Risk of Marine Spills in the Pacific Islands Region and its Evolving Response Arrangements

Sefanaia Nawadra* - Marine Pollution Adviser, SPREP and
Trevor Gilbert** – Principal Environmental Adviser, AMSA

Abstract

Assisting the South Pacific Regional Environment Programme's (SPREP) island members to plan, prepare and respond to marine spills is one of the four activity areas of the Pacific Ocean Pollution Prevention Programme (PACPOL). PACPOL activities currently include a regional risk assessment, regional and national contingency plans, formulation of a regional equipment strategy and facilitating regular workshop to discuss marine spill issues.

The aim of this initial shipping risk study was to identify and quantify the shipping routes, frequency of voyages and types of cargoes transported in the region as well as to map shipping incidents, navigational hazards and assess the risk of marine pollution across the region, EEZs and at a port scale. The regional and EEZ distribution of risk potential showed clusters of high risk in Fiji, French Polynesia, Papua New Guinea and Solomon Islands. Smaller clusters occurred in Tonga, the Samoa's, Vanuatu and the corridor from Chuuk northward past Guam and the Northern Mariana Islands.

Another potential marine pollution risk for the Pacific is the fuel oil and cargoes remaining on WWII shipwrecks deteriorating in the waters of the region. More than 1000 such wrecks have been identified amounting to over 3 million tons of shipping lost.

1. Introduction and Background

1.1. The Region

The term 'Pacific islands region' is used to describe that area of the Pacific Ocean encompassing the island countries and territories that make up the sub-regions of Melanesia, Micronesia and Polynesia, excluding Easter Island, New Zealand and Hawaii. These 14 countries and 7 territories are all members of the South Pacific Regional Environment Programme (SPREP). Australia, France, New Zealand and the United States of America are also members of SPREP due to their proximity and close links or the presence of their territories within the region. They are termed as "Metropolitan Members."

Within this region exists a diversity of physical and biological environments; from large, high, jungle-clad continental islands in the west to rugged volcanic outcrops and isolated, low-lying coral atolls throughout the north and east. The total combined land area of these islands constitutes a mere 550,000 km^2, spread across a huge 30 million km^2 of ocean. Coastal and marine environments are therefore extremely important. The importance of coastal and marine environments to every aspect of the lives of Pacific Islanders cannot be overstated. The impacts of marine pollution, including ship-related pollution, constitute a major concern for Pacific Island peoples.

* *author for all correspondence (email SefanaiaN@sprep.org.ws)*
** *on secondment to SPREP (email Trevor.Gilbert@amsa.gov.au)*

Table 1. PACPOL Countries and territories

Country Name	Land Area, Km^2	Combined Sea Area , Km^2	% Land area/ Sea area	Population	Population /Km^2
French Polynesia	3521	4,742,000	0.074%	188814	53.6
Kiribati	811	3,457,000	0.023%	77658	95.8
Federated States of Micronesia	701	3,012,000	0.023%	105506	150.5
Papua New Guinea	462840	2,413,000	19.181%	4705126	10.2
Marshall Islands	181	1,996,000	0.009%	43380	239.7
Cook Islands	237	1,977,000	0.012%	18617	78.6
Solomon Islands	28370	1,612,000	1.760%	285176	10.1
Fiji	18272	1,285,000	1.422%	715375	39.2
New Caledonia	19103	1,082,000	1.766%	196836	10.3
Pitcairn	47	842,000	0.006%	49	1.0
Tuvalu	26	753,000	0.003%	9043	347.8
Northern Mariana Islands	471	746,000	0.063%	58846	124.9
Tonga	747	665,000	0.112%	94649	126.7
Vanuatu	12190	655,000	1.861%	142419	11.7
Palau Islands	488	607,000	0.080%	17270	35.4
American Samoa	200	405,000	0.049%	46773	233.9
Tokelau	10	325,000	0.003%	1507	150.7
Niue	259	320,000	0.081%	2239	8.6
Nauru	21	310,000	0.007%	9919	472.3
Wallis and Futuna	255	259,000	0.098%	13705	53.7
Guam	541	219,000	0.247%	133152	246.1
Samoa	2935	134,000	2.190%	161298	55.0
TOTAL	**552226**	**27816000**	**1.98%**	**7027357**	**12.7**

Combined Sea Area = Territorial Sea + EEZ
Sources: USP GIS Unit, CIA World Factbook, MapInfo integration of SPREP EEZ map.

1.2. Shipping in the Region

The Pacific islands have an extremely rich maritime heritage. The islands themselves were first populated by some of the greatest mariners in human history who used wooden canoes held together by coconut fibre and used the stars and their intimate knowledge of the sea to navigate thousands of miles of open ocean. There are also the epic voyages of European exploration, with seafarers such as Magellan, Tasman, Cook and Bligh carving their places into history with their own outstanding feats of navigation. World War II heralded another major chapter in maritime history. Some of the largest naval battles in history were fought in the Pacific Theatre.

In modern times, as island states located within the world's largest ocean, the island members of SPREP are overwhelmingly dependent on shipping for economic survival in the modern age. The initial marine spill risk assessment for the region is currently being completed. Its aim is to characterise quantitatively the shipping routes, pattern and frequency of voyages and types of cargoes as well as to map navigational hazards and assess the level of shipping risk at both the regional and national levels. This data has

been mapped on a Geographic Information System (GIS) to determine marine collision and grounding hazard potential, and will be used for shipping management and contingency planning purposes at both levels. Shipping in the region can be grouped into the following broad categories:

- Transit shipping: Ships, which pass through the region without stopping, en-route to other destinations.

- International shipping (as distinct from transit shipping): Ships calling at the major ports of the region from outside the region, either with incoming cargo or tourists (cruise ships) or to take out exports.

- Regional shipping: Ships trading (both cargo and passengers) between the countries and territories within the region.

- Domestic shipping: Ships trading (both cargo and passengers) within each country in the region.

- Foreign fishing fleet: Fishing vessels from distant fishing nations operating within the region.

- Domestic fishing fleet: Local fishing vessels from the Pacific islands.

- Miscellaneous: Special purpose vessels such as warships research vessels, tourist vessels, private yachts, pleasure craft and fishing vessels.

1.3. Marine Pollution in the Region

Despite the benefits and necessity of shipping, this human use of the ocean can also cause a range of sometimes-severe environmental impacts. These include:

- Shipping accidents resulting in sometimes-catastrophic releases of oil and possibly other contaminants.

- The disposal of ships' wastes, including oil, plastics and other garbage into the sea.

- The dumping of wastes other than ships' wastes at sea (as defined by the London Convention).

- The leaching into the sea of toxic chemicals from anti-fouling paints on ships' hulls.

- Coastal and marine environmental impacts from the development and operation of ports that serve the shipping industry.

- The translocation and introduction of marine species across environmental barriers attached to ships' hulls and within ships' ballast tanks.

Marine spills as in all regions of the world is perceived as a significant shipping related pollution hazard for the Pacific Islands. A marine spill risk assessment was carried out as a first attempt at quantifying the issue in our region and to assist our members to address the issue of shipping related marine spills.

2. Preliminary Marine Spill Risk Assessment.

The major objective of this study is to assess the risks of shipping incidents that might cause marine pollution in a region comprising 22 island countries and territories. We have succeeded in classifying all of the ocean area in the region into zones of high, moderate and low potential for collision and grounding incident, at three scales: - regional, Exclusive Economic Zones (EEZ) and major ports.

This study is at the level of a preliminary risk assessment, a comparison of the potential for occurrence of incidents among locations within the region. A full risk assessment would quantitatively evaluate both right-hand terms of the equation for some defined set of incident types, effect types and region of interest.

Risk = (Probability of incident) X (Harmful consequences of incident) 2.1 Regional and EEZ Levels

Our first task was to get an understanding of the commercial shipping movements within the region.

In figure 1 shows the actual routes taken by large commercial vessels in the Pacific region over a period of one year and logged into a GIS.

Figure 1. Shipping Movements in the Pacific

Maps showing the main shipping movements by volume (in GRT) and frequency were constructed for both tankers and container vessels. We also mapped the distribution of commercial fishing vessels that constitute a significant proportion of vessel movements in the region.

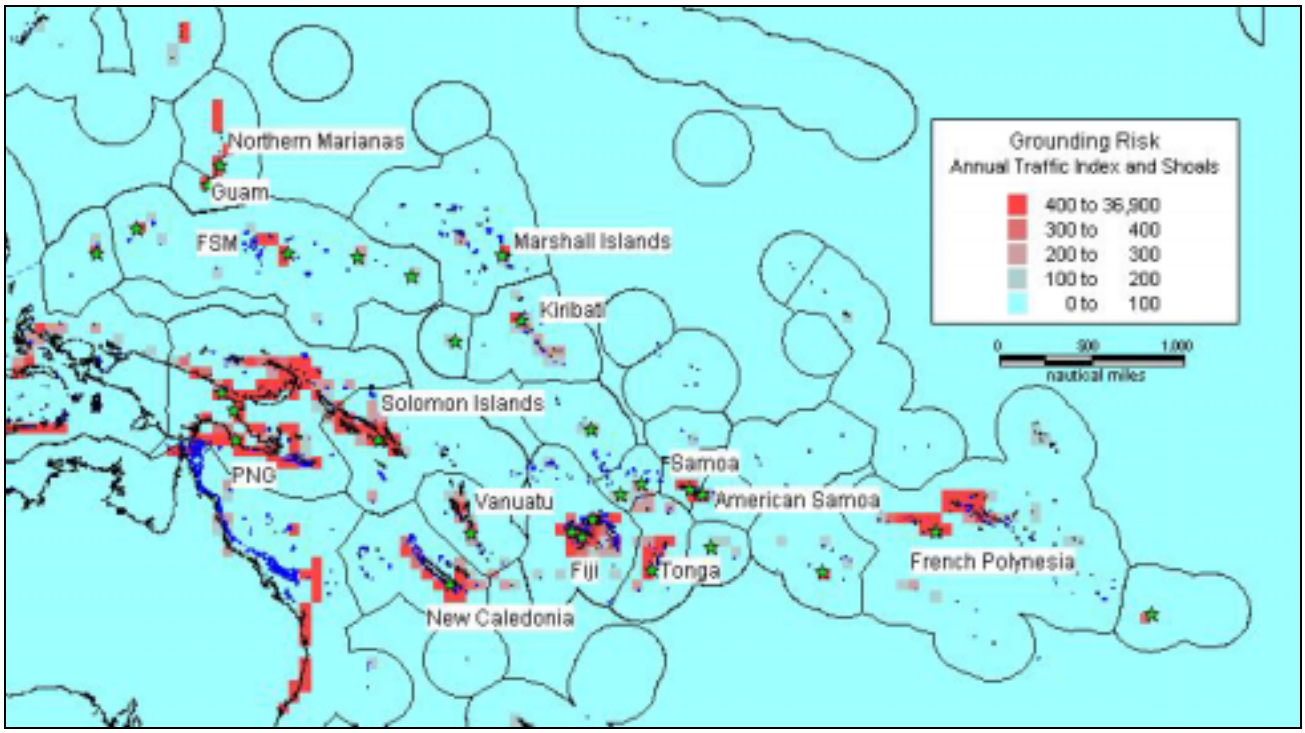
We identified grounding and collision as the predominant casualty types. The model for the assessment of grounding and collision risks at regional and EEZ scales is to calculate for each grid cell in the region:

Risk Potential = (Traffic) X (Presence of hazard)

For the calculation of grounding risk, the hazard is presence of reef(s) or shoreline in the grid cell. For collision, the hazard is the probability of another vessel in the grid cell. We estimated this as (Total Traffic) X (Number of routes crossing cell). We used a 1-degree square grid for both analyses.

On the worldwide scale, about 0.75% to 1% of registered vessels are involved in significant casualty incidents each year, and 0.2% to 0.3% become total losses. We have classified and geo-referenced 283 known casualties that occurred in the region during the period 1976 to 2000. Grounding under power accounted for 65% of incidents, indicating that faulty navigation was the major proximal cause of casualties. Smaller vessels were more likely to become casualties than larger vessels. Fishing vessels had the highest casualty incidence, and 66% of fishing vessel incidents led to total loss.

Figure 2: Regional Grounding Risk



The regional to EEZ distribution of risk potential showed clusters of high risk in Fiji, French Polynesia and Solomon Sea shores of Papua New Guinea and Solomon Islands. Smaller clusters occurred in Tonga, the Samoa's, Vanuatu, and the corridor from Chuuk northward past Guam and the Northern Mariana Islands. The pattern of predicted casualties corresponded well with the pattern of historical occurrences, except in French Polynesia and New Caledonia, where our database showed fewer casualties than expected. This apparent difference could be the result of uneven success in data collection, or of chance, or of other factors to reduce risk in these areas.

Fishing vessels, especially the distant water fleets of long-line tuna vessels, are prominent among historical casualties. The model cannot assess their risk potential because it is only appropriate for vessels that travel directly from port to port along regular routes. We present a grid map of long-line fishing effort as a proxy for the presence of fishing through the region, and thus the relative risk potential. Long-liners were active in two broad areas: one in the south central pacific from about 160°E to 160°W or 150°W, and 10°S to 30°S or 40°S; and one in the western equatorial Pacific from 130°W to 165°W and 0°N to 10°N (Figure 3). Purse-seiners showed a different pattern with a single broad band near the equator from 140°E or 175°E and 5°S to 10°N (Figure 4). Fishing patterns, and ports chosen for trans-shipment to mother vessels, change from year to year depending on environmental and political factors. Roving tankers refuel some fishing vessels at sea, but this traffic is difficult to identify and assess.

Figure 3: Long-line Vessels Fishing Effort, 1999

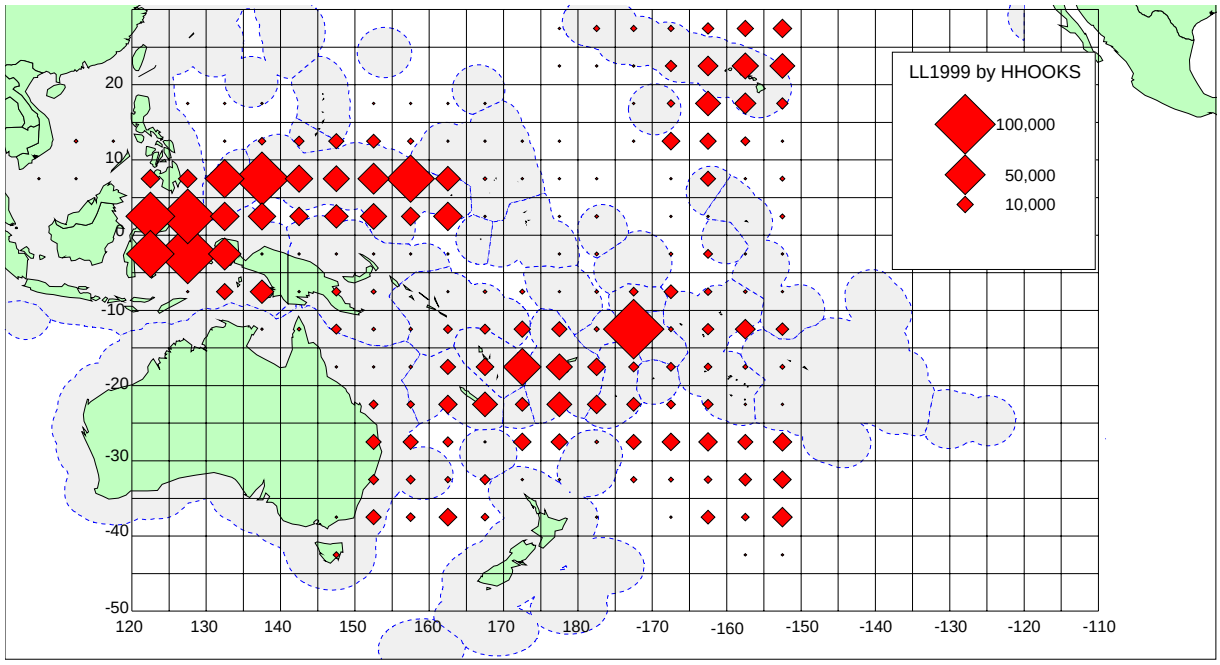
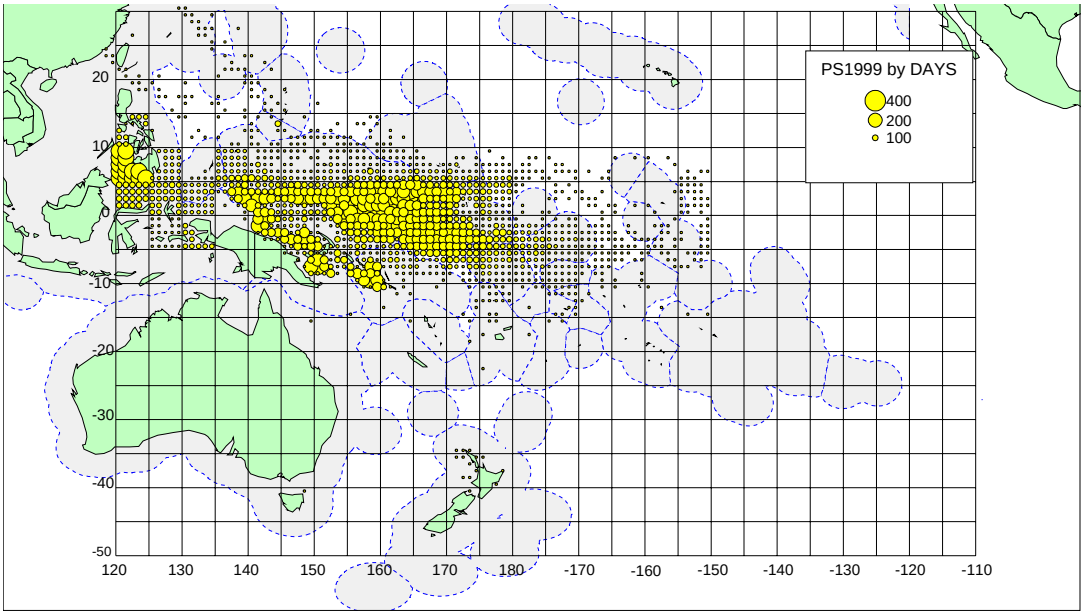
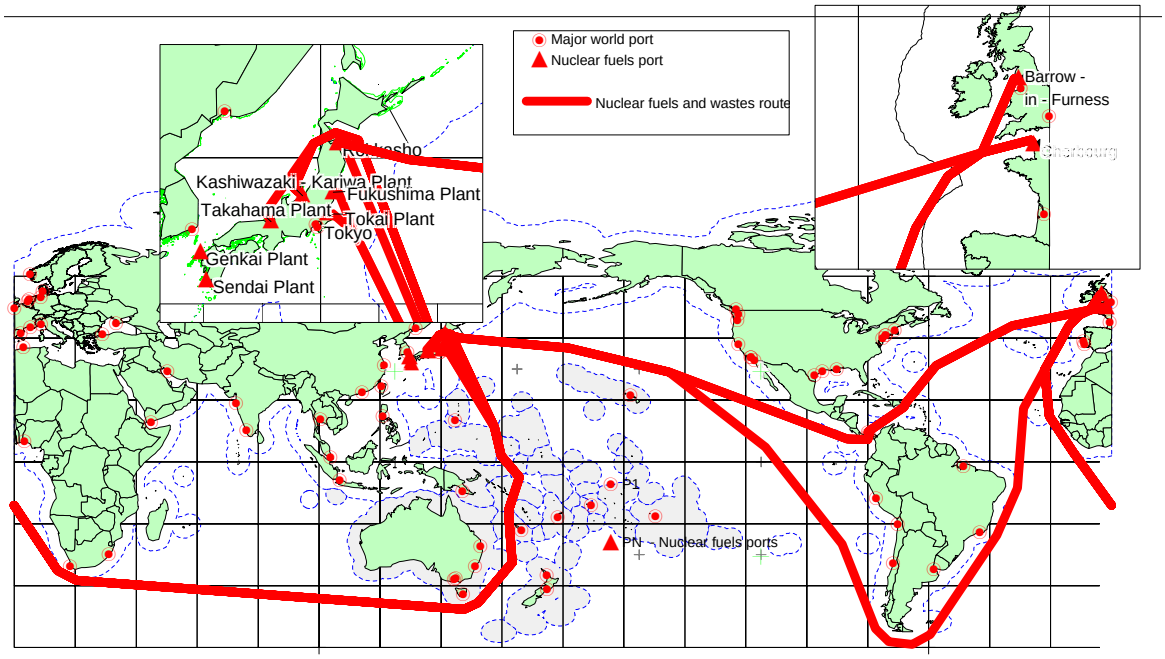


Figure 4: Purse-seine Vessels Fishing Effort, 1999



The region is not heavily industrialised and therefore hazardous chemical cargoes (apart from petroleum products) into the region are in relatively small quantities. However other hazardous materials and wastes do transit the area. Spent nuclear fuels are shipped from Japan for reprocessing in Europe, and returned as plutonium/uranium mixed oxides fuel and vitrified high level waste. Of three known routes in use, one via Cape of Good Hope passes through the region, the other through the Tasman Sea and through the EEZs of PNG and/or the Solomon Islands.

Figure 5: Nuclear Fuel and Waste Shipment Routes



This study is semi-quantitative at the level of a preliminary risk assessment. It is suitable as the foundation for a full quantitative risk assessment. We have succeeded in classifying a 1-degree grid of the region into areas of high, medium and low risk of grounding and collision. We have identified ports of high, medium and low potential for casualties, in particular incidents involving oil tankers. The database and GIS system built for these analyses is an open and dynamic system that can accommodate revision, modification or amplification for other uses.

2.2 Port Scale

At the port scale, we applied a more detailed model to account for physical characteristics of the port in comparison to the requirements of the vessel for safe passage. This model is similar to standard methods practiced in Europe and North America for the evaluation of port and waterway risks. It compares the available channel width (CW) to the Minimum Safe Distance (MSD) required for safe passage of a particular vessel through the most challenging passage to the port, and accounts for auxiliary variables as turns, currents, wind and aids to navigation. For each port, we used a vessel representative of the larger vessels using that port. The ratio CW/MSD is termed a the "Safety Measure" of passage into the port with a safety measure of 1 or less being unsatisfactory. (Table 2)

Table 2: Summary of Regional Port Risk Assessment

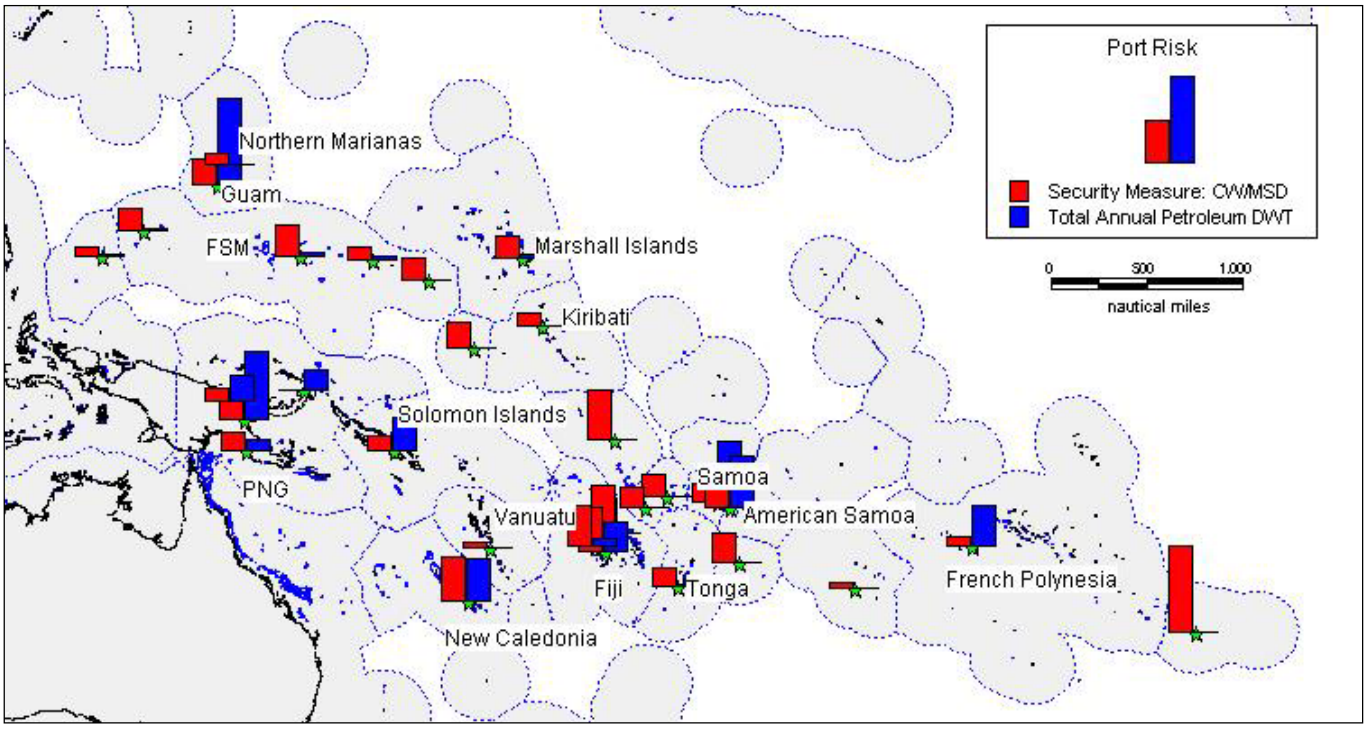
Country	Port	Channel	MSD	CW	CW/MSD
Vanuatu	Port Vila, Mele Bay	Entrance to Paray Bay to fuel jetty	194ft	110ft	0.6
Cook Islands	Rarotonga (Avatiu)	Entrance to Avatiu	165ft	110ft	0.7
Republic of Palau	Malakal Harbour, Koror	Malakal Pass	266ft	280ft	1
French Polynesia	Papeete	Passe de Papeete	334ft	340ft	1
Northern Marianas	Saipan	Reef transit, entrance to Saipan	356ft	400ft	1.1
Kiribati	Betio Island, Tarawa Atoll	Betio Entrance	458ft	600ft	1.3
Federated States of Micronesia	Pohnpei	Jokaj Passage	223ft	300ft	1.3
Papua New Guinea	Madang Harbour	Dallman Passage-Turn to jetty approach	579ft	800ft	1.3
Solomon Islands	Honiara	Approach to tanker moorings	313ft	450ft	1.4
Samoa	Apia Harbour	Reef passage to mooring buoys	420ft	700ft	1.7
Papua New Guinea	Port Moresby	Basilisk Passage-Lark Patch Turn	709ft	1300ft	1.8
Tonga	Nuku'alofa	Ava Lahi Passage-turn to 215°	1077ft	1980ft	1.8

Country	Port	Channel	MSD	CW	CW/MSD
Wallis and Futuna	Ile Futuna	Ava Leava Anchorage	310ft	600ft	1.9
Marshall Island	Majuro	Calalin Channel	399ft	800ft	2
Federated States of Micronesia	Tamil Harbour, Yap Island	Entrance to Tamil Harbour	197ft	400ft	2
Federated States of Micronesia	Lele Harbour, Kosrae	Lele Approach	283ft	600ft	2.1
Wallis and Futuna	Mata Utu Harbour, Ile Uvea, Iles Walli	Passe Honikulu	244ft	500ft	2.1
Guam	Apra Harbour	Outer Harbour entrance	389ft	900ft	2.3
Nauru	Phosphate Moorings	Approach to cantilever & moorings	421ft	1000ft	2.4
Niue	Alofi Bay	Alofi Bay Anchorage	185ft	500ft	2.7
Papua New Guinea	Lae	Lae Approaches	353ft	1000ft	2.8
Federated States of Micronesia	Moen Harbour, Truk Islands	Northeast Passage	306ft	900ft	2.9
American Samoa	Pago Pago Harbour, Tutuila Island	Harbour entrance	283ft	900ft	3.2
Republic of Fiji	Lautoka	Navula Passage	1133ft	4100ft	3.6
Republic of Fiji	Suva	Levu Pass	332ft	1300ft	3.9
New Caledonia	Noumea	Passe de Dumbea	543ft	2200ft	4
Republic of Fiji	Malau Harbour, Labasa	Mali Pass	686ft	2900ft	4.2
Tuvalu	Funafuti Island, Funafuti Atoll	Te Ava Te Lape Pass	356ft	1600ft	4.5
Pitcairn Islands	Bounty Bay	Approach to anchorage	277ft	2100ft	7.6
Papua New Guinea	Rabaul	(No chart available)	-	-	0

The safety measure was equal to or less than 1.0 at four ports: Port Vila (Vanuatu), Avatiu (Cook Islands), Malakal (Palau) and Papeete (French Polynesia). This indicates that available channel width is less than that required for safe passage. Saipan (Northern Marianas), Betio (Kiribati), Pohnpei (Fed. States of Micronesia) , Madang (PNG) and Honiara (Solomon Islands) have low to moderate safety measure. However most of these ports have low volumes of traffic.

In order to assess the potential for a major pollution incident, we compared the safety measure to the volume of oil tanker traffic for each port with a lower safety measure and higher traffic indicating greater risk (figure 6). By inspection, the highest potential for an oil pollution incident was at Guam, Papeete and Madang. Noumea (New Caledonia) and Suva/Vuda/Lautoka (all Fiji) also have high tanker volume, but risk is moderated by higher safety measures.

Figure 6: Regional Port Risks Vs Total Annual Petroleum (DWT)



3. Regional Developments in Contingency Planning

3.1 Legal Framework

The *SPREP Protocol Concerning Cooperation in Combating Pollution Emergencies in the South Pacific* provides the legal framework through which marine spill contingency planning is addressed. Apart form Kiribati, Tonga and Vanuatu, all members of SPREP are party to this protocol. It predates OPRC and is drafted along similar lines but addresses all types of marine pollution emergencies not only persistent oils in cargo. The SPREP Secretariat has been instructed by the parties to the protocol to carry out a review of the protocol to make it more consistent with OPRC. These proposed changes are to be submitted for approval in 2003.

National Legislation to enable the Protocol and OPRC provisions has been lacking in most SPREP Pacific Island Country (PIC) members. PACPOL has drafted model legislation that enables theses and other regional and IMO related conventions. This model legislation has been discussed and distributed to all PICs with the Cook Islands enacting the necessary legislation and Tonga and Fiji well into their legal drafting process.

3.2 Contingency Planning Arrangements

PACPOL drafted the *Pacific Islands Regional Marine Spill Contingency Plan (PACPLAN)* and at the 11th SPREP Meeting in September 2000, members endorsed PACPLAN as the regional framework through which the SPREP Pollution Emergencies Protocol is operationalised. To date PACPLAN has been activated once in response to the spill at Ulithi atoll, Yap State, Federated States of Micronesia (FSM) when the FSM requested assistance from the United States. The spill was from the USS Mississinewa, the wreck of a US Navy World War II Tanker sunk in 1944.

At the national level when PACPOL started out in 1999 only Fiji and PNG had National Marine Spill Contingency Plans (NATPLAN). To assist island members and to ensure that arrangements throughout the region were consistent with PACPLAN and international best practice, PACPOL formulated a model NATPLAN. We have provided technical assistance to PICs to formulate and review their NATPLANs and to date only Tonga and Niue remain to be provided this assistance.

PICs are now at the stage that they are ready to purchase spill response equipment. To assist members determine their needs and rationalise a network of equipment throughout the region we will carry out a review of marine spill combat equipment needs in 2003. We have received funding assistance to do this from the IMO and Canada and have requested technical assistance through the provision of equipment specialists from Australia, France, New Zealand and the United States.

PACPOL has conducted 4 workshops with an approach similar to SPILLCON but also with a strong training focus. National administrations, ports authorities and the shipping and oil industries have attended these workshops. The next workshop is proposed for Auckland in September/October 2003.

3.3 Regional Strategy to Address World War II Wrecks

At the 12th SPREP Meeting held in Apia in September 2001, the Delegation of the Federated States of Micronesia raised concerns about an oil spill incident that occurred during July and August 2001 from a sunken World War II US Navy oil tanker at Ulithi Atoll, Yap State. (Figure 7)

This concern was shared by a number of other Members some of whom also had World War II wrecks within their Exclusive Economic Zones. The Meeting requested the SPREP Secretariat to work with other regional agencies to formulate a regional strategy to address World War II Wrecks for presentation at the 13th SPREP Meeting to be held in the Marshall Islands in July 2002.

Figure 7. USS Mississinewa oil tanker sinking in 1944 and during SPREP inspection dive of the leaking shipwreck in September 2001

The SPREP Secretariat asked PACPOL to formulate a Regional Strategy to address the Issues related to World War II Wrecks. A draft Strategy was formulated and presented at the 13th SPREP Meeting. Some of the key elements of the strategy are given below.

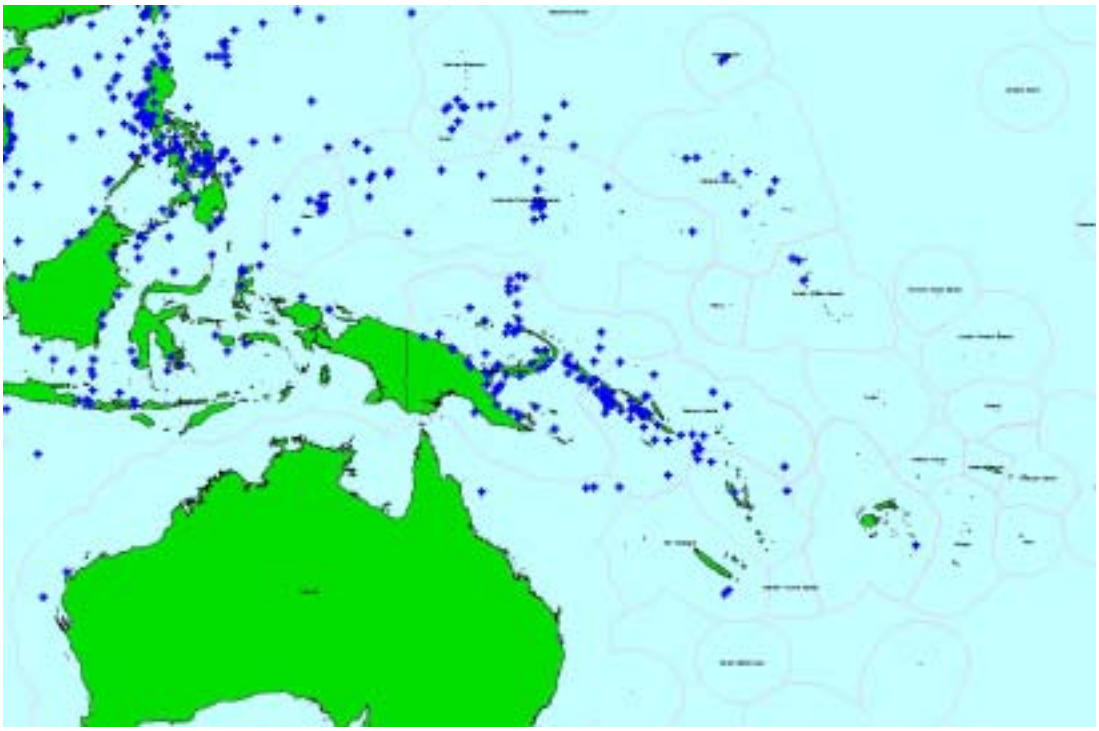
The Emergencies Protocol associated with the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention) obligates Parties to address pollution emergencies such as oil spills in two ways:

- On a bilateral basis provided the Party informs other Parties and the SPREP Secretariat of its arrangement and outlines the provisions of this arrangement. The SPREP Secretariat may be involved in assisting the Party in this arrangement but only upon the submission of a request to it by that Party.
- On a multi-lateral (regional or sub-regional) basis, with the SPREP Secretariat assisting upon the submission of a request by a Party (ies). Again, there is the requirement to keep all Parties informed of the intended arrangement and its provisions.

Internationally, there is currently no multi-lateral legal instrument governing the ownership of sunken warships or military aircraft. However, there is a well-developed body of customary international law governing the treatment of sunken warships and military aircraft. The presence of a wreck within a country's EEZ does not transfer its sovereign ownership from the Flag State to the Coastal State. Any activities carried out to manage the risk from WWII wrecks will need both Flag State and Coastal State consent.

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. Currently the database contains information on over 1080 WWII shipwrecks including 23 large aircraft carriers, 213 destroyers, 22 battle ships and around 50 oil tankers. In all the ships so far logged amount to over 3 million tons of shipping sunk in the Pacific region. In figure 8 an output from the PACPOL WWII shipwreck GIS is shown for the central Pacific region.

Figure 8. SPREP WWII Shipwreck GIS



The Strategy 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 and cargoes/bunkers carried.

2. Generic Risk Assessment – To carry out a generic risk assessment tools to compare the risk levels between sites. A tool used by the US department of Defense was identified as the most appropriate tool to use. 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 and Flag 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.

A significant number of WWII shipwreck sites are also war graves and sites of historical and archeological significance. This needs to be considered when working on these sites.

The 13th SPREP Meeting gave the mandate for the Secretariat through PACPOL to commence with Steps 1-3 of the Strategy.

4 Conclusion

PACPOL activities have assisted members and the region to gain a better understanding of the risks they face regarding marine spills and have assisted in steps to ensure more effective planning and response arrangements for marine spills. The Pacific Islands Regional Marine Spill Contingency Plan (PACPLAN), a regional co-operative response plan is now in place. The majority of countries have or are finalising their national contingency plans.

In the next few years PACPOL activities will continue to be aimed at strengthening the legal, institutional and technical capacities of members to effectively address marine spills. In order to meet our member needs in the area we will work with members to assess their individual needs and find practicable solutions and arrangements with due consideration to national and regional arrangements.

Regional and international co-operative arrangements will remain an essential element through which PICs meet their responsibilities and obligations. The small size and limited resources of many PIC administrations mean that they will probably never be self-sufficient. Our Metropolitan Members have provided, and continue to provide, assistance in strengthening PIC capacities. In our activities to build national capacities we have always advocated the need to build closer and more effective partnerships with the private sector.

The issue of spills from World War II wrecks has become one of PACPOL's focal areas. The problem has been with the region for 60 years and will not fade away by our continuing to ignore it. It is not a question of "what if" another WWII wreck related oil spill will happen but rather of "when". With the endorsement of our members of our Regional Strategy to Address World War II Wrecks, we are making strides in the right direction to at least ensure that we collect data on and analyse the risks posed by these wrecks so that decision makers can make informed and balanced decisions. Through the implementation of this strategy we aim to do our part to minimise the potential for "when" or at least be better prepared for when the "when" happens. We hope that at the end of the day good faith and goodwill prevails and we effectively remove these hazards.

Acknowledgements

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