ENVIRONMENTAL CONSIDERATIONS DURING WRECK REMOVAL AND SCUTTLING

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ABSTRACT

Environmental considerations are outlined as strategies for protecting benthic habitats, water-column and water-surface resources, and issues associated with scuttling sites. Examples are provided for each component of the salvage operation to demonstrate how environmental considerations were successfully incorporated into the response, or where they were ignored, resulting in additional environmental damage. Many of these environmental concerns should be integrated with the salvors work product to assure that operations are conducted appropriately.

INTRODUCTION

Historically, marine salvage efforts focused on the protection of private property including the recovery of the damaged vessel and rescue of the cargo or vessel contents. In recent years, however, heightened ecological concerns and increasing financial liabilities regarding marine pollution have shifted the role of the salvor and protection of the environment is more and more often the goal of the salvage operation. The salvors actions may prevent or reduce the size of an oil spill, or protect marine sensitive habitats such as coral reefs, and hopefully reduce the overall environment impacts of an incident. However, there are significant environmental trade-offs and even when the primary goal of the operation is environmental protection, salvage and wreck removal activities can result in unexpected and sometimes considerable collateral damage. In some cases, a shipwreck may pose an obvious threat (e.g., fuel oil), but the actions taken to reduce that threat should consider the broader impacts of the salvage to mitigate potential collateral impacts and maximize the environmental benefit of the overall operation.

One of the keys to successful wreck removal is addressing environmental considerations in all aspects of the salvage operation. Many of the following considerations are integral components of best management practices. During salvage emergencies, however, these good practices can be forgotten. In past occasions, salvors have come on scene during an emergency action, operating independently without consulting with environmental specialists. Environmental considerations do not have to become impediments to a quick and successful operation; rather, they can become part of the overall success of the operation. Good environmental practices during wreck removal begin with involving environmental specialists early in the process.

Environmental considerations are discussed in terms of strategies for protection of benthic habitats; protection of water-column and water-surface resources; and issues associated with scuttling sites.

PROTECTION OF BENTHIC HABITATS

Wreck removal usually involves vessels resting on the seafloor, either having sunk in deep water or grounded in shallow water. Deep water wrecks may provide a stable platform for marine growth and provide a habitat for fish and other marine life. Protection of seafloor or benthic habitats is of greater concern for operations in shallow water since these areas are more productive biologically and because shallow water wrecks may be unstable and may break up more rapidly in the higher energy environment and additionally may pose greater concerns for navigation and human health and safety . In fact, wrecks in shallow water are often removed and scuttled in deep water to prevent further damage to more valuable nearshore benthic habitats. Environmental considerations are discussed for the following salvage operations.

1. Salvage Vessel Anchoring Systems

    - Identify and avoid sensitive seafloor habitats (e.g., coral reefs, seagrass, hardbottom communities), if possible.
    - In sensitive habitats, design anchoring systems to minimize the number of anchors needed and control drag.
    - Example: During the 2003 off-loading of the World War II oil tanker *Mississinewa* in Ulithi Lagoon, Yap, Federated States of Micronesia, the support tug and tank barge was anchored in a four-point moor. This mooring limited bottom disturbance from anchor and chain dragging. Also, the mooring allowed the vessels to relocate over the wreck without moving the anchors (NAVSEA, 2002).

2. Towing Systems

    - Use floating lines, especially in areas with sensitive benthic habitats.
    - Example: During removal of the *Fortuna Reefer* from Mona Island in 1997, use of non-floating lines caused extensive damage to 6.8 acres of coral reef habitat, much greater than the footprint of the grounded vessel (NOAA, 1997).

3. Salvage Vessel Operations

    - In shallow water, avoid using the propulsion systems of salvage tugs where the prop wash can scour the bottom.
    - Instead, moor the tugs and use a ground tackle system to provide maneuvering and pull.
    - Example: During the November 2000 barge grounding and salvage incident on the north shore of Petit Bois Island in Mississippi Sound in the Gulf Islands

National Seashore, the tugboat *Gilbert Taylor* created three large areas of anomalous depressions, pits, and mounds were created on the seafloor, causing damage to the bottom habitat and resources (RPI, 2001).

4. Tow Path

- Where a vessel has to be dragged across the seafloor to deep water, consider following the same ingress path, to minimize additional seafloor damage.
- Alternatively, identify the least sensitive, operationally feasible tow path. In some cases, a longer tow path may reduce overall impacts.
- Example: Two of the grounded tuna longliners in Pago Pago harbor, American Samoa were pulled from the reef flat along the initial grounding path, to minimize additional damage.

5. Construction of Access Platforms

- For vessels stranded close to shore, it may cause less environmental impact to dismantle the vessel in place rather than dredge or drag a vessel across an extensive shallow habitat. Under the conditions where the only access to vessels grounded very close to shore requires construction of access platforms, minimize impacts to intertidal and shallow subtidal habitats.
- Use the smallest footprint for access platforms. However, it is important to acknowledge that oftentimes the actual footprint can be actually built larger than the design, particularly under emergency conditions.
- Use elevated systems rather than solid-fill causeways.
- When solid-fill causeways are constructed, check the source of the fill material to make sure that it does not contain excess fines. Washing to remove fines is not always feasible.
- Consider that restoration of any damaged habitat may be required.
- Example: Access for removal of oil and hazardous materials from seven of the nine tuna longliners in Pago Pago, American Samoa required construction of three solid fill causeways across reef flat habitat. Damages resulting from the response actions were restored by complete vessel removal (Michel et al., 2001).

6. Debris Removal

- It is important that all vessel debris be removed during the salvage operations. Fishing lines, nets, hooks, etc. can cause damage to benthic habitats by scouring and can entrap and kill wildlife.
- Plan for floatable debris (wood and insulation and other floatables) that needs to be contained or recovered when cutting up or refloating vessels.
- Hazardous materials on board can include ammonia and other refrigerants, asbestos, zinc plates (used as a sacrificial anode for corrosion), and an infinite variety of cargo.
- Potentially toxic metals, including copper and tin-based antifouling paints may be a concern. In addition to coatings on the hull of the vessel, there may be bulk

paints and other hazardous materials stored in the vessel's paint or boatswain's locker

- Rusting vessel debris can also cause iron enrichment in enclosed areas, leading to the spread of invasive species and longer-term impacts in tropical, open-ocean settings.
- Example: Grounding of the Taiwanese longliner *Jin Shiang Fa* on Rose Atoll in 1993, where salvage operations removed most of the larger pieces of wreckage and debris, but not the stern and its associated debris, or the engine block. Iron corroding from the wreckage is thought to be contributing to the maintenance of an algae bloom that continues to dominate in the spill zone and spread to other areas of the atoll, overgrowing and killing otherwise healthy portions of the reef (Green et al., 1997). During 1999 and 2000, the U.S. Fish and Wildlife Service removed over 100 tons of the metallic debris and fishing gear from the reef. Another 50 tons of vessel metal debris remains on the reef (USFWS, 2001).

PROTECTION OF WATER-COLUMN AND WATER-SURFACE RESOURCES DURING WRECK REMOVAL

The cargo, fuel, and other hazardous materials remaining on wrecks often are the primary environmental concern during marine salvage operations. Operational and catastrophic releases of oil and hazardous materials threaten water-column resources (e.g., fish, shellfish, marine mammals, eggs and larvae of many species) and water-surface resources (e.g., marine birds, sea turtles, marine mammals, nekton). Spilled oil can release dissolved fractions into the water-column during releases from submerged vessels, as well as form surface slicks that threaten both water-surface and shoreline resources. Aqueous liquids, such as acids and bases, can have acute, toxic impacts to water-column resources. Wrecks can contain many persistent chemicals, such as mercury in thermometers, organotin in paint,

1. Controlled Releases of Aqueous Solutions

   - When the wreck contains aqueous solutions that pose limited environmental risks after dilution, such as acids and bases, it may be appropriate to release the cargo under controlled conditions rather than risk a sudden release of the entire cargo.
   - Specialists can assist by calculating a "safe" release rate, considering the strength and density of the cargo solution, the buffering capacity and dilution rate of the receiving water, water depth, and the distance down current to sensitive resources.
   - The controlled release plan can include water-quality monitoring to validate the calculated dilution rates and plume distance assumptions.
   - Example: The T/B TMI-11 sank in 100 feet of water 33 miles off the central east coast of Florida, containing 1.9 million gallons of 50% caustic soda solution. The vessel sank on 11 March, approval was given for a controlled release on 8 May, and operations were completed by 24 July. The cargo was released mid-water at a rate that was modeled and monitored to create a plume that would not exceed a pH of 10 at 100 m downcurrent, which was the distance that the plume was expected to contact the bottom.

2. Contingency Planning for Uncontrolled Releases

   - Where there is a risk of uncontrolled releases, such as operational releases during cargo off-loading or a catastrophic release of the entire cargo, the salvage plan should include a risk assessment to determine the most likely release scenarios.
   - Based on the risk assessment, contingency plans should be prepared using the best practices of the industry, including containment, oil recovery, dispersant use, wildlife plans, and storage and disposal of wastes. The normally "adverse" conditions of emergency response operations should be considered.
   - Where the risk is significant, dedicated response teams and equipment may be required.

3. Environmental Windows for Salvage Operations

   - For non-emergency salvage operations, scheduling of operations should include environmental considerations so to minimize potential impacts on natural resources.
   - It is often a trade-off between best operational conditions and environmental windows. Environmental considerations include periods when: few sensitive species are present; avoidance of critical reproductive periods (e.g., synchronous coral spawning); and weather patterns that influence the trajectory of potential releases during operations.
   - Example: The off-loading of the *Mississinewa* was scheduled during January and February 2003 when the trade wind pattern would rapidly transport any spilled oil out of the lagoon and when fewest birds and sea turtles were present NAVSEA, 2002).

SCUTTLING SITE ISSUES

Salvage operations often include scuttling of the wreck in deep water rather than risk further environmental damage from bringing an unstable vessel into port. Examples include the sinking of the *T/B Morris J. Berman* that grounded just off Puerto Rico in 1994 and the *M/V New Carissa* that grounded off Coos Bay, Oregon in 1999. Vessel scuttling is always a trade-off. Little is known about deep-sea environments, but clearly there is a lot more of it than intertidal and nearshore habitat. There is still a trade-off if we put the material in a landfill, or tow the vessel to a foreign country for shipbreaking. The landfills in remote locations may be limited, or unable to take a lot of steel debris. Once the decision is made to scuttle a vessel, environmental considerations in selection of the scuttling site are outlined below.

1. Conditions at the Scuttling Site

   - The scuttling site is usually a deep-water location (greater than 1,000 feet) in Federal or EEZ waters.
   - The scuttling site selection and rationale for oil and hazardous material incidents requires approval by the Regional Response Team.

- The site should not include any sensitive resources or geological hazards.

2. Trajectory of Possible Releases During Scuttling and Episodic Releases After Scuttling

   - Trajectories analyses using forecasted weather conditions can be used to determine the likely impacts of possible releases during scuttling.
   - Climatic weather data can be used to determine the probabilistic trajectories of episodic releases from the scuttled vessel.

3. Uncertainty in the Fate of Remaining Cargo and Fuels in Scuttled Vessels

   - For oil cargo and fuel, there is uncertainty in the timing until the oil congeals at the sea bottom temperatures.
   - There is the certainty that, at some time in the future, the vessel will eventually degrade to the point that remaining cargo or fuel will be released. The fate of released cargo and fuel is uncertain.
   - Example: The T/V *Prestige* sank in over 11,000 feet of water with about 20 million gallons of a heavy fuel oil (API = 11) remaining on board. She leaked at an estimated rate of 33,000 gallons per day for at least six months, even though the heavy oil was expected to quickly solidify. Lehr and Simecek-Beatty (2003) used simple models to calculate that the oil would cool to ambient temperatures (4 degrees C) within about 40 days if there was no convective mixing inside the tanks, or within about 25 hours if there was free convective flow. Such a large difference in predicted cooling rates is important in predicting the duration of leaks from sunken vessels. Their models did not include possible heat transfer effects due to the movement of the water surrounding the vessel, the thermal resistance of the steel walls of the vessel and the surrounding water boundary layer, or degree of internal mixing inside the tank that would occur from oil-water exchange due to the actual oil leakage. They proposed laboratory experiments to better define the cooling mechanisms and develop a practical response model for such incidents.

REFERENCES CITED

Green, A., J. Burgett, M. Molina, D. Palawski, and P. Gabrielson. 1997. The Impact of a Ship Grounding and Associated Fuel Spill at Rose Atoll National Wildlife Refuge, American Samoa. Honolulu, Hawaii: U.S. Fish and Wildlife Service Report. 60 pp.

Lehr, W. and D. Simecek-Beatty. 2003. Calculation of the thermal inertia of sunken oil. Proceedings of the 26th Arctic and Marine Oilspill Programme. Environment Canada, Ottawa, Canada.

Michel, J., S. Zengel, L. Cotsapas, J. Dahlin, and J. Hoff. 2001. Scaling of injury to reef flat habitats resulting from removal actions of grounded vessels in Pago Pago, American Samoa.

Proceedings of the 2001 International Oil Spill Conference. American Petroleum Institute, Washington, D.C.

NAVSEA. 2002. Environmental Assessment: *Mississinewa* Offloading, Ulithi Lagoon, Yap State, Federated States of Micronesia. Commander Naval Sea Systems Command, Washington, D.C. 47 pp. + appendices.

National Oceanic and Atmospheric Administration (NOAA). 1997. Report on the reef repair project at Mona Island, Puerto Rico. NOAA Damage Assessment Center, Silver Spring, Maryland.

Research Planning, Inc. 2001. Damage Assessment: Tug *Gilbert Taylor* Incident Petit Bois Island, Gulf Islands National Seashore. Report Prepared for Gulf Island National Seashore, National Park Service, Ocean Springs, Miss. 11 p.

U.S. Fish and Wildlife Service (USFWS). 2001. Final Restoration Plan for the Rose Atoll National Wildlife Refuge. USFWS Region 1, Portland, Oregon. 44 pp.