3D | 2B | 5D | 3D | 1C | 2D | 1B | 1B | 1A | 2D | 3A | 3C | 4A | 1C | 1B | 1B | 2A | 3D | 4A | 2C | 2D | 3C | 1D | 3D | 3B | - | 1C | 4D | - | | |
| Dispersants | 1D | 1D | 1D | 3D | 2C | 5D | 4D | 1C | 2D | 1C | 2C | 1B | 3D | 3A | 3D | 4A | 1D | 1A | 1C | 2B | 4D | 4A | 2D | 2D | 3C | 1C | 3D | 3B | - | 1D | 4D | - | | |

| Response Options | Subtidal | | | | | | | | | | | | | | | | | | | | Water Column | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Natural Recovery | 1D | 5D | 3D | 4D | 1C | 1C | 1D | - | 1D | 5D | 1C | 5D | 3D | 5D | 4D | 5D | 5D | 5D | - | - | 2D | 5D | 1D | 4D | 3D | 5D | 4D | 5D |
| Mechanical Recovery | 1D | 5D | 3D | 4D | 1C | 1C | 1D | - | 1D | 5D | 1C | 5D | 3D | 5D | 4D | 5D | 5D | 5D | - | - | 2D | 5D | 1D | 4D | 3D | 5D | 4D | 5D |
| Dispersants | 2D | 5D | 3D | 1C | 1B | 1C | 1D | - | 3B | 1B | 1C | 1B | 3D | 5D | 4D | 5D | 5D | 5D | - | - | 3C | 5D | 1C | 4D | 3D | 5D | 4D | 5D |

**Figure 11.** Risk rankings for the different response options. The four columns under each habitat type represent the rankings of the four different breakout groups.

## WORKSHOP RECOMMENDATIONS

Table 4 lists the recommendations made at the end of the workshop. They are listed in the order that they were identified. Table 4 also identifies a relative priority (A-C, with A being highest) of the task and who should be involved in pursuing and implementing each recommendation.

**Table 4.** Workshop recommendations.

| Recommendation | Priority and Responsibility for Implementation |
|---|---|
| Update the Environmental Sensitivity Index (ESI) maps for the U.S. Virgin Islands (USVI) | Priority = A<br>The CRRT is working on funding in FY2009 |
| Provide better data on winds and currents to improve oil spill trajectory model results<br>- Offshore buoys are needed to provide real-time wind and current data<br>- Studies are needed to better understand inshore currents<br>- Drift card studies in the region | Priority = A<br>The USVI DREP will bring up this need at the next CARIB IOOS meeting.<br>NPS will review nearshore processes studies being conducted by the US Geological Survey.<br>NOAA will check with the National Weather Service about future plans and needs in the region.<br>NOAA and a local sponsor will discuss planning for drift card studies |
| Review the Geographic Response Plan and determine the response resources needed to meet the protection priorities and response needs, including<br>- Dispersant stockpiles<br>- Amount of boom and other response resources<br>- Ground-truth response strategies | Priority = A<br>The USVI Area Committee is working on this. |
| Conduct a good scientific review of the existing literature on dispersed oil toxicity (start with the recent NRC report) and then identify data gaps for tropical resources, including oil and dispersed oil effects on all life stages of sea turtles, seagrass as an ingestion pathway of exposure, conch, etc. | Priority = A<br>No specific implementing agency identified. May be appropriate to suggest as a topic for funding by the Coastal Response and Restoration Center (CRRC) at the University of New Hampshire (UNH). |
| Develop a plan and funding for a monitoring program to be implemented following actual spills, to include water sampling to document actual oil exposure in the water column | Priority = A<br>The CRRT and Resource Managers should work together on the plan and identify funding. |
| Seek out partnerships with academic and other researchers to fill data gaps on effects of oil and dispersed oil. | Priority = B<br>USEPA will take the overall lead and review the possibility of funding under the Science to Achieve Results (STAR) program. NPS will review potential partnerships through their Cooperative Ecosystem Study Unit (CESU) program.<br>NOAA will discuss the possibility of funding from the CRRC at UNH. |

**Table 4.** Cont.

| | |
|---|---|
| Develop a "job-aid" that provides short summaries of the likely effects of oil on key resources, including marine mammals, birds, fish, shellfish, and reptiles. This information would be very useful to participants in future ERA workshops. NOAA/Research Planning, Inc (RPI) produced a series in the mid-1980s that could be the basis for an update. | Priority = A<br>NOAA will take the lead. The idea is to update the booklets NOAA created in the 1980s on these resource groups.<br>USEPA will evaluate the use of Integrated Risk Information System (IRIS) for providing toxicity thresholds. |
| Conduct shoreline surveys to document background rates of tarball accumulations on beaches and to evaluate risks. | Priority = C<br>All resource managers, NGOs, and industry would be involved. It might be an appropriate public outreach program. |
| Establish a mutual-aid agreement for dispersant availability and application in the USVI. | Priority = A<br>The CRRT and Area Committees should address this issue. |
| Have each natural resource agency develop a plan for emergency notification and response in the event of spills; with such limited staff resources in the Caribbean, an Incident Management Team concept is needed. Keep the CRRT apprised of the Volunteer Guidance currently under development from USCG and cooperating agencies. | Priority = A<br>Each agency is to implement its own plan. NPS has such a plan in the works. |
| Provide GIS data on the boundaries of NPS and other important marine areas to response groups. | Priority = A<br>CRRT to make sure that this gets implemented. |
| Improve the NOAA 3D GNOME model to include the ability to use the model results in GIS overlays with resources. | Priority = A<br>NOAA |
| Identify shipping routes and the risks to high sensitivity areas; evaluate potential mitigation measures and/or posting information on high sensitivity areas on navigation charts, coast pilots, notice to mariners, etc. Private aids to navigation were identified as a specific issue. | Priority = C<br>USCG to implement. |
| Finalize recommended guidance on case-by-case evaluation of dispersant use in waters managed by the NPS. | Priority = A<br>NPS to implement |
| Finalize recommended guidance on case-by-case evaluation of dispersant use in USVI territorial waters. | Priority = A<br>USVI to implement |

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## APPENDIX 1:

## LIST OF PARTICIPANTS IN THE CARIBBEAN DISPERSANT WORKSHOP DAYS 1 AND 2 AT HOVENSA

| Name | Organization | Email |
|---|---|---|
| Alan Mearns | NOAA | alan.mearns@noaa.gov |
| Allison Palmer | NPS - Biscayne Bay NP | allison_palmer@nps.gov |
| Bradford Benggio | NOAA | brad.benggio@noaa.gov |
| Charlie Huber | MSRC/C.A. Huber, Inc. | HuberCharlesA@hotmail.com |
| Christy McManus | NPS - Virgin Islands NP | christy_mcmanus@nps.gov |
| Claudia D. Lombard | USFWS | Claudia_Lombard@fws.gov |
| Danene Birtell | Tri-State Bird Rescue & Research | dbirtell@tristatebird.org |
| Dave Anderson | NPS - Spill Response Program | d_l_anderson@nps.gov |
| David Herbert | HOVENSA | dherbert@hovensa.com |
| Earl McFarlane | USCG | earle.k.mcfarlane@uscg.mil |
| Eric Marquette | PPS, Inc. | ericmarquette@ppscorp.com |
| Eric Mosher | EPA - Region 2 | mosher.eric@epa.gov |
| Erik Demicco | Clean Caribbean & Americas | edemicco@cleancaribbean.org |
| Felix Lopez | USFWS | felix_lopez@fws.gov |
| Fermin Rodriguez | HOVENSA | frodriguez@hovensa.com |
| Frank Burgard | HOVENSA | fburgard@hovensa.com |
| Fred Remen | USCG | fremen@sfwmd.gov |
| Gregory Hogue | DOI | gregory_hogue@ios.doi.gov |
| Ian Lundgren | NPS - Buck Island NM | ian_lundgren@nps.gov |
| Jacqueline Michel | Research Planning, Inc. | jmichel@researchplanning.com |
| James Haeghaert | NRC St. Croix | jhaeghaert@nrcc.com |
| Jeff Mihan | NPS - Virgin Islands NP | jeff_mihan@nps.gov |
| Jennifer Valiulis | DPNR - DFW | jennifer.valiulis@gmail.com |
| Joel Tutein | NPS - Christiansted/Buck Island | joel_tutein@nps.gov |
| Jorge E. Saliva | USFWS | jorge_saliva@fws.gov |
| Kemit-Amon Lewis | DPNR - CZM | kemit.lewis@dpnr.gov.vi |
| Kent Bernier | DPNR - DEP | kent.bernier@dpnr.gov.vi |
| Kristen Keteles | EPA | keteles.kristen@epa.gov |
| Lindy Nelson | NPS - Spill Response Program | Lindy_Nelson@NPS.gov |
| Lorena Harris | NPS | lorena_harris@nps.gov |
| Mark Hardgrove | NPS - Cape Hatteras NS | mark_hardgrove@nps.gov |
| Mark Senna | USCG | mark.t.senna@uscg.mil |
| Maurice A. Pinder | HOVENSA | mpinder@hovensa.com |
| Michael Dupris | HOVENSA Safety | mdupuis@hovensa.com |
| Nicolle Rutherford | NOAA | nicolle.r.rutherford@noaa.gov |
| Paul Gebert | PPS, Inc. | paulgebert@ppscorp.com |
| Peter Brown | HOVENSA | pbrown@hovensa.com |
| Rafe Boulon | NPS - Virgin Islands NP | rafe_boulon@nps.gov |
| Ricardo Alonso | USCG | ricardo.m.alonso@uscg.mil |
| Rickard Fricke | HOVENSA | rfricke@hovensa.com |
| Rocco Colabella | HOVENSA | rcolabella@hovensa.com |
| Ross Blouin | MSRC | blouin@msrc.org |
| Sarah Bostwick | HOVENSA | sbostwick@hovensa.com |
| Sarah Tegtmeier | Tri-State Bird Rescue & Research | stegtmeier@tristatebird.org |
| Sloan Schoyer | HOVENSA | SSchoyer@hovensa.com |
| Steve Touw | EPA | touw.steve@epa.gov |
| Susan Duke | NPS - Christiansted NM | susan_duke@nps.gov |
| Thayer Broili | NPS - Cape Hatteras NS | thayer_broili@nps.gov |
| Thomas Kelley | NPS - Virgin Islands NP | thomas_kelley@nps.gov |

| | | |
|---|---|---|
| Tim Pinion | NPS - Southeast Region | timothy_pinion@nps.gov |
| Troy Holloway | MSRC | holloway@msrc.org |
| Wayne Donadelle | DPNR - DEP | wayne.donadelle@dpnr.gov.vi |
| Wes McNeil | HOVENSA | wmcneil@hovensa.com |
| William Coles | DPNR - Fish & Wildlife | william.coles@dpnr.gov.vi |
| William Tobias | DPNR - DFW | williamtobias@vitelcom.net |
| Zandy Hillis-Starr | NPS - Buck Island NM | zandy_hillis-starr@nps.gov |

## APPENDIX 2:

## LIST OF PARTICIPANTS IN THE CARIBBEAN DISPERSANT WORKSHOP DAYS 3 AND 4 AT NPS

| Name | Organization |
|---|---|
| Lindy Nelson | NPS-WASO |
| Thomas Kelley | NPS-Virgin Islands NP |
| Erick Demicco | Clean Caribbean & Americas |
| Eric Mosher | USEPA – Region 2 |
| Charlie Huber | MSRC |
| Ross Blouin | MSRC |
| Jeff Mihan | NPS-Virgin Islands NP |
| Christy McManus | NPS-Virgin Islands NP |
| Frank Burgard III | Hovensa |
| Maurice A. Pinder | Hovensa |
| Eric Marquette | PPS, Inc. |
| Paul Gebert | PPS, Inc. |
| Zandy Hills-Starr | NPS-Buck Island Reef NM |
| Susan Duke | NPS-Buck Island Reef NM |
| Fermin Rodriguez | Hovensa |
| Dave Anderson | NPS-WASO |
| Allison Palmer | NPS-Biscayne NP |
| Rafe Boulon | NPS-Virgin Islands NP |
| Felix Lopez | USFWS |
| Bradford Benggio | NOAA |
| Gregory Hogue | DOI |
| Alan Mearns | NOAA |
| Nicolle Rutherford | NOAA |
| Fred Remen | USCG |
| Joe Cood | USCG |
| Ricardo Alonso | USCG |
| Steve Touw | EPA |
| Kristen Keteles | EPA |
| Jennifer Valiulis | DPNR-DFW |
| Mary Hubbard | Booz Allen Hamilton |
| Candace Buckmen | Booz Allen Hamilton |
| Jacqueline Michel | Research Planning, Inc. |
| Danielle Birtell | Tri-State Bird Rescue & Research |
| Sarah Tegtmeier | Tri-State Bird Rescue & Research |
| James Haeghaer | NRC/STX |
| Claudia O. Lombard | USFWS/STX |
| Tim Pinion | NPS-Southeast Region |
| Thayer Broili | NPS-Cape Hatteras NS |
| Kemit Amon Lewis | DPNR CZM |
| William Tobias | DPNR-DFW |