

## Shoreline Oiling Deepwater Horizon Oil Spill

and persisted. This type of information is highly pertinent to oil spill response scenarios linked with contingency planning and responding to future incidents.

**Methods**

During the *Deepwater Horizon* spill response, up to 18 SCAT teams, consisting of Federal, State, local, and BP representatives, conducted field surveys to document the location, shape, and character of shoreline oiling using standard methods and terminology. As of January 2013, this effort involved over 2,000 SCAT team-days during which 7,600 kilometers (km) of shoreline has been surveyed; however, over 51,000 km of total shoreline has been surveyed, because of the many repeated surveys of the same sections of shoreline over time. These data were the basis for developing shoreline treatment recommendations for specific shoreline segments, using cleanup criteria developed through consensus based on habitat type and use. Following shoreline cleanup strategies, SCAT teams inspected each segment against these criteria. Guidelines for cleaning oiled shorelines have been developed through government and industry-funded research, lessons learned from previous spill responses, and onsite tests. The Office of Response and Restoration, National Oceanic and Atmospheric Administration has developed general guidelines for cleanup strategies and cleanup objectives as part of

conditions, progression through cleanup operations, and seasonal factors [9] as summarized below:

**Stage I/II Nearshore and Shoreline Response**

These stages (May to September 2010) covered the period during which oil continued to strand onshore. Oil spill cleanup tactics create an intrinsic level of environmental impact and the standard approach is to initiate shoreline cleanup once the risk of further shoreline oiling has abated. The ongoing release from the wellhead during this incident required that shoreline cleaning begin while oil was still coming ashore. SCAT shoreline surveys during this Stage were rapid and focused on locating bulk shoreline oiling for immediate response. Shoreline cleanup consisted of removal of floating oil adjacent to the shoreline and bulk oil removal from the shoreline, especially where such oil could resuspend and spread to other areas.

**Stage III Shoreline Response**

This stage (September 2010 to March 2011) began once significant quantities of floating oil no longer remained on the sea surface, addressed all shorelines within the Area of Response, and included detailed SCAT surveys. The end of Stage III was a target date to meet cleanup goals by spring 2011, when shorelines are to look, sea turtles, and people increases. Shoreline Treatment Recommendations (STRs) prepared within the SCAT program

patches, rather than a continuous slick. In marshes, the emulsified oil pooled on the surface with little penetration into the marsh soils. On some sand beaches, the oil penetrated up to a few

centimeters by wind and currents for 20–30 km through warm Gulf of Mexico waters to reach the shoreline. The oil that eventually stranded on the shoreline was in the form of a thick, viscous emulsion, containing up to 60% water, as opposed to fresh, liquid oil. In most cases this emulsified oil stranded as discrete patches, rather than a continuous slick. In marshes, the emulsified oil pooled on the surface with little penetration into the marsh soils. On some sand beaches, the oil penetrated up to a few centimeters into the sediments, forming a semi-solid oil/sediment matrix, referred to as surface oil residue (SOR). To reflect the different oiling characteristics observed during the response, SCAT terminology was modified to include surface residue balls (SRBs), <10 cm; surface residue parties (SRPs), >10 cm; and large SR mats that could be 100% of or long and up to 30 cm thick. Samples of SRBs collected in January 2011 consisted of 4.2–22.8% oil and 87.2–95.8% sand [6]. These SRBs are different from “beachballs” commonly found following oil spills because they are turbidized pieces of sand, shell, and other beach materials loosely bound by surface oil residue. Figure 1 shows representative photographs of the types of oil stranded on sand beaches and marshes.

The shoreline response program encompassed four steps, defined primarily to recognize changes in oiling threat, oiling

NET guidelines were developed through consensus by representatives from the Responsible Party and Federal and State jurisdictions. These NET guidelines were designed to be qualitative and receptive to both cleanup workers and assessment teams. The objective was to proceed with shoreline treatment until the actions were no longer effective or caused more harm than good and begin to slow the recovery process in other work periods until a Net Environmental Benefit was achieved.

**Stage IV Shoreline Response**

This stage (March to November 2011, the latter before the end of hurricane season in the United States) consisted of a re-survey of all affected shorelines to document Spring 2011 conditions and determine the need for cleanup to meet “2011 NET guidelines.” The 2011 NET guidelines were developed through the same process as the 2010 NET guidelines. New Stage IV STRs were issued for shorelines requiring treatment based on the oiling conditions documented at the time. Shoreline segments that met the 2011 guidelines were removed from active response. Many segments entered a patch and maintenance phase since they met the 2011 NET guidelines because of the risk of re-oiling from remobilization or re-exposure of subsurface oil on the beaches, as well as oil in marshes should mean and on marsh platforms.