Utilizing Net Environmental Benefit Analysis (NEBA) as a Tool for Evaluating Applied Response Technologies in Response to a Marine Oil Spill.

Yvonne Najah Addassi, Staff Environmental Scientist, Office of Spill Prevention and Response, Department of Fish and Game

Introduction

Over the last several years, localized Ecological Risk Assessments (ERAs) have been conducted in the states of California, Washington and Texas. The purpose of these workshops was to provide response planners and other stakeholders with a forum for discussing oil spill response measures, with an emphasis on chemical dispersants. Many members of the Region IX Regional Team (RRT) participated in these workshops and decided to try and streamline the decision making process dispersant use in California. In 2000, the Region IX RRT requested that Area Committees within the state, utilizing local expertise, make recommendation for the use of dispersants into three zones; pre-approval; pre-approval with consultation; and RRT approval required. The first of the Dispersant-Use Zone recommendations was approved by the RRT in July 2002, for the North Coast Area Committee.

The RRT envisioned that the Dispersant-Use Zones Recommendations and subsequent Dispersant-Use Plans will be incorporated into the Federal Area Contingency Plans and will become an integral process of planning and preparedness for spill response. In development of the Dispersant-Use Plans, the area committees used a modified ERA process (best described as a NEBA) to identify concerns and prioritize risk so that sound and appropriate recommendations could be made. This process provided a mechanism to clearly identify species of concern, routes of exposure and trade-offs associated with each response option and begin to make determination regarding their appropriate use.

After reviewing this ERA process and its benefits around the country, the USCG began to more formally consider the feasibility of incorporating the ERA process into the overall maintenance and modification of the ACPs. Their goal was to create a tool that could be used by staff to teach the ERA process and a guidebook was developed to further this end. Although several of the subcommittees completed their work before the Guidebook was developed, it provides an excellent background on the development of the modified ERA for use in spill response and provides excellent guidance for conducting a workshop. Many of the charts and graphs below were cited, by permission of Don Aurand, a co-author of the Guidebook, Developing Consensus Ecological Risk Assessments: Environmental Protection In Oil Spill Response Planning. A citation at the end of this document is provided as well as how this Guidebook can be obtained.

Net Environmental Benefit Analysis (NEBA) Process Used By the Dispersant Subcommittees:

The stated purpose of the Dispersant Subcommittees was to examine the use of dispersants in the federal waters within their area of operation and to propose how a Dispersant Use Plan (DUP) could be implemented with the area contingency plan. Recommendations for dispersant zones would be forwarded to the area committees and then finalized by the RRT. As part of the examination, the Subcommittee assessed and compared the impacts of an oil spill and associated cleanup activities on the biological resources of this area of operation. This examination was conducted using a Net Environmental Benefit Analysis (NEBA), modeled on an Ecological Risk Assessment previously conducted for the San Francisco Bay (Pond et al., 2000). In this case, the NEBA examined and compared the risk to the environment associated with available oil spill response options. Spill response options are:

1) No on-water response
2) Mechanical cleanup
3) In-situ burning
4) Dispersant use

Most NEBAs were conducted using a spill of a dispersible product or a product that was frequently moved within the area of operation. Most spill scenarios used to formulate the NEBA were very general and incorporated all habitats that could be impacted by an oil spill in the region. The analysis used the "what if" approach by examining the individual impact of oil and cleanup activities on all habitats and species in the region. The analysis was a worst case scenario in that all sensitive species that may be found in the region, regardless of time of year, were incorporated. This approach was undertaken to eliminate the need to conduct the multitude of NEBAs that would be necessary to address spatial and temporal differences found in the region. By using this approach, the Subcommittees had all the pertinent resource information at their disposal at one time and could examine and incorporate temporal and spatial differences in their single analysis.

The risk of these cleanup options were examined using a NEBA risk matrix, which qualitatively combines the risk to the biological resource resulting from both the magnitude (percentage) of the population impacted with the expected time for the population to recover from the impact. For each of the response options, impact on the habitats was assessed and a matrix used for determining routes of exposure. This sample matrix for exposure routes was developed for the San Francisco Ecological Risk Assessment (Pond, et al. 2000) and is provided in the Guidebook.

Zones:	Terrestrial					Water Surface				Intertidal				
Habitats: / Sub-Habitats:	Upland and Supratidal									Marsh				
RESOURCES:	Vegetation	Mammals	Birds	Reptiles/Amphibians	Insects	Mammals	Birds	Reptiles/Amphibians	Vegetation	Mammals	Birds	Fish	Crustaceans	Mollusks
STRESSORS:														
Natural Recovery	7	1,7	1,7	1,7	1,7	1,4,7	1,4,7	1,4,7	2,4	1,4,7	1,4,7	2,7	2,4,7	2,4,7
On-Water Recovery	3	3,6	3,6	3,6	3,6	3	3	3	3	3	3	3	3	3
Shoreline cleanup	3,4,6	3,4,6	3,4,6	3,4,6	3,4,6	4,7	4,7	4	3,4	3,4	3,4	3,4	3,4	3,4
Oil + Dispersant	NA	NA	NA	NA	NA	7	7	NA	2	4,7	4,7	2,7	2,7	2,7
ISB	1	1	1	1	1	1,5	1,5	1,5	4,5	1,4,5,7	1,4,5,7	5,7	4,5,7	4,5,7

Note: On-water recovery includes protective and diversion booming
Note: N/A indicates that stressor and resource do not contact each other
These hazards represent changes from oil only scenario.
Shaded zones indicate areas of emphasis for the risk analysis

Hazards:
1. Air Pollution
2. Aqueous Exposure
3. Physical Trauma (mechanical impact from equipment, aircraft, people, boat bottoms, etc.)
4. Physical Oiling/Smothering
5. Thermal (heat exposure from ISB)
6. Waste
7. Indirect (food web, etc.)

The habitat-specific results were developed for each region. Most of the subcommittees were able to review the work done in other States as well as the work completed in the initial ERA conducted in San Francisco. Utilizing the same approach along the California coast helped ensure consistency within the planning process. This sample matrix for habitat types and resources was developed for the San Francisco Ecological Risk Assessment (Pond, et al. 2000) and is provided in the Guidebook.

ZONES	HABITAT	SUB-HABITATS	RESOURCE CATEGORIES	EXAMPLE ORGANISMS
Terrestrial	Upland and Supratidal		Vegetation	American dune grass; threatened and endangered dune plants; lichens; algae; vascular plants
			Mammals	raccoon; fox; humans
			Birds	waterfowl; seabird colonies; snowy plover; least tern; raptors
			Reptiles/Amphibians	SF garter snake; red-legged frog
			Insects	mission blue butterfly
Water Surface			Mammals	cetaceans; sea otters; pinnipeds
			Birds	pelicans; grebes; waterfowl;cormorants; terns; loons; shearwater; alcids
			Reptiles/Amphibians	leatherback turtle
Intertidal	Marsh		Vegetation	saltmarsh cordgrass; pickleweed
			Mammals	salt marsh harvest mouse; shrew; voles; canids
			Birds	rails; wading birds; shorebirds; waterfowl; loons; grebes; canvasback; raptors; Suisun song sparrow
			Fish	salmonids; sculpins; surf perch; delta smelt
			Crustaceans	fiddler crabs
			Molluscs	snails
	Mud Flats		Vegetation	Gracilaria
			Birds	gulls; wading birds; shorebirds; waterfowl; canvasback
			Fish	sculpins; surf perch; topsmelt; flatfish
			Crustaceans	fiddler crabs; ghost shrimp
			Molluscs	clams
			Polychaetes	fat innkeepers; Nereis
	Sandy Beach		Mammals	raccoon; canids
			Birds	gulls; shore birds; snowy plover; sea ducks; raptors; loons; grebes
			Fish	surf perch; surf smelt; striped bass
			Crustaceans	sand crabs; crabs
			Meiofauna	unknown

In addition to specific habitat results, some of the subcommittees developed specific findings regarding the use of dispersants and the trade-offs associated with the response scenario of “what if” analysis use for the process. Below is an example of the preliminary findings being developed by one or more of the subcommittees:

1) In average or worse-than-average offshore response settings, and/or where spill distance from shore significantly increases the response time, mechanical cleanup techniques and in-situ burning may, by themselves, provide very little improvement over the no response option. When this is the case, these response techniques will not significantly reduce the risk of spilled oil contacting biological resources at the sea surface or in more inshore (e.g., inertial) regions.

2) When used in an appropriate and timely manner, dispersants can remove a significant amount of oil from surface water (appropriate and timely application includes a number of decision factors).

3) While dispersants may measurably reduce the risk of oil to surface and coastal biological resources, there may be a temporally-limited increase in risk to the plankton community in the upper several meters of the water column;

4) Shoreline cleanup methods may not be available or appropriate for use in some sensitive coastal habitats (e.g., rocky inertial, marshes, wetlands); their inappropriate use may pose a greater risk to these sensitive habitats and dependent species than the oil itself. The goal in this case shifts to keeping the oil from ever reaching sensitive coastal and inland areas.

In the NEBA process, the benefits and risks of each cleanup option were evaluated separately. However, an effective spill response may use a combination of several available response options. Oceanographic conditions permitting, it is expected that dispersants would be used in combination with mechanical cleanup equipment and response strategies.

As part of the analysis, the Subcommittee examined how the use of the various cleanup techniques would impact regional habitats at risk during an oil spill. The process develops a qualitative ranking of risk using a risk square approach. The risk square combines severity of impact (percent of population impacted) with the time necessary for the population to recover from the impact. The risk square used by the subcommittee was originally developed for used in the San Francisco Bay region (Pond *et al*., 2000), and is depicted below.

		Population Recovery Time			
Percent of Population Impacted		SLOW > 7 years **1**	3 to 7 years **2**	1-3 years **3**	FAST < 1 year **4**
LARGE > 60%	**A**	1A	2A	3A	4A
40 - 60%	**B**	1B	2B	3B	4B
20 - 40%	**C**	1C	2C	3C	4C
5 - 20%	**D**	1D	2D	3D	4D
SMALL 0 - 5%	**E**	1E	2E	3E	4E

The columns in the risk matrix denote the percent of the population oiled during an oil spill, while the rows are divided into estimated recovery times for the impacted population. The choice of the seven-year limit on recovery time was a subjective judgment based on El Nina weather patterns and population cycles.

Risk scores were further divided into three categories denoting a general "level of concern" with respect to oil-related impacts:

Level of concern Scores	Description
High 1A, 2A, 1B, 2B 1C, 1D	High population impact & potential for serious long-term population effects.
Moderate 1E, 2C, 2D, 2E, 3A 3B, 3C, 3D, 4A, 4B.	Moderate ecological concern & potential limited population effects.
Low 3E, 4C, 4D, 4E	Minimal ecological concern & potential short-term population effects

The NEBA conducted by the area committees each examined the impact of oil on each habitat and associated biological resources at risk in the area of operation. The NEBA used available resource information and toxicological endpoints from the literature and assigned a risk score based on the best professional judgment of the subcommittee members. Below is an example of a sample matrix resulting from a NEBA.

Zones:	Terrestrial			Water Surface			Intertidal														
Habitats:	Upland and Supratidal						Marsh			Mud Flats			Sandy Beach			Rocky/Rip Rap/Sea Walls			Pier Pilings		
Sub-Habitats:																					
Nat. Rec.	4e	NA	4e	1b	3a	3c	1b	2a/ 2b	2c	1c	3d/ 2a	3d	2c	3c	4e	2c	3c	3c	3c	3d	3d
Mech. Rec.	4e	NA	4e	1b	3a	3c	1b	2a	2d	1c	2a	3d	2c	3c	4e	2c	3c	3d	3c	3d	3d
Shoreline Cleanup	4d	3e	4d	1b	3a	3c	1b	2a	2c	1c	2c	3d	2c	3d	4e	2c	3b	3b	3c	2b	3c
Dispersant use (35%)	4e	NA	4d	1b	4b	3c	1b	2b	2c	1c	2b	4a	2c	3d	4e	2c	3c	3c	3c	4e	3d
Dispersant use (80%)	4e	NA	4d	1d	4d	3d	2d	3d	3d	2d	3d	3d	3d	4d	4e	2d	4d	4d	3d	4e	4d
ISB	4e	4e	4d	1b	3a	3c	1b	2a	2d	1c	2a	3d	2c	3c	4e	2c	3c	3d	3c	3d	3d

Indicates high level of ecological concern
Indicates moderate to high level of ecological concern
Indicates moderate level of ecological concern
Indicates low level of ecological concern

The conclusions drawn by many of the subcommittees suggested that the appropriate and timely use of dispersants (on oil spills characterized as “dispersible”) could greatly enhance the ability to remove significant quantities of oil from the offshore water surface. This may greatly reduce the risk of spilled oil reaching the more abundant and sensitive habitats and species found in the more inshore, coastal areas. While dispersing oil into the water column can pose a short-term risk to the plankton community inhabiting the upper few meters of the water column, the impacts will be to a much more geographically limited area, and the temporal duration will be relatively very short. The environmental “trade-off” decision-making at the time of a response – weighing the impacts associated with oil on the surface for weeks to months versus the short term toxicity (minutes to hours) resulting from dispersed oil in the water column – can and will by made by the response agencies on a case-by-case basis.

Citations:

Aurand, D. 1995. The application of ecological risk principles to dispersant use planning. Spill Sci. Tech. Bull. 2(4): 241-247.

Aurand, D., L. Walko, R. Pond. 2000. Developing Consensus Ecological Risk Assessments: Environmental Protection In Oil Spill Response Planning A Guidebook. United States Coast Guard. Washington, D.C. 148p.

Pond, R.G. Aurand, and J.A. Kraly (compilers). 2000. Ecological Risk Assessment principles applied to oil spill response planning in the San Francisco Bay area. California Office of Spill Prevention and Response, Sacramento, CA. 70 + App.

Acknowledgements:
Thank all the wonderful people on the San Diego, Los Angeles and Santa Barbara dispersant subcommittees for all their hard work and patience in working toward a better spill response in California.

Much appreciation for all my co-members of the Region IX RRT and ART subcommittees. It amazes me how much work we accomplish as a part of this team.

And a special thanks to Michael Sowby. His work and efforts on behalf of the original San Francisco Ecological Risk Assessment as well as that with the North Coast Area Dispersant Subcommittee has provided templates for all of us to use.

Report Availability: Copies of the Report . Developing Consensus Ecological Risk Assessments: Environmental Protection In Oil Spill Response Planning A Guidebook. can be obtained from the following address:

Commandant (G-MOR)
United States Coast Guard
2100 Second Street, SW
Washington, DC 20593