Caribbean Regional Response Team Information and Lessons Learned During Emergency Response Operations For Vessel Groundings Involving Oil Spills In Coral Reef and Seagrass Habitats

Developed by the
Caribbean Regional Response Team

Final August 2015

Caribbean Regional Response Team
Information and Lessons Learned During Emergency Response Operations
For Vessel Groundings Involving Oil Spills In Coral Reef and Seagrass Habitats

Introduction

The global decline in the condition of the coral reef ecosystem (that includes seagrass beds, coral reefs, colonized hard bottoms, and mangrove wetlands) is a crisis that places a multitude of human, natural, and economic needs in jeopardy. The rapid decline of the world's productive and economically vital coral reef habitats represents a serious threat to consumers, business, communities, cultures, and the environment. Significant progress has been made to map, monitor, and conserve U.S. and other coral reef ecosystems to ensure that these valuable ecosystems survive the current threats from pollution from coastal development, over-fishing, over-use, and other impacts.

Declines in Caribbean coral reefs, once dominated by elkhorn and staghorn corals and the other primary framework-builders, the star coral complex of the genus *Orbicella* (formerly *Montastraea*) in shallow waters of the insular shelf throughout the Caribbean, have occurred due in part to natural factors such as hurricanes and human-driven impacts such as sedimentation and eutrophication from coastal development and boating. These declines prompted the National Marine Fisheries Service (NMFS) to list elkhorn (*Acropora palmata*) and staghorn (*A. cervicornis*) corals as threatened under the Endangered Species Act (ESA) on May 6, 2006, throughout their range in U.S. waters in Florida, Puerto Rico and U.S. Virgin Islands. These declines also prompted NMFS to publish a Final Rule on September 10, 2014, listing the following additional corals as threatened under the ESA: pillar coral (*Dendrogyra cylindrus*), rough cactus coral (*Mycetophyllia ferox*), lobed star coral (*Orbicella annularis*), mountainous star coral (*O. faveolata*), and boulder star coral (*O. franksi*). The importance of other components of the ecosystem, such as seagrass beds, for ESA-listed species such as sea turtles has also resulted in the designation of critical habitat by NMFS for areas such as the seagrass beds 3 nm around the island of Culebra and its surrounding islands and cays.

Vessel groundings on coral reefs can cause extensive environmental degradation from the spilling of oil and the mechanical impacts of the grounding such as crushing, breakage and scarring. Boating impacts from both large commercial vessels and recreational vessels was one of the stressors identified by NMFS in the ESA listing of Atlantic acroporid corals. These groundings can also impact other components of the ecosystem such as seagrass beds due to oil toxicity and mechanical impacts such as propeller wash, scarring and dredging and scraping by the keel of the vessel.

This document will provide planning guidance and information to Area Contingency Planners concerning actions and considerations for response to a vessel grounding that has resulted in an oil spill in coral reef habitats. This information has been gleaned from past incidents where lessons learned were identified, in an effort to improve decision-making and overall effectiveness, while minimizing further injury to the coral reef ecosystem.

What is the Coral Reef Ecosystem?

Corals are individual animals called polyps. Corals are cnidarians in the family of jellyfish and anemones. Polyps are mobile only during their larval or planular stage when they are free-swimming in the water column. When coral larvae settle on a suitable hard substrate, they become sessile and most begin to divide to form a coral colony. Coral polyps are small animals with tentacles around a central opening. In addition to catching food in their tentacles, coral polyps have unicellular algae called zooxanthellae living in their tissues in a symbiotic relationship. The algae use waste products produced by the polyps and the polyps use byproducts of photosynthesis produced by the algae for sustenance. There are four types of corals: hard or stony, soft, black corals, and fire corals. Hard corals are the main building blocks of coral reefs. Coral reefs occur in subtropical and tropical oceans worldwide. Corals require hard substrate and warm, clear ocean water to form reefs. Corals are sensitive to factors such as high turbidity, low salinities, high nutrient concentrations, and high temperatures. In the southeastern United States coral reefs are restricted to Florida, some areas of the Gulf Mexico, and in Puerto Rico and the U.S. Virgin Islands in the Caribbean.

The coral reef ecosystem also includes habitats such as mangrove forests and seagrass beds. There are four species of mangroves: red (*Rhizophora mangle*), white (*Lacunaria racemosa*), black (*Avicenia germinans*), and button (*Conocarpus erectus*) in the U.S. Caribbean. Red mangroves are the most common species along the coast and on offshore cays, although white and black mangroves may also be present in these areas. Mangroves are salt resistant trees or shrubs that have evolved different strategies for eliminating salt from the tissues and tolerating flooded conditions. These include aerial roots of red mangroves, pores at the base of the leaves of white mangroves, and pneumatophores that grow from the roots of white and black mangroves and serve as gas exchangers. The roots of red mangroves often support a diverse community of organisms such as sponges, algae, oysters, and corals and provide nursery habitat to many species that migrate to the coral reef when adults such as spiny lobsters, snappers and groupers.

There are several species of seagrass reported in the U.S. Caribbean. The most common species in shallow areas where groundings and response actions typically occur are turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule beaudettei*), although paddle grass (*Halophila decipiens*) may also be present. Seagrass are true plants with roots, leaves, stems, flowers and fruits. Seagrasses are common in coastal areas naturally protected from heavy waves and currents with clear waters, although paddle grass can tolerate higher turbidities than other species of seagrass. Seagrass forms large expanses known as seagrass beds in shallow coastal waters. Seagrass beds provide important habitat, including nursery habitat, for many coral reef species that later migrate to coral reefs when adults.

Coral Reef Ecosystem Importance:

Coral reef ecosystems are very important to the ecology and the economy where they occur. The wave breaking ability of coral reefs helps limit the damage to the coastline caused by hurricane generated waves. Similarly, mangrove forests protect the coastline from heavy waves and seagrass beds serve as baffles diminishing the force of waves and currents. Coral reefs and associated systems such as mangrove forests and seagrass beds also support one of the highest levels of species diversity of any habitat in the world providing forage, refuge, nursery and reproductive habitat for numerous marine organisms. Many of these species such as spiny lobsters, queen conch, groupers, and snappers, support a large and valuable fishery. The beauty and diversity of coral reefs also support a large recreational diving and fishing industry, which in turn supports many other service related businesses.

How Oil Effects the Coral Reef Ecosystem:

In the event of a spill, oil will pass over sub-tidal reefs and seagrass beds with no direct contamination. Areas of coral reefs and seagrass beds that are exposed during low tide are at risk to smothering from oil. Except in the event of extremely heavy oil concentrations, oil will be readily removed from these areas with the rising tide. Studies have shown sub-lethal impacts with short-term recovery in these instances. Some of these effects would include reduction in the functionality or expulsion of zooxanthellae (bleaching), impaired feeding, impaired sediment cleaning ability, increased mucus production, and tissue death in corals and reduced epibiotic community, photosynthetic ability and death in seagrass.

The greatest threat to a coral reef is the spill of a light refined product directly into the shallow water over the reef, where high concentrations of the toxic water-soluble components could persist long enough to cause impacts. If a spill happens during a storm event, the oil may be driven into the water column. This subsurface oil could be a threat to corals that would not normally be at risk during an oil spill.

The coral reef ecosystem supports a tremendous diversity of plants and animals. An oil spill may severely affect the health of the larger reef community. Many sponges, plants, and mollusks are sessile and unable to avoid the effects of the spill. Some of the more territorial fish will even remain in the area until death. Epibionts and seagrasses themselves are sessile and cannot avoid the effects of the spill either.

Although not a direct result of oil contact, physical damage from a vessel grounding related to an oil spill event, and the ensuing response, should be considered. Salvage efforts should be directed to remove the vessel so as not to cause further damage to the reef or seagrass bed. Of particular concern is the impact from propeller wash, propeller scarring, and propeller dredging by the grounded vessel and the tugboats that assist. Propeller wash can cause sediment to cover undamaged coral. If this sediment is not promptly removed the corals can suffocate. Propeller wash can lead to blowouts and deepening of seagrass beds. Salvage vessels operating in shallow areas can cause propeller scarring or propeller dredging in seagrass beds in addition to impacts to corals. Salvage operations should be conducted using vessels whose draft is appropriate to the water depths. Similarly, the depth of the propeller below the response vessel also needs to be considered and the motor may need to be raised and operated at lower speeds to avoid or minimize propeller impacts. Steel cables can cut wide swathes of in corals and seagrass beds, as the tugboat frees the grounded vessel. Floating towlines should be used instead to avoid these impacts. Any anchoring required during the salvage operation should be in unvegetated and uncolonized sandy bottom. If sandy bottom areas are not present in the area, sand screws or Halas®-type moorings should be installed in seagrass beds and anchoring in coral areas should be avoided unless not anchoring would cause more damage to reefs. Any mooring buoys installed should have the anchor chain or line supported with a float so that the line does not clear a halo of marine bottom around the mooring.

Clean Up Options for the Coral Reef Ecosystem:

Every effort should be made to minimize the amount of oil that is allowed to enter the coral reef ecosystem. These efforts should not cause additional damage or slow the natural recovery of the affected area. Studies have shown that leaving the wreck on the reef or in seagrass beds has the potential to cause further degradation of the reef ecosystem through movement or shading.

Booming:

Booms should be deployed to divert the oil from the reef, seagrass bed or mangrove forest. Collection boom, if used, must be positioned so as not concentrate the oil in the area of the coral reef or seagrass bed to the maximum extent practicable. Sorbent booms can be used to collect the oil, and will need to be changed periodically. Care must be taken in anchoring booms so as not to damage the corals or seagrass beds. Anchoring should be in unvegetated sandy bottoms or using sand screws in seagrass beds to the extent practicable. Boom should never be allowed to come in contact with the reef or the marine bottom.

Chemical Dispersants:

Guidelines developed by the American Society for Testing and Materials (ASTM) recommend dispersants be considered for use in the vicinity of reefs to prevent floating oil from reaching any emergent portions of the reef. The use of dispersants should be evaluated in waters greater than 10 m in depth, to reduce the risks of oil to sensitive habitats on shore. Experiments conducted in Panama in 1987 (TROPICS Ballou, et al 1987) using oil and dispersed oil in a mangrove, seagrass, coral reef environment indicated that use of dispersants in deeper water would reduce the exposure to shore side communities without toxic concentrations impacting the coral reef. The use of dispersants in the Caribbean should be according to the established requirements for consultations with resource agencies such as ESA Section 7 with NMFS and the U.S. Fish and Wildlife Service (USFWS).

Natural Recovery:

If oil makes contact with the reef or shallow seagrass bed, it may be naturally removed on the next rising tide. Once the oil is on the reef, there is no effective way to remove this oil without causing more damage to the reef. Natural recovery would be the best response method under these circumstances. It may be possible to remove oil from shallow seagrass beds but this will depend on the location of the area and extent of oiling.

The Vessel Grounding Occurs

The crunching sound of the impact between ship and the ocean bottom is a frightening sound for any mariner. The damage to the ship is not the only damage the grounding causes. Depending on the type of bottom, the vessel's impact may have substantial effects on the environment. These effects range from the minor displacement of sediment on a mud or sand bar to catastrophic damage to coral reefs or seagrass beds. By following a few simple procedures the impacts of the grounding on the environment can be greatly minimized.

Initial Actions

Immediately following the impact, the vessel's master should determine the extent of damage to the vessel and crew and take proper action to ensure their safety. Communication with the U.S. Coast Guard should be initiated immediately.

A grounded vessel may be determined to have been abandoned, creating additional challenges due to the lack of an owner/operator. In response to growing concerns over abandoned vessels throughout US waterways, the National Response Team (NRT) developed the "Abandoned Vessel Authorities and Best Practices" guidance document. The document provides OSCs with information about the regulatory and policy authority of each agency having a major nexus to abandoned vessels; roles and responsibilities of each agency pursuant to those authorities; best practices used for responding to abandoned vessels; and options for removal and ultimate disposition of abandoned vessels. The document offers a wide array of solutions to abandoned vessels including abatement of pollution, removal of the abandoned vessels through a variety of alternative programs, or application of navigable waterway solutions. Based on previous case studies, it has been observed that a combination of both federal and state authorities and programs may provide the most effective and comprehensive approach for addressing abandoned vessels.

The first impulse is to power the vessel off the bottom. This action may greatly damage the ocean bottom habitat in the area and could cause further damage to the vessel. The vessel's propeller wash will scour the bottom and the displaced sediment will cover undamaged substrate in the area. Before attempting to power off, determine the extent of the grounding. If the vessel is barely aground and the ocean bottom has not created any known damage to the vessel, an attempt to back out of the same area the ship entered may be warranted. However, if the vessel is hard aground or has caused damage to seagrass beds or corals, it may be necessary to wait for the next high tide, tug support, and conduct a thorough damage survey of the hull, voids, and tanks before attempting to refloat the vessel. If the vessel has grounded in an area with ESA-listed corals and damage to the corals has occurred, all possible care must be taken to avoid additional impacts to these corals as part of the vessel removal operation. The response will also require an emergency ESA Section 7 consultation with NMFS and/or USFWS if ESA-listed species or designated critical habitat may be impacted by the response actions.

The Environment and Weather

Wave activity may cause the vessel to roll excessively and "work" on the ocean bottom, comprising the vessel and creasing the damage to the hull and ocean floor. Taking on additional ballast into clean tanks may minimize the rolling motion if the vessel is being driven harder aground by the wave action. The use of minimal astern propulsion may be useful in countering this effect.

Winds and currents can also affect the vessel's ability to remain stable within a tidal energy zone. If the surf action is severe, safety of the vessel's crew while on deck should be a priority. The deck of the vessel could become immediately awash carrying members of the crew over the side.

Salvage Support

The proper use of tugs during high tide can minimize the damages to the environment. The tug should use a floating hawser instead of steel towing cables to stabilize or refloat the vessel. As the vessel and tug pivot during the removal process, the catenary in the steel cables can act like a scythe on the ocean bottom. The back and forth motion may destroy acres of seagrass and coral. The towing vessel should be deployed in the deepest water available and use the least amount of power necessary to free the vessel. Propeller wash from the tug and the vessel if under power can also damage to the ocean bottom. Propeller scarring can result in the removal of seagrass beds or corals in paths followed by the salvage vessels. In addition, the operation of vessels in shallow areas can lead to propeller dredging resulting in the deepening of the bottom and the removal of submerged vegetation or burial of hard substrate.

Once the decision is made to refloat and move the vessel, it is best if the vessel is removed on the same track line as she grounded. This ensures that further damage to the bottom resources will be minimized. Also this will reduce the possibility of damage to the vessel from unseen hazards if removed via a different route. If possible, a bottom survey should be conducted and an egress channel should be identified or marked. When marking the channel, care should be taken not to cause additional damage to coral habitats or seagrass beds.

Vessel Discharges, Fluid Transfers, and Lightering

Upon grounding, at the soonest opportunity, the vessel's tanks and voids should be sounded. The type, location, and amounts of all oil should be identified. It may be necessary to shift fluids internally to stabilize the vessel or during refloating operations. The shifting of fluids should be in accordance with any agreed upon salvage plans. If possible, the identification of tankage to move oil products from the skin of the vessel's hull should be identified.

Under no circumstances should oily ballast water be released into the ocean. Consultation with the U.S. Coast Guard (USCG) should take place before releasing freshwater, heavily discolored, or super saline ballast. Lightering of any fluids from the vessel should be in accordance with salvage/lightering proposals/plans accepted by the U.S. Coast Guard/Unified Command.

Grounding in Areas with ESA-Listed Coral or Designated Critical Habitat

On May 9, 2006, NMFS published the listing of elkhorn and staghorn corals as threatened under the ESA. On October 29, 2008, NMFS published a 4(d) rule extending “take” (harm, kill, damage, transport, etc.) prohibitions to the two species. The 4(d) rule for elkhorn and staghorn corals exempts response activities such as emergency restoration of elkhorn and staghorn corals damaged by a grounding. NMFS also published a rule designating critical habitat for elkhorn and staghorn corals on November 26, 2008. Critical habitat units for elkhorn and staghorn corals encompass large areas around Puerto Rico and the U.S. Virgin Islands (USVI) in waters up to 30 meters in depth where substrate suitable for the settlement and growth of these 2 coral species is present.

On September 10, 2014, NMFS listed pillar coral, rough cactus coral, lobed star coral, mountainous star coral, and boulder star coral as threatened under the ESA. On January 15, 2015, NMFS published an advanced notice of proposed rulemaking for the creation of a 4(d) rule for these 5 species of corals.

Critical habitat has also been designated in the U.S. Caribbean for 3 species of sea turtles. Leatherback sea turtle critical habitat was designated March 23, 1979, and includes waters adjacent to Sandy Point, St. Croix, USVI, up to and inclusive of waters from the hundred fathom curve shoreward to the level of mean high tide. Green sea turtle critical habitat was designated September 2, 1998, and includes all areas up to 3 nautical miles (nm) around the island of Culebra and its surrounding islands and cays, Puerto Rico. Hawksbill sea turtle critical habitat was also designated September 2, 1998, and includes all areas up to 3 nm around Mona and Monito Islands, Puerto Rico.

Response actions need to operate so as to avoid or minimize additional impacts to ESA-listed corals and designated critical habitat to the maximum extent practicable. The responsible party is not exempt from take prohibitions under the 4(d) rule for elkhorn and staghorn corals. Federal response agencies are also not exempt from the need for take authorization prior to certain response actions that could lead to additional impact to ESA-listed corals. Federal response agencies are also required to consult with NMFS if their response action will result in the destruction or adverse modification of designated critical habitat (see http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/critical_habitat/index.html). An emergency consultation should be completed with NMFS to address all potential impacts to ESA resources during a response.

Lessons Learned from M/V Jireh Response

In June 2012, the M/V Jireh grounded on the west side of Mona Island, Puerto Rico. The area contains designated critical habitat for elkhorn and staghorn corals and for hawksbill sea turtles, the area also contains ESA-listed corals and hawksbill sea turtle nesting habitat. The response was closely coordinated with NMFS, USFWS, and other local and federal resource agencies, and local and federal trustees. Despite the implementation of avoidance and minimization recommendations to protect ESA resources, some impacts to nesting sea turtles related to disorientation from lights and some impacts to ESA-listed corals related to anchoring by response vessels, anchoring of boom, and the movement of the vessel during storms. Below are the recommendations NMFS developed to inform the USCG during future response actions. These are general recommendations only and many reflect some of the information contained in other sections of this document. Best management practices (BMPs) specific to a particular response may also be necessary based on site-specific conditions.

1. NMFS should be included in early conversations with the salvor to discuss specifics of the response operation in order to select which BMPs are most appropriate or develop BMPs relevant to a particular response as necessary.

2. Based on the methodology for the salvage operation, areas shall be selected in coordination with NMFS and based on benthic surveys for actions such as towing of vessels, anchoring, and spudding in order to minimize impacts to ESA-listed species and designated critical habitat.

3. Cargo should be assessed early in the process and organics should be removed quickly to avoid hazardous build-up of gases in the hold and the potential use of chemicals to reduce hazardous levels of the gas to protect response workers as these chemicals could impact marine resources. If cargo cannot be removed quickly, then a seawater pumping and filtering system similar to that used during the M/V Jireh response should be designed and implemented in coordination with NMFS and USFWS.

4. Fuel and cargo should be offloaded from the grounded vessel to reduce the vessel's draft and minimize the potential for environmental hazards, such as spills.

5. Boom should be deployed around the grounded vessel to minimize the potential for transport of materials outside the immediate area of the grounding. The location of boom anchors should be coordinated with NMFS based on surveys of the area immediately following the grounding as long as sea state permits the safe completion of these surveys. Booms and other underwater equipment should be monitored during the response action to ensure they do not cause damage to ESA-listed species, including breakage or abrasion of corals and entrapment of sea turtles.

6. All response vessels should be required to comply with NMFS's *Vessel Strike Avoidance Measures and Reporting for Mariners*.

7. When applicable to the response action, compliance with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* should be required.

8. Anchoring of all response vessels should be in uncolonized sand bottoms only. The installation of mooring pins or other anchor systems that eliminate the use of non-floating line and minimize impacts to bottom substrate is preferred if uncolonized sand areas are not available or are not large enough to anchor the vessels. Anchor methods and anchor and spud locations should be selected in coordination with NMFS for all response vessels associated with a particular response action.

9. Salvage activities should be conducted at high tide to facilitate refloating the grounded vessel over areas containing ESA-listed species and designated critical habitat.

10. The response area should be surveyed daily by divers to ensure proper placement of anchors, lines, and other equipment, and to remove debris and other materials to avoid damage to ESA resources, including corals, sea turtles, and designated critical habitat.

11. Properly tie-down or secure all equipment in designated areas to prevent accidental loss of equipment into the water. Any debris that accidentally falls into the water during response actions should be retrieved immediately.

12. A protected resources monitor should be on-site to monitor response impacts, BMP compliance, protected species sightings, and prepare daily summaries so that steps can be taken to address issues such as BMP non-compliance or unanticipated impacts to ESA resources that require the implementation of additional BMPs.

13. In areas where sea turtle nesting is known to occur, deck lighting at night should be minimized so as not to attract sea turtle hatchlings or disorient nesting females. Lighting of night operations should be shielded to avoid attracting in-water sea turtle hatchlings to the response area. Similarly, lighting of night operations along the coastline should be minimized and a lighting plan developed in coordination with NMFS and USFWS to ensure that nesting females are not affected by light pollution.

14. If a vessel will be refloated and towed out of an area, an extraction path having the least impact on ESA resources shall be selected in coordination with NMFS and based on benthic surveys of the area. This path may not be the same as the ingress path. Once the extraction path has been agreed upon, temporary buoys should be used to mark the extraction path and GPS plots of the path should be input into the grounded vessel's GPS and all towing vessels' navigation systems to assist the salvors in staying on course.

15. In shallow waters, in order to minimize the potential for propeller wash damage to ESA resources, the use of propulsion systems and high RPMs should be avoided. If this is not possible, then areas for these operations should be selected in coordination with NMFS and based on benthic surveys of the site.

16. If a vessel will be scuttled, after obtaining all required permissions, alternative locations for scuttling the vessel both close to the grounding site in deep water and further offshore in deep water should be selected in case the vessel proves too unstable to float a long distance from the grounding site. Appropriate measures should also be taken to secure the vessel at the scuttling location to minimize the risk of movement of the sunken vessel during storms.

17. The BMPs required for the protection of ESA resources for a particular response shall be included in the salvage plans and IAPs for each response.