RESPONSE TO AN OIL SPILL FROM A SUNKEN WWII OIL TANKER IN YAP STATE, MICRONESIA

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ABSTRACT

In August 2001 a State of Emergency was declared in Yap State, Federated States of Micronesia (FSM) following a significant oil spill from the USS Mississinewa, a sunken WWII US military oil tanker, in the remote and environmentally sensitive atoll known as Ulithi Lagoon.

Due to the severity of the spill, a complete ban on fishing within the lagoon area was imposed by the Environment Protection Agency and Marine Resources Department of Yap State. The spill occurred over a two-month period between July and August 2001. A request for assistance to the US Navy to plug the leak and salvage the cargo was made by the President of FSM. He also requested the assistance of the South Pacific Regional Environment Programme (SPREP) to do an independent study on the wreck and determine the environmental impacts of the oil spill from the sunken vessel.

This paper highlights the response to oil spills from the vessel and the findings of the field environmental assessment in Ulithi lagoon and surrounding islands. It also addresses the issue of more than 1000 WWII shipwrecks around the Pacific and the strategy and database currently being developed by SPREP to document and address the pollution risk posed to environmentally sensitive Pacific Island Nations.

Background

It is early morning on the 20th November, 1944 in a remote lagoon of the Pacific called the Caroline Islands (now called the Federated States of Micronesia). Admiral Halsey's massive third fleet stands ready at anchor. The early morning quiet of Ulithi lagoon is broken by a loud explosion as a one-man suicide submarine, a new Japanese secret weapon called the Kaiten, explodes into the hull of the USS Mississinewa, a navy oil tanker and refueler.

The fully loaded 24,400 ton tanker contains around 19 million litres (146,000 barrels) of highly volatile aviation gasoline and fuel oil. Fires rage on the vessel, the starboard side is breached and the bow is ripped off in a series of massive explosions of fuel and ammunition. Its deck and bulkheads blow out at around 6am as its 5inch gun magazines explode. Many of the nearly 300 crew are rescued by other ships of the fleet and many heroic attempts are made to save lives and the valuable tanker that was

seen as essential for the fleet and the final battle to take Japan. The 553 foot long USS Mississinewa slowly sinks, rolls over and goes down to the bottom of the lagoon taking 60 enlisted men and 3 officers with it. (Figure 1)

Figure 1. USS Mississinewa oil tanker sinking – Ulithi Lagoon 1944
(Photo -US Navy Historical Archives)

For nearly 57 years the vessel remained undiscovered and silently resting in 35 metres of water at the bottom of the beautiful tropical lagoon in Yap State, Micronesia. The nearly 700 islanders continued to live peacefully and fish for their daily food unaware of the tragedy of the past or the problems that the ghosts of the past were about to bring upon them.

In early 2001 an adventure dive team finally finds the vessel lost since WWII. A few months later a typhoon passes through the area and the islanders awake to find their pristine lagoon and beaches fouled by heavy fuel oil leaking from the vessel. The oil spill continues for months and there is no sign of abatement or help from the outside world. (Figure 2) The deeply religious islanders pray for help.

Figure 2. Oil spill from the Mississinewa August 2001 – Ulithi Lagoon

In August 2001, the Governor of Yap State declared a State of Emergency in Ulithi lagoon. The Environment Protection Agency and Marine Resources Department of Yap State put an immediate ban on all fishing within the lagoon area.

The President of FSM contacted the US for assistance with their environmental emergency. The US Navy Supervisor of Salvage and Diving (SUPSALV) responded with a dive team and dive contractors funded by the Chief of Naval Operations. The Yap governments' vessel, the M/V Micro Spirit, supported the American team. In early September 2001, the teams plugged the leak in tank number 4 with quick setting cement on piping. Other cracks leaking oil were identified in tank 5. These additional leaks were also sealed by divers and around 5,000 gallons of oil trapped in dead spaces on the wreck was pumped to the surface.

At this time, the President of FSM also requested the assistance of the South Pacific Regional Environment Programme (SPREP) to provide an independent study on the wreck and the environmental impacts of the recent oil spill from the USS Mississinewa in Ulithi lagoon.

Objectives of the Strategic Environment Assessment

In discussions with the Yap State Disaster Co-ordinator, and various other agencies of Yap State, a series of objectives were agreed to in order to guide field assessment activities at the spill site. SPREP was requested to:

- confirm if all oil leaks from the sunken USS Mississinewa oil tanker had ceased,
- determine the resources at risk in the area of the spill and any ecological damage,
- document the oiling and physio-ecological character of the shorelines of Ulithi lagoon,
- assess the extent of remaining oil on shorelines with particular focus on the environmentally sensitive islands known as the "turtle islands", to the south east of the lagoon,
- determine if the oil reported to have impacted Fais Island was from the USS Mississinewa spill,
- cross check existing information on environmental sensitivities and clarify observations from previous surveys,
- determine priorities and requirements for any shoreline cleanup action or restoration,
- observe and assess the impacts of oil on any wildlife in the region,
- document any ecological constraints on spill response or cleanup operations,
- provide an overall recommendation on any necessary action related to the remaining oil on the USS Mississinewa and,
- provide environmental, technical and spill response advice to the Yap government and agencies.

The inspection dives and environmental surveys on the islands of Ulithi lagoon were carried out in early September, 2001. (Gilbert, 2001). A series of recommendations were made to the Yap government on remedial actions and an assessment of the environmental impacts in mid September 2001.

Assessment of Wreck, Response Options and Actions

The USS Mississinewa shipwreck lies in 35-40 meters of water at a position approximately 2.5 nautical miles (nm) in a NW direction from Mangejang Island and 2 nm from the Mugai Channel in Ulithi Lagoon. (Figure 3)

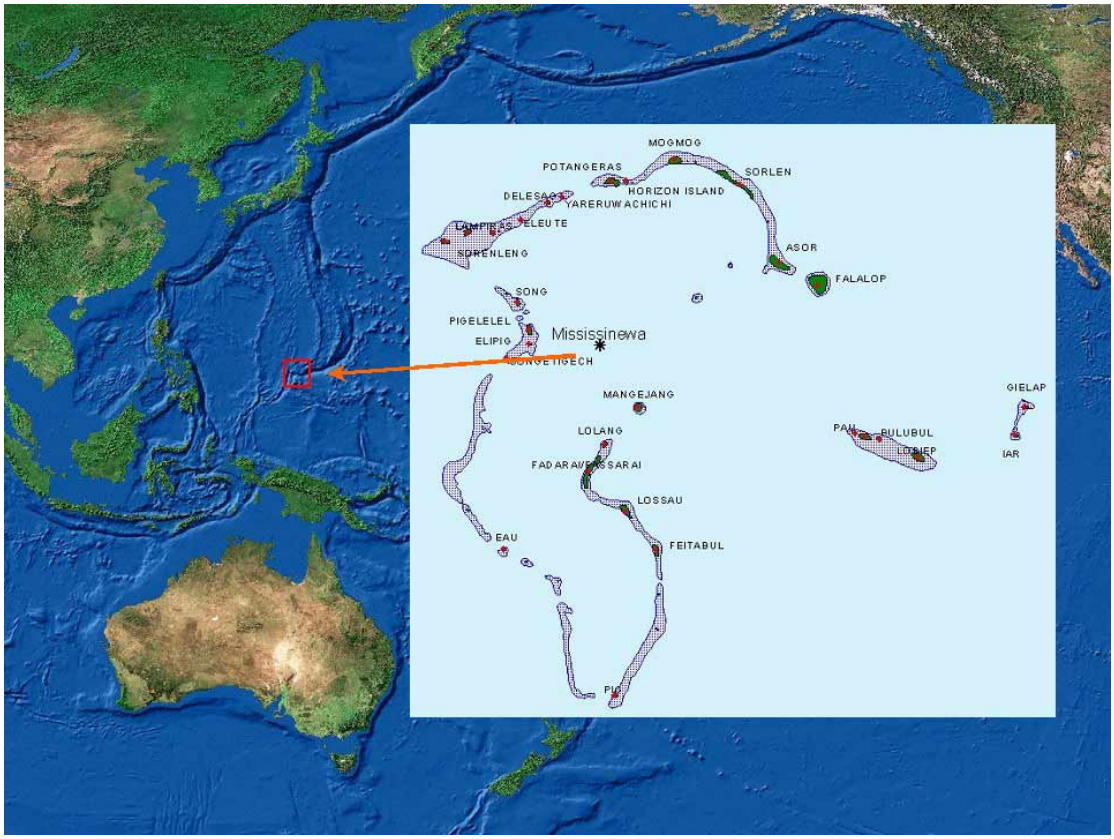

Figure 3. Location of Ulithi Lagoon and USS Mississinewa Shipwreck

The vessels' damaged and completely separated bow section is on its port side with the remainder of the vessels' hull facing vertically upright with some wreckage and debris from the forward sections of the ship located between the two. The external appearance of the hull is generally good with no other major superstructure problem areas noticed.

A detailed visual inspection was made of the vessel and underwater video and photos were taken. A montage of the inspection photos are presented in figure 4 along with a historical photograph of the USS Mississinewa, indicating approximate reference positions.

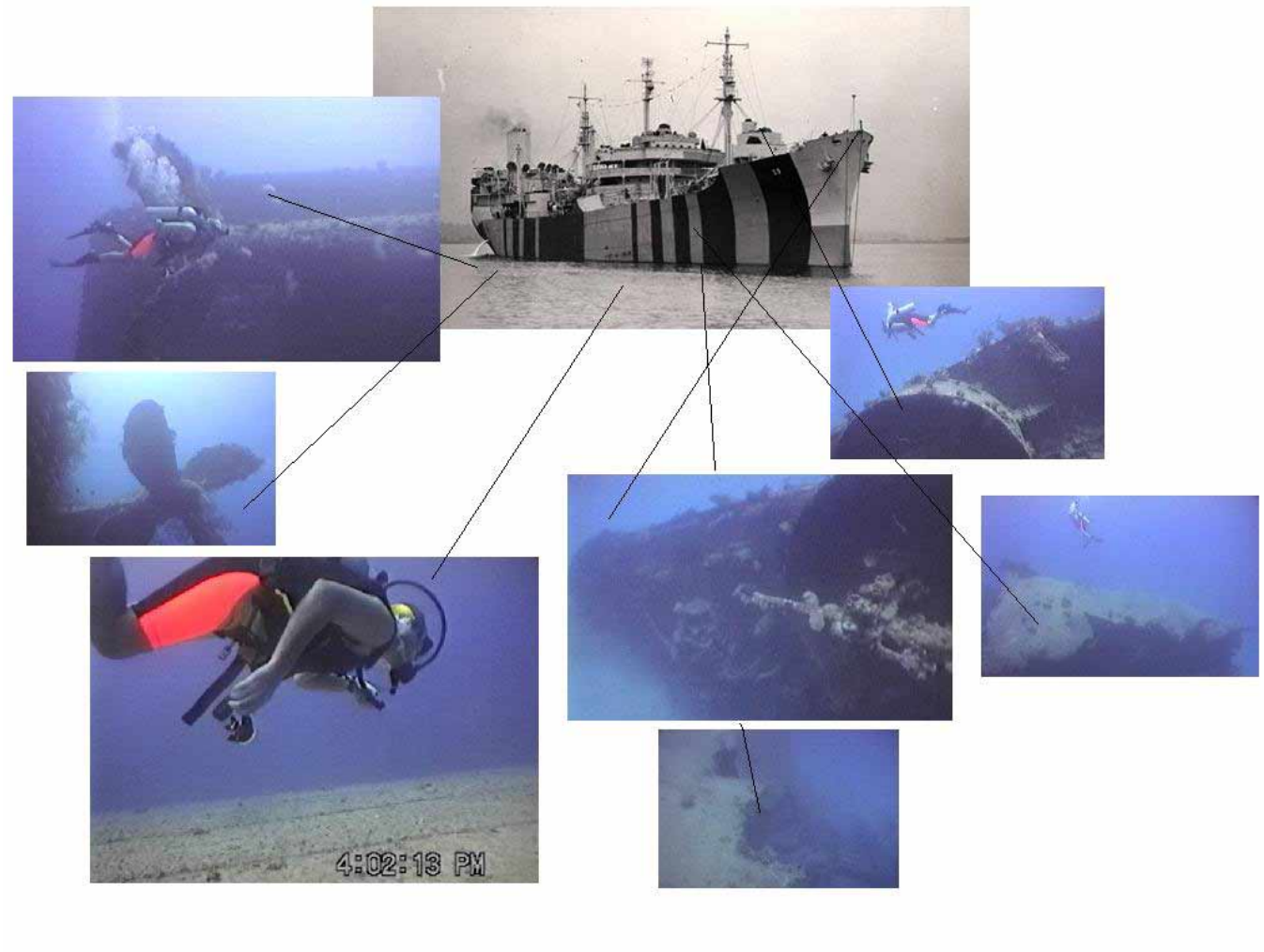

Figure 4 Wreck Inspection Photo-survey Montage with Reference to Historical Photo of USS Mississinewa

Yap officials had estimated oil release rates from the vessel by underwater volume measurements during late August 2001. Assuming a continuous steady oil release over the whole time period for this spill, somewhere between 18,000 gallons (approx. 68,000 litres) to 24,000 gallons (approx 91,000 litres) of oil was released into the lagoon over the two months.

From estimates of total cargo (approximately 5,000,000 gallons or 19,000,000 litres) significant oil still remains on board in cargo tanks within the wreck of the USS Mississinewa. Therefore, only between 0.35% and 0.50% of the oil cargo was released in the recent oil spill. The magnitude of the worse possible case scenario is between 200 and 300 times the amount of oil already spilt.

In the SPREP assessment of the wrecks' integrity, it was concluded that the estimated 5,000,000 gallons of oil remaining on the USS Mississinewa represented a "grave and imminent danger" of a pollution hazard to Ulithi lagoon and the government of Yap State, FSM and related interests.

In the SPREP assessment report it was highlighted that major doubt and uncertainty exists as to the structural integrity of the vessel in the long term. It was reported in September 2001 to the Yap Government that it was not a case of "if" the next oil leak occurs from the USS Mississinewa but "when". Unfortunately this prediction did eventuate.

Subsequent Oil Spills from the Wreck & Remedial Actions

In late December 2001, another oil spill was reported from the Mississinewa shipwreck by the Islanders of Ulithi lagoon. At the request of the Yap government the US Navy dive teams and contractors again returned to the remote lagoon and plugged the leaks in February 2002, apparently with stronger epoxy cements.

The most efficient and cost effective response option is often to "control at source" any potential ship sourced spill. A clean-up of an oil spill once it has occurred is a "reactive strategy" whereas oil cargo salvage from a wreck is an "active" preventative strategy. The magnitude of the risk, the likelihood of extensive environmental damage, and common sense dictates that the most responsible option would be to tap the fuel oil tanks of the Mississinewa and drain any remaining oil under controlled conditions from the deteriorating wreck.

A release of the vessels' cargo, whether by chronic low level discharge over a long time period, or by catastrophic failure during a storm or typhoon, could have severe impacts on the lagoons coral reefs, the foreshore environment, subsistence fishing, food supply and health of the Ulithi population. Also any oil leak would pose a significant threat to one of the most important remaining sea turtle breeding colonies in the western pacific region.

It was concluded by SPREP investigation that the wrecks' extensive oil cargo posed an unacceptable and ever present risk to the marine environment of Ulithi lagoon and should be offloaded under controlled conditions within the "window of opportunity"

as specified in the report (Gilbert 2001). A number of response options were also detailed in the body of the report.

As of November 2002 it is understood that the US State Department has notified the government of FSM that a salvage team has been tasked by the US Navy to off load the remaining oil cargo from the USS Mississinewa, during January/February 2003, prior to the typhoon season.

Summary of Foreshore and Wildlife Impacts on Ulithi Islands from the Oil Spill

From the surveys carried out on a limited number of islands in September 2001 it was apparent that no major foreshore oiling remained in Ulithi lagoon. Some oil had impacted the turtle island of Pau. The western beaches Falalop facing the lagoon were probably the most contaminated with oil during the surveys. The oil tar balls and mats were concentrated in the upper tidal zone region near the concrete boat ramp and the boat harbour in Falalop.

The natural removal/cleaning processes due to wind, wave and sediment abrasion action during the storms to have passed through the region in mid 2001 had helped the self cleaning of most of the previously oiled foreshores. There is a major gap in the knowledge of the fate of the heavy residues of oil removed by the natural foreshore cleaning processes. That is, where is the "sink" for all the remaining persistent oil residues in Ulithi lagoon? It was recommended that surveys be carried out in Ulithi lagoon to determine if any oiled sediments exist in any significant quantities in the intertidal and near shore areas of the previously oiled foreshores.

No signs of any abnormal crustacean or mollusc mortality were apparent. None of the dead turtles examined showed any sign of oil contamination and the deaths may be attributed to natural causes. Bird population appeared to be diverse, healthy and very active with no signs of oil contamination, oil intoxication or behavioural changes. No apparent or significant damage was observed on wildlife by the oil spill on any island surveyed during the assessment.

Coral reefs are the richest and most diverse of all of the ecosystems in the sea and very sensitive to marine pollution. During oil spills incidents coral reefs should receive a high protection priority since they are easily damaged if oiled. They may take several decades to recover if impacted by oil and are extremely difficult to clean. Coral reefs in Ulithi Lagoon are mostly sub-tidal in nature, although the shallowest portions of some fringing reefs can be exposed during very low tides. All of the reefs are completely submerged during high tide, and only a few reefs are routinely exposed during normal low tides. More commonly, reefs are exposed only during extreme low tides a few times a year.

Submerged reefs may be exposed to oil droplets in the water column, especially if the oil is physically dispersed through high wave energy. Deep corals are more likely to come into contact with sedimentary oil adsorbed onto particles. If slicks float over submerged reefs without significant dispersal of oil into the water column, adverse effects are likely to be less and recovery more rapid. (Figure 5)

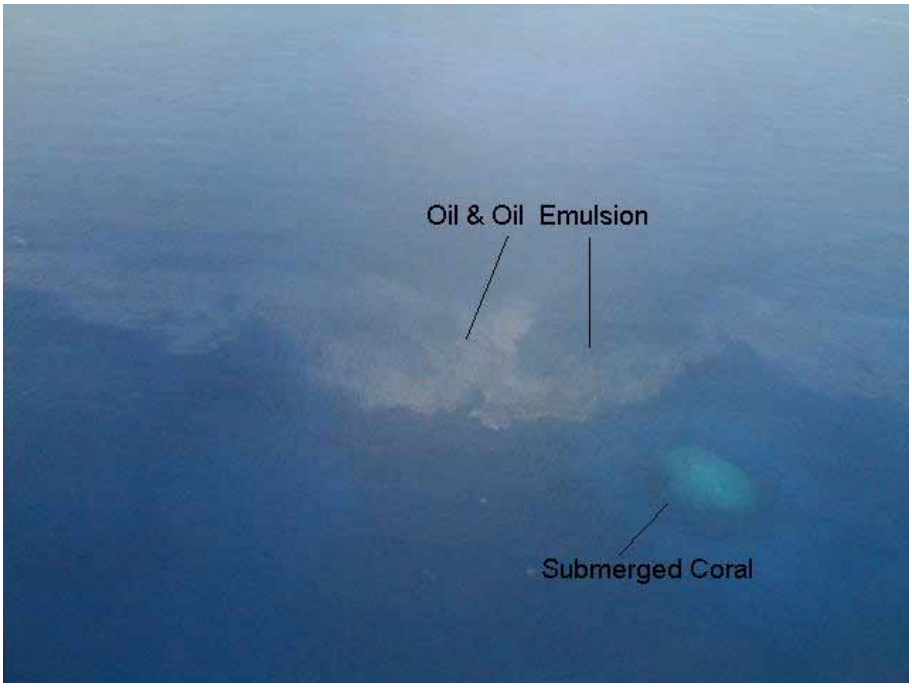

Figure 5. Oil spill from USS Mississinewa near coral reefs in Ulithi Lagoon (Yap EPA photo)

Impacts on Fisheries from the Oil Spill

The SPREP report concluded that the ban placed on fishing within Ulithi lagoon by the Yap Authorities during the height of the 2001 oil spill was a prudent and sound measure to protect the health of its citizens. Since the immediate spill source had been contained, and sufficient time had passed for most fish species to depurate (detoxify) from the effects of oil components, the ban was lifted after the conclusions of the independent assessment.

It was recommended that the reopening of the fisheries within Ulithi Lagoon occur immediately. Also that any long term monitoring of seafood for hydrocarbons should focus on the "indicator" or "sentinel" species mentioned in the report which are more sensitive to background levels of oil in the environment.

WWII Shipwreck Integrity and Risk of Oil Release

The sea is a sacrificial and corrosive chemical environment for metal objects and wooden materials. The shifting sediments, marine bacteria and organisms, destructive storms, immense water pressures and currents reduce shipwreck structures back to their original basic elements over time. Degradation rates also depend upon the depth, water oxygen content and temperature the vessel has been lying in as well as the extent of damage prior to sinking.

Military vessels that have been sunk during wartime are expected to have suffered extensive structural damage, fires and explosion of munitions, prior to sinking. Each year that passes the vessels sunk in WWII across the Pacific deteriorate more and the risk of significant oil release becomes more likely.

It must be recognised that the WWII shipwrecks of the Pacific:

- are at least over 57 years old,
- been continuously exposed to corrosive seawater at high oxygen levels and at high water temperatures accelerating steel corrosion and metal loss,
- been weakened by the initial explosions that sank the vessel and the fires on board prior to it sinking,
- have been crushed and deformed by the enormous forces of the sea if sunk in deep water,
- served in combat with associated wear & tear prior to sinking,
- have settled over time into bottom sediments and will continue to do so placing different structural stresses and strains on the vessel over time,
- suffered the impacts of storms, typhoons and ocean currents over many decades,
- been suffering slow degradation of the super-structure due to general metal loss from rust as well as pit corrosion causing pin hole leaks,
- are suffering the loss of strength of fasteners throughout the vessel tanks, superstructure and associated pipe-work causing possibly internal and external leaks of oil.

Oil leakage from shipwrecks, often occur at pipe-work, mechanical connections, valves and joints, usually in the water-exposed parts of decks, holds or tanks. Metal fasteners over time lose their ability to hold flanges together (e.g. nuts and threads waste away), rubber seals fail and the ingress of seawater to metal components and seals causes rust and metal wastage. Iron oxide (rust) occupies more physical volume than the iron/steel itself, causing expansion and the forcing apart of the already weakened fasteners, hence oil leakage and seepage.

Identification of Oil Spills from Shipwrecks using Remote Sensing

One of the difficulties of monitoring suspected shipwrecks for pollution or responding to intermittent oil spills from sunken ships, especially in remote regions, is locating the exact geographic position of the submerged vessel. Regular aerial surveillance for oil spills over large sea areas is not only extremely expensive but also inefficient. Often appropriate aircraft are not available in remote island countries. Oil spill reconnaissance by sea-surface craft and sonar surveys is time consuming and also very expensive over the large geographic areas and in the remote island regions. Fortunately remote sensing by optical and radar satellites offers many advantages over sea and aircraft surveillance.

To demonstrate the advantages of satellite technology for oil spill monitoring and detection from sunken vessels in remote locations, SPREP in conjunction with the Australian Centre for Remote Sensing (ACRES) and RadarSat Canada acquired a series of satellite images of Ulithi lagoon during the last spill from the USS Mississinewa in late 2001 and early 2002.

Satellite remote sensing for oil spills and seeps at sea previously had to rely totally upon optical remote sensing or aerial over-flights. Optical sensors are ‘passive’ instruments and rely upon light reflected from the earth’s surface back to the satellite.

Radar sensors on satellites are 'active' devices. They transmit microwave energy, bouncing it off the earth's surface back to the satellite. The returning signals, received and stored as data by the satellite, are known as backscatter. Radar sensors see through cloud, fog and in the dark, the technology is often referred to as Synthetic Aperture Radar or (SAR).

The radar approach has the added advantage of penetrating darkness, cloud, rain or haze over sea or land, enabling spill responders to acquire imagery day or night under any atmospheric condition. This is crucial when monitoring suspect sites or tracking oil slicks on the ocean where clouds and haze are common atmospheric conditions especially near or in the equatorial regions.

The RadarSat image below of Ulithi lagoon on the 2nd January 2002 clearly shows the oil plume from the wreck of the USS Mississinewa. The reported positions of the wreck have been overlaid on the imagery. (Figure 6.)

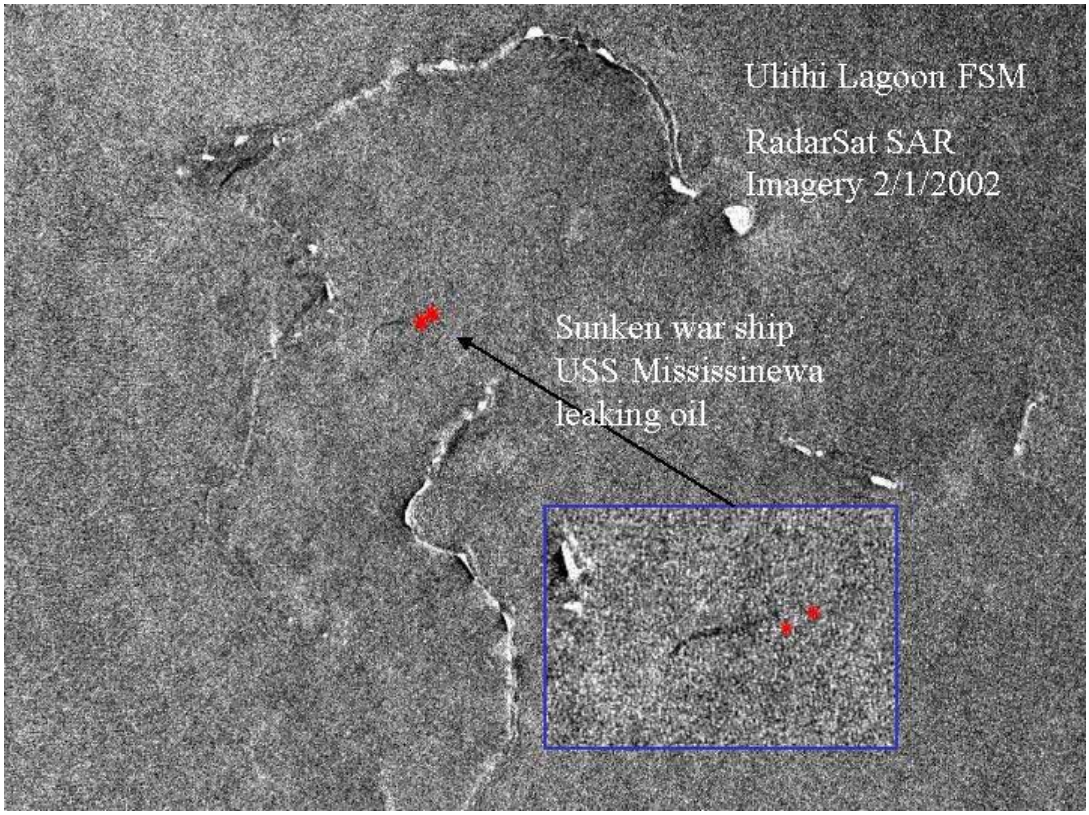

Figure 6. – RadarSat Satellite Image of Oil Spill Ulithi Lagoon 2 January 2002
(courtesy RadarSat Canada and ACRES Geoscience Australia)

As the location of many of the WWII shipwrecks in the Pacific are not known precisely this SAR technology is useful to help pinpoint the location of vessel wrecks by the oil plumes leaking to the surface. SAR imagery over a suspected area is taken at regular intervals and any detected plumes overlaid upon the scene using a GIS to indicate any sources of the oil seeps.

Strategy to Address Pollution from WWII Wrecks in the Pacific

In the Pacific war many nations of the region lost both military and civilian vessels, ranging from large aircraft carriers, battle ships, destroyers, cruisers, oil tankers, submarines, landing craft and merchant vessels. In Truk lagoon (now Chuuk lagoon) Micronesia, dozens of vessels were sunk with over 200,000 tons of shipping lost into a lagoon only 60 odd kilometres across.

The oil, chemicals and unexploded ordnances still on board many of these vessel poses a grave and imminent danger to the people and fisheries of the region as well as the marine and coastal environments of many small Island nations of the Pacific. (Gilbert, T & Nawadra, S 2001)

It was the oil spill from the USS Mississinewa in mid 2001 that brought home the reality and scale of the problem to island countries. For many years small-scale oil spills have occurred from WWII wrecks in the Solomon Islands, in Chuuk Lagoon Micronesia, Papua New Guinea and the Marshall Islands.

At the request of the members of the 12th meeting of the South Pacific Regional Environment Programme, held in Apia in September 2001, SPREP was required to investigate and formulate a regional strategy to address the pollution risk posed by the many World War II shipwrecks across the Pacific.

The Pacific Ocean Pollution Prevention Programme (PACPOL) of SPREP was tasked with formulating a Regional Strategy to address the issues related to World War II Wrecks. A draft Strategy was developed and presented at the 13th SPREP Meeting in July 2002. (Nawadra S, 2002)

The prime consideration in the mitigation strategy is the reduction of risk of any marine pollution incident and the conservation of the marine and coastal environment of the Pacific region. Control of pollution is essential for the maintenance of health, the standard of living and future of the islanders. Some of the key elements of the strategy are given below. (Nawadra S, 2002)

PACPOL carried out a desk study to collate data on WWII wrecks. A Geographic Information System (GIS) has been established to allow for storage of thematic data such as vessel type, cargo/bunkers, date of sinking and the mapping of relevant geographic features such as vessel location, bathymetry and various maritime zone boundaries. (Figure 7.)

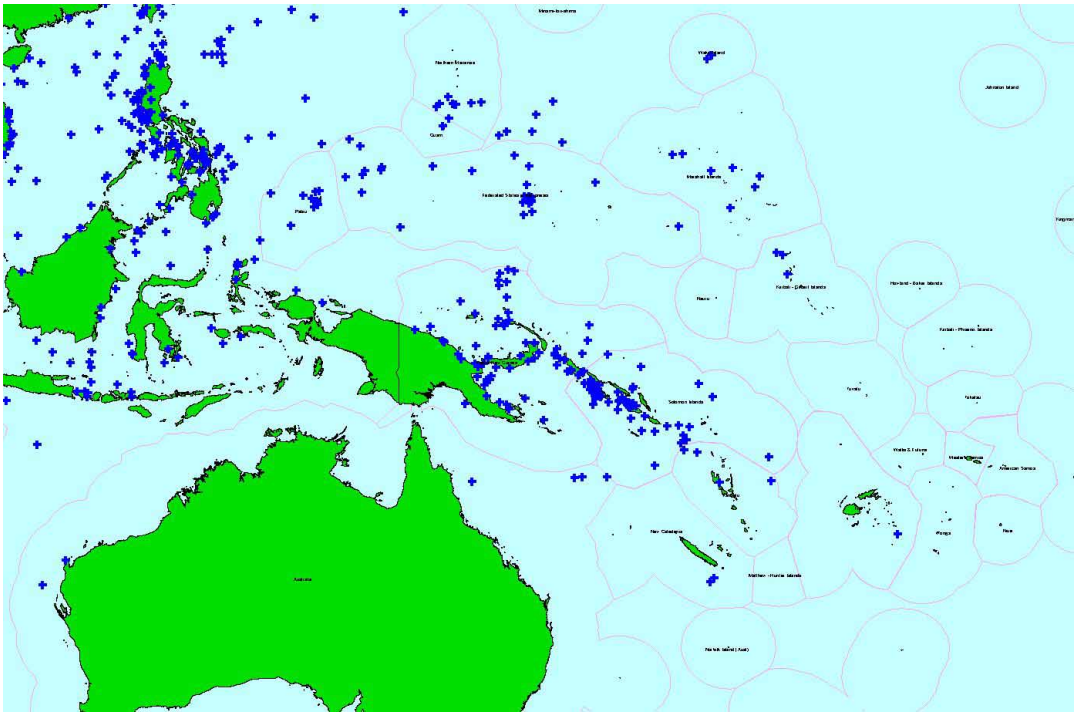

Figure 7. Output from the SPREP GIS database of WWII Shipwrecks in the Pacific

Currently the SPREP/PACPOL database contains information on over 1080 WWII shipwrecks including 23 large aircraft carriers, 213 destroyers, 22 battle ships and around 50 oil tankers. The ships so far logged amount to over 3 million tons of shipping sunk in the Pacific region. Approximately 2 million tons of shipping belonged to Japan, around 640 vessels lost. The United States owned vessels within the database amounts to over 900,000 tons of shipping.

In the Solomon Islands EEZ alone over 550,000 tons of sunken vessels has been logged, many within the region known as Iron Bottom Sound and around the islands of Guadalcanal and Savo.

The Strategy developed by PACPOL recommends that the implementation of activities to address WWII wrecks be carried out within a comprehensive risk assessment framework and provides guidance on these recommended activities. The strategy recommends a 5-step approach to addressing the issue;

1. Data Collection and analysis – Continue with the identification and analysis of wreck sites, wreck depth, access and cargoes/bunkers carried.

2. Generic Risk Assessment – To carry out a generic risk assessment to compare the risk levels between sites. All sites will be ranked high, medium and low.

3. Agree on the interventions: - high risk – direct (pump-out, salvage); medium risk – manage site (contingency plan, restricted access); low risk – leave alone and monitor.

4. Site Specific Risk Assessments – According to level of risk, specific site assessments will need to be carried out. These would include Environmental

Impact Assessment (EIA), Shoreline Contamination Assessment & Treatment (SCAT), consultations with Coastal, Flag or Sovereign States and logistics assessments.

5. Planning Implementation – Drawing up of final implementation plans for interventions including determining responsibility budgets, timing, logistical requirements, environmental and social issues.

Due to the age and extent of structural damage to sunken WWII vessels, their status as historic sites and war graves, the salvage and refloating of the vessel would be impossible, impractical or unnecessary. The main concern for this strategy is not vessel salvage but oil cargo removal, securing or other preventive measures with minimum disruption to the vessel, ultimately to avoid marine pollution.

The volume of oil lost during a spill incident is not necessarily the most important factor in determining the seriousness of an oil spill event or possible risk posed by a sunken vessel. The location of the incident/vessel, the oil type, how the oil behaves and weathers, the prevailing sea and weather conditions as well as the sensitivities of the environmental resources it impacts are often the important considerations.

It is expected the majority of oil within the large sunken WW II vessels will be heavy fuel oil along with diesel, lubrication oils and some aviation fuels and gasoline. Vessels such as submarines and patrol boats would be mostly diesel driven and have smaller quantities of fuel on board whereas large aircraft carriers, battle ships, destroyer are likely to have large quantities of the heavier more persistent oils. Tankers, and other refuelling vessels, may contain mixtures of oils, gasoline, aviation fuels and diesel.

Status and Future of WWII Ship wreck Strategy

The presence of a shipwreck within a country's EEZ does not transfer its sovereign ownership from the Flag State to the Coastal State where the wreck resides. Any activities carried out to manage the risk from WWII wrecks will need both Flag State and Coastal State consent. Currently no international legal instrument governing the ownership of sunken warships, however, there is a well-developed body of customary law governing the treatment of sunken warships and military aircraft. Some countries have stated policies on the ownership of wartime shipwrecks, for example the US Government retains custody of its wrecks regardless of their geographic locations through sovereign immunity provisions of admiralty law. Abandonment of US Navy wrecks requires specific congressional action.

Any decision to salvage the remaining oil cargo from any particular WWII shipwreck under the strategy should be based upon an agreed position with the sovereign country and the upon the premise;

"The eventual environmental impacts and risks posed by the oil and other hazardous cargo outweighs the costs of the mitigation action".

The 13th SPREP Meeting gave the mandate for the SPREP Secretariat, through PACPOL, to commence with Steps 1-3 of the Strategy, which is currently in progress.

A significant number of WWII shipwreck sites are also war graves and sites of historical and archaeological significance. Under the strategy multilateral agreements and relationships with governments need to be developed to control access to wreck sites, confidential information collected and any recovered artefacts. The unexploded ordnance that may be associated with wartime wrecks also poses problems with the management and uncontrolled access by divers to these sites.

Conclusion

The livelihood, food supply and way of life for Pacific Islanders depends upon the ocean, its fragile coastal environments and its natural resources. These delicate coral reefs, coastal marine environments and important fisheries, vital for subsistence living, are also very sensitive to marine pollution and could suffer severe damage during an oil spill.

The various oil spills from the sunken USS Mississinewa oil tanker highlight the problems of oil spill response and cargo salvage in remote regions of the Pacific. The lack of infrastructure, support services, equipment and transport difficulties hampers effective and timely response to marine pollution incidents. The USS Mississinewa also highlighted the problems of aging and slowly deteriorating WWII shipwrecks across the Pacific region.

The problem of more than 1000 WWII shipwrecks, amounting to over 3 million tons sunk across the pacific, has been with us for 60 years and will not fade away by continuing to ignore the issue. It is not a question of "what if" another WWII wreck related oil spill will happen but rather of "when". As the Regional Strategy to Address Pollution from World War II Shipwrecks develops, SPREP will continue to collect data on, and analyse the risks posed, by these wrecks so that regional decision makers can make informed and balanced decisions.

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