POTENTIALLY POLLUTING WRECKS IN MARINE WATERS

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INTRODUCTION

Catastrophic losses of vessels in recent years, such as M/T *Prestige*, M/T *Erika*, M/V *Tricolor*, and M/T *Ievoli Sun*, have produced increasing pressure on vessel owners and governments to engage in extraordinary efforts to remove all pollutants from submerged wrecks. Similarly, a number of vessels that sank decades ago (e.g., SS *Jacob Luckenbach*, M/V *Castillo De Salas*, and USS *Mississinewa*, among others), have begun releasing oil, fouling sensitive environmental habitats, stimulating criticism of the insufficient oil removal efforts undertaken (if any), and generating demands for removal of all pollutants from those wrecks and removal of the wreck itself if all the pollutants cannot be completely removed. However, what about vessels that have sunk, but have not started leaking, both recent and relic? These "potentially polluting wrecks" are in a gray zone, particularly relic wrecks that seldom have a Responsible Party who is willing or obligated to pay for the oil removal. The "reactive" approach often followed in the past (e.g., respond only when oil starts to leak) has become scarcely acceptable. There is a growing public demand for "proactive" oil removal from wrecks, including war casualties or other sunken vessels, to remove any significant threat of future pollution (Basta and Kennedy, 2004). The justification is based on not "*if* there will be an oil release" but rather "*when* will the oil start leaking."

The goals of this paper are to provide an objective analysis of current state of potentially polluting wrecks, due to release of petroleum products, and to make recommendations for future actions. The paper is organized by: 1) data analysis, 2) legal and financial issues associated with wreck response, 3) technological feasibility of response, and risk assessment. This paper is a summary of the 2005 International Oil Spill Conference Issue Paper of the same title and authorship (Michel et al., 2005).

THE SCALE OF THE PROBLEM

To estimate the number of potentially polluting wrecks, n international database of potentially polluting wrecks was developed from various national and international data sources. Extensive efforts were made to remove duplicate records and combine information

to create the most comprehensive data set possible. The criteria used for inclusion of incidents in the database were:

- **Location:** marine waters, including navigable-in-fact estuarine waters;
- **Vessel types:** *non-tank vessels* of at least 400 gross tonnage (GT) holding petroleum-based oil or oil products as fuel/bunkers (and for operations); and *tank vessels* of at least 150 GT holding petroleum-based oil or oil products as cargo and fuel/bunkers (and for operations); and
- **Incident types:** groundings, collisions, structural failures, or military attacks resulting in the sinking (submergence) of the vessels. Any incidents in which the vessel was reported to have been raised, salvaged, lightered, or scrapped were excluded.

There are 1,583 tanker wrecks (including tank barges) and 6,986 non-tank vessel wrecks, for a total of 8,569 incidents in the database. The database spans the years 1890 through 2004. The majority of incidents stem from the years of World War II (1939 – 1945), with 69 percent of tanker incidents and 75 percent of non-tanker incidents (a total of 75 percent of all incidents).

Several methods were used to develop a "high" and "low" estimate of the amount of oil likely remaining on each vessel (Michel et a., 2005). The estimates of wrecked vessels and amount of oil contained in those vessels are shown in Table 1. The geographical locations of the wrecks using Marsden squares are shown in Figure 1, and the distribution of the estimated volumes of oil remaining in these wrecks is shown in Figure 2. The frequency distribution of estimated vessel ages is shown in Figure 3. Clearly, wrecks associated with World War II comprise the largest group of potentially polluting wrecks. These wrecks are of particular concern because of age.

The South Asian-Pacific region has the highest number of sunken potentially polluting tank vessels with 34 percent of the known tank vessels, 21 percent of the known non-tank vessels, and 20 percent of the worldwide estimate of oil remaining (maximum estimate of 4,100,000 tonnes and minimum estimate of 510,000 tonnes). The second highest region in terms of the number of tank vessel wrecks is the Northwest Pacific, with over 15 percent of the tank vessels but only about 5 percent of the estimated oil volume remaining. This concentration of wrecks reflects the importance of the "Pacific Theatre" during World War II. There is significant concern that these World War II vessels are reaching the age where further corrosion will lead to increased rates of oil leakage. The case of the World War II oil tanker, *Mississinewa*, is an example of the potential environmental and socio-economic impacts of these World War II wrecks (NAVSEA, 2002).

Table 1. Estimates of Worldwide Oil-Containing Wrecks.

Vessel Type	Number Vessels	Estimated Potential Total Amount Oil	
		HIGH ESTIMATE	LOW ESTIMATE
Tank Vessels ≥ 150 GT	1,583	14.6 million tonnes 4.3 billion gallons	1.8 million tonnes 535 million gallons
Non-Tank Vessels ≥ 400 GT	6,986	5.8 million tonnes 1.7 billion gallons	720,000 tonnes 212 million gallons
TOTAL VESSELS	**8,569**	**20.4 million tonnes 6 billion gallons**	**2.5 million tonnes 747 million gallons**

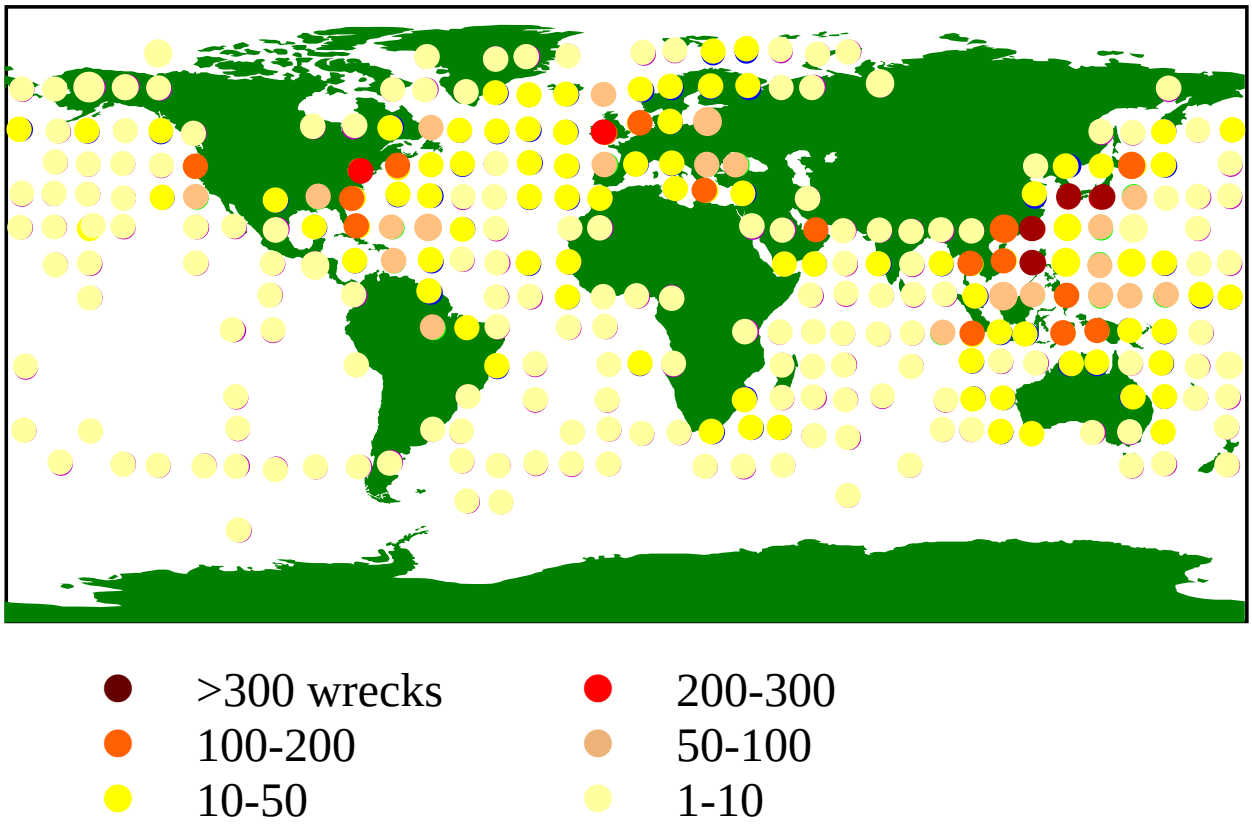

Figure 1. Approximate distribution of potentially polluting shipwrecks, plotted by Marsden Square.

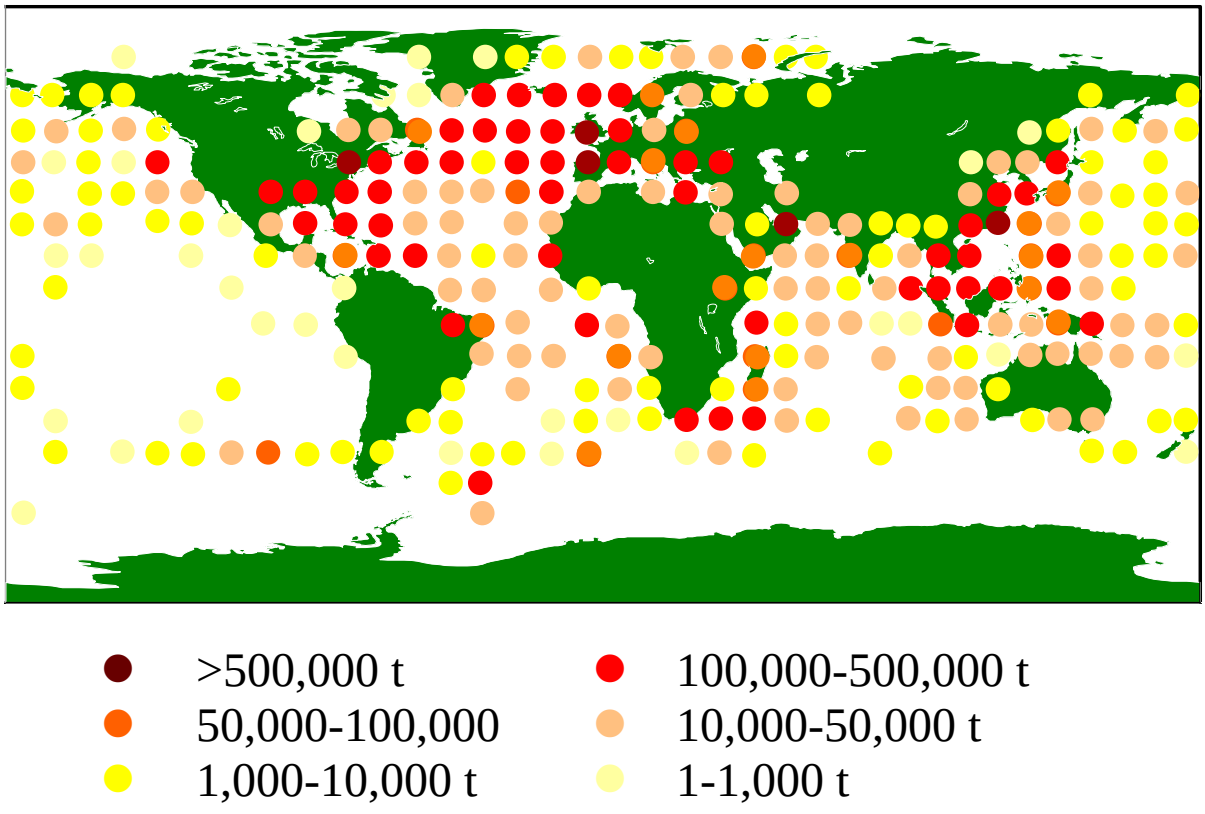

Figure 2. Estimated volume of oil (in tonnes) by Marsden Square in sunken wrecks.

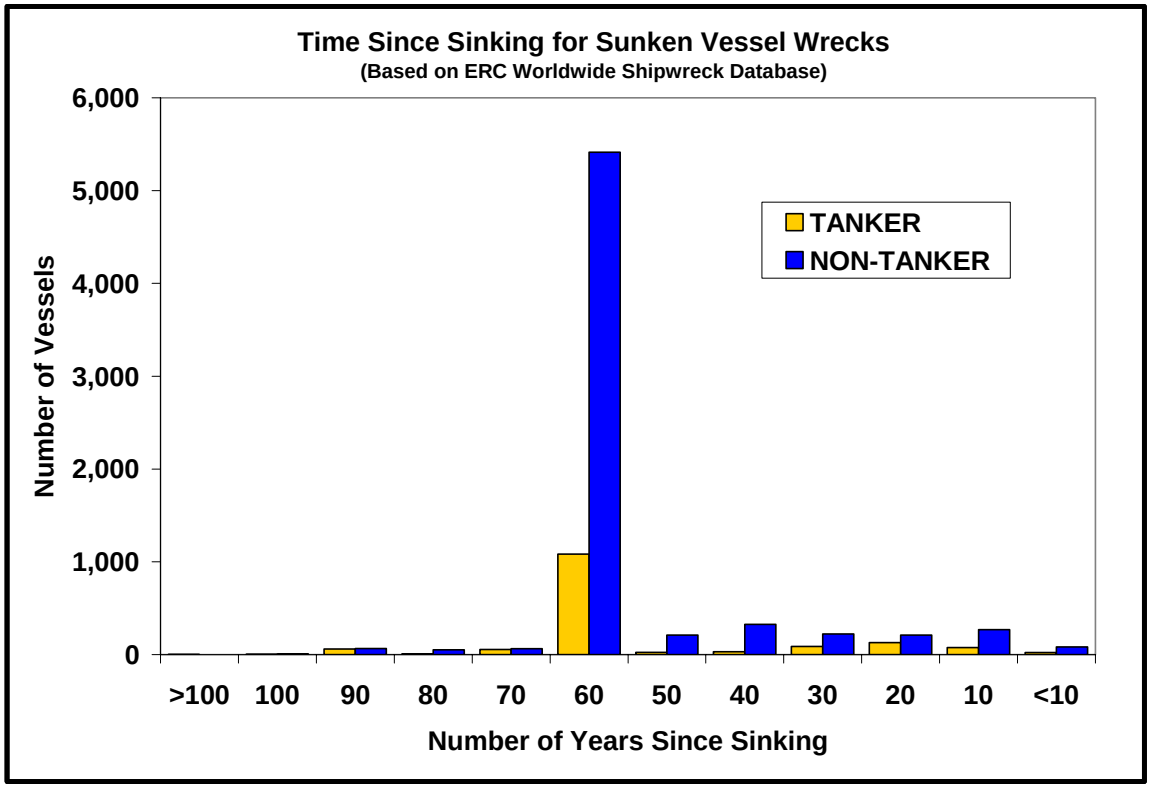

Figure 3. Distribution of the number of sunken vessels by age since sinking. The large peak at between 60 and 70 years old is a result of the wrecks associated with World War II.

The Northwest Atlantic has the highest number of non-tank vessel wrecks (22 percent), the third highest number of known tank vessels (15 percent), and about the same estimated volume of oil remaining as the South Asian-Pacific (maximum estimate of 4,000,000 tonnes and minimum estimate of 512,000 tonnes, or about 20 percent of worldwide estimates). The Northeast Atlantic is ranked third in the estimated number of non-tank vessels, with over 20 percent of the worldwide estimate, and third in the estimated volume of oil remaining with 17 percent of the worldwide estimates. Thus, the North Atlantic Ocean has 25 percent of the potentially polluting wrecks in the world, and these wrecks are estimated to contain nearly 38 percent of the worldwide oil estimates. The large numbers of sunken vessels in the combined North Atlantic reflect the intensity of the maritime attacks between the Germans and the Allied Forces during World War II (Campbell et al., 1977).

LEGAL AND FINANCIAL POLICIES

The question of how to deal with vessel wrecks with potentially damaging pollution consequences has increasingly become more of a social and political issue over the last 30 years. The international community, under the auspices of the IMO, has been working on a DWRC for several years. Individual concepts and ideas have traditionally circulated throughout the international community, but there were no serious deliberations regarding the draft until 1998. Following its introduction that year, there have been numerous meetings of the IMO Legal Committee to further develop appropriate provisions.

The DWRC is intended to provide international rules on the rights and obligations of States and shipowners in dealing with wrecks and drifting or sunken cargo that may pose a hazard to navigation and/or pose a threat to the marine environment. The DWRC is intended to

clarify rights and obligations regarding the identification, reporting, locating and removal of hazardous wrecks, in particular those found beyond territorial waters. In general, the DWRC covers:

- Reporting and Locating Ships and Wrecks – which covers reporting of casualties to the nearest coastal State; warnings to mariners and coastal States about the wreck; and action by the coastal State to locate the ship or wreck;
- Determination of Hazard – provides guidelines for assigning responsibility for determining whether a hazard exists when the wreck or ship is beyond territorial waters, based on a list of specific criteria, including depth of water above wreck and proximity of shipping routes;
- Rights and Obligations to Remove Hazardous Ships and Wrecks – sets out when the shipowner is responsible for removing the wreck and when a State may intervene;
- Financial Liability – for locating, marking and removing ships and wrecks;
- Time-bar – sets a time limit for claims for compensation;
- Jurisdiction – sets out jurisdiction(s) where actions for compensation may be brought;
- Financial Security – sets out security required to cover liabilities regarding claims for compensation under the Convention; and,
- Settlement of Disputes

The DWRC provides a good framework to identifying, locating, and dealing with wrecked vessels. The most significant problem, however, is the funding to remove the wreck in the event that the registered owner is neither available nor sufficiently solvent to deal with the potential threat. Initially, the idea was forwarded to make the flag state responsible for all costs associated with the removal. This idea was quickly rejected by most of the participating countries. If the international community fails to accept a funding mechanism satisfactory to IMO Member States, there is a risk that the DWRC, when and if adopted, will result in a phantom framework rather than a workable solution in those circumstances when removal action is left to the coastal state. It is noble to suggest what needs to be done and how to do it, however, it is more important to explain who will pay and how they will pay for what could potentially be a multi-million dollar endeavor.

IMPROVING TECHNOLOGY FOR WRECK ASSESSMENT AND OIL REMOVAL

Recent cases such as *Prestige* and *Jacob Luckenbach* have shown that there are few technological limitations to oil recovery from wrecks, even under very difficult conditions (deep water, strong currents, poor visibility). As long as there are funds available, salvors will come up with innovative solutions for wreck assessment and oil removal. Some considerations for improving the technological capabilities include:

1. The installation of emergency offloading piping and other technical design innovations of new vessels may assist with oil removal from a sunken vessel. Ship hull, piping and machinery design standards could be investigated to include simple requirements to assist in oil detection, containment, and recovery within a wreck. The increasing use of double-hull oil cargo tanks may increase the difficulty and risk of oil recovery operations. Drilling of double-hulls has been done using remote vehicles but at increased cost and risk.

2. A standard method of surveying the condition of wrecks to determine the relative risk of pollution should be developed. Such a method should consider:

a. Oil Survey and Sampling. The advent of non-destructive oil sensing instruments, such as gamma-ray or neutron back-scatter meters, may allow for rapid assessment of oil volumes of a wreck. The increased use of this technique may now allow for a relatively low-cost survey of potentially polluting wrecks. Techniques for direct sampling of oils should also be developed and formalized for light and very heavy oils.
b. Structural Condition. Further analysis of wreck corrosion rates could be used to develop a more complete understanding of the rate of hull and superstructure failure. Such data could become the basis of a wreck, risk stability model. A standard survey technique to measure and report on hull, piping and superstructure condition should be developed so that salvors and government authorities can share common data formats. Standard guidance and some basic training on the issues of wreck surveys, risks, and recovery techniques would be useful in assuring common approaches and evaluation techniques.
c. Quality Control. Standard procedures should be developed to document the volume of oil recovered, to estimate the remaining oil volume, and to verifying tank close-out procedures.

3. The use of heat and/or fluidizers for removing heavy oils from tanks will remain an essential technique even with the use of pump annular water injection. Improved heat exchangers and similar techniques to fluidize oil should be developed to reduce the time, cost, and reliability of heavy oil recovery operations.

ASSESSING THE RISKS OF POTENTIALLY POLLUTING WRECKS

The decision to salvage oil from a sunken vessel must be based upon a sound risk assessment and a well-developed cost-benefit analysis because any salvage effort is usually expensive, time-consuming, and risky. Cost-benefit analysis must assess the potential environmental and biological impacts of any pollution from the wreck as well as the socioeconomic implications of any spill and remediation costs. The obvious difficulty is that the valuation of “real” potential costs (e.g., ship time, fuel, pay for salvors, and even loss of fisheries) is much easier than valuation of “perceived” potential costs (e.g., aesthetics, environmental integrity, non-commercial species loss). These perceived costs are either poorly considered, or excluded from the evaluation process because they cannot be adequately valued. Therefore, the decision on overall benefits and costs has to be based on a qualitative, but consistent approach.

Therefore, there is a need for a systematic risk assessment of potentially polluting wrecks to characterize the pollution threat well enough to support decisions regarding appropriate mitigation. A general methodology for the assessment of environmental risk posed by sunken shipwrecks was first proposed by the South Pacific Regional Environment Programme (SPREP, 2002; Nawadra and Gilbert, 2002). The methodology consists of the following steps:

1. Conduct a coordinated worldwide collection and collation of data on sunken wrecks, their locations, and potential pollutant loadings. This effort could be coordinated through regional associations that deal with oil pollution risk prevention and planning.
2. Create an integrated geospatial database of information related to sunken wrecks and make it available to all jurisdictions. The issues associated with protection of wreck sites from vandalism will need to be addressed.

3. Conduct systematic assessments using the best data sources and methods to identify those wrecks that pose significant environmental risks. Such assessments would include ranking categories related to site, environmental, and economic criteria. The assessments should be updated as new information is made available.
4. Support research that will improve our understanding of the potential problem areas for oil leakage related to wrecks of different vessel types, such as:
    a. Improved ability to predict rates of corrosion and degradation of sunken wrecks for different seawater conditions; and
    b. Knowledge of the physical properties and behavior of heavy oils in deep water, cold water, and high-pressure seawater environments.

SUMMARY

There has been increased awareness and concern about the oil-pollution risks posed by sunken wrecks, both recent and relic. The goals of this paper are to provide an objective analysis of the current state of potentially polluting wrecks, due to the discharge of petroleum, or the substantial threat of such a discharge, and to offer considerations for addressing the issues.

The first step was to compile existing data into the first-ever worldwide database of potentially polluting wrecks. The resulting database includes 8,569 potentially polluting wrecks, with 1,583 tank vessels and 6,986 non-tank vessels. Estimates of the likely volume of oil remaining onboard these wrecks were a low estimate of 2.5 million tonnes (757 million gallons) and a high estimate of 20.4 million tonnes (6 billion gallons).

Regulatory and financial regimes vary significantly. The international community has struggled with a policy regarding wreck removal and began officially considering a comprehensive Draft Wreck Removal Convention (DWRC) in 1998. One of the most controversial points of this convention is the funding mechanism. The DWRC's inclusion of a financial security regime is intended to ensure that the owners of sunken vessels are primarily liable and responsible for marking and removing the polluting wrecks. The current draft of the DWRC contemplates using a system of insurance and other financial security to ensure that mitigating action is taken, which may arguably take care of a great percentage of the international removal efforts. However, an international fund should be established to provide funding in case the owner cannot be found or such funds are insufficient. Adoption of the DWRC, even in its present form, could greatly improve the current gap internationally with regard to mitigating polluting or potentially polluting wrecks. The establishment of universally acceptable international rules on the rights and obligations of States and shipowners in responding to wrecks with dangerous cargoes and posing a threat to navigation and/or the environment may be a welcome improvement to the current situation.

During response, salvors and the response community have shown that they can be innovative and cost-conscious. There are few technological limitations to recovering oil from deep depths, cold waters, and other challenging conditions. Some of the remaining oil removal challenges are viscous oils that require heating to make them pumpable, double-hull oil cargo tanks that may increase the difficulty and risk of oil recovery operations, locating and estimating the volume of oil in cargo and other spaces, and close-out procedures. Further research is needed on wreck corrosion rates and field survey methods to support development of a wreck stability model.

Because there are limited funds available to proactively remove oil from potentially polluting wrecks, it is important that oil removal efforts be prioritized according to the likelihood and consequence of oil releases. Therefore, there is a need for a systematic risk assessment of potentially polluting wrecks. Such a framework would include ranking categories related to site, environmental, and economic criteria. Furthermore, the available databases of known wrecks lack key data for use in fully characterizing risk to the environment. Standardization of information and methods of risk assessment for individual wrecks or groups of wrecks could provide enough state and regional impetus for enactment of a viable international legal regime concerning action on such wrecks.

REFERENCES CITED

Basta, D.J. and D.M. Kennedy. 2004. The need for a proactive approach to underwater threats. Marine Technology Society Journal, Vol. 38 (3): 9-11.

Campbell, B., E. Kern, and D. Horn. 1977. *Impact of Oil Spillage from World War II Tanker Sinkings.* Report No. MITSG 77-4/Index No. 77-304-Nnt. Massachusetts Institute of Technology Sea Grant Program, Cambridge, Massachusetts, USA. 85 pp.

Michel, J., D. Etkin, T. Gilbert, J. Waldron, C. Blocksidge, R. Urban. 2005. Potentially Polluting Wrecks in Marine Waters: An Issue Paper Presented at the 2005 International Oil Spill Conference. American Petroleum Institute, Washington, D.C., 76 pp.

Nawadra S. and T.D. Gilbert. 2002. Risk of marine spills in the Pacific Island Region and its evolving response arrangements. *Proceedings of the International Spill Conference, SpillCon 2002*, Sydney, Australia. http://www.spillcon.com/2002/2002papers.htm.

NAVSEA. 2002. Environmental Assessment – *Mississinewa* Offloading, Ulithi Lagoon, Yap State, Federated States of Micronesia. Commander Naval Sea Systems Command, Washington, D.C. 49 pp + appendices.

SPREP. 2002. Regional Strategy to Address Marine Pollution from World War II Shipwrecks, Thirteenth SPREP Meetings of Officials (Item 7.2.2.1) Majuro, Marshall Islands 21-25 July, 2002. (Pub. SPREP) http://www.sprep.org.ws