Ship Groundings in the Pacific Islands Region

Issues and Guidelines

Photo from slide to be placed in this space

Photo by Robert D. Gillet

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by

G. L. Preston, R. D. Gillett, M.A. McCoy, P.A. Murrell and E.R. Lovell

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Prepared for publication by the South Pacific Regional Environment Programme. Printed with the financial assistance of the Australian Agency for International Development (AusAID)

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SPREP Library Cataloguing-in-Publication Data

Ship groundings in the Pacific Islands region :
issues and guidelines/by Garry L. Preston
...[et.al.]. - Apia, Western Samoa : SPREP, 1997.

vi, 106 p. ; 29 cm.

ISBN: 982-04-0156-9

1. Marine accidents. 2. Shipwrecks-Oceania.
I. Preston, Garry L. II. Gillett, Robert D. III McCoy, Michael
A. IV. Murrell, Peter A. V. Lovell, Edward R. VI. South Pacific
Regional Environment Programme.

363.1236

Prepared for publication in June 1997 by the
South Pacific Regional Environment Programme (SPREP)
PO Box 240
Apia
Western Samoa

Printed on Savannah Matt Art 90gsm (60% recycled)
by Commercial Printers Limited, Apia, Western Samoa

Cover photograph:
The *Ever Prosperity* grounded on New Caledonia's main barrier reef.

Original Text: English

PREFACE

The present document arises from a project conceived by the South Pacific Regional Environment Programme (SPREP) which aims to develop, from a multi-disciplinary perspective, guidelines for dealing with ship grounding events within the Pacific Islands region.

McCoy (1992) identified some of the basic considerations that need to be taken into account in developing national-level protocols for dealing with grounded ships. They included:

- safety of the crew;
- extent of damage to vessel and potential for salvage;
- legal issues; and
- pollution.

This earlier report highlighted some basic considerations which SPREP felt should be further developed and expanded, and this in turn led to the preparation of the present document.

These guidelines are intended to assist Pacific Island Governments who need to deal with the consequences of ship grounding events that take place within their national waters. They aim to provide advice to national Governments on appropriate immediate and longer-term responses to ship groundings, as well as suggesting measures that might prevent or minimise the negative consequences.

Preparation of the guidelines was contracted by SPREP to the consulting firm of Gillett, Preston and Associates Inc., who coordinated the production of various sections of the draft document by a number of technical specialists during the period 4 October 1995 - 13 January 1996. A ten-day meeting was then held from 14-24 January 1996 in Suva, Fiji, during which the principal specialists were brought together to refine and finalise the draft. The remainder of January was spent in obtaining outstanding data and information needed to complete the document, and in bringing it to camera-ready stage. The final document was dispatched to SPREP on 31 January 1996, as specified in the original contract.

Many individuals contributed to the document as principal authors by providing advice during interviews, by responding to written questions, or by reviewing material produced by the principal contributors at various stages during the drafting process. The authors would like to express their thanks to these individuals who are listed in Annex 1.

Initially consideration was given to the concept of visiting Pacific Island countries, collecting information on groundings, and reporting on the various issues involved. It was decided however, that a better approach would be to utilize specialized expertise, obtain historical information on ship groundings from an existing commercial database, and obtain as much information as possible from well-studied groundings in tropical conditions.

The present project was not intended to be an exhaustive long-term study, or to address the specific characteristics of every country of the region, each of which has different characteristics in regard to ship-grounding issues, including legal systems based on variations of British, American or French law. Rather, the study has taken a regional perspective, illustrated wherever possible by examples drawn from individual countries and especially from the Cook Islands, Fiji and Federated States of Micronesia. These countries were selected as being representative of the Pacific's three principal sub-regions.

A review of issues associated with ship groundings that is oriented to the needs of Pacific Island Governments constitutes a new area which does not appear to have been extensively treated in earlier documentation. The field is truly multi-disciplinary and to some extent includes topics that have themselves been quite well studied. However this is the first time that a serious attempt has been made to consolidate the various issues - operational, environmental and judicial - that bear on responses to a ship-grounding event.

LIST OF ACRONYMS USED

AMOSC	Australian Marine Oil Spill Centre Pty. Ltd.
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
ASEAN	Association of South-east Asian Nations
CNMI	Commonwealth of the Northern Mariana Islands
CRISTAL	Contract Regarding an Interim Settlement of Tanker Liability for Oil Pollution
DWT	Deadweight
EARL	East Asia Response Pte. Ltd.
EEZ	Exclusive Economic Zone
FFA	South Pacific Forum Fisheries Agency
FSM	Federated States of Micronesia
GBRMPA	Great Barrier Reef Marine Park Authority (Australia)
GRT	Gross registered tonnage
IMO	International Maritime Organization
IOPP	International Oil Pollution Prevention (Certificate)
ITOPF	International Tanker Owners' Pollution Federation Fund
LCT	Local coastal tankers
LMIS	Lloyd's Maritime Information Service
LOF	Lloyd's Open Form
MARPOL	International Convention for the Prevention of Pollution from Ships
MR	Medium range (tankers)
OSCC	Oil Spill Service Corporation (now known as Oil Spill Response Ltd.)
P&I	Protection and Indemnity (Insurance Associations)
PNG	Papua New Guinea
SCUBA	Self-contained underwater breathing apparatus
SPREP	South Pacific Regional Environment Programme
SSB	Single Side Band
TOVALOP	Tanker Owners Voluntary Agreement on Liability for Oil Pollution
UNCLOS	United Nations Conference on the Law of the Sea
USA	United States of America

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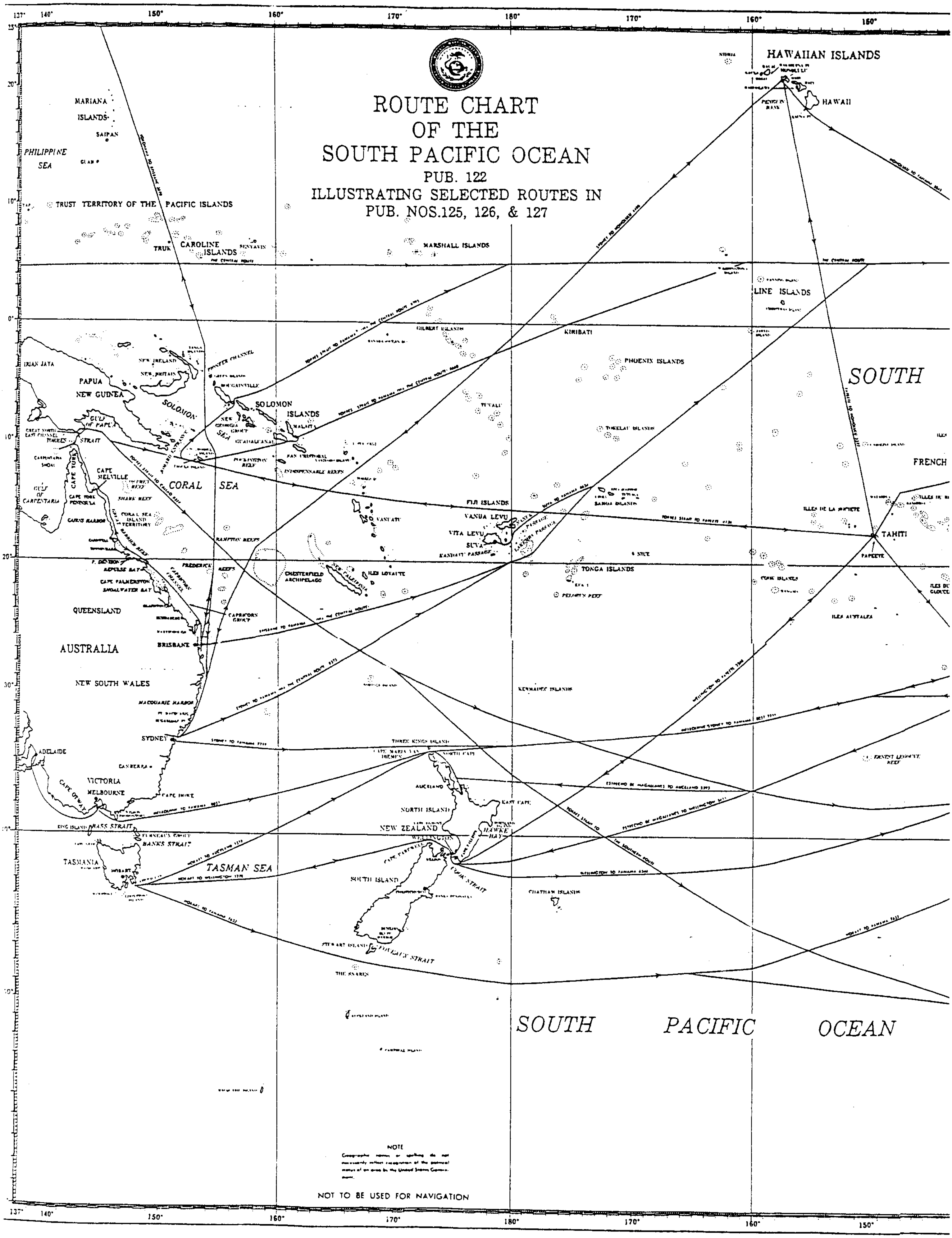
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LINE ISLANDS
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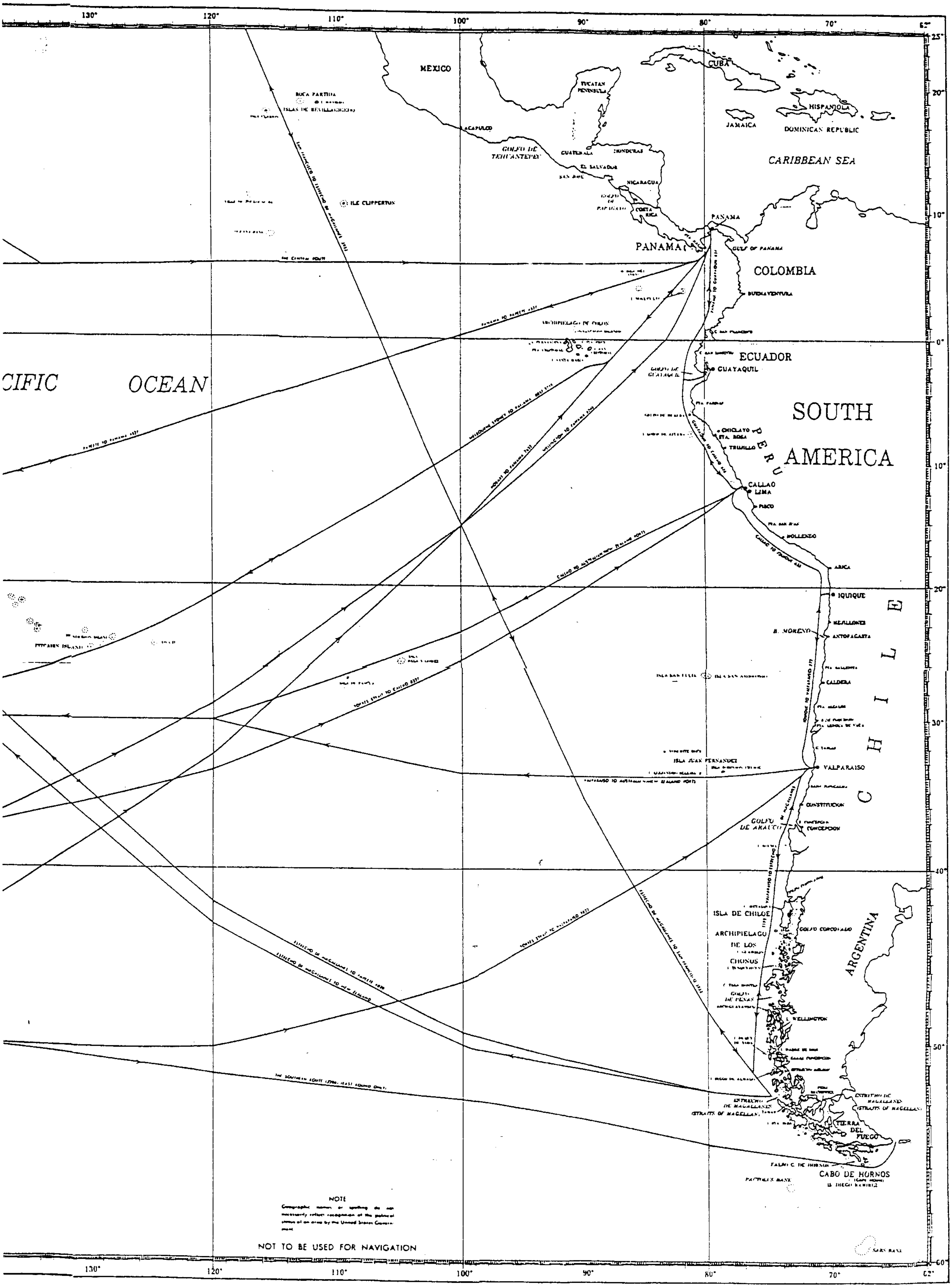
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CALDERA
CHILE
ISLA JUAN FERNANDEZ
VALPARAISO
CONSTITUCION
CONCEPCION
GOLFO DE ARAUCO
ISLA DE CHILOE
GOLFO CORCOVADO
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ARGENTINA
ESTRECHO DE MAGALLANES
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TIERRA DEL FUEGO
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NOTE
NOT TO BE USED FOR NAVIGATION

1 VESSEL TRAFFIC AND SHIP GROUNDINGS IN THE PACIFIC ISLANDS

1.1 GENERAL

The Pacific Islands' region is host to several categories of international seagoing traffic, as well as numerous domestic and distant water cargo, fishing, passenger vessel and tourist fleets.

In the *Strategy and Work Programme for the Protection of the Marine Environment in the South Pacific Region*, SPREP and the International Maritime Organisation (IMO) have classified the region's various forms of marine transport into the following categories (SPREP, undated):

- traffic which passes through the region without stopping;
- traffic coming into the major ports of the region, carrying either cargo or passengers, including cruise ships;
- traffic among the major ports of the region;
- inter-island passenger and freight traffic within each of the island countries; and
- industrial fishing vessels operating in the region.

The *Strategy and Work Programme* states that there is little information available on the level of shipping activities operating through, into, and within the region, and on the types of cargoes involved. Accordingly, the document proposes that a study of shipping activities in the region be carried out. Recent information suggests that the study may be funded through SPREP in the foreseeable future (A. Munro, pers. comm.).

Some information on domestic fleets is, however, available from a study commissioned in 1992 by the Forum Secretariat (Leefax, 1992). The study indicated that there are 615 domestically registered vessels (including fishing vessels) with a gross registered tonnage (GRT) greater than 10 tonnes in the countries which are Pacific Island members of the South Pacific Forum (26 of which were greater than 1,000 GRT).The distribution of these vessels is as follows:

Table 1: Domestically registered vessels of Pacific Island members of the South Pacific Forum (from Leefax, 1992)

Country	Vessels between 10 and 1,000 GRT	Vessels greater than 1,000 GRT	Total
Cook Is.	12	3	15
FSM	20	0	20
Fiji	123	7	130
Kiribati	23	0	23
Nauru	0	0	0
Niue	0	0	0
PNG	180	12	192
Marshall Is.	13	2	15
Solomon Is.	155	1	156
Tonga	21	0	21
Tuvalu	2	1	3
Vanuatu	29	0	29
W. Samoa	11	0	11
TOTAL	**589**	**26**	**615**

1.2 INTERNATIONAL CARGO VESSELS TRANSITING THE PACIFIC REGION

Since they have no need to call at ports in the region, transiting international cargo vessels should in theory be exposed to the least risk of grounding. Many aspects of the international shipping trade have become highly advanced and technological innovations have improved the efficiency as well as the safety of these vessels. However, their sheer size, as well as their past history of groundings, dictate that the risks their presence represent in the region be acknowledged and considered.

The economic realities of the international shipping trade dictates that international cargo vessels are generally the largest ships entering the region. These same economic considerations drive the masters and crew of these vessels to complete their journeys as quickly as possible, and this sometimes increases the risk of groundings. For instance, rather than detour to avoid areas of heavy weather, or heave to and wait for it to subside, many vessels will now steam straight through even bad storms.

In the case of the Pacific Islands, most coastal aids to navigation (lights and beacons) were installed to assist smaller coastal traffic and are not designed for the larger shipping now operating in the region. Most of the region's navigation beacon systems are unsuited to large vessel traffic because they are too thinly dispersed, suffer from poor maintenance schedules, and most of the lights themselves are of insufficient candlepower. Given that large cargo vessels or tankers may require several miles to change direction or come to a stop, the importance of good beacon systems is self-evident.

International shipping on established routes transects the region in several well established "shipping lanes", which are shown in figure 1 (inside front cover). In general, those routes attempt to take advantage of the shortest distance between points of departure and destination while minimising the necessity of passing in close proximity to islands or hazards to navigation such as submerged reefs. Because of seasonal weather patterns, proximity to intermediate ports and other factors, there is sometimes more than one major route between the same two points.

For example, there are at least two major routes between Sydney and Panama. One goes north of New Zealand and then eastward over a great circle route of 7,719 miles. The only land masses in proximity to this route are the northern tip of New Zealand, Pitcairn, and the southern Galapagos. An alternate route from Sydney passes between Norfolk Island and New Caledonia, then south of the Lau islands in Fiji, west of Savai'i in Western Samoa, continuing south of Tokelau and through the Line Islands of Kiribati. This route, covering a total distance of 8,375 nautical miles, crosses the Equator and merges with the major "central route" that tracks across the Pacific from the Philippines to Panama from roughly 5° to 7° North latitude.

Some major routes of concern, i.e. those which might pass in proximity to islands or reefs in the region, include the alternative Sydney-Panama route described above, as well as the following:

- Southern Asia to Panama via Torres Strait, Fiji, and French Polynesia;
- Southern Asia to Panama via Torres Strait, in proximity to Papua New Guinea's Louisiade Archipelago, Solomon Islands, southern Kiribati (Gilbert group), northern Line Islands and the Central Route;
- Eastern Australian ports to Japan, in proximity to the southern tip of the Louisiade Archipelago, New Ireland, the central Caroline Islands and Northern Mariana Islands; and
- Sydney to Honolulu in proximity to Santa Cruz Islands, Tuvalu, and Phoenix Islands.

Cargoes carried by vessels on these routes include:

- iron ore, coal and other minerals from Australia northward to Japan, Korea and Taiwan; manufactured goods, including automobiles and machinery, southward;
- crude oil shipped on an opportunistic basis from Indonesia and South Australia to Hawaii and the west coast of the USA;
- timber, logs, and wood chips from Australia, New Zealand and various island ports to Taiwan, Japan, and Korea; and
- refined petroleum products and manufactured goods from Singapore and other Asian ports to both North and South America, as well as to various Pacific Island ports.

1.3 INWARD/ OUTWARD-BOUND INTERNATIONAL CARGO VESSELS

1.3.1 Inward-bound cargo

1.3.1.1 Petroleum products

The world production of crude oil is 3 billion tonnes per year, of which half is transported by sea. However, as there is little oil refined in the Pacific Islands region (the only active refinery is in the Highlands region of Papua New Guinea, refining small amounts of oil for domestic use), crude oil is not a major component of inbound/ outbound cargoes, although, as noted above, some crude oil transits the region from time to time.

On the other hand, products refined from oil (distillate, petrol, etc.) are one of the principal cargoes entering the region. The total regional demand for all product forms of petroleum is estimated by the Forum Secretariat to be in the neighborhood of 23,633,000 barrels (bbls) (3.2 million tonnes[1]) per year or about 65,000 bbls (8,870 tonnes) per day. Of this total all must be imported from outside the region by sea except for about 5,000 bbls (680 tonnes)/ day which is produced and consumed in the Highlands region of Papua New Guinea (source: Energy Section, Forum Secretariat). The main consumers of imported petroleum products are: Guam with about one third the total; PNG, roughly 20%; New Caledonia with 13%; and Fiji and French Polynesia each using about 10%.

Major supplies to these centres enter the Pacific on medium-range (MR) tankers, mainly in the 25,000 - 50,000 DWT (deadweight) class, which service Fiji, Western Samoa, Solomon Islands, Papua New Guinea, New Caledonia and French Polynesia. As an example of traffic levels, about 16 MR tankers come to Fiji per year (10 or 11 from Australia, 5 to 6 from Singapore). Guam's products come almost exclusively from Singapore, while Papua New Guinea receives most of its supply from Australia. In American Samoa, a 16,000 tonne MR tanker from Honolulu regularly replenishes the shoreside terminal storage at Pago Pago (total capacity: 194,900 barrels) for use by fishing vessels as well as the island's two canneries and power plant.

Although countries such as Western Samoa and Solomon Islands, with relatively low levels of fuel consumption, do not have the demand for the large quantities carried by MR tankers, such ships often divert from their normal routes to provide service to these areas in return for payment of a “divergence fee”.

There are basically three routes for medium range tankers (parentheses indicate stops which are not always made):

- Melbourne, Port Moresby, Lae, Madang, Rabaul, (Honiara);
- Singapore, (Noumea), Vuda, (Vatia, port for Fiji's gold mine), (Apia), (Suva);
- Melbourne, Noumea, Suva.

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[1] 7.33 bbls = 1 metric tonne = 256 imperial gallons = 308 US gallons. See Annex 2.

South of the equator, local coastal tankers (LCT) service other locations, mainly out of Vuda (Fiji). These include Tonga, Niue, and the Cook Islands to the east, Tuvalu and Kiribati to the north, and Vanuatu to the west. These ships, of which an example is the *Pacific Rover,* have a capacity of 800 to 1,000 tonnes of oil-based products. Mobil's outlets in Palau, Federated States of Micronesia and the Marshall Islands are serviced by a 6,000 tonne ship, the *Golden Craig.*

As well as delivering to shoreside bases, several ocean-going tankers (exact number unknown but probably 3 to 6 at any one time) operate in support of the tuna purse seine vessels in the western and southern parts of the Pacific Islands region. These tankers, which are mainly controlled by Korean and Taiwanese interests, are available to steam to points on the constantly changing fishing grounds, but usually operate outside the exclusive economic zone of any one country. As a rule they do not enter island ports and are for the most part invisible to island authorities.

1.3.1.2 General cargo

Goods imported into the region arrive on break-bulk (i.e. non-containerised) general cargo vessels, container ships (where facilities exist to handle them) or, occasionally, on dry bulk carriers which transport large quantities of specific homogeneous products, such as flour. Many smaller, break-bulk cargo vessels are "tramp" steamers which work opportunistically, as opposed to the "line" vessels which provide regular, scheduled services.

These vessels follow routes which are much more variable and complex than those described above. While shifts in export production within Asia has occasionally led to routes being altered, basic cargo services flow into the region from ports in Japan, Korea, Taiwan, China, Singapore, and elsewhere. Shipping from North America serves Micronesia and continues onwards to the Philippines and SE Asia on a round trip basis. The Micronesian region is also served by direct shipping from Japan, Korea and other parts of the Far East as well as trans-shipped cargo from both regions, plus Australia and New Zealand, via Guam. Fiji is provided service to and from New Zealand, Australia and North America and, along with PNG, also has regular cargo service to and from Europe, north Asia (Japan, Korea), east Asia (Hong Kong, Taiwan) and southeast Asia (Thailand, Singapore, Malaysia, Indonesia). Many of these routes serve other south Pacific countries as well.

1.3.2 Outward-bound cargo

Major exports from the region are usually commodities which are often not back-hauled on general cargo or container ships but rather are carried in specialised or purpose-built ships or bulk carriers. The exceptions are canned fish and the output of light manufacturing (furniture, clothing, etc.) from Fiji, American Samoa, Solomon Islands and elsewhere.

Logs, sawn timber and wood chips are exported both from major ports and from remote sites in various countries, including PNG, Solomon Islands, and Fiji. Coconut oil and palm oil in quasi-bulk quantities is sent from Western Samoa, Solomon Islands, PNG and elsewhere. Phosphate is Nauru's major export, while Fiji exports sugar to European and US markets. PNG has recently begun export of about 30,000 bbls per day of crude oil to Singapore and Brisbane from its Kutubu oil field. Ore carriers transport semi-refined nickel from New Caledonia to destinations in Japan and Australia.

Refrigerated fish carriers operate out of various ports in the region in support of the tuna fishing fleets of Korea, Taiwan, the US and others operating in the region under licensing agreements. A large proportion of the fish caught by these fleets is "transshipped" onto these carriers for export from the region. In the past most transshipment activity in the region took place on the high seas, but this practice was banned by FFA member countries in June 1993 in order to allow better control over information on catches, and to create additional financial benefits for the countries involved. It is estimated that there are about 30 such "steamers" (as they are called in the tuna industry), ranging from 300 to upwards of 8,000t capacity, active in fish trans-shipment from Guam, Tinian, Pohnpei, Chuuk, and Honiara as well as various ports in PNG including Wewak, Manus, Kavieng, and Rabaul.

Operations have also been attempted once or twice in Tarawa, Majuro, Suva and elsewhere. The location of these sites can change with shifts in fishing grounds or changes to fishing agreements. The destinations of such vessels include ports in Thailand, South America, Puerto Rico, Korea, and Japan, with seasonal shipments also made to Europe.

1.4 DOMESTIC CARGO VESSELS

National shipping activity is most developed in the coastal trade of Papua New Guinea, Fiji and, to a lesser extent, Solomon Islands and Vanuatu. General cargo and passengers are carried, with the services sometimes providing the only regular link between regions of the country. Distances and costs of operation in most countries of the Pacific Islands region mean that many such services are Government-operated or subsidised.

In Papua New Guinea and Solomon Islands, the rapid growth of the logging industry in recent years has led to substantial increases in the amount of coastal cargo traffic. The nature of logging operations often requires vessels to navigate in unfamiliar or poorly charted waters, frequently at night and when heavily loaded or overloaded. Logging vessels are reported to be one of the principal causes of grounding incidents in northern Papua New Guinea (B. White, pers comm.).

Levels of competence and training among crews of domestic ships in the region vary greatly, with several countries supplying ongoing training through marine schools or academies. In many cases, skippers and crews are familiar with their own local areas through long experience, but would not have the navigation or other skills needed to safely operate in unfamiliar waters.

1.5 INDUSTRIAL FISHING VESSELS

Today the Pacific Islands region is the operational home to numerous fishing fleets of various nationalities, including those of its own constituent countries. As well as licensing distant-water fishing vessels, several countries of the region have established domestic industrial fishing fleets and are encouraging their growth. It is estimated that in 1995 there were approximately 1,600 foreign and domestic fishing vessels operating in the region covered by the Forum Fisheries Agency (FFA, 1995). Fishing vessels of Australia, Canada, China, Federated States of Micronesia, Fiji, French Polynesia, Indonesia, Japan, Kiribati, Korea, Marshall Islands, Mexico, New Caledonia, New Zealand, Palau, Papua New Guinea, Philippines, Russia, Solomon Islands, Taiwan, Tonga, Tuvalu, Vanuatu and the United States of America are currently operating or have recently operated in the EEZs of Pacific Island countries and the adjacent high seas areas. The region's ports host these vessels for provisioning and fueling, repair, and off-loading or trans-shipment of catches. All are primarily involved in fishing for tuna by longline, pole-and-line and purse-seine methods.

1.5.1 Longliners

About 1,400 longliners operate in the region, of which about half are sashimi (fresh fish) longliners which land their catches in regional ports for export by air. The remainder are frozen fish vessels which freeze their catch on board. The fishery includes Japanese, Taiwanese and Korean fleets, as well as, in the Western Pacific, growing numbers of vessels from mainland China. Chinese vessels dominate the sashimi fishery while Japanese vessels are most numerous in the frozen fish fishery (about 400 boats). Indonesian and Philippine longliners operate on the periphery of the Pacific fishery and occasionally enter the region. The longline fleets are expected to continue growing in future years.

Japanese longliners over 20 GRT tend to return all fish directly to Japan, while those under 20 GRT mostly transship in regional ports. Both types often call into regional ports to pick up and discharge crew.

A number of Taiwanese and Korean longliners targeting albacore are based in Pago Pago and Levuka and land their catches at canneries in these ports. Otherwise Taiwanese vessels tend to transship in regional ports.

As well as the distant-water vessels, domestic longline fleets have also developed in many Pacific island countries, partly because this fishing method can be adapted for use from small vessels operating locally and is thus in reach of the entrepreneurial capital available in the region. Substantial locally based fleets now operate in French Polynesia (69 vessels) and Fiji (50), with smaller fleets in Cook Islands, Federated States of Micronesia, Marshall Islands, New Caledonia, Papua New Guinea, Tonga, and Western Samoa. In some cases (specifically Pago Pago and Levuka) foreign vessels under charter or joint-venture operations act as domestically-based fleets attached to canneries.

1.5.2 Purse seiners

Approximately 163 purse seiners from the USA (46), Taiwan (43), Japan (32), Korea (31) and the Philippines (11) operate in the region. There are also 12 locally-flagged seiners in the fishery from the Federated States of Micronesia (4), Solomon Islands (3), Papua New Guinea (2), Vanuatu (2) and Kiribati (1), operating under varying levels of local ownership and operation.

Japanese seiners return all catches to Japan, while others either off-load at the canneries in American Samoa or transship to canneries outside the region.

1.5.3 Pole-and-line vessels

There are 38 distant-water pole-and-line vessels operating in the region, all of which are Japanese. This fleet has been in decline for several years due to worsening operating economics. Domestic fleets also operate in Fiji and Solomon Islands.

1.5.4 Other

As noted earlier, trans-shipment activity in support of all these fleets, involving refrigerated carrier vessels, may take place in various regional ports convenient to the fishing grounds.

In addition to the increasing activities of these vessels and the continuing introduction of fishing fleets new to the region, numerous fishing vessels transit the region from time to time as they deliver catches to non-regional ports or relocate for seasonal or licensing reasons. These include Japanese and other Asian vessels operating for part of the year in Australia, New Zealand or the Southern Ocean, such as squid boats which fish seasonally in New Zealand and the Falkland Islands.

1.6 GOVERNMENT VESSELS

In order to provide shipping, transportation and Government services, it is necessary in some countries for the Government to own and operate its own ships. These vessels are flagged in the country concerned, and may operate differently from commercial vessels with respect to such issues as crew welfare, insurance and liability.

The Australian Government Pacific Patrol Boat Programme has supplied vessels, spares, training and management expertise to numerous Pacific island countries for the past 9 years. These vessels are operated by the local navy, police or defence force.

In addition, several nations maintain a military presence in the Pacific Islands region, or have vessels transiting the area. As well as domestic vessels operated by the navies of Fiji and Papua New Guinea, naval vessels of the USA, New Zealand, Australia, France, the United Kingdom and other countries regularly visit the region or are based at regional ports, including those in Guam, New Caledonia and French Polynesia. These vessels range from small frigates to nuclear-powered submarines. Naval vessels have been implicated in at least one grounding event in recent years, in which a US naval vessel ran aground in Fiji.

1.7 CRUISING YACHTS

Yachts from North America, New Zealand, Australia, and to a lesser extent from Europe are common in the region. Yachts, both overseas and local, are especially active in the area stretching from the Marquesas to Nouméa and Port Vila. Their movement tends to be seasonal, especially in areas subject to cyclones. The large total number of such vessels and the non-professional nature of the crews are factors contributing to a high incidence of yacht groundings.

1.8 CRUISE SHIPS

There are four main categories of cruise ships operating in the Pacific Islands

- vessels based outside the region (often Sydney) which travel on circular routes to well known harbours such as Noumea, Port Vila, Suva;
- cruise ships traveling through the South Pacific on round-the-world cruises, most typically from Panama westward, and stopping at the capital cities of many Pacific Island countries;
- specialty adventure holiday ships, including dive vessels, traveling to destinations which tourists would otherwise have difficulty reaching, such as Rotuma and Kioa in Fiji or Tikopia in the Solomons;
- locally-based cruise ships making shorter domestic voyages in several Pacific Island countries, including Fiji, French Polynesia and New Caledonia. This last category tends to include mainly smaller vessels, as well as specialty boats such as dive vessels.

1.9 FREQUENCY/ INCIDENCE OF GROUNDINGS

Obtaining even the most basic information on the frequency of ship grounding events in the Pacific is difficult. Many countries of the region are unable to produce simple summaries of maritime incidents which have occurred in their waters in recent years. In those few cases where summaries could be produced, the listings were clearly incomplete due to a combination of lack of reporting of incidents, absence of a good system for recording the information, misplaced files, and other reasons.

The responsible Government agencies in Federated States of Micronesia, Cook Islands and Fiji were contacted to obtain ship grounding statistics, and provided the following information:

- Federated States of Micronesia: 15 groundings from March 1994 to September 1995;
- Cook Islands: 6 groundings from January 1987 to December 1995;
- Fiji: a search of the available files in the Shipping Office of the Marine Department indicates that in the 2-year period 1992-1993, 45 marine accident enquiries were carried out on Fiji-registered vessels. Not all files were available, and not all enquiries concerned groundings, hence no estimate of grounding numbers could be produced.

In each case, anecdotal and other information suggested that other groundings had occurred during the stated period of coverage, but these incidents did not appear among the Government statistics.

Several insurance companies or associations maintain records of maritime incidents, including ship grounding events. Relevant data relating to ship groundings in the Pacific Islands region was extracted from the most comprehensive of these, the Lloyd's Maritime Information Service (LMIS) Casualty Register. The register has operated since 1969, at which time it focused mainly on tanker incidents. Since 1976, however, coverage has been broadened to include all vessel types over 100 GRT. To ensure an unbiased view of the data, records prior to 1 January 1976 have been excluded from the analyses presented in the following paragraphs.

The database indicates that, since January 1 1976, there have been 343 serious maritime incidents in the Pacific Islands region involving vessels over 100 GRT, of which 161, or 47%, were groundings or other incidents that involved contact with land. The remainder were other types of maritime incident such as collisions, fires, contact with wharves, etc. Details of each grounding are shown in Annex 3, classified by country and date of incident.

The 161 groundings that have occurred in the region since 1/1/1976 equate to a rate of approximately 0.67 groundings per month throughout the region over the 20-year period. Looking only at the last ten years, there have been 64 groundings, or 0.53 incidents per month, so there may have been a slight downward trend since the 70's and early 80's. Over the last 5 years there have been 33 groundings, or 0.55 per month, suggesting that the frequency of grounding events has not decreased any further since the beginning of the present decade.

Of the 161 grounding incidents in the region over the last 20 years:

- 67 (42%) involved cargo vessels, of which 5 (3%) were dry bulk carriers;
- 61 (38%) involved fishing boats;
- 13 (8%) involved oil tankers.

The distribution of groundings by vessel type is illustrated in figure 2 below.

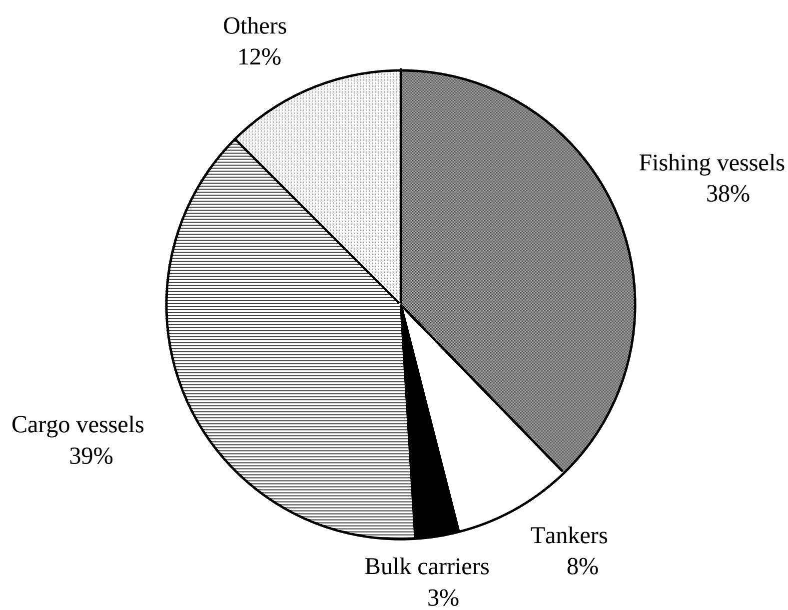


Figure 2: Ship groundings in the Pacific Islands region since 1/1/1976, based on the LMIS Casualty Register, by vessel category.

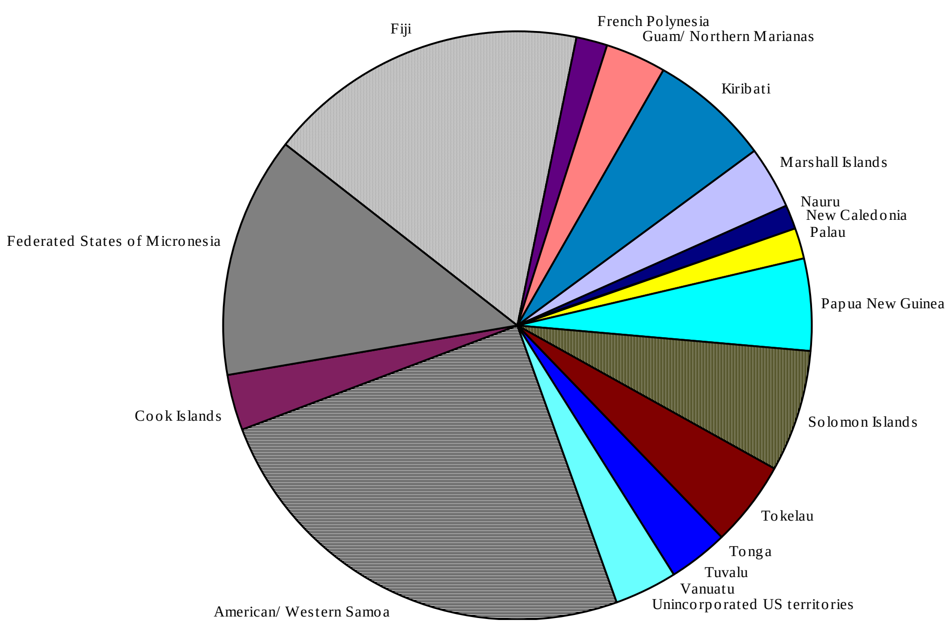
Table 2 and figure 3 (opposite) show the geographic distribution of grounding events.

Predictably the pattern of groundings is linked to the frequency of shipping, fishing and port entry activity. Incidents in the database were concentrated in countries with higher levels of trading and fishing traffic, i.e. Fiji (34), Papua New Guinea (34), American/ Western Samoa (18), Solomon Islands (16) and Guam/ CNMI (12). Groundings by tankers and bulk carriers were concentrated in Fiji (7) and Guam (4), while the highest incidence of general cargo vessel groundings (20) occurred in Papua New Guinea.

Table 2: Ship groundings in the Pacific Islands region since 1/1/1976, based on the LMIS Casualty Register, classified by country and vessel category

	Fishing vessels	Tankers	Bulk carriers	Cargo vessels	Others	Total	Vessels over 15 yrs old
American/ Western Samoa	15	0	0	2	1	**18**	10
Cook Islands	2	0	0	2	0	**4**	4
Federated States of Micronesia	8	0	1	4	0	**13**	3
Fiji	11	6	1	11	5	**34**	18
French Polynesia	1	0	0	2	0	**3**	2
Guam/ Northern Marianas	2	3	1	5	1	**12**	8
Kiribati	4	0	0	1	0	**5**	3
Marshall Islands	2	0	0	1	0	**3**	1
Nauru	1	0	0	0	0	**1**	0
New Caledonia	0	1	0	0	1	**2**	0
Palau	1	1	0	0	0	**2**	1
Papua New Guinea	3	2	0	20	9	**34**	8
Solomon Islands	4	0	1	8	3	**16**	11
Tokelau	3	0	0	1	0	**4**	2
Tonga	0	0	0	0	0	**0**	0
Tuvalu	2	0	0	2	0	**4**	2
Vanuatu	0	0	0	3	0	**3**	3
Unincorporated US territories	2	0	1	0	0	**3**	1
Total	61	13	5	62	20	**161**	77

Figure 3: Ship groundings in the Pacific Islands region since 1/1/1976 based on the LMIS Casualty Register, by country.



Approximately 145 of the 343 recorded maritime incidents in the region, or 45%, involved ships which were over 15 years old at the time of the incident. This is also true of groundings: 77 out of a total of 171, or 48%, involved vessels that were over 15 years old when the grounding occurred. This fact is significant because vessels older than 15 years are reaching a point where owners and insurers are less likely to want to incur the high costs of salvaging them if they go aground.

Twelve of the groundings (7.5%) were noted as having given rise to a pollution incident. Oil was noted as being the pollutant in each of these cases.

Since many ship groundings go unreported, the LMIS register does not contain information on every single incident that has taken place. If vessels are registered or insured through the Lloyd's system (as is the case with many Asian-based vessels) or if a grounding takes place in a location where there is a Lloyd's agent, then there is a better chance of the event being reported and captured in the system. The likelihood of reporting for some vessel types, such as tankers and larger cargo vessels, is also higher than it is for others, such as smaller fishing vessels. Vessels under 100 GRT are not included in the database, but this class of vessel includes many fishing operations in the region which can and do go aground and cause damage. The LMIS data can thus be regarded as a minimum estimate of the probable frequency of ship grounding events.

1.10 CAUSES OF GROUNDINGS

The causes of ship groundings are complex, often unclear and frequently disputed. In many incidents there are several compounding factors which may contribute. As in any form of casualty, there may be different perceptions of the reason held by the various parties involved. A formal legal enquiry into the incident is a mechanism for objectively considering the various facts, but in at least some Pacific Island countries the results of such enquiries are confidential and never made public. As noted above, most countries of the region do not even collect and maintain simple lists of ship grounding events, and this makes it difficult or impossible to statistically summarise the causes of groundings over a period of years. Finally, the various terms used to describe causes may be overlapping or synonymous with other terms. For example, nine recent groundings in the Federated States of Micronesia were officially attributed to navigation error (5 cases), poor command (2), negligence (1), and unsound seamanship (1), all of which terms may overlap in their meaning.

In a discussion of causes of ship groundings, watch-keeping (keeping a lookout, monitoring the ship's position and functions and maintaining communications as appropriate) is important. Poor watch-keeping is perhaps the leading cause of ship groundings in the region. Conversely, good watch-keeping could prevent a grounding which may otherwise occur for another reason.

A large number of groundings occur in entrances to harbours. Because of the proximity to the coast or reef, problems in harbour entrances result more often in groundings, whereas similar problems in the open ocean may simply result in the vessel drifting. Causes of incidents include unfamiliarity with the channel (especially at night), malfunctioning of navigation aids (lights and beacons), excess speed, failure of steering gear, tidal effects, changes to familiar points of reference, avoidance of other vessels, unusually large surf, and desire to enter port at night rather than spend the night wallowing at sea. Poor seamanship may result in failure of the crew to take effective remedial action in emergency situations (e.g. anchoring), the result being a failure to prevent a grounding that may have been avoidable.

Aboard fishing vessels, many incidents ultimately stem from fatigue of the crew. For example, the fishing operation aboard longliners may continue for over 18 hours without a break. Extremely large catches or net problems on purse seiners may result in the crew (many of whom may also have to stand wheelhouse or engine-room watches) having no rest over extended periods of time. In addition, some fishing vessels may increase their risk of grounding by approaching too closely to reefs or coasts during fishing operations.

In countries with few good anchorages, a large portion of the groundings occur while vessels are at anchor. For example, two of the recent groundings in the Cook Islands occurred while the vessels were in poor anchorages during weather changes.

Additional causes of ship grounding in the Pacific Islands are:

- tropical storms;
- poor towing practices;
- lack of passage planning;
- failure to continuously monitor the position and track of the ship;
- confusing commands, or commands being misunderstood;
- equipment failure
- misinterpretation of radar charts;
- deliberate groundings for the prevention of sinking, or for financial reasons;
- inappropriate or out-of-date charts;
- over-reliance on electronic navigation devices which may be at variance with local charts;
- pilot error;
- abandonment.

In response to the loss in close succession of six bulk carriers off Western Australia between 1989 and 1993 an Australian parliamentary enquiry was carried out and concluded that commercial pressure on ship operation and ships' masters was a major factor influencing the use of substandard ships and substandard practices (Parliament of the Government of Australia, 1994). Undoubtedly this situation also occurs in the Pacific Islands. For example, in Papua New Guinea, log carrying vessels, which frequently enter uncharted waters and which often over-load, have a dismal grounding record.

Conditions in the Pacific Islands region may produce an environment conducive to ship groundings. These include a high prevalence of cyclones, local authorities giving low priority to maintaining lighthouses, beacons and other aids to navigation, the existence of many low islands and detached reefs, and occasional strong currents.

The issue of formal enquiries into the causes of ship groundings deserves additional attention. As mentioned above, the results these enquiries in many Pacific Island countries are confidential and are not available to the general public or even masters of vessels. It appears, therefore, that the primary objective of the enquiry is to lay the blame for the incident. In contrast, some countries outside the Pacific Islands region feel that the results of enquiries should be used as a tool for improvement in the future. For example, the report of the investigation into the grounding of the vessel *Iron Baron* in Australia is prefaced with the note: "to increase the value of the safety material presented in this report, readers are encouraged to copy or reprint the material in part or in whole for further distribution" (Inspector of Marine Accidents, 1995).

2 ENVIRONMENTAL CONSEQUENCES OF SHIP GROUNDINGS

2.1 GENERAL

The impacts of ship groundings on tropical reefs or other coastal areas are not well understood. One of the major potential effects of a ship grounding is fuel or oil spillage, but even this topic has not been studied extensively in the tropics, partly because the number of major oil spills in tropical areas has so far been small. Predicting the environmental impacts of ship groundings in the Pacific Islands region is therefore difficult.

To illustrate a variety of effects of ship groundings and related pollution incidents in tropical coastal areas, five examples were chosen, concerning the following events:

- the bulk carrier *Wellwood*, which went aground in Florida in 1984. This is the best studied grounding of a vessel on a coral reef. It is an example of a vessel which was re-floated with no loss of cargo or contamination by debris or fuel;
- the freighter *Safir*, which ran aground in the Red Sea in 1989, dumping several hundred tonnes of phosphate powder on the reef. It was pulled off and scuttled without the immediate loss of fuel or further debris;
- the Taiwanese longliner *Jin Shiang Fa,* which grounded on American Samoa's Rose Atoll in 1993. The vessel subsequently broke up depositing fuel, lubricating oil and debris on the reef. Much of the vessel was removed, leaving only the stern section on the reef;
- the *Florida*, which grounded on the Great Barrier Reef in Australia depositing 700 tonnes of pozzalin (fly ash produced from the burning of coal, and used in cement manufacture), on the reef and seabed. The wreckage marked an area of change in the nature of the reef community over at least the next five years;
- a tropical oil spill in which 8,000 tonnes of crude oil from a collapsed refinery tank was released into the coastal zone in Panama in 1988. Although in this case the spill was not derived from a ship grounding, the effects might be comparable if a tanker carrying crude oil were to go aground on a Pacific Island reef or shore.

These studies are summarised in ANNEX 4. The comments and generalisations that follow are based mainly on these incidents which, it should be noted, mostly occurred outside the Pacific Islands region.

2.2 FACTORS INFLUENCING ENVIRONMENTAL IMPACTS

A wide range of factors influence each ship grounding event and combine to create a unique set of features, problems and solutions. When a vessel strikes a coral reef, the damage caused is dependent on a number of variables:

- the size and type of the vessel (e.g. large bulk carrier, medium-sized fishing boat or small yacht);
- the location on the reef where the collision takes place. The windward and leeward portions of the reef are characterised by different conditions which will influence the fate of the ship and its cargo;
- the depth of water in which the vessel lies;
- the state of the sea and tide;
- the nature of the cargo, which is important if the hull is breached or the cargo is jettisoned, particularly in the case of fuel, oil or a toxic product.

Initially the environmental effect of a ship grounding is localised, involving mechanical damage by the ship's hull which results in a loss of substrate complexity and mass due to crushing and compacting. The vessel's fuel, cargo or contents may be spilled and swept about by waves and currents, causing damage to spread to a larger area than just the grounding site. Attempts to salvage or remove the wreck may cause additional damage.

Consequently, following a vessel's stranding on a coral reef or other coastal area, there may be:

- physical damage to the bottom, and to bottom-living organisms;
- creation of rubble and sediment;
- acute and/or chronic pollution.

These may result in impacts on some or all of the following:

- reef structure;
- coral communities;
- mangrove communities;
- algal and sea grass communities;
- fish communities;
- beach and soft-bottom communities.

Subsequent recovery of the reef will depend on:

- natural re-colonisation by the original community;
- restoration actions taken to promote or accelerate natural recovery.

An understanding of how reefs differ on a regional basis is important in assessing the effects of a grounding. In high latitude reefs, growth may have a prominent seasonality or a naturally high macroalgal component. Low latitude reefs of the central or western Pacific are characterised by the dominant coral genus *Acropora*, which has a rapid rate of recolonisation and high growth rate. This genus is virtually absent in Hawaii and the eastern Pacific, even though coral reefs are present in those areas. Caribbean reefs may have differences in their ability to regenerate when compared with those of the tropical western Pacific. One of the most extensively studied groundings referred to above, that of the *Wellwood*, took place in Florida where latitude places it at the margin of coral reef development, such that these reefs may not be representative of other parts of the world.

2.3 PHYSICAL DAMAGE TO THE GROUNDING AREA

The physical impact by a vessel on the grounding area is dependent on the size and speed of the vessel. The effect on a coral reef is also dependent on the location of the grounding on the reef: if on the windward margin, the circumstances and type of damage to the reef and vessel will differ from that caused by a leeward or lagoon stranding. The physical shape of the reef and, for smaller vessels, the state of the tide will also affect whether the vessel skids on to the reef top, superficially damaging the reef surface, or whether the impact is into a steep coral face such that the vessel ploughs into the reef. Subsequently, sea state will determine the working or settling of the vessel into the reef structure or its further migration on to the reef top, and will thus influence the type and extent of the physical damage caused.

The effects of impact can therefore be wide-ranging, as illustrated by the studies of grounding events presented in Annex 4. They may vary from superficial damage to the reef top or the spur and groove system (as in the case of the *Jin Shiang Fa*), to a furrow dug into the reef (the *Florida*), to a massive channel cut by the bulbous bow of a large ship traveling in excess of 20 knots ploughing its way into the reef structure, pulverising the reef into a 1.5 m deep bed of rubble in the floor of the trench, as occurred in the case of the *Oceanus* (Annex 5). In all cases, the crushing and flattening effect of the vessel acts to reduce the vertical relief provided by corals or other benthic organisms.

The zone of reef or bottom damage may be localised if the vessel is re-floated or pulled off the reef immediately following impact. If the vessel remains aground, the area of structural damage may be increased with the movement of the vessel due to wave action, salvage attempts or the subsequent break up and dispersal of wreckage.

The rubble and sediment created from the breaking of coral and reef by the impact and movement of the vessel give rise to a broader problem of loose material moving around the reef. This causes abrasion to or scouring of attached organisms as well as burial and smothering, and it eliminates the natural relief in the habitat by filling up holes and recesses. As long as it is loose, the rubble does not provide a suitable substrate on which new coral colonies can develop.

The fate of this rubble material is dependent on the action of wave and current. It may remain in the impact channel and eventually become consolidated into the bottom, or be transported on to the reef flat, into inshore areas, or into deeper water. In each case the biological community will be subjected to abrasion and burial. Depending on hydrographic conditions, wave action may move the material into deeper water where it may be less damaging or, alternatively, scatter it about the reef, widening the area of damage. Rubble and sediment therefore play a prominent role in both the physical damage caused and the process of natural recolonisation or recovery following a ship grounding event. Lessening the adverse effects of rubble and debris require its consolidation or removal.

Damage resulting from impact or the abrading effect of moving debris creates space for recolonisation by newly-settling larvae. Recolonisation will be by those organisms whose larval stages are ready to settle; often these will be algae. Since seasonality is a major factor affecting the reproductive cycles of marine organisms, the season during which the grounding takes place will probably be influential in determining which organisms recolonise the newly created substrate.

The ultimate result of a grounding may therefore be a radical change in the nature of the reef community. Depending on the type of organisms that settle, consolidation and regeneration of the reef surface may be promoted or impeded.

2.4 OIL POLLUTION

2.4.1 General

Of urgent concern in any grounding is the spillage of fuel from the ship's tanks as well as any oil or petroleum products which are carried as cargo on the vessel. Even a 25 m longline fishing boat may carry over 100 tonnes of fuel, while a large purse-seiner may have a capacity of 600 - 1,000 tonnes, with additional fuel sometimes being stored in brine tanks or other vacant spaces on the vessel. Tankers may carry tens or even hundreds of thousands of tonnes of a range of petroleum products.

Oil pollution from a ship going aground is inevitable if the ship is irretrievably grounded and its fuel is not removed. The petroleum may be jettisoned in an attempt to re-float the vessel or may be released when the vessel breaks up due to storm or wave action. In any case the resulting pollution will impact on the coral reef ecosystem with effects which range from the hardly discernible to disastrous consequences which continue to affect the system over the long-term.

2.4.2 Oil composition and toxicity

Crude oil is a complex mixture of hydrocarbons and other substances whose composition varies from one oil field to another. For example, North Sea oil is light, contains little sulphur and is low in tars and waxes, while oil from the Beatrice field in Scotland is heavy and waxy and needs to be heated so that it can be pumped through pipelines. After extraction crude oil is refined, a process in which various components (fractions) are separated.

Crude oils and refined products contain a variety of compounds that are toxic to marine organisms. Aromatic compounds (those that include benzene rings, which are circular arrangements of 6 carbon atoms) are more toxic than aliphatic compounds (in whose molecules the carbon atoms are arranged in straight chains), and middle molecular weight constituents are more toxic than high molecular weight tars.

Low molecular weight compounds have generally been considered unimportant in terms of persistence because they are volatile and rapidly lost to the atmosphere. They can however be extremely toxic if they come in direct contact with organisms exposed at low tide, are ponded in shallow intertidal pools or are concentrated or resident in a lagoon-like situation.

Ships use various grades of fuel oil for propulsion and onboard uses such as power generation. While all oil can be considered a potentially dangerous pollutant, marine diesel in particular is considered “dirty diesel” because the refining process gives a product that can be produced more cheaply and is not as pure as automotive diesel. Marine diesel can contain heavy fractions that can harm a coral reef even if most of the lighter fractions are lost to evaporation.

Certain fuels are produced from “waxy crude” which when dispersed can leave wax residue that can damage corals or other marine life. An important characteristic of waxy crude is the “cloud point”, or point at which wax can separate from the liquid diesel. Because this is temperature-dependent, fuel intended for use in the tropics can have a higher cloud point, and thus a greater propensity to produce waxy residues, than that used in temperate climates.

2.4.3 Evolution of oil slicks

Once oil has been discharged into the sea, it undergoes several stages of dispersal from spreading and evaporation through to emulsification and finally degradation and sedimentation. The oil does not remain in one place but travels downwind at 3-4 percent of the wind speed, except where tides and currents have a greater influence on its movement.

During the spreading phase an oil film or slick is formed. The rate of spreading and the thickness of the film depend on the sea temperature and the nature of the oil; a light oil spreads faster and to a thinner film than a heavy, waxy oil. During this phase the greatest amount of evaporation also takes place, with the heavy oils losing very roughly 10 percent in quantity and light fuel oils losing up to 75 per cent.

The slick's effect on the appearance of the water can range from:

- barely visible or appearing as a silvery sheen in low concentrations;
- traces of colors in medium concentrations;
- bright bands of colour which appear with higher concentrations;
- colours which dull and become much darker at the heaviest concentrations.

Just 50 gallons (190 litres) of oil can cause a film with a silvery sheen on roughly a square mile (2.5 sq. km.) of ocean surface. At a concentration rate of 200 gallons (750 litres) per square mile the bright bands of color appear: a rate of roughly 1,300 gallons (4,900 litres) per square mile produces dark, dull colours (Gold, 1985).

As the slick ages, water soluble components dissolve in the water column, and non-water-soluble components become emulsified and dispersed as small droplets. The rate of emulsification of the oil depends on the agitation caused by waves and turbulence. In some conditions a water-in-oil emulsion can be produced which contains 70-80% water and forms a viscous mass known as "chocolate mousse".

All components of crude oil are ultimately degradable by bacteria, though at varying rates, and a variety of yeasts and fungi can also metabolise petroleum hydrocarbons. Some fractions of the oil degrade rapidly, others very slowly. The surface area over which bacterial attack can take place is enlarged when wave action emulsifies the oil into microscopic droplets, thus increasing the ratio of surface area to volume and improving access by bacteria.

2.4.4 Impact of oil pollution

The severity of an oil pollution incident on a coral reef is influenced by the nature of the petroleum products involved, the quantity spilled, the specific location of the incident on the reef or coastal area, general coastal morphology and hydrography (which may act to concentrate or disperse the spill), and a range of environmental conditions including weather, tide and wave action which may or may not bring the oil onshore, and which will influence the rate of spreading, evaporation and emulsification.

Given these variables, it is not surprising that a wide variety of consequences can occur. The literature indicates that the impact of oil on the marine environment can range from total devastation to the actual enhancement of growth rates in some marine algae and marsh plants. There are so many variables involved that it is not possible to accurately predict the impacts of a spill. Nevertheless, some of the more likely or possible impacts are illustrated by the studies summarised in Annex 4.

The soluble fractions of petroleum products are toxic to corals, plankton and other marine life, and may cause a reduction in successful recruitment of food fish or molluscs. Chronic spillage can lead to a change in the nature of the living environment and fuel contamination has been observed to progressively reduce the numbers of corals, coral cover and species diversity with increased amounts of exposure. In other areas of the world, chronic oil pollution has been shown to be responsible for damage to the spawning activities of bonito and mackerel.

For many marine organisms spawning occurs all at one time, making the effect of an oil or other toxic spill more pronounced if it occurs at the spawning time, since the planktonic stages of the various reef organisms may experience high mortality. If an oil slick develops and resides in the area for several days, or if the pollutants become stranded on the shore or reef flat, then the negative effect will be increased.

In the intertidal zone, damage by petroleum products may be severe and the response of the biological community may include such alterations as rapid recolonisation by microalgae, or a more persistent or even permanent change in macroalgae. Generally the effects of oil pollution are greatest in low energy environments (those where there is little water movement) since the oil can become concentrated and reside for a longer period of time, or become deposited in fine sediment. This is particularly important when considering the effects of oil pollution on mangroves or beaches. Leaching of oil from heavily oiled sediments will provide a source of contamination to the coral communities and other organisms for an unknown time in the future.

In high energy intertidal environments the oil tends to be more quickly dispersed. The disturbance by oil spills to mangrove root communities along open coasts is less extensive and persistent than it is to those along rivers and channels, and there may be more rapid recovery in abundance of organisms at the seaward edge of the reef flat than in the more protected inshore areas.

In the subtidal zone, the impact of oil pollution on corals, sea grasses and marine organisms living there may range from substantial mortality to sub-lethal effects that may nevertheless be equally important in the long term. Corals under stress from oil pollution are likely to become more prone to disease, grow more slowly and have depressed reproduction compared to unaffected colonies. This may allow colonisation by algae and other organisms which may overgrow parts of coral colonies that survived the initial effects of the oil spill. The combination of sub-lethal effects may ultimately result in as much mortality as the initial contact with oil, further reducing the overall abundance of corals. This situation may continue long after any petroleum hydrocarbons are obviously present in the environment or in coral tissues.

2.5 OTHER POLLUTION

A ship grounding may give rise to non-oil related pollution due to spillage or deliberate dumping (for instance, to lighten the vessel during a salvage attempt - see section 6.4.1) of many types of harmful or toxic cargo or debris, each of which could enter and affect the coral reef environment. The effects range from no local impact (as occurs when the spilled material simply floats away) to physical or toxic damage to the coral and other attached organisms. This may have severe effects on the reef community through inundation or scouring, and residual material may impede or prevent recolonisation. In some cases re-suspension of material, transport and dispersal by waves and currents may help reduce the potentially harmful effects: alternatively it may increase them, or transfer them to other areas.

Appendix II of annex II of the International Convention for the Prevention of Pollution from Ships (MARPOL 1984 - see section 4.2.2) lists some 250 noxious liquid substances which are carried by sea in bulk. Appendix III of annex II lists other liquid substances not considered harmful but which are carried by sea in bulk. The substances (which are described by their chemical names, and are thus not easily identifiable to the layman) have been evaluated and categorised based on environmental criteria and are ranked by the degree of hazard to human health and aquatic life in four categories:

- Category A substances contain a high hazard to human health or aquatic life and are moderately to highly toxic to aquatic life (e.g. naphthalene);
- Category B substances produce a tainting of sea food and are moderately toxic to aquatic life (e.g. white spirit);
- Category C substances are slightly toxic to aquatic life (e.g. octane);
- Category D substances are non-toxic to aquatic life but may have a nuisance effect on amenities (e.g. coconut or palm oil).

Typical cargoes (and therefore possible pollutants) likely to be encountered in the Pacific Islands region include:

- Coal. This is Australia's principal bulk export commodity, and the country is one of the world's largest exporters of coal. Several Australian ports are increasing their capacity for handling coal exports in anticipation of more open pit mining to be carried out in the near future. The physical effects of a spillage are greater than the chemical ones, and have impacts similar to those caused by sediments and rubble created by the physical impact of a grounded vessel on coral. Coal types vary, and the lower ranked coals will eventually degrade, although bituminous coals are more persistent. Spillage of coal onto the reef occurred in the case of the *Oceanus* (Annex 5);
- Iron ore. Impacts are similar to coal and rubble in that the physical effects of the spillage would be the major concern;
- Sulphite minerals, such as lead, zinc and manganese ores. These are exported from ports in Queensland and Western Australia, and are of greater concern than iron ore because as well as the physical effects of spillage, such minerals can produce sulphuric acid and cause chemical damage;
- Cyanide is imported into certain Pacific Islands (PNG & Fiji) for gold processing, as well as into the Philippines. Australia uses 70,000t of cyanide per year, although most of this is domestically produced and only a small proportion transits the region;
- Sulphuric acid or caustic (alkaline) materials, which are needed by various industries in a number of countries in the region.

The persistent or long-term presence of some of these pollutants may inhibit recovery of impacted coastal areas through a continued physical presence on the reef flat which may cause continuing damage through particle mobility and abrasion, burial and suffocation, or toxicity. The permanent stranding of a wreck may become a source of continued pollution as it slowly degrades, creating debris and releasing fuel and perhaps other toxins.

2.6 IMPACTS ON THE BIOLOGICAL COMMUNITY

2.6.1 Corals and other attached organisms

Where the reef is pulverised by the hull of the vessel the effect on the living surface of the reef is total destruction. There is a margin around this area where the damage is severe due to the heaping up of broken reef fragments and detached coral colonies. Peripheral to this and for perhaps kilometres in distance, corals and other attached organisms may be subject to the toxic or abrading effects of exotic material originating from the grounding which are transported by waves or currents. Bleaching of coral (i.e. loss of symbiotic zooxanthellae) has been observed to result from stress, and a combination of sub-lethal influences that may result from a grounding could lead to extensive coral mortality.

Maragos (in press) cites the following as impacts on the coral community of the *Jin Shiang Fa* grounding at Rose atoll, American Samoa:

- toxicity of spills of fuel or other toxic fluids;
- mechanical breakage and pounding from the collision and subsequent vessel movement;
- smothering or scouring by re-worked or re-suspended sediments;
- competition from benthic algae and soft corals whose abundance has increased as a result of the ship grounding;
- bleaching from reduced light penetration, toxicity or other stresses attributed to the grounding and its aftermath;
- smothering and snagging from clothing and line debris.

Even where oil or chemical pollution does not cause high initial coral mortality, there are still extensive sub-lethal effects. Corals subject to chronic oil pollution have been shown to have impaired development of reproductive tissues, decreased reproductive success, degeneration and loss of symbiotic zooxanthellae, and atrophy of mucus secretory cells and muscle bundles (Rinkevich and Loya, 1979).

2.6.2 Algae

Ship groundings often result in blooms of either micro- or macroalgae, or both. A bloom may result from the creation of newly exposed substrate amenable to algal colonisation, from high initial mortality of competing corals, or from other consequences of the grounding such as a supply of nutrient-rich pollutants, or the fact that the grounding took place during the algal reproductive season.

If the impact zone of the grounding is small, then the consequences of an algal bloom may be insignificant. However if debris, wreckage and pollutants widen the area of damage or if nutrient-rich pollution stimulates the bloom, then this may permanently alter the nature of the community over a large area of reef.

The development of algal turf is a typical successional stage of disturbed reef areas. Subsequently a macroalgal bloom sometimes occurs. This may be small and of minor importance, as with the wreck of the *Safir* and its phosphate pollution, or it may result in a large, permanent change, as in the grounding of the *Florida*.

Circumstances which encourage the rapid recolonisation and growth of macroalgae are paraphrased from Hatcher (1984) as follows:

- insufficient herbivores to crop the algae in what is a relatively small area due to toxic, turbidity or increased predation effects resulting from a grounding;
- clearing and/or modifying a large area of the substrata in a manner or at a time which favours colonisation by a formerly rare alga;
- an increase in the availability of potentially limiting nutrients;
- reducing competition with other benthic organisms (e.g. coral) which may be killed or have their growth inhibited as a result of the grounding.

The persistence of large quantities of macroalgae after the perturbation may occur because:

- an unpalatable macroalga which previously had nevertheless been consumed incidentally by large herbivorous fish feeding non-selectively becomes recognisable to, and is avoided by, the grazers;
- a macroalga is able to inhibit the colonisation of microalgae and/or out-compete smaller forms for potentially limiting resources (e.g. light);
- the macroalga provides increased shelter for micro-grazers which can therefore increase in abundance, and which feed on potentially competing microalgae.

Algal colonisation of damaged areas will alter the trophic structure of the reef community and will have a particular impact on the fish assemblage. It may also lead to ciguatera fish poisoning (see section 3.2.2). Algal re-growth therefore has significant implications for fishing activities especially when it occurs in relatively small reef areas or in places where access to marine resources may be limited by customary marine tenure and fishing rights.

2.6.3 Fish communities

Ship groundings affect fish communities in several ways:

- habitat alteration through loss of vertical relief caused by crushing, and through filling of interstices by rubble and sediment;
- changes in availability of food types due to coral mortality and/ r algal growth;
- mortality caused directly by toxic pollutants or, to a lesser degree, debris and sediment.

In general, these impacts will lead to a localised reduction in fish species diversity due to habitat loss and the destruction of epifauna and in-fauna (organisms living in and near the habitat). This may be accompanied by an initial decline in overall abundance.

If the grounding damage is principally physical, and is followed by an algal bloom, then overall fish abundance may subsequently recover, although the proportion of herbivorous species may increase. If, however, the grounding is accompanied by an oil spill or other major toxic pollution event, or if chronic pollution occurs from the wreck, then fish abundance will probably be substantially reduced due to high levels of initial or ongoing mortality.

2.7 INTRODUCED ORGANISMS

The transfer and introduction of exotic species or harmful animals, plants and micro-organisms through the dumping of ballast or bilge water has become a worldwide issue in recent years. It has been recognised as a significant problem in Australia, where the Government recently announced the creation of the Australian Ballast Water Council which will seek to develop international protocols for dealing with ballast water.

In the Pacific Islands region, ballast taken on elsewhere might contain organisms harmful to the local environment. In the event of a ship grounding, pumping of ballast water would be one of the typical actions to be taken if an attempt were being made to re-float the vessel.

Exotic organisms may have an effect on coral reef ecosystems particularly in an island situation where the marine community has evolved in isolation, and the introduction of an exotic form may lead to monopolisation of habitat. This may result in the reduction of indigenous species through predation or competition, resulting in the loss of resources used for commercial or subsistence purposes. Exotic organisms may threaten biodiversity and, in contrast to physical or toxic damage, the effects may be irreversible.

2.8 RECOVERY AND RESTORATION

In terms of a reef system or coastal area, "the definition of what constitutes recovery is something that the scientific community needs to address. Is it a return to an ecosystem with the same species composition, community structure and function as that present before the spill, or simply attainment of a state where the toxicity or other damaging properties of the oil have declined to a level that is tolerable to the most robust colonising organisms?" (Baker, 1993).

Irrespective of how recovery is defined, the time span involved in natural recolonisation by a range of different organisms is difficult to predict. Natural recruitment is the major element influencing the regeneration of reefs and as such, the time of year of the grounding may be important in determining the types and abundance of larvae available to recolonise the damaged areas.

Smith (1985) recorded a recovery rate of 25 sq. cm of coral/sq.m/year (0.25% of the surface area per year) on Bermudan reefs affected by a ship grounding. Species diversity remained low for five years with recruits being primarily from two dominant colonising species. Despite their being common in neighbouring areas, gorgonian corals did not begin to recolonise the damaged areas until five years after the accident occurred.

Conversely, research two years after the 1984 grounding of the *Wellwood* showed that gorgonians were recruiting well within the area of impact. However, hard coral recruitment was more limited (Hawkins et al., 1991); 27 months after the grounding, hard coral cover in areas which had been virtually destroyed was only 13% of the pre-impact level. Recolonisation was by dominant species from the surrounding areas and was highest in damaged areas which still contained some surviving adult colonies (Gittings et al., 1988).

Three years later however, recovery seemed to have accelerated. A study five years after the grounding of the *Wellwood* showed that coral abundance in one area of major impact had increased from virtually 0% to a level approximating 65-78% of supposed pre-impact populations. Overall cover of hard corals in 1989 was 22% and gorgonian cover approximately 40% of estimated pre-impact levels. At this rate, 100% recovery of coral populations in terms of colony numbers is expected in another 6 years, although their sizes will be generally small (Gittings, Bright and Holland, 1990).

Natural recolonisation of corals may be accelerated through human intervention. In the case of the *Wellwood*, reef framework was repaired using concrete. Hard and soft coral colonies were then transplanted to the damage zone and cemented in place. Although costly, this restoration procedure met with a certain amount of success, as described in more detail in Annex 4.

3 ECONOMIC AND SOCIAL CONSEQUENCES OF SHIP GROUNDINGS

3.1 INJURY AND LOSS OF LIFE

Ship groundings usually do not involve loss of life at the time of the casualty. A grounded ship is by definition in close proximity to land so the risk of drowning by the crew is only serious if the grounding occurs in severe weather conditions. Even if this is the case, the ship usually continues to provide a safe refuge until such time as the crew can disembark safely.

Once grounded, however, a ship presents a dangerous environment and the risk of injury is high, particularly if the ship is abandoned and has deteriorated. Salvage experts and surveyors know to be cautious and to use extreme care when investigating such a wreck. However the presence of a grounded ship on a reef can act like a magnet to local villagers and passers-by who are understandably interested in its potential "treasures", or are just curious.

The dangers posed by a grounded ship are numerous. The machinery spaces represent an unfamiliar and often very dark environment, while the bridge and living spaces can contain other hazards. Putrefying fish in cargo holds produces several gases, including methane, carbon monoxide and hydrogen sulphide, all of which can be and have been causes of mortality among unsuspecting boarders. Many fishing vessels and refrigerated carriers use ammonia as a refrigerant and rupture of pipes can cause the gas to collect in various parts of the vessel and cause intoxication. On older wrecks, corrosion of deck plates and other steelwork can result in boarders falling through decks or bulkheads and suffering severe injuries from the rusty metal.

There have been many incidents which underline the dangers to intruders on grounded ships:

- loss of life has occurred in Papua New Guinea when a vessel shifted on the reef while being explored by villagers
- Fijian villagers have suffered severe injury from noxious chemicals found on board a grounded ship;
- several islanders in the Federated States of Micronesia were blinded by drinking what they thought were alcoholic beverages when in fact the bottles contained harmful substances.

It should be noted that under most legal regimes in the region, the vessel owners, masters and insurers may not be liable for damages resulting from these injuries, since the boarding of a grounded ship constitutes unauthorised entry.

3.2 FISHERIES

3.2.1 Reduced catches

There are no studies of the quantitative effects of ship groundings on fishery production that can be used as a basis for prediction. Fishery production is in any case influenced by so many variables that it is doubtful whether any change in production could be attributed with certainty to a ship grounding event unless the impact was catastrophic (as may be the case in a major oil spill). Nevertheless it is possible to speculate about the likely effects of ship groundings on fisheries based on their observed impacts on fish assemblages, as described in section 2.6.3.

The immediate consequences of a ship grounding are habitat loss due to physical damage, elimination of vertical relief, sedimentation, filling of interstices and abrasion by rubble. These impacts can be expected to lead to an immediate decline in populations of some fish species, including those used for food. The importance of the decline will be proportional to the extent of the damaged area. Any oil or toxic pollution arising from the grounding may lead to more extensive mortality, possibly far in excess of that resulting from the physical damage.

Subsequent recovery of fish populations would depend on the type of substrate recolonisation taking place. If recolonisation is by corals or other members of the original pre-impact fauna then fishery production may return to its pre-grounding condition. On the other hand if, as often happens, the damaged area is recolonised by algae, this may result in an accompanying change in the composition of the fish community, with an increase in the proportion of herbivores and a possible increase in total biomass. Whether this is positive from the point of view of the fishery depends on the nature of the fishing activities taking place in the area.

3.2.2 Ciguatera

Coral damage as occurs in a ship grounding often result in an increase in algal growth (see section 2.6.2) and this can lead to the occurrence of ciguatera fish poisoning. Ciguatera, which is actually produced by a group of neurotoxins, can cause a variety of symptoms in humans. It is of concern in many Pacific Islands, as the consumption of ciguatoxic fish by humans can cause illness, and in extreme cases, death. In addition to causing health and nutrition problems for island inhabitants, an outbreak of ciguatera on a previously unaffected reef may have implications for resource and economic development.

Certain types of algae provide a substrate for the dinoflagellate *Gambierdiscus toxicus* which produces toxins associated with ciguatera. A disturbance which results in macroalgal growth may give rise to conditions that may result in ciguatera. Increases in the incidence of ciguatera poisoning have been attributed to human disturbance on the coral reef which affect the biological nature of the reef.

The following review of the circumstances which give rise to ciguatera is paraphrased from Kaly and Jones (1990):

> Toxic fishes appeared within 1.5 to 2 years when the atoll of Hao (Tuamotu Islands) was converted to a military base in 1965. The reef apparently became toxic in a pattern spreading out from the centre of disturbance, first appearing in herbivorous fish and later the carnivores.
>
> Some workers have identified blasting for the construction of boat channels as a probable cause for an increase in fish poisoning. Other disturbances have also been implicated in fish poisoning, such as storms, die-back of corals, and any other form of disturbance. When interviewed, the people of Kiribati associated areas of toxicity with ship wrecks, bombing during World War II, sewage, rubbish dumping and many other forms of disturbance.
>
> A mechanism for the link with disturbance was first proposed in 1958 when it was suggested that the toxicity in fish was caused by an alga which was the first to grow on new substrata. Wrecks, rubbish, etc. all provide new substrata, either in themselves, or by destroying corals. The poisoning was attributed to a dinoflagellate *Gambierdiscus toxicus* which lived under the surface mucous layer of algae, eaten by fish. The "host" algae carrying the toxic dinoflagellate have included red, green and brown forms, with finely branching forms harbouring the greatest numbers of cells.

Several accounts suggest that disturbances to the coral reef community caused by ship grounding have resulted in an increase in fish poisoning:

- Pelasio (1988) states that fish poisoning was not common in Tokelau but increased in 1977 after a Korean longliner was wrecked on one atolls;
- Anon (1988) states that the first recorded incident of ciguatera fish poisoning in the Solomon Islands was in 1975 after a Taiwanese fishing vessel went aground on an isolated reef;
- In Kiribati eleven cases of ciguatera were reported at the "wrecked boat" north of the western reef of Abemama Atoll over the period 1978-1983 (Tikai, 1988);
- Anecdotal information from villagers living on Vatoa Island in Fiji indicate that subsequent to each of the four major recent groundings on the island there were outbreaks of ciguatera, with the worst being that following the *Aragna Rangdahl* outbreak which reached its peak about 12 months after the grounding.

3.2.3 Tainting

Taint (the presence of a faint taste of a pollutant) in food can result from a ship grounding, especially one involving an oil spill. Though consumption may not cause illness, tainting makes the food less desirable, less marketable and can result in economic loss.

Light oils and those produced from the middle-boiling range of crude oil distillates are prominent sources of taint. Crude oils, refined products, refinery effluents, wastes from petrochemical complexes and a host of other sources can also impart an unpleasant flavour to fish and seafood which is detectable by taste at extremely low levels of contamination. The level of taint can vary from a stale taste in seafood to a strong petroleum-like flavour.

Commercial species of mullet have been condemned in Queensland, Australia due to taint which was presumably the result of contamination of their food source in the Brisbane River (Connell, 1971). Oil pollution has resulted in the tainting of a variety of fish and bivalves, rendering them unmarketable near oil ports in Spain, France, Italy, and Yugoslavia. As well as actual tainting of the flesh, oil may adhere to the shells of bivalves for a long time and may taint the catch when it is cooked (Clark, 1993).

3.2.4 Mariculture

Commercial mariculture operations, including farms for seaweed, pearl oysters, sponges, and giant clams are located throughout the region, as are a number of mariculture research stations. Usually the sites for these endeavours are chosen carefully with regard to their specific environmental requirements. Groundings and subsequent pollution at or near these sites could affect them and cause temporary or permanent damage which could range from being a mild nuisance to a complete financial disaster.

3.3 LIFESTYLE IMPACTS

3.3.1 Hazards and obstructions to navigation

A grounded ship may represent a hazard to navigation, especially when, as is often the case, the grounding occurs in proximity to a harbour entrance. In general, the smaller the entrance, the greater the navigational difficulty, and therefore the greater the possibility of a grounding. In addition, a grounding in a small passage may represent a greater navigational hazard than one in a wide entrance.

Some countries in the region, including Fiji, have specific legislative provisions to facilitate the expeditious removal of a vessel presenting a hazard to navigation. In others the general legislation requiring removal of wrecks is usually only enforced when the wreck obstructs navigation, as was the case in the blockage of the pass at Mangaia Island in the Cook Islands in 1970.

3.3.2 Disruption to daily life

Apart from the actual physical damage caused, a ship grounding on an inhabited island will cause varying levels of disruption to the daily lives of the inhabitants. The degree to which this disruption changes or is detrimental to their lives depends on many factors including the proximity of the grounding site to inhabited villages or habitually visited areas, the duration of salvage operations, the degree to which the local inhabitants are called upon to render assistance or are involved in the decision making processes required of the emergency and whether or not they are asked or required to provide food and/ or lodging to those involved.

3.3.3 Other damages

Many reef areas are used for traditional purposes such as subsistence or artisanal fishing, the placing of fish traps and weirs and so forth. In some parts of the region particular reef areas still have religious or mystical significance and damage to the reef by non-natural forces can cause dismay and anxiety.

4 LIABILITY AND INSURANCE

4.1 LEGAL RESPONSIBILITIES FOR CONSEQUENCES OF SHIP GROUNDINGS

4.1.1 General

Due to the nature of shipping generally, those involved in the operation of a vessel who could be held responsible for a grounding can include the master and crew, the owner and the charterers. Furthermore, those who may have an interest in any grounding incident may include, in addition to the above, the insurers of the vessel, cargo owners, insurers of the cargo, the relevant Protection and Indemnity Association (discussed in section 4.4.2) and the authority that is responsible for the seaworthiness of the vessel itself.

As to the extent of legal responsibility of ship owners and operators for the consequences of ship groundings, the legal basis of any liability would normally be founded in the breach of a specific statutory duty or in the more general Law of Negligence or Law of Nuisance. In the case of actions based on negligence, the most important issue is usually whether or not there was a failure by a party to act reasonably in all circumstances.

4.1.2 Master and crew

The master and crew of the vessel must exercise reasonable care, skill and competence in its navigation. For example, charts should be up-to-date, position fixing should be carried out in accordance with established procedures, look-outs should be posted when required and the speed of the vessel should be reasonable in the circumstances. In some cases the owner or charterer of the vessel may be liable at law for the negligence of the master and crew (vicarious liability).

4.1.3 Ship owners

In addition to the previously discussed liability of the master and crew, ship owners may be negligent in their own right. The vessel should be maintained in a seaworthy state, have an up-to-date survey certificate for hull integrity and be manned by a competent crew. Appropriate records should be kept.

Ships which are owned directly by Governments are immune from suit for an incident in another country by the doctrine of sovereign immunity when the ship is in use for non-commercial activity. This is not the case when the same ships are engaged in commercial operations. Ships owned by subdivisions of sovereign Governments, such as provinces or states, are not protected by this doctrine.

4.1.4 Charterer

Where a vessel is on what is known as a "demise" charter, control of the vessel is given to the charterer and this may have a significant impact on the degree to which the ship owner is responsible for his vessel's actions. As a general rule the demise charterer, not the owner, is responsible for any loss or damage caused by a vessel on a charter. Where damage is suffered by a third party, the charter agreement may point to the party in control or responsible for an activity.

4.1.5 Pilots

Where a vessel is required to take on a pilot there would usually be legislation that will exclude or limit the pilot's liability for any damage caused by him whilst carrying out his duties. However, the authority responsible for appointing pilots must exercise reasonable skill and care in their selection, or it may have to assume some or all of the liability for the grounding.

4.1.6 Cargo owners

Where a vessel is involved in an incident by reason of the movement or escape of dangerous cargo, an issue may arise as to whether or not the cargo owner has acted with the required degree of skill and care and has notified the ship's management of the dangerous nature of the cargo. The law may also require that the master exercise a higher degree of skill and care in such circumstances.

4.1.7 Other parties

Other parties who may be liable in respect of a grounding include stevedores, surveyors, naval architects, ship builders, managing agents and classification societies etc.

4.1.8 Summary

As is apparent from the above, in making a determination as to the liability for a particular grounding, there are many factors that should be taken into account and each case must be viewed in the context of its own particular set of facts. As a general rule a party will normally only be liable if actual fault can be shown, save in situations where a party may be liable at law for the actions of another person (for example as previously discussed owners or charterers may be liable at law for the actions of the captain and crew).

4.2 RELEVANT ASPECTS OF NATIONAL AND INTERNATIONAL LAW

4.2.1 National law

Since there are some 22 countries and territories in the Pacific Islands region, it is not possible or desirable to analyse the relevant laws that apply in each case. Accordingly there may be some variation in the manner in which legal liability for a grounding is incurred. However, it is likely that under national laws for various countries the following will apply:

- liability will be incurred for negligence, that is, performance of a duty that falls short of the standard reasonably expected by a person in that position;
- liability will be incurred through nuisance, that is, interference with a public right (for example, where a vessel or a wreck blocks a channel and prevents access to a berth or anchorage);
- liability will be incurred through breach of specific laws or statutes;
- national laws incorporate various international conventions to which the country in question is a state party.

4.2.2 International law

For the purposes of the present document, international law will normally be in the form of international conventions or treaties. These will only have the force of law if they have been signed and ratified or acceded to by the country concerned and incorporated into domestic law.

There are numerous international conventions that may be relevant, but the more significant include:-

- Convention on the International Regulations Preventing Collisions at Sea (1972 & 1981). This convention provides for the "rules of the road";
- United Nations Conference on the Law of the Sea. This convention provides for the right of innocent passage and may be relevant in archipelagic waters for example where, in the interest of safety, navigation is restricted;
- International Convention relating to the Limitation of the Liability of Owners of Sea-Going Ships (1957), Brussels Protocol (1979) and International Conference on the Limitation of Liability for Marine Claims (1976). These conventions deal with the right of owners of sea-going ships to limit liability in respect of claims for personal injury or property damage occurring as a result of occurrences that do not result from the actual fault or privity of the owner. The benefit of this limitation can be passed to the master and crew and to the charterer, manager or operator of a vessel. The conventions also apply to obligations or liabilities imposed by any law relating to the removal of wreck;

- International Convention for the Prevention of Pollution from Ships (MARPOL 1973/78, 1984). This convention provides for design and carriage standards in certain tankers with a view to reducing the possibility of pollution;
- International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (1969). This convention provides a coastal state threatened by grave or imminent danger to its waters with rights to take preventative steps in respect of a vessel on the high seas that are proportional to the damage threatened;
- International Convention on Civil Liability for Oil Pollution Damage (1969). This convention provides for strict liability of a ship owner (that is, the ship owner is liable whether or not it was at fault) for oil pollution damage to a coastal state provided that the total amount of damage from an incident does not exceed USD14 million;
- International Convention on Salvage (1989). This convention supercedes a 1910 salvage convention. It retains the “no cure, no pay” provision for salvors and adds a provision of special compensation to be paid to salvors when there is a threat to the environment;
- Protocol Concerning Co-operation in Combating Pollution Emergencies in the South Pacific Region (of the Convention for the Protection of the Natural Resources and Environment of the South Pacific). The parties agree *inter alia* to take the following steps in regard to a pollution incident: make a preliminary assessment of the event; communicate information regarding the event to other parties; determine ability to respond to the event; consult with other parties in regards to the event; and carry out measures to prevent, eliminate, or control the effects of the pollution incident.

4.3 WRECK REMOVAL

It is usual for legislation to provide powers to harbour authorities and other relevant authorities to deal with wrecks that are hazards to navigation. Such authorities usually have statutory powers to light, buoy, raise, remove or destroy wrecks, often at the expense of the owners.

In those cases where legislation permits a Government to remove a wreck, it may do so particularly if the wreck constitutes a hazard to navigation. However, since this can be a costly business, the probabilities are against it doing so unless the wreck constitutes a hazard to navigation or there are actual or potential environmental consequences involved.

In some jurisdictions the office of "Receiver of Wreck" has been established by legislation (e.g. Fiji’s Wreck and Salvage Act of 1887). In law the duty of the Receiver is to proceed to the site of a wreck and take charge to preserve the ship, lives and any cargo and wreck provided that he does not interfere between the master and the crew in the management of the ship without a request from the master. He is empowered to require persons to assist, pass over private land, suppress plunder and disorder, and examine on oath persons who can give an account relating to the wreck. It is an offence to wilfully disobey the Receiver's directions, to refuse to assist without reasonable cause and to impede him or take possession or secrete any wreck. A person finding or taking possession of a wreck is obliged to notify the Receiver. Having taken possession of any wreck to which no owner establishes a claim the Receiver may sell it to meet salvage, fees and expenses and must pay any remaining proceeds to the Government. The owner of a wreck which is in the possession of the Receiver has one year in which to establish a claim but is to pay all salvage, fees and expenses before being entitled to the wreck.

Whilst there is an obligation to notify the Receiver of Wrecks where the particular legislation requires, a Notice of Abandonment is only required to be given to insurers where the vessel involved is a constructive total loss. A question that may arise is whether an insurer, in circumstances where an owner has given Notice of Abandonment, assumes liabilities in respect of wreck removal. If insurers do accept abandonment or on payment choose to exercise the rights of ownership to which they are entitled then they must also assume whatever liabilities may attach to the ownership of the property. Hence underwriters will often take care not to take any action capable of being construed as the exercise of rights of ownership.

Separate legislation may apply to "historical wrecks" to preserve historic wrecks and relics.

4.4 FORMS OF INSURANCE AND INDEMNITY COVER

For the purpose of this document, the most important forms of insurance and indemnity cover are hull insurance, ship owners liability insurance and cargo insurance.

4.4.1 Hull Insurance

Hull insurance provides a ship owner or operator cover against loss, damage, liability or expense in relation to a vessel. Risks covered include loss or damage to the vessel itself caused by, among other things, perils of the sea, fire, explosion, latent defects in machinery or hull, negligence of master, crew or pilots and negligence of repairer. Hull policies may also cover loss or damage to a ship when, by reason of damage sustained by an insured peril, it presents such a pollution hazard that a state has to step in. Most hull policies contain a "three-fourths collision liability" such that if the vessel insured collides with another ship as a result of which the assured becomes liable for damages to the owner of the other vessel, the insurer will pay three-fourths of the sum so paid to the owner of the other vessel. In general terms therefore, the cover provided in a hull policy would normally only cover damage to the particular ship insured except in the event of a collision with another ship, in which case damage to the other ship may be covered.

4.4.2 Ship owner's liability policies

Ship owners and operators will normally have ship owner's liability policies with one of the Protection and Indemnity Associations (known as P&I Clubs). Such associations were formed initially to cover the one-fourth collision liability not covered under the hull policies. Risks covered by P&I Clubs over the years have been considerably extended as a result of which this area of insurance has become increasingly important. The IMO estimates that 85% of all ocean-going ships are entered in P&I Clubs.

Cover provided under ship owner's liability policies includes, among other things, liability for injury, illness and death, liability for loss of or damage to property, liability for pollution (including liability for which the ship owner is liable as a party to TOVALOP - see section 4.5.2) and, in some circumstances, liability for fines.

4.4.3 Cargo insurance

As a general rule, cargo insurance is taken out by cargo owners to protect their interest in the cargo. Cargo insurance will normally only cover loss of or damage to the subject matter insured along with salvage and other charges.

4.5 INSURANCE REQUIREMENTS AND OBLIGATIONS

4.5.1 National

From a practical standpoint it can be expected that vessels engaged in trade, the ownership of which is underwritten by financial institutions, could have some sort of indemnity cover as required by the mortgage holder. This does not mean however that there is an absolute guarantee that such a policy is in place at the time of an incident; that the vessel is covered in all cases; or that the insurers would consent to pay damages.

In general, ship owners and operators are not usually obligated under national laws to carry insurance. National laws may provide that certain types of insurance cover are required in certain areas (for example the Great Barrier Reef Marine Park in Australia requires owners and operators to have insurance against various risks in certain circumstances). However, it is not usual for domestic laws to require ships operating in national waters to carry insurance.

Of relevance to the region are the US requirements in Guam and Pago Pago for vessels which enter those ports to demonstrate the ability to cover liability. This is usually done by the provision of a "Certificate of Financial Responsibility" (COFR) issued by the ship's P&I insurer. In situations where a COFR is not in place, the ship can be required to deposit a cash bond with the US Coast Guard. Since such certificates are based on the vessel's timely compliance with certain underwriter survey requirements, it should not be automatically assumed that cover would be in place for these vessels at non US ports. In fact the opposite may be true, and alternate ports (such as Apia in lieu of Pago Pago) could be chosen for operations when requirements have not been met or are out of date.

National laws may however affect the operation of insurance policies entered into voluntarily by ship owners and operators. For example, issues such as the requirement for the insured to have a legal interest in the goods insured, insurable value, warranties, seaworthiness, legality of the adventure insured against, wilful misconduct and onus of proof are all matters that may be the subject of national laws.

In many cases the law governing the Contract of Insurance will be the law of a different country. For example, a Contract of Insurance covering an incident occurring in the Pacific Islands region may well be determined by the law of England.

4.5.2 International

While there are normally no obligations under international law for ship owners or operators to have insurance cover, there are private international agreements that in effect provide cover similar to insurance cover in certain circumstances.

The Tanker Owners Voluntary Agreement on Liability for Oil Pollution (TOVALOP) in 1969 was an agreement by major oil companies which provided a guarantee by each participating tanker owner that it would reimburse national Governments for any preventative or clean-up expenses with a USD12 million limit on liability. Under the agreement a "bare boat charterer" is considered a tanker owner. Liability is presumed for an oil spill unless the owner can demonstrate no fault or negligence on the part of the tanker.

A further fund, created as the Contract Regarding an Interim Settlement of Tanker Liability for Oil and Pollution (CRISTAL) came into force in April 1971 by agreement among 38 oil companies. It provided clean-up expenses beyond those covered by TOVALOP and compensation for direct damage from oil to a coastal state. Under CRISTAL, the principle of strict liability has been applied with a maximum of USD30 million per incident, less the liabilities paid for clean-up under TOVALOP.

4.6 DEFRAYAL OF GOVERNMENT COSTS

When a vessel is a constructive total loss and an insurance claim is paid then as a general proposition, provided that a Government acts promptly, it should be able to obtain some of the claim moneys in order to defray costs, pay compensation, etc.

Although a Government would have a personal right to sue the party to whom the payment was made, in practice it frequently happens that money is dissipated on receipt, so that if and when a Government takes action there may be nothing to recover against. However there are several other mechanisms through which a Government might seek redress:

- if the Government knew that the insurance company was about to make payment, it could ask the court to issue an injunction to restrain payment;
- it may be able to obtain what is known as a Mareva Injunction whereby, if the owner is out of the jurisdiction, money from the receipt of the insurance claim is apprehended;
- it may be possible to garnishee the insurance company. This involves a court order being made directing that any money due to the owner be paid to the Government instead;
- where it has obtained a judgment the Government could levy execution against the owner and sell up his, her or its assets in order to recoup the amount involved;
- the Government could issue bankruptcy proceedings if the owner was a natural person. In the case of a company the Government could issue proceedings for its winding up.

All these mechanisms would, in theory at least, enable the Government to attempt to obtain some of the claim money to defray costs.

5 OIL SPILL PREVENTION AND MITIGATION

5.1 General

As noted in section 1.3.1.1, tankers servicing the Pacific islands are generally MR tankers of around 25 - 50,000t DWT, which mainly carry refined products. The absence of sources of crude oil (with the exception of Papua New Guinea) and refineries means that tankers in the region are mostly engaged in the carriage of refined products. Crude oil does nevertheless transit the region on an occasional, opportunistic basis.

Despite the fact that in many parts of the Pacific Islands region, shipping has to contend with outdated or inaccurate charts, a lack of well-maintained aids to navigation, uncharted reefs and shoals and seasonally adverse weather conditions, the region has been spared a catastrophic oil spill to date. A great deal of attention has been paid to minimising the risk of spillage from oil tankers following the disastrous effects of the *Torrey Canyon*, *Exxon Valdez* and other major oil spill disasters of the past three decades (as well as the very bad publicity and major fines that oil companies suffered as a consequence of these). Design improvements such as the use of double-hull tanks for oil storage have reduced the likelihood of an oil spill even if the outer skin of the vessel is ruptured (although the merits and demerits of double-hull tanks are still the subject of controversy within the industry). Nevertheless, the large quantities of product transported by even medium-range tankers means that any cargo spillage that does occur from one of these vessels is likely to have very severe local impacts.

A recent study undertaken by the International Tanker Owners' Pollution Federation Fund (ITOPF) reported that "oil spills from marine sources, particularly tanker accidents, continue to pose a risk to coastal nations and island countries". Another study noted that in spite of greater awareness and worldwide improvement in the science, engineering and technology dealing with the transportation of oil, worldwide tanker "spill rates" (for "major" spills, i.e. more than 1,000 bbls or about 135 tonnes of oil) stayed constant from 1974 to 1992 at 1.3 spills per billion barrels of oil transported. This figure refers to all kinds of tanker incidents, not just groundings (Nordvik, Simmons and Champ, 1995).

5.2 Shipboard emergency plans

A properly manned and insured vessel should have a Shipboard Oil Pollution Emergency Plan on board. Such a plan is required of a vessel engaged in trade where an International Oil Pollution Prevention (IOPP) Certificate is required. The owners are responsible for having such a plan on board, and often develop it with the assistance of surveyors or other experts. The contents of the plan should be familiar to both the ship's personnel and on-shore management. However, the existence of such a plan does not necessarily mean that the crew of the vessel will know exactly what steps to take when faced with the emergency itself.

An adequate plan should set out the steps to be taken to control the discharge of oil from the ship. It should cover the more common problems likely to be encountered during regular ship operations such as pipe leakage, tank overflow or mechanical breakdown of oil pollution prevention devices on board. A separate set of instructions should be included to deal with a casualty (grounding, collision, fire, explosion, etc.).

Professionally trained mariners should have the background and experience to decide on the course of action that will minimise pollution in an oil spill situation. Examples of such action would be organising oil spill response stations and duties for the crew, minimising the risk of fire or explosion, and creating preventing additional outflow of oil by adjusting ballast, closing off piping, transferring oil from damaged tanks, etc. One of the reasons an Emergency Plan is required is to provide a checklist for captains who might not be fully familiar with such procedures.

Since groundings can involve a high potential for oil pollution, the master should know to whom he reports such an incident, in addition to the ship owners. All of this information should be available to him in the Emergency Plan.

5.3 Oil spill response methods

5.3.1 General

If an oil spill does occur, the most efficient response is determined by its location, the type of petroleum product(s) involved, the availability of clean-up equipment, and the length of time it takes to mount a response. In particular the chemical properties of the petroleum product spilled play a major role in determining the best response. After spillage oil becomes "weathered" (subject to evaporation, emulsification and bacterial attack). This causes changes in its physical and chemical properties and in general makes it more difficult to clean up.

There are four basic categories of response to an oil spill, which are described in the following sections.

5.3.2 Leave alone but monitor

Sometimes a decision not to clean up the spilled oil may be the best course of action. If the oil looks like it may be washed out to sea or is not immediately threatening a coastal area, then it may be sufficient to monitor the movement and state of the spill while allowing natural processes of dispersal and bio-degradation to take their course. Allowing the oil to break down naturally may be the most environmentally friendly solution. There have been cases when actions undertaken to demonstrate "concern for the environment" in response to oil spills or to public or media pressure have resulted in more serious damage to the environment than the oil alone would have caused.

5.3.3 Chemical treatment

Treatment with chemical dispersants and emulsion breakers helps to break the slick up into small droplets which disperse into the water column. The surface area of the oil increases and this accelerates its bio-degradation. Unlike early versions, modern dispersants are often less toxic than the oil itself, provided they are used at recommended dilution.

Dispersants are generally considered to be of greatest value when employed quickly after a spill, and are best used as an enhancement to natural dispersal. Most crude oils and heavier refined products will form emulsions which gradually increase in viscosity, water content and chemical stability, and as this happens they become more resistant to the action of dispersants. The usefulness of chemical dispersants is thus diminished with time, and more than one or two days' delay in application greatly reduces their effectiveness.

The effective delivery of dispersants relies on the use of aircraft or specialised ships. Dispersants are most useful on relatively small amounts of freshly spilled oil, particularly where containment is not feasible. In the case of a major slick, the logistics of spraying large areas may be beyond the capacity of available ships, aircraft or available supplies of dispersant.

5.3.4 In-situ burning

In-situ burning is the process whereby a relatively fresh oil spill of at least 3 millimetres in thickness is ignited. Efficiencies of up to 90% may be obtained, particularly if the oil is contained.

As with dispersants, burning is most effective if carried out quickly. As the more volatile components of the oil begin to evaporate immediately following a spill, there is less potential for successful in situ burning as the oil ages. Following burning, a residue is left which itself may be a problem to clean up.

5.3.5 Mechanical recovery

The technology now available for mechanical oil recovery is diverse, and includes:

- **Containment/ protection booms:** mechanical barriers which extend above and below the water to contain the spilled oil or divert its flow. Booms may be fixed in position to protect specific areas, or may be towed between two boats. When the oil has been contained by a boom it allows for easier recovery;
- **Oil recovery devices:** skimmers, pumps and oil/ water separators which can be deployed to pump or skim floating oil off the water surface at various rates, depending on the oil layer thickness, viscosity and sea conditions. The oil is collected into a sump and is then discharged through a hose to a collector. Skimmers are usually used most effectively once booms have been deployed and the oil contained in a specific area. They may not be practical in rough weather;
- **Adsorbents and absorbents:** these include sorbent booms, pads, rolls, and oil mops which are used for soaking up oil where access might be a problem for skimmers. An oil mop is up to 90 meters or longer and made of polypropylene fibers interwoven through a central rope core. The gathered oil is squeezed out through a wringer into a sump and the mop is re-deployed. Some sorbents can absorb up to 20 times their own weight in oil, and their use can provide the “finishing touch” to a clean-up operation.

In addition, many different types of self-propelled oil spill recovery vessels and barges exist for the purpose of recovering oil from harbours, coastal areas, rivers and lakes. They can be used in conjunction with booms to concentrate the oil before recovery.

Unfortunately the scarcity of appropriate equipment and trained manpower in the Pacific Islands region, let alone the ability to make such equipment available on a timely basis at remote sites, makes the employment of such technology unlikely in the event of an emergency. Even in countries where it is available and transport facilities are good, delivery of this equipment, much of which is bulky and requires trained personnel to operate or handle, to a spill site is a major operational difficulty.

Nevertheless, since the deployment of mechanical means is not as time-sensitive as the use of dispersants or in-situ burning, booms and other containment devices should be considered where environmental and logistical conditions permit. An example of the appropriate use of such systems might be in a calm atoll or lagoon environment where containment and subsequent removal of floating oil is practicable.

5.4 OIL SPILL RESPONSE GROUPS

Generally, oil companies doing business in the region are now trained and equipped to handle spills at off-loading points in most countries; however they are not equipped to effectively handle spills from ship groundings which might occur very far away from the usual point of discharge. Available response equipment and manpower for oil spills within harbours that contain oil terminals are owned and controlled by the oil companies themselves, or in some cases are jointly owned and controlled by Government and the oil companies concerned.

Oil spill response groups located in Australia and Singapore are cooperatives formed by oil companies and represent an important resource for the Pacific Islands region. Although neither of these groups are located in the region itself, both have the ability to deploy specialist personnel and equipment on behalf of their member companies. They are formed on the model of the Oil Spill Service Corporation, or OSSC (now called Oil Spill Response, Ltd.), which was created by British Petroleum after the *Torrey Canyon* disaster in the late 1960s.

The two groups in question are the Australian Marine Oil Spill Centre Pty. Ltd. (AMOSC) and the East Asia Response Pte. Ltd. (EARL). Both have large inventories of oil spill response equipment and supplies and both could respond to major oil spills in the Pacific Islands region if appropriate arrangements for this were to be put in place.

5.4.1 Australian Marine Oil Spill Centre Pty. Ltd. (AMOSC)

In Australia the Government's Australian Maritime Safety Authority (AMSA) is responsible for overall planning and coordination of responses to oil spills. Activities are carried out pursuant to the "National Plan to Combat Pollution of the Sea by Oil". There are also state agencies which play a major operational role during oil spill incidents. As a follow-up to Australia's 1992 accession to the International Convention on Oil Pollution Preparedness, Response and Cooperation 1990, Australia, via AMSA, is developing a bilateral agreement for oil pollution preparedness and response with Papua New Guinea (ANZECC, 1995). AMSA is also the Australian Government contact point on oil spill issues for other Pacific Island countries. In 1991 the South Pacific Regional Environment Programme (SPREP) collaborated with AMSA and the International Maritime Organisation to produce the SPREP Draft Marine Emergency Contingency Plan.

AMOSC is a cooperative formed as a subsidiary of the Australian Institute of Petroleum by the oil companies in 1991. It has its headquarters and a large stockpile of oil spill recovery equipment in Geelong, Victoria. The AMOSC mandate is to assist in oil spill prevention, preparedness and clean-up on behalf of the oil companies in cooperation with the Government's overall plans. Its activities are managed by a small group which can call on a team of over forty industry professionals in the event of an emergency deployment of its resources. AMOSC's nominal response capability is for spills of up to 10,000 t of crude oil.

AMOSC's field operations are carried out under contract, either with one of its member companies or with Government. Deployment of certain resources overseas is possible, but AMOSC is required to maintain at least two thirds of its capabilities within Australia during such deployments. As a cooperative, it can provide assistance to Pacific Island countries with both expertise and equipment under pre-arranged agreements which could guarantee a certain level of response capability to be deployed in an emergency at pre-arranged rates. To date, no Pacific Island country has entered into such an agreement.

5.4.2 East Asia Response Pte. Ltd. (EARL)

While the EARL cooperative and its equipment is based in Singapore, it was set up by the participating oil companies' corporate entities, not their Singapore affiliates. The area of potential operation extends from the east coast of Africa to Western Samoa, and from Sakhalin Island to New Zealand.

Membership of EARL is not exclusive to oil companies, but while several countries have expressed interest in joining, to date only oil companies have become shareholders. In order to be eligible for assistance from EARL, a country must be either a shareholder or have a third-party agreement in force which sets out the terms of assistance and applicable charges.

Nominal response capabilities at EARL are rated at 30,000t of crude oil. In addition, EARL conducts training courses and assists countries with contingency planning in the ASEAN region. According to officials at the cooperative, one thing that sets EARL apart is their ability to deploy a C-130 Hercules aircraft with an airborne dispersant delivery system module. The aeroplane is available at short notice but can only fly 4 hours from Singapore, hence the range of operation is somewhat limited as far as countries in the east of the Pacific Islands region are concerned.

5.5 CONTINGENCY PLANNING

Contingency planning for response to oil spills has advanced in recent years. Although the limited resources of most island countries are insufficient to deal with a major oil spill, several countries in the region have been active in preparing oil spill response contingency plans that draw on the expertise of industry and external or regional organisations. Fiji's contingency plan, for example, identifies the major risks from oil and chemical spills in the country and lays down a response plan that has been agreed by Government departments, industry, and other involved bodies. Funding for the plan is based on the "polluter pays" principle.

In the USA the Oil Pollution Act of 1990 requires that appropriate response capabilities be in place to deal with possible spills. This legislation also applies to US Pacific territories and has led to the following arrangements being put in place:

- in American Samoa, a Pago Pago-based cooperative consisting of Government and one oil company oversees training and preparedness activities for both Government and company personnel. Oil terminal staff receive hazardous waste operator training and yearly refresher courses. Once per year a drill involving the deployment of all major equipment is undertaken, and exercises in notification of key personnel are conducted monthly. Oil recovery equipment available is rated at 4,000 bbls (550 tonnes) per day; two containment booms which are 1,400m total length; on-board water storage is 1,500 bbls (205 tonnes); and identified shoreside tanks can hold over 14,000 bbls (1,900 tonnes). Contingency planning includes identification of several local vessels which are available for emergency deployment of available response equipment.
- in Guam, Guam Response Services Ltd. is an organisation formed by oil companies without direct involvement of the Government. The oil recovery equipment available reflects the larger harbour area and greater through-put at the terminals. Oil recovery equipment is rated at 5,000 bbls (680 tonnes) per day, containment booms are 2,800 meters total length, on-water storage capacity is 1,400 bbls (190 tonnes), and shore storage is 80,000 bbls (10,915 tonnes). There is also a significant US military and Coast Guard presence in Guam which could be deployed in the event of an oil spill.

This type of contingency planning has, however, bypassed many other Pacific Island countries. Pacific Island Governments should prepare for oil spills through the formulation of national plans to deal with oil pollution. In many countries the principal risk of an oil spill is from ship groundings, so an oil spill contingency plan would also be useful in developing appropriate responses to ship grounding events.

A contingency plan should include at a minimum the agreed administrative arrangements for responding to an oil spill and/or ship grounding, including delegation of responsibility for the specific areas of action required, identification of the local or offshore resources to be deployed during the response and a description of the training, coordination and financial aspects of the plan. While the plan needs to address all sources of oil spills, it should provide for specific responses to oils spills arising from ship groundings. It should also include a provision for periodic updating and revision.

6 OPERATIONAL RESPONSES TO A SHIP GROUNDING

6.1 GENERAL

In a grounding, time is of the essence. Actions taken by the ship's crew, rescuers, salvors, Government officials, and local people present at the scene should be coordinated and well thought out, but at the same time quick and effective in minimising the effects a grounding might have on people, property and the environment. The immediate consequences of ship groundings can be injury and loss of life, environmental damage (including physical degradation of resources and pollution) and damage to property and belongings.

The grounding can take place on a remote island or reef, making response by Government difficult and sometimes quite expensive. Rescue and the sending of investigators and other personnel to the scene are often unplanned expenditures for Governments. When salvage vessels from outside the country are dispatched to the scene it is often important to have them travel directly to the grounding site. This is more than simple expedience, but often in the best interests of all concerned in attempting to free the vessel and minimise the damage caused. However, arrival at a site without prior port clearance can cause problems regarding compliance with immigration and quarantine regulations.

At the first notice of a ship grounding, of paramount importance to all concerned should be the safety of the crew. As soon as grounding of a manned vessel occurs, the first response will come from the master and his crew and will depend on the circumstances of the grounding: the size and condition of the vessel, weather, location, sea state and so forth. The master will give top priority to the safety of the crew, and at the same time be considering actions to prevent escalation of the incident which will complicate the problems he is already facing. He will obtain detailed information on the damage incurred, both by visual inspection as well as by sounding tanks and other compartments. He should be paying particular attention to the condition of the ship's hull and any damaged areas. If the vessel is taking on water due to the grounding, he will order preventative measures such as the closing of water-tight doors. Based on the judgment of the master an emergency call might have already been sent, depending on the severity of the situation faced. Once the master feels he has stabilised the immediate situation to the best of his ability, he can then turn his attention to notifying the owner and appropriate authorities as required.

6.2 SAFETY AND RESCUE

Rescuers or on-shore authorities should establish communication with the vessel and account for all the crew as soon as possible, as there may have been injuries sustained during the grounding. There is also potential for the impact to knock seamen overboard and those on the vessel may not be in a position to assist.

The first potential rescuers on the scene of a grounding might be local people with little or no knowledge of procedures to follow in such a situation. If the vessel is a commercial cargo carrier, particularly a large vessel, those on the vessel should have the knowledge and training necessary to participate in the planning of their own rescue if required. Larger vessels in international trade usually carry mechanical or explosive line throwers on board as well as sufficient mooring lines and equipment with which to rig a "breeches buoy" or similar apparatus for safely bringing the crew ashore or to a point where they can be rescued.

Some vessels, particularly commercial fishing boats involved in a fishery near the area of the grounding, may call for assistance from other vessels in the fishing fleet. Once on the scene of a grounding, these other vessels might be manned by mariners with limited knowledge of salvage and rescue techniques and procedures. Depending on the severity of the grounding, sea conditions and location, such a rescue undertaken by other fishing vessels could include attempts to salvage equipment, fishing gear, catch and cargo. In cases where such rescue vessels have arrived quickly on the scene of a grounding, local inhabitants should allow the rescue to proceed without interference and should render assistance only when asked.

It is important that local residents, particularly those not familiar with machinery or the contents of stranded vessels, be advised of hazards and warned away from boarding the vessel for any reason, particularly when the vessel's crew or a salvage crew are not present. Apart from the legal implications, there are very real hazards to people who might board a stranded vessel without authority, as detailed in section 3.1.

6.3 OIL OR FUEL POLLUTION

The greatest potential for major environmental damage from ship groundings is in the form of oil spills from the cargo carried by tankers. However, while only 8% of grounding events in the region in the last ten years have involved tankers, all vessels which go aground carry fuel for their own propulsion, sometimes in quite large quantities (tens or hundreds of tonnes). On a small reef or isolated coastal area even the smaller amounts of fuel oil carried by a fishing or cargo boat can cause major environmental damage.

Most commercial cargo vessels, as well as many larger fishing vessels, carry fuel in "double bottom" tanks which have a stabilisation as well as a storage function, integrated into the hull. Rupture of these tanks at impact or from subsequent movements of the ship due to wave action or salvage operations should be of primary concern.

In addition to double bottom tanks, larger vessels will also have "day tanks" as well as separate tanks for lubricating oil and hydraulic oil. Large tuna purse seiners carry quantities of petrol for use with outboard powered chase boats, as well as aviation or jet fuel for helicopters. Smaller vessels, particularly those under 30 meters in length, will usually carry fuel supplies in separate tanks within the hull.

6.4 SALVAGE

6.4.1 Practical aspects

Although a detailed discussion of salvage techniques is beyond the scope of this report, knowledge of the practical issues involved is important in planning Government responses to a ship grounding.

It should be emphasised that every salvage job is different. The size of vessel, location of grounding, damage incurred to vessel and other factors contribute to the uniqueness of the grounding and the subsequent salvage technique. However, in general the following procedures are often followed or considered:

- stabilising the vessel: a vessel stranded on a reef may be incurring damage if it is semi-floating and periodically contacting the reef while being pounded by surf. Stabilisation can frequently involve setting ground tackle and flooding tanks and other areas so that the ship rests firmly on the reef;
- damage inspection: determination, frequently by using SCUBA gear, of the extent of damage to the hull, steering and propulsion machinery;
- temporary repairing of the damage to the hull: this may involve a temporary patch, construction of a cofferdam (new bulkhead), plugging with cement, or water displacing foam;
- lightening of the vessel: this frequently involves removal of cargo, fuel, ballast, parts of the vessel, or any sea water which may have been taken on to stabilise the grounded vessel. This could be done by jettison into the sea, transferring to another vessel or removal by helicopter. Because much damage can be sustained while the vessel is pounding the reef in the semi-floating state, it is often essential that lightening be carried out rapidly;
- moving the vessel off the reef: the vessel may be towed by one or more vessels, pulled by ground tackle, pushed by mechanical means, moved under its own power, or a combination of these mechanisms;
- moving the vessel to a harbour of refuge: the vessel may be cautiously moved to a location where more permanent repairs can be effected.

Although salvage is attempted with assistance from many different types of vessels, the larger jobs are usually undertaken by a dedicated salvage vessel carrying specialised gear. Standard salvage equipment consists of:

- air compressors to force water out of compartments;
- water pumps;
- electrical generators, for especially lighting;
- welding equipment;
- wire ropes;
- polypropylene tow ropes;
- hoses for transferring liquids;
- lifting bags;
- block and tackle;
- assorted tools and fittings.

In the past a dedicated salvage vessel, the *Pacific Salvor*, was based in Suva and available for salvage work in most of the Pacific Islands region. In the late 1980s the salvage operation was transferred to Australia and there is presently no dedicated or equipped salvage vessel with a home port between Australia and Hawaii. This may adversely affect the economics of salvage in the Pacific Islands.

The issue of fuel deserves special mention. Because the fuel aboard a vessel can impede salvage, it is often removed along with other cargo in order to lighten the vessel. The value of the fuel can be considerable (even a fishing vessel can have USD200,000 worth of fuel aboard) and therefore there is financial incentive to salvage. If tank barges are available and the cost of the use of the barge (including charges for transport to the salvage site) is in proportion to the value of the fuel that can be recovered, then the fuel would probably be salvaged. There are cases in the Pacific Islands, however, in which tank barges were not available or where financial or other conditions resulted in the fuel being dumped in the ocean or lagoon. Many Pacific Island countries appear not to have such barges. It should be noted that a delay in salvaging due to waiting for a tank barge could result in the ship becoming unsalvageable and ultimately doing more damage than dumping the fuel.

During the preparation of the present document, several salvage specialists offered the opinion that a complex salvage job should be attempted only by skilled salvors and that more damage frequently occurs to a vessel during salvage than during the initial grounding. This contention is supported by the Lloyd's Maritime Information Service Casualty Register which contains four cases (in Papua New Guinea, French Polynesia, Federated States of Micronesia and Fiji) in which the vessel operated by the salvors went aground during the salvage attempt. It also appears likely that more environmental damage (including the above-mentioned dumping of fuel) may be caused by non-specialists than by professional salvors.

6.4.2 Legal aspects

The legal issues surrounding salvage are dependent on the national law of the country in which any action for salvage is being brought. Since countries are free to make laws as they please in relation to matters such as salvage, there may be variations from country to country with regard to certain aspects of the law of salvage. The following discussion of salvage will therefore be in general terms, setting out the rules that apply in most maritime jurisdictions. While this accurately reflects the laws in most countries, it should be borne in mind that there may be slight variations in either procedure or the substantive law of salvage from country to country.

In law, salvage services are those services which save or contribute to the ultimate safety of vessels, cargo or the lives of persons belonging to vessels in danger at sea or in tidal waters. The service has to be rendered "voluntarily" and not in the performance of any legal or official duty or merely in the interest of self preservation. The person who renders the service, known as the salvor, becomes entitled to remuneration (reimbursement of costs) and salvage award. Usually, to qualify as a salvor a person must be personally engaged in the salvage service or be the owner of either a vessel or property which was used to provide a salvage service. Recovery of cargo from a sunken ship can be the subject of salvage.

The procedure for bringing a salvage claim will normally be set out in legislation and where a party salves the property of another, salvage rights can be enforced in the courts. One of the peculiarities of maritime law is that in addition to taking action against the owner of the vessel or the cargo, the salvor can take action against the ship itself. This frequently involves "arresting" the ship concerned and holding it until the owners pay a sum of money to cover the claim into the court or alternatively, the arrested vessel can be sold to provide a fund in the court from which the salvage amount can be drawn. Legislation may provide for a limitation period (that is, a period beyond which action cannot be brought) in respect of a salvage claim. Commonly salvage rights can be enforced by either actions *in personam* (against a legal person or entity) or actions *in rem* (against the ship).

For a salvage award to be sustainable there must normally be a danger to the object of the salvage services. The danger need not be immediate but normally the salvor has the onus of proving that there was a danger. Because courts encourage salvage, the degree of danger does not have to be significant provided it is not fanciful.

To be successful in a claim for salvage, a salvor must not be under any prior contractual or other obligation to render salvage services. In some cases (for example in Australia) there may be a statutory obligation on a master of a ship to render assistance to any person found at sea in danger of being lost. The English courts have held that compliance with such a statutory obligation does not prevent assistance from being voluntary for the purpose of a salvage reward. Further, there must be some degree of success on the part of the salvor. The salvor must be able to show that some property in the ship, cargo or life was preserved and secondly that the salvor's efforts were effective in some way towards that preservation.

The right to a salvage award for saving human life in danger at sea usually only exists in statute and was not a part of the original law of salvage. There can be no salvage reward for salving ones own property, nor can there be reward for masters and crew in performing their obligations (even though the same services may give rise to salvage if a "volunteer" were to perform them).

Criminal misconduct of the master and crew does not forfeit or diminish the award, but misconduct on the part of salvors may disqualify some of them from reward. If the danger into which the salved vessel placed was caused by the salvor, no reward is payable.

As to the amount of the award, the courts usually reward salvors on a liberal scale. Factors taken into account include the degree of danger to either human life or the salved property and the value of the property as salved along with the degree of danger to either life or property of the salvor, the salvor's skill and conduct, the time occupied and work done in performance of the salvage service, responsibilities incurred by the salvor and the loss or expense incurred by the performance of the salvage service.

Courts recognise that as a matter of public policy encouragement should be given to professional salvors who, at considerable expense, maintain and keep specially equipped salvage tugs in a state of readiness to assist vessels in distress. Consequently awards granted to professional salvors are generally more liberal than would be granted in similar circumstances to other salvors.

Because of the nature of salvage, salvage services are often rendered without any formal or written contracts being in place. The principle is that by performing the salvage services, the salvor becomes entitled to an award in the event that some or all of the vessel or cargo is salved. The parties may, however, enter into a formal contract for salvage which may alter some of the usual rules of salvage, for example, the basic salvage principle of "no cure - no pay". A common form of salvage agreement is the Lloyds Open Form (LOF). In LOF 1990 unsuccessful attempts at salvage of oil tankers may result in an award to the salvor of his cost plus 15%. Potential salvors should be aware that salvage agreements may make provision for arbitration in respect to the salvage to take place in a nominated country, frequently the United Kingdom.

As to the right of Government or naval forces to salvage, some doubt has existed in the past. In many cases this aspect of salvage may be covered by legislation.

Remuneration payable to salvors is usually awarded to cover all the salved property i.e. the ship, cargo and freight. The amount then has to be apportioned to take account of the salved values so that the owners of the salved property contribute rateably in proportion to the benefit each has received from the successful completion of the services.

6.5 PROPERTY AND BELONGINGS OF THE CREW

The personal property of the crew of a grounded vessel remains their personal property until such time as they voluntarily relinquish ownership. There have been incidents in the past where both Government officials and local residents at a grounding site have impounded or taken away a crew's personal property, including sextants and other equipment. Items claimed by the crew as personal property should not be confiscated, as long as that property is not needed in determining the circumstances of the grounding and is not contraband or otherwise illegal in the jurisdiction of the grounding.

6.6 REPRESENTATION AT THE GROUNDING SITE

During the salvage operation it is quite likely that there will be professional representatives present on the scene to safeguard the interests of the various parties associated with the ship (ship owner, insurer, cargo owner, etc.). In past Pacific Island ship groundings there has often been no competent Government representative present to safeguard local interests (villagers in the area, environment). Because this has worked to the disadvantage of local interests it is suggested that the Government have some representation oriented to local needs at the grounding site.

In many Pacific Island countries, a "Receiver of Wreck" is established by law and this Government official is required to proceed to scene of a grounding. The duties of this individual relate mostly to protecting the interests of the vessel. For example in Fiji the aforementioned Wreck and Salvage Act specifies that the Receiver of Wreck is charged with the "preservation of the ship or boat or lives of persons belonging thereto and the cargo or apparel thereof". This further emphasises the past lack of concern for local interests which may be adversely affected by the grounding and the need for representation of these interests at the scene.

7 LEGAL ISSUES ARISING FROM A SHIP GROUNDING

7.1 JURISDICTIONAL ISSUES

7.1.1 Criminal

In cases of ship groundings, criminal jurisdiction by the state is exercised when there is a breach of relevant domestic law. It appears that very few countries in the region actually make it an offence to run aground and/or cause physical damage to a reef[2]. However where it is an offence, as with all criminal prosecutions the severity of the penalty is mainly determined by the gravity of the behaviour of the master and not necessarily by the gravity of the damage, which is usually the subject of civil action. In situations where the vessel is insured by a P&I Club, it is usually the club which would pay the fine or indemnify the master for any fines imposed, as long as no gross negligence (e.g. drunkenness while on duty) is proven.

In most countries any vessel operating in territorial waters, regardless of nationality, must report to the Government any incident, damage, collision, or if the ship has been in a "position of great peril". Depending on the country involved or situation, penalties can be assessed for a failure to report.

7.1.2 Civil

Before civil claims are put forward, there must be a demonstrated liability on the part of someone or something. Civil claims can be for loss, damage, and expenses reasonably foreseeable from the grounding incident. Claimants can include not only the resource or reef owner, but also those who sustain economic loss, for example tourism operators or fishermen whose business or livelihood is damaged by the grounding.

It is possible for the Government to bring suit on behalf of people who would otherwise have no standing before the court, such as a group of village people who are resource owners. This representation of the group for its protection and benefit is discretionary on the part of the Government as a kind of "class action". In application to the court, the Government can request to represent the identified members of the group. The court would then approve any settlement reached in the dispute, or if no agreement has been reached, order its own settlement and determine the distribution of benefits from it.

Ship owners are not oblivious to their potential exposure in these (and many other) situations and commonly minimise that exposure by keeping the vessel's operating entity as separate as possible from the owning entity, limiting access to the latter's assets as much as possible.

7.1.3 Writs and arrest

One unique feature of maritime law is that it recognizes inanimate objects such as the ship, cargo, bunkers and stores, each of which can be sued in its own right. Arresting a ship is not difficult, requiring the filing of a statement of claim or writ of summons. Following other procedures in the appropriate court a warrant of arrest is issued. It is the responsibility of the court to see to the execution of the warrant, and to the maintenance of the vessel while it is under arrest.

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2 A notable exception is the State of Yap, in the Federated States of Micronesia, which enacted a law in 1991 making it a crime to damage any coral reef or any part of the natural environment that is important to the maintenance of a coral reef, including but not limited to sea grass areas and mangroves. The law covers damage due to "petroleum disposal and shipwrecks", and was employed in the *Oceanus* case of 1994 when the master pleaded guilty and was assessed a total fine of USD130,000.

Yap State also has legislation which provides for criminal penalties for both intentional disposal (maximum fine USD25,000 or 60 days imprisonment) and negligent disposal (of at least fifty gallons released or disposed ,maximum fine USD25,000) of oil. In the context of a ship grounding such penalties would be relatively minor compared to the value of the vessel and the costs of salvage.

Time is a critical factor as owners, salvors and others with a direct interest in the vessel can be expected to do their utmost in avoiding arrest of the ship and its potential consequences. The issuance of an arrest warrant is usually an administrative act, and not a judicial one. While the court does not consider the validity of the action when ordering the arrest, there can be large penalties for a party which orders a wrongful arrest.

Once an arrest is effected by delivery of process to the ship itself, legal action can continue for damages and losses due to the grounding. An arrested ship cannot be moved without the permission of the court, and this in itself can be a large incentive for vessel owners and operators to provide adequate security, and in some cases to the payment of damages.

7.1.4 Traditional Attitudes

The notion that "anything that comes ashore on my reef belongs to me" is an attitude still held in some countries in the region. While this attitude has little consequence in relation to, for example, drift logs or beached whales, its application in ship grounding situations may be in conflict with statutory law. This may be an issue which could lead to difficulties in countries which grant standing to aspects of traditional law, either in their constitutions or by other means. As one country facing some aspects of this issue, the Federated States of Micronesia is reportedly considering an approach which would involve meetings with traditional and community leaders to explain the international situation and legal obligations of the Government in these situations.

7.2 COMPENSATION CLAIMS

7.2.1 Basis for claims

Until now when a vessel has grounded the villagers adjacent to the reefs and others directly and indirectly affected by the grounding have rarely received compensation for damages suffered as a result of such grounding. This is principally due to the affected persons being unaware of their legal rights and not in a position to pursue a claim for compensation. As a general proposition, if loss or damage results from a grounding for which one or more parties may be responsible and the nature of the loss is reasonably foreseeable to the perpetrator, then a claim for compensation may be brought.

Some of the problems that have been identified which until now have made difficult the bringing of a claim for compensation include:

- the identification of the people who have been affected and can bring a claim;
- the identification of precisely what loss and damages such people may have sustained;
- the assessment or quantification of the actual or prospective loss and damage that such people may be entitled to receive;
- the absence of domestic laws to permit the bringing of a claim for compensation;
- the absence of laws permitting the enforcement in an overseas country of any award or damages obtained.

It is now recognised that a grounding of a vessel on a reef can probably give rise to problems other than physical damage to the reef (e.g. depletion of local food sources, loss of economic returns to reef users, etc.). As a result of overseas changes in the law, it is now possible for villagers adjacent to wreck areas and others to bring “class” or “representative” actions to recover damages for economic loss sustained as a result of a vessel grounding, and not just for physical damage that may have been sustained.

In order to obtain such compensation, affected people need to be made aware of their possible rights to pursue a claim. It should also be stressed that claimants need to obtain adequate security from the vessel's P&I Club, owners or others interested in the vessel, to ensure they have real prospects of recovering any damages they may be awarded. This security may consist of:

- acceptable letter of undertaking by a reputable P&I Club;
- bank or insurance bond or guarantee;
- payment into court;
- letter of guarantee from a reputable company.

In such a situation it is essential to seek good legal advice, obtain evidence, and act quickly so that action can be taken to obtain security as soon as possible after the grounding occurs, and certainly before the ship can depart the scene. If the ship owners/operators are reluctant to provide such security, or cannot be traced, then the claimants may at that point wish to consider applying to the court to intervene by setting a bond, or to issue a warrant for the vessel's arrest. Following arrest, the vessel's owners/operators will almost certainly make themselves known and enter into negotiations that they may not previously have been willing to consider.

An evaluation of the extent of potential damage plus a hedge against unexpected or unforeseen damages need to be calculated as quickly as possible if a realistic security is to be obtained from the ship's owners or agents. Any valuation should allow for possible undetected consequences of the grounding, costs of reconstructing the reef, or other eventual future consequences (such as ciguatera), and should produce a result which is a high estimate or an over-estimate of the value of damages.

Determining a preliminary damage value in this way is only done for the purposes of establishing a financial commitment, bond or security from the ship owners, and as such it may serve to establish an upper limit to the damages that may ultimately be payable. This being the case, care should be taken to ensure that this upper limit does not turn out to be below the true estimate of the cost of damages which may be assessed by a later, more detailed study. In this context it should also be noted that wherever an estimate of the material cost of damages is made, the true cost of those same damages usually turns out to be between three and five times the material estimate after all consequential and other losses have been factored in.

In the case of a dispute as to the level of commitment or security required, the court may be asked to set a suitable level of bond, to make a preliminary estimate of the value of damages or even to issue a warrant for the arrest of the vessel. However, since the ultimate settlement is independent of the level of commitment or bond initially established, it is normally possible for both parties to reach agreement on a suitable level of bond. In agreeing to a commitment or bond the vessel owners or insurers are simply agreeing to negotiate and the amount of the final settlement will depend greatly on more refined damage estimates, as well as issues such as the ability of the injured parties to obtain and pay for legal representation and the actions taken by the community to restore the damaged area themselves before the claim reaches court.

Finally it should be noted that since there is no prior guarantee that a compensation claim will be upheld by the courts, reef owners should take whatever actions they can to restore the reef of their own accord. The legal system is likely to be less sympathetic in a case where local residents take no action because they anticipate a compensation payment.

7.2.2 Damage assessment

Damage to the reef itself may fall into a variety of categories, for which circumstances will determine the amount, if any, that may be the subject of a compensation claim. There is no standard system of valuing coral reefs; each case must be assessed according to its particular characteristics and its potential as well as current uses.

Some of the more easily quantifiable uses or value bases of coral reefs are paraphrased from Spurgeon (1992) as follows:

- **Fisheries**. Loss of revenue from commercial exploitation of marine resources (fishing, business operations such as aquarium fish collection, the harvesting of coral for the curio market, pearl or seaweed farms, or recreational fishing) may be estimated by assessing changes in the production or productivity of the resource. The monetary value of reef damage in a subsistence situation or where the damage is in terms of fish quality rather than quantity (e.g. where a grounding results in ciguatera or tainting) may need to be based on different criteria, since the consequences experienced include nutritional deficiency, social disruption and inconvenience;
- **Tourism**. Substantial benefits arise from coral reef-based tourism ventures (SCUBA diving, boating, fishing, eco-tourism, etc.). In addition to the direct revenues generated by on-reef tourist activities, indirect revenues such as those from accommodation, food and travel also arise and their values may exceed those of the direct benefits; and
- **Navigation**. Damage from a grounding which impedes thoroughfare, as may occur when a channel is blocked, may be assessed on the basis of the cost of removing the wreck, cost of placement and maintenance of navigational aids, and the inconvenience caused in extra travel and risk encountered in the resultant deviation.

In addition, there are other less easily quantified values attached to reefs and coastal areas. These are paraphrased from Spurgeon (1992) as follows:

- **Social value**. Loss of resources may equate to the loss of livelihoods. The social cost of the damage equates to the loss of earnings and associated welfare expenses;
- **Biological value**. Damage to a habitat may affect adjacent habitats. Coral reef fisheries in particular are integrally related to nearshore habitats such as sea-grass beds and mangroves. Juvenile fish and invertebrates migrate between reef areas and among habitats, providing a reservoir for recruitment and food for other species including commercially important ones;
- **Cultural value.** Aesthetic appreciation of coral reefs is an important asset and will be marred by the appearance of a stranded vessel or pieces of wreckage strewn on the reef, as well as by the consequences of pollution. Portions of a coral reef may be of particular importance to local residents for cultural or spiritual reasons;
- **Existence value**. There is a value attached to the inalienable nature of the community's association with the coral reef. Satisfaction is gained from the knowledge that the coral reef equates to nutritional security. The greater the quality, condition and uniqueness of the reef on a national or global scale, the higher the existence value. In a subsistence sense, the importance of security is proportional to the degree of community dependence on the reef and the availability of alternative food sources, particularly if the reef is small and isolated;
- **Option value**. This is the value attached to the option of designating a reef area as restricted or as a preserve for future use, for example in setting aside a marine reserve so that it will enhance fisheries in other areas, or to act as a "larder" which will only be fished during periods of poor catch elsewhere or when large amounts of food are required for community social occasions;
- **Rarity value**. As pristine coral reefs become more and more scarce in the world today, the value of such an ecosystem to science and research should increase with time;
- **Heirloom value**. The bequeathing to future generations of an ecosystem which has some or all of the above characteristics. In a subsistence situation, its importance is inextricably linked to survival and cherished as such. In an affluent society which has recognised the natural environment as a global asset, the value is represented as a national source of pride.

Further values may also exist, depending on the local situation. For instance, the mass of the reef itself functions to dissipate wave energy and this may be important in protecting the coastline from erosion. Damage to the reef by a majot grounding could result in longer-term changes to coastal morphology (U. Kaly, pers. comm.).

In any given grounding there will be a sum of these individual values which provides an approximation of the overall cost of the damage or disadvantage. Ideally, compensation requires valuation of financial and social benefits on an annual per unit area basis.

Reefs used for tourism are most obviously of high economic value. It may be more difficult to calculate values of reefs used primarily for fishing unless detailed catch statistics are available, which they are often not. This is particularly true of subsistence fisheries, where a sympathetic understanding of the type of lifestyle involved is necessary to fully appreciate the disadvantage experienced by a community that leads a wholly subsistence existence. In an isolated island or coastal situation, non-monetary uses of the reef may include considerations of culture or heritage that are foreign to the understanding of those responsible for arbitration of the case. A damaged reef in the Federated States of Micronesia was valued at USD20 per sq. m., the same as for agricultural land which was considered equivalent in food value. In the Red Sea, following an oil spill from a tanker that affected about 50 kilometers of the Saudi Arabian coastline in 1989, the reef was valued at only USD0.10 per sq. m. on the basis of its potential fishery yield (J. Kirby, pers. comm.).

Some examples of compensation considerations relating to recent grounding events are as follows:

- Molasses Reef in Florida, on which the *Wellwood* grounded, was valued at USD2,000 per sq.m, a notably high value because of its importance as the most popular dive site in the Key Largo National Marine Sanctuary. The Cypriot company that owned the ship reached an out-of-court settlement with the US Federal Government of USD6.3 million for the 1,500 sq.m damaged, USD3 million of which was allocated to reef restoration (Bonareff, 1988);
- taken over the whole region, Florida’s reefs have been calculated to have an annual value of USD15.75 per sq. m. of live coral based on direct income from diving, snorkeling and boating, or USD85 if the revenue from travel and accommodation costs for reef users is taken into account. If fishing, other reef-use activities and the vital role of protecting the shore are also included, the value would be even higher;
- In 1990, a dredging company paid USD1 million compensation to the local authorities in Florida for scraping coral off one hectare of reef while pumping sand to replenish beaches, a settlement that is being used for reef conservation (J. Kirby, pers. comm.);
- in a grounding incident in Egypt the Government claimed USD4.8 million for 411 sq. m. of damage on the periphery of a diving site (the damage was independently valued between USD100,000 to USD600,000, depending on the assessment method used). The Egyptian Government had arrested the ship and so had a strong bargaining position, and the case was settled out of court for USD1.1 million (C. Roberts, pers. comm.);
- another Egyptian grounding resulted in a payment of USD600,000 for an affected area of only 341 sq. m. in an area not even used for recreational diving. The Egyptian Government originally claimed USD30 million compensation for this grounding but settled for much less in the end because they did not have possession of the ship as a “bargaining chip” (C. Roberts, pers. comm.);

Clearly the process of valuation is complex and the results at present are variable and highly dependent on the site in question and the amount of information available. In fact the Australian Great Barrier Reef Marine Park Authority (GBRMPA) now takes a different approach to valuing reef damage than in the past. GBRMPA has found that the concept of putting a value on reefs is too arbitrary and has fallen into disrepute because the methodologies used have been challenged and proven easy to dispute. The only time GBRMPA now uses this method is when a specific value can be attributed to the damage, such as the degree to which a fishery with a known value has been affected. The approach GBRMPA now prefers is to define an “acceptable state” for the reef, which depends greatly on its location and other values. This involves setting a level of condition for the reef that is acceptable to maintain the ecological integrity of the area. That level may not necessarily be 100% of the original condition. GBRMPA then estimates the costs involved to return the reef area to that “acceptable state”, for instance how many divers would be required for how long to remove the rubble, transplant coral, etc. This is then taken as the value, or cost, of the damage done (J. Oliver, pers. comm.).

Since values depend on local circumstances to a considerable degree, there is in practice no universal way to value reefs. However, it would be extremely helpful to have a formula or mechanism on which to base the amount of damages or security required of the vessel owners following a grounding event.

8 GOVERNMENT/ ADMINISTRATIVE RESPONSES TO A SHIP GROUNDING

8.1 GENERAL

Government and administrative responses to a ship grounding should be pursuant to a Contingency Plan. If no such contingency plan exists, then serious consideration should be given to its development at the first opportunity. For situations in which contingency plans are not in place, the general issues to address and possible actions to take during a ship grounding event are described below.

To keep all the involved parties appraised of current and proposed responses to the grounding, most of the issues described below should be discussed and decided on in conjunction with the relevant Government Departments, especially those such as the Marine or Transportation Departments and the Office of the Attorney General which may have special technical knowledge or skill. Briefings should be given to all concerned parties regarding the eventual need for review of the incident and the importance of maintaining detailed records of actions taken, costs incurred, damage sustained and remedial action taken.

8.2 SAFETY, PREVENTION OF LOSS OF LIFE OR INJURIES

Injuries may have been sustained in the grounding or during the evacuation from the vessel. Alternatively, sea conditions may be preventing evacuation and therefore the crew may be in danger. Government authorities should assess the rescue situation immediately and decide who should respond and whether outside assistance is needed to ensure crew safety.

The safety of those people residing in the area of the grounding should be considered. Authorities should determine if the type of cargo carried poses any immediate threat to human life. Throughout the incident it is important that local residents, particularly those not familiar with machinery or the contents of stranded vessels, be advised of hazards and warned away from boarding either the stranded vessel or salvage vessels for any reason without permission. Aside from the legal implications, there are very real hazards to people who might board a stranded vessel without authority, as detailed in section 3.1.

8.3 ESTABLISHING CONTACT WITH SHIP'S OWNERS/INSURERS

Following a grounding, it is important to ascertain who is the owner and/or charterer of the grounded vessel in order to determine the owner's intentions as well as for the purposes of possibly initiating legal proceedings and/or a compensation claim. Government authorities should determine the identity of the owners of the grounded vessel as soon as possible.

The master of the vessel or its agent should be asked to provide this information if it is not already known or easily obtainable from Government or other sources. If the master and/or agents are not prepared to provide the information it may be obtainable (for a fee) from Lloyd's Maritime Information Service (see page 7). Lloyd's maintains several database listings of ship owners, managers and parent companies, ships' particulars and casualty and demolition information. These databases contain details of all known self-propelled seagoing merchant vessels of 100 GRT and above and comprise records on over 85,000 ships including 25,000 fishing vessels.

Alternatively, ownership information may be available from:

- the vessel's flag state registration authority;
- the vessel's classification society (if in class);
- the vessel's P&I Club or its correspondents at the place of grounding;
- the vessel's hull insurers and/or any legal advisors, marine surveyors or other representatives that they may have appointed; or
- shipping publications such as Lloyd's List, Fairplay, Seatrade, Daily Commercial News, etc.

If, after attempting to obtain ownership information through these channels, the vessel owners still cannot be identified, then consideration might be given to arresting the vessel, at which time the owners will almost certainly make themselves known.

Officials should ascertain the plans of the owners and insurers for the stricken vessel, including details of any visits planned by the owner or his representative to the grounding site. The owner's representative should be included in a meeting of involved Government Departments to discuss actions to be taken, and should be required to provide the latest information from surveyors and salvors as well as stating the owner's intended course of action (which may include abandoning the vessel). Information from the owners/insurers on the amount of fuel, oil products and dangerous cargo on board is especially important and should be compared to or verified against any details obtained from the ship's personnel at the grounding site. Information on any plans to use a tank barge for removing fuel should also be obtained.

8.4 IMMEDIATE POLLUTION

As early as possible in a grounding event a determination should be made of the quantity and type(s) of fuel, petroleum and chemical products on board the vessel, as well as the location and the condition of fuel and oil tanks. Verbal or written confirmation of the quantities involved should be obtained from the ship's crew or others at the scene. To avoid later confusion, officials obtaining such information should make sure they understand the quantities involved, and should ask for clarification if these are expressed in unfamiliar terms (such as barrels rather than tonnes - see Annex 2 for conversion table) or if the quantities stated do not seem reasonable for the size of vessel in question.

In situations where conditions such as heavy wave action or high seas at the grounding site mean that any spillage from these tanks may not be readily apparent, a preliminary check of the tanks' integrity should be made by inspection of the tank air vents or fill pipes at deck level. In the presence of wave action, the pressure changes caused by air movement in ruptured tanks can emit "whooshing" or whistling sounds that are not normally present.

The quantity, nature and location of any other cargo, particularly toxic fluids, being carried on the vessel should also be checked, and any signs of leakage or spillage noted.

In the case of a major pollution event such as a grounding and subsequent breaking up of a tanker or a vessel carrying hazardous cargo, most of the countries of the region are bound by treaty to follow certain procedures as stipulated in the Protocol Concerning Co-operation in Combating Pollution Emergencies in the South Pacific Region (see section 4.2.2). These procedures include:

- making a preliminary assessment of the event;
- communication of information regarding event to other parties;
- determination of ability to respond to the event;
- consultation with other parties in regards to the event.

8.5 PRELIMINARY ASSESSMENT OF ENVIRONMENTAL IMPACT POTENTIAL

An initial assessment of overall environmental impacts or potential impacts will be important in determining if and how salvage operations should be allowed to proceed, in setting initial limits to the liability of the ship owners and operators, and in the ultimate determination of any damage awards. It should be noted that in a major grounding, the owners and insurers are likely to have high-quality professional assistance in recording environmental information that will subsequently be used to support their perspective on events connected to the grounding. This underlines the need for local authorities to accurately collect adequate information on the grounding's effects.

It may be that an environmental monitoring programme will ultimately be established to fully assess the effects of the grounding. It is unlikely, however, that such a monitoring programme will be initiated immediately. It is therefore important to collect basic information related to the environment immediately after the grounding. This might include:

- samples of fuel or other substances leaking from the vessel;
- samples of fuel and lubricating oil taken directly from the vessels tanks;
- details of weather and sea conditions;
- any movement of the vessel on the reef;
- the amount of coral rubble in the area;
- the position of the vessel on the reef, measured from a prominent feature on the reef. This should preferably be marked on a chart and agreed to by the master;
- details of any attempt to lighten the vessel by discharging cargo overboard and, if safe, samples of the jettisoned material
- notes on the location and extent of areas to which any jettisoned material has drifted.

Because much of the damage resulting from a grounding is likely to arise from the effects of oil pollution or from loose coral rubble, special attention should be focused on collecting information on these aspects of the grounding. All samples must be collected carefully for evidential reasons. They should be placed in clean containers and be labeled immediately with the location, date and time, and the name of collector. In the past there have been cases where samples could not be used in legal proceedings due to the use of contaminated containers.

Where environmental damage is likely to be substantial, information which can withstand scrutiny during future legal action is extremely important and details should be recorded with great care. In the past the use of videos or photographs to support data collected has been useful and is to be recommended wherever feasible.

It should be stressed that until the vessel is stabilised on the reef, approaching the vessel too closely to collect information on reef damage near the hull can be dangerous and should be avoided.

8.6 APPROVAL OF SALVAGE PLANS OR SALVORS

Government action immediately after a grounding must reconcile the need for rapid action with the desire to minimise damages to individuals and the environment. Salvage operations by their nature give priority to the recovery of the vessel in the shortest time at the least cost. However this approach often leads to environmental considerations receiving a low priority, and there have been cases in which the salvage operation has caused far greater damage than the original grounding, sometimes involving actions that appear negligent or even cavalier. In response, there is a body of opinion which says that, in order to ensure that environmental concerns and the interests of local residents are given adequate consideration, salvage plans should be approved by Government prior to the salvage operation commencing.

An alternative course of action is, however, recommended here. Rather than risk protracted negotiations over a salvage plan, during which time the stricken vessel may do further damage, it is suggested that the most appropriate mechanism to ensure timely salvage with minimum negative environmental effects is for the Government to insist that the work be undertaken by an experienced salvage company. The Government should obtain information on the abilities and experience of the salvor and consent to his use prior to the actual undertaking of salvage operations. The salvor should exhibit proof of his own liability insurance. If it is thought necessary, the ship owner or the salvor himself should be required to post adequate security to encourage responsible action.

In cases where for whatever reason (e.g. lack of financial incentive) it is not possible to engage professional salvors, Governments have been known to become directly involved in salvage operations, often with poor results. If Governments do plan to become involved in the actual salvage operation, planning discussions should address the same concerns of financial responsibility, abilities and experience as would be the case with commercial salvors.

8.7 FACILITATION OF TIMELY SALVAGE

Once the ship owner's choice of salvor has been agreed to, Government should take steps to expedite immigration and customs clearance of salvage personnel, vessels and equipment, including those needed for clean-up. With time often the most important factor in successfully completing a salvage operation and minimising damage, Governments should be prepared to either provide these services expeditiously or consider waiving entry requirements because of the exceptional circumstances involved.

8.8 LETTER OF UNDERTAKING REGARDING COMPENSATION

As early as practicable a commitment should be obtained from the ship's owners or insurers to pay for the damages caused by the grounding. This should ideally be sought as a cash bond, but as groundings can involve millions of dollars in subsequent claims it is more commonly given in the form of a "Letter of Undertaking".

The Letter of Undertaking commits the insurer, usually a P&I Club, to pay for damages and losses resulting from the grounding. It should be issued by a person in authority who is empowered to bind the insurance company or P&I Club concerned. It should come on the P&I Club's letterhead and be given on behalf of the owners of the ship and all others with an interest in it.

The Letter needs to be as broad as possible (from the potential claimant's point of view) and not refer to just one aspect of damage (e.g. reef destruction). It should not attempt to limit recovery within a short period but should be reasonable in this regard (i.e. years rather than months or weeks). It should cite a forum for arbitration or litigation that is most convenient and favourable to the claimant. Most importantly it should state an amount that is sufficient to cover the damage and expected losses. As a rule of thumb the commitment, security or bond sought from ship owners/operators should be set at least five, and preferably ten, times the maximum preliminary estimated value of the damages (see section 7.2.2). This does not mean that the insurer will pay the stated amount, but rather it obligates him to pay *proven* claims up to that amount if the claims are subsequently upheld in court.

It should be expected that the terms of such a letter will be subject to negotiation with the insurer. Since these discussions should normally be carried out while the vessel is aground and still relatively easy to arrest (see section 7.1.3), Government is in a favourable position and delays should not be tolerated. The need to agree on terms within a matter of hours is often the case. However, if the potential claimant is satisfied with the terms of the letter, he should then do his utmost to take steps to prove his claims.

Should neither a Letter of Undertaking nor other promise to pay for damages and losses be forthcoming, the vessel can be arrested by the claimant.

8.9 MONITORING OF SALVAGE ACTIVITIES AND ENVIRONMENTAL FACTORS

After the initial environmental assessment has been carried out (see section 8.5), arrangements should be made with the appropriate Government Departments (Environment, Fisheries, etc.) for the establishment of a more rigorous monitoring programme and for maintaining a presence at the grounding site, at least for the duration of the salvage operation. Those Pacific Island regional organisations with involvement in fisheries or environment may be able to assist in providing technical advice for a long-term monitoring programme.

The specific information to be collected will vary depending on the grounding circumstances, but should be oriented to monitor those factors likely to be most damaging. Often these are leaking petroleum and the production of loose coral rubble. A quantification of the amount of reef suffering varying degrees of damage should be carried out. Some of the references listed in the bibliography of this report (Annex 6), and especially those cited in Annex 4, provide details on the type of data collected by monitoring programmes after grounding events in other areas.

As with the initial environmental assessment, individuals involved in the monitoring programme should be instructed in the proper collection and labeling of samples and provided with appropriate clean containers for samples of both cargo and fuel.

8.10 LEGAL ADVICE

Governments should carefully evaluate the need for additional specialist legal advice. They should not underestimate the complexities of maritime law, and should be aware that ship owners and insurers have access to, and probably will use, highly experienced maritime lawyers.

It is therefore recommended that competent and experienced legal counsel should be sought in all such actions. The Maritime Law Association of Australia and New Zealand and the US Maritime Law Association (see Annex 1) are two professional bodies with literally hundreds of specialist lawyers in this field from whom to choose. Their addresses are provided in Annex 1, as also are the names and addresses of several specialised lawyers who may be able to provide legal counsel or contact details for other sources of advice.

8.11 CLEAN-UP AND WRECK REMOVAL

Governments should monitor any clean-up required as part of the salvage undertaking. The clean-up, if any, should be considered an extension of the salvage operation, with appropriate Government Departments having responsibility for oversight of the clean-up procedures.

Some Pacific Island countries have statutory or other requirements in dealing with the removal of wrecks. Where discretion is allowed, such as removal only of those which are judged to constitute a hazard, the negative effects of having the wreck remain must be reconciled with the damage which may result from the removal.

The costs for removing the wreck should be considered when negotiating a settlement with a P&I Club. It should be noted that wreck removal costs can be very large.

8.12 POST INCIDENT DE-BRIEFING

After the period of urgency following a grounding, a meeting should be held of all the departments and/or individuals having responsibilities under the ship grounding contingency plan. The meeting should identify the strengths and weaknesses of the Government response with a view to improving its efficiency for the future, as well as providing an accounting or adding up of the costs of the operation. The contingency plan should be modified or updated as a result of the meeting.

9 RECOMMENDATIONS

9.1 ACTION BY NATIONAL GOVERNMENTS

Recommendation 1

Governments of the Pacific Island region should prepare, disseminate, and implement contingency plans for dealing with ship grounding events. These plans should consider and include responses to the major issues raised in section 8 above.

As part of each plan a lead agency should be nominated and the duties of the plan should be partitioned among Government Departments or specific individuals within those departments. The plan should be formulated so that it is compatible with and complementary to any oil pollution contingency plans.

The plan should be regularly reviewed and updated. The review procedure should take into account any civil service reorganisation that may result in redistribution of responsibilities among the Government departments involved, as well as the movements of key individuals responsible for aspects of the plan's implementation.

Recommendation 2

Pacific Island Governments should consider enacting strict liability legislation (i.e. legislation under which the ship owner is liable whether or not he was at fault) which makes it an offence for a ship to go aground, and under which a grounding event and any subsequent damage could become the subject of criminal actions.

In drafting domestic legislation on this topic, the following points are of relevance:

- in addition to any fine imposed, the offending party should also be ordered to pay for costs of clean-up, wreck removal and other related costs;
- the law should allow for charges to be brought against the owner, operator, manager, charterer or others who might be in a position to influence or direct the operation of the vessel;
- the court should be given the power to order detention of the vessel and subsequently levy fines or sell the vessel to recover costs associated with the offences involved;
- the level of fines and penalties should be sufficient to deter irresponsible action by masters and ship owners;
- consideration should be given to the role assumed by Government as a trustee of resources for its people and its obligations in fulfilling this role. Fines collected pursuant to criminal acts are usually deposited in a general revenue fund. In relation to a ship grounding, this money would not therefore mitigate the damage caused or provide a means by which future cases could be judged or injured parties provided with compensation. A possible solution to this would be to provide in legislation for the creation of a mitigation fund from all or a portion of the fines.

Recommendation 3

In past Pacific Island ship groundings, there has often been no competent Government representative to safeguard local interests (villagers in the area, the environment, etc.). Because this has worked to the disadvantage of local interests it is suggested that Pacific Island Governments establish mechanisms to ensure that there is representation at the grounding site that is oriented to local needs. In countries where there is legislative provision for a Receiver of Wrecks, consideration should be given to adding this area of responsibility to the Receiver's duties.

Recommendation 4

To help reduce the likelihood of future ship groundings, Pacific Island Governments should consider the following administrative actions:

- changing policies regarding inquiries into ship groundings to allow for the dissemination of findings as widely as possible, rather than maintaining the more usual current practice of keeping enquiry results confidential;
- compiling historical summaries of ship groundings and their causes, and disseminating this information widely.

Recommendation 5

Governments should support and facilitate civil actions taken by groups of villagers who have suffered damages as a result of a ship grounding. This support might include acting as the representative of the injured party or parties in class actions, providing assistance in securing legal counsel, and the use of Government funds to finance legal actions as appropriate.

Recommendation 6

Governments should consider the merits of entering into cooperative arrangements with organisations such as the Australian Marine Oil Spill Corporation, East Asia Response Pte Ltd., etc. which can provide a capability to respond to major oil spills.

Recommendation 7

Because a surprisingly large number of groundings occur with local pilots on board the grounded vessel, Pacific Island Governments should individually review the qualifications and performance of local pilot services and if necessary amend the training and professional achievement requirements for formal pilot certification.

9.2 ACTION BY REGIONAL ORGANISATIONS

Recommendation 8

Because a high and growing proportion of grounding incidents have involved fishing vessels, Pacific Island Governments, through the Forum Fisheries Agency, should consider requiring foreign fishing vessels (including refrigerated carriers and other ships servicing the fishing fleet and likely to enter ports) to demonstrate proof of protection and indemnity insurance covering reef and associated damage prior to the issue of fishing licences. Administratively, this could be accommodated by designating such insurance as one of the regionally agreed minimum terms and conditions of access for foreign fishing vessels.

Recommendation 9

Regional organisations with technical competence in the environmental and marine resource fields should consider providing the following forms of assistance to Pacific Island Governments:

- technical information and field assistance in support of environmental evaluation and monitoring programmes after a ship-grounding incident;
- assistance in assessing the economic value of reef damage resulting from ship grounding events.

Recommendation 10

Because there is little published information available on the level of shipping activities in and through the Pacific Islands region, the project "Survey of Shipping Activities" proposed for funding under the *Strategy and Work Programme for the Protection of the Marine Environment in the South Pacific Region* should be given a high priority by the South Pacific Regional Environment Programme.

ANNEX 1 USEFUL CONTACTS FOR DEALING WITH SHIP GROUNDINGS

Main institutions are listed first, followed by individuals, both listed in alphabetical order. Institutions or individuals marked with an asterisk (*) were contacted and provided information during the course of the present study

INSTITUTIONS

***Australian Marine Oil Spill Centre**
PO Box 305, North Shore, Geelong, Victoria 3214, Australia
Tel: (061-3) 52-721-555, fax: (061-3) 52-721-839

***Australian Maritime Safety Authority**
Marine Environmental Protection Services, PO Box 1108, Belconnen, ACT 2616, Australia
Tel: (061-6) 279-5680, fax: (061-6) 279-5076, e-mail: TDG@AMSA.GOV.AU

***Billett, Wright, & Associates Ltd., [Marine Surveyors]**
PO Box 13940, Suva, Fiji
Tel: (0679) 313-766, fax: (0679) 303-024

***East Asia Response Pte. Ltd.**
2 Jalan Samulun, Singapore 2262
Tel: (065) 266-1566, fax: (065) 266-2312

***Great Barrier Reef Marine Park Authority**
PO Box 1379, Townsville, Queensland 4810, Australia
Tel: (061-77) 81-8811, fax: (061-77) 72-6093

***International Maritime Organization**
Legal Affairs and External Relations Division, 4 Albert Embankment, London SE 1 7SR, United Kingdom.

***Lloyd's Maritime Information Services Ltd.**
1200 Summer Street, Stamford, Connecticut 06905, USA
Tel: (01-203) 359-8383, fax: (01-203) 358-0437

***Lloyd's Maritime Information Services Ltd.**
One Singer Street, London EC2A 4LQ, United Kingdom
Tel: (044-071) 490-1720, fax (044-071) 250-3142

Maritime Law Association of Australia and New Zealand
c/o Epsworth & Epsworth, Level 23, Riverside Centre, 123 Eagle St., Brisbane, QLD 4000, Australia
Tel: (061-7) 3303-8888, fax: (061-7) 3303-8822

***Shell Company of Australia**
GPO Box 872K, Melbourne, Australia 3001
Tel: (0613-3) 9666-5444, fax: (0613-3) 9666-5006

Oil Spill Response Ltd.
Oil Spill Service Centre, Lower William Street, Southampton SO14 5QE, United Kingdom
Tel: (044-1703) 331-1551, fax: (044-1703) 331-1972

***South Pacific Regional Environment Programme (SPREP)**
PO Box 240, Apia, Western Samoa
Tel: (0685)-21-929, fax: (0685) 20-231

United States Maritime Law Association
Williams Woolley Cogswell Nakazawa and Russell, Attorneys, Suite 2000, 111 West Ocean Boulevard, Landmark Square, Long Beach, California 90802 4614
Tel: (01-310) 495 6000, fax: (01-310) 435 1359 6812

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Pacific Tuna Industries, Inc., P.O. Box PTI, Kosrae FM 96944, Federated States of Micronesia

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Director of Maritime and Shipping, P.O. Box 61, Rarotonga, Cook Islands
Tel: (0682) 28-810, fax: (0682) 23-880

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Leefax Marine Services, 12 Rosemount Avenue, Halifax, Nova Scotia
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Murrell Stephenson, Solicitors and Attorneys, GPO Box 2247, Brisbane 4000, Australia
Tel: (061 7) 3221-6206, fax: (061-7) 3229-2443

***David Martin**
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***Navitalai Moceica**
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***Kelvin Passfield**
c/o Secretary for Marine Resources, PO Box 85 , Rarotonga, Cook Islands
Tel:(0682) 28-721, fax:(0682) 29-721

***Leon Pors**
Park Manager, Curacao Underwater Park, Curacao, Netherlands Antilles
Tel: (0599)-624-242

***Mere Pule'a**
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Tel: (065) 266-1566, fax: (065) 266-2312

***Azim Quereshi**
Marine Chartering Co., Inc., 781 Beach St., San Francisco, CA 94109, USA,
Tel: (01-415) 441-3100, fax: (01-415) 776-7166

***Robert H. Rath II**
Manager, Oil Spill Prevention & Response, BHP Hawaii, Inc., 733 Bishop St. Suite 2700, PO Box 3379, Honolulu, Hawaii 96842 USA, USA
Tel: (01-808) 547-3190, fax: (01-808) 547-3689

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ANNEX 2 CRUDE OIL CONVERSION FACTORS

The following are some common equivalent measures for crude oil and other petroleum products.

- 1 metric tonne = 2,205 lb. = 1,000 kg
- 1 long ton = 2,240 lb.
- 1 short ton = 2,000 lb.
- 1 kilolitre (kl) = 1,000 litres = 6.29 barrels (bbls)
- 1 barrel (bbls) = 159 litres = 35 imperial gallons = 42 US gallons

To convert crude oil quantities from the units in the left-hand column to the units in the top row, **multiply** by the appropriate conversion factor in the table below.

From:	Metric tonnes	Long tonnes	Barrels (bbls)	Imperial Gallons	US Gallons	Tonnes/ year
To:						
Metric tonnes	1	0.984	7.33	256	308	-
Long tonnes	1.016	1	7.45	261	313	-
Barrels (bbls)	0.136	0.134	1	35	42	-
Imp. Gallons	0.00391	0.00383	0.0286	1	1.201	-
US Gallons	0.00325	0.00319	0.0238	0.833	1	
Barrels/day	-	-	-	-	-	49.8

Conversion factors are based on average (Arabian Light) 33.5° API gravity crude oil (GESAMP, 1993).

ANNEX 3 LISTING OF MAJOR SHIP GROUNDING EVENTS INVOLVING VESSELS OVER 100 GRT IN THE PACIFIC ISLANDS REGION SINCE 1976

The following data is extracted from the Lloyd's Maritime Information Service Casualty Register, a computerised database that contains information on major vessel casualties for ships over 100 GRT. While the Register provides a good indication of the type and extent of ship groundings in the region, it cannot be considered complete or comprehensive for the reasons discussed in section 1.9. In addition, errors or omissions of fact may exist in certain records due to the need to make entries quickly, often based on preliminary casualty reports. The information presented below is nevertheless exactly as contained in the database, and has not been edited or verified.

AMERICAN/ WESTERN SAMOA

Vessel name: MICHELANGELO
Type: FISHING (1066 GRT)
Built: 1970
Date of incident: DECEMBER 1978
Age at time of incident: 8 YEARS
Incident details: STRANDED ON REEF OUTSIDE TAFUNA AIRPORT, TUTUILA AMERICAN SAMOA AT 21.30HRS ON THE 22.12.1978., REFLOATED & PROCEEDED TO WHANGEREI FOR REPAIRS REFLOATED BY TUG 0100HRS 23.12.78 VESSEL SANK 7.1.79 WHILST PROCEEDING TO WHANGEREI FOR REPAIRS.

Vessel name: HSIUNG HSING
Type: FISHING (187 GRT)
Built: 1977
Date of incident: JUNE 1980
Age at time of incident: 3 YEARS
Incident details: WRECKED OFF SAMOA IN LAT. 14 17S. LONG. 170 39W. ON 9/6/80 LLOYD'S STANDARD FORM SIGNED & TUG PACIFIC ARRIVED ABOUT14/6/80 DURING SALVAGE OPERATIONS SHIP CAPSIZED.

Vessel name: JUI MAN NO. 3
Type: FISHING (216 GRT)
Built: 1969
Date of incident: APRIL 1981
Age at time of incident: 12 YEARS
Cargo: FISH
Pollution: OIL
Incident details: WRECKED OFF PAGO PAGO IN LAT 14 16 42S. LONG 170 35 12W. ON 8/4/81 IN HEAVY WEATHER. EXTENSIVE DAMAGE TO DOUBLE BOTTOM IS ALLOWING SMALL QUANTITY OF FUEL TO LEAK OUT. FAIRLY EXTENSIVE DAMAGES TO PROPELLER, RUDDER AND PLATING LOWER HULL. DAMAGE TO WHEEL HOUSE SUSTAINED BY FIRE AFTER GROUNDING.

Vessel name: KWANG MYUNG NO. 65
Type: FISHING (352 GRT)
Built: 1968
Date of incident: OCTOBER 1982
Age at time of incident: 14 YEARS
Pollution: OIL
Incident details: STRANDED AT PAGO PAGO, SAMOR ISLAND, 31/10/82, REFLOATED AND TAKEN IN TOW TO INNER PORT WHERE SUBSEQUENTLY SANK. VESSEL REMAINS PARTIALLY SUBMERGED AT PAGO PAGO. OIL AND FUEL REMOVED FROM VESSEL TO PREVENT SPILL AND POLLUTION, 12 TONNES OF OIL COLLECTED FROM BEACH AND DISPOSED OF. OIL FILLED NO. 1 HOLD FROM DOUBLE BOTTOM TANKS LEADING TO 'SURVIVOR' THAT DOUBLE BOTTOM BULKHEADS RUPTURED.

AMERICAN/ WESTERN SAMOA (continued)

Vessel name: YOUNG KWANG NO. 1
Type: FISHING (233 GRT)
Built: 1963
Date of incident: JUNE 1985
Age at time of incident: 22 YEARS
Incident details: WRECKED ON AUNUN ISLAND IN LAT. 14 17S. LONG. 170 33W. ON 22/6/85 IN HEAVY WEATHER. VESSEL HOLED AND ENGINE ROOM FLOODED.

Vessel name: YOUNG KWANG No. 3
Type: FISHING (184 GRT)
Built: 1965
Date of incident: FEBRUARY 1987
Age at time of incident: 22 YEARS
Incident details: WRECKED ON CORAL REEF IN LAT. 15 57S., LONG. 173 43W., ON 23/2/87.

Vessel name: POLYNESIA
Type: CONTAINER SHIP (10774 GRT)
Built: 1979
Date of incident: SEPTEMBER 1988
Age at time of incident: 9 YEARS
Incident details: STRANDED ON EAST REEF, OFF APIA, UPOLU ISLAND, ON 9/9/88. REFLOATED WITHOUT ASSISTANCE 11/9/88, RETURNED TO APIA FORDIVER SURVEY AND SAILED LATER SAME DAY FOR LONG BEACH, CA,WHERE TEMPORARY REPAIRS EFFECTED. RESUMED SERVICE. DAMAGE CONFINED TO AN AREA APPROXIMATELY 2.5 M IN LENGTH IN WAY OF BULBOUS BOW.

Vessel name: QUEEN SALAMASINA
Type: RORO CARGO/FERRY (714 GRT)
Built: 1977
Date of incident: FEBRUARY 1990
Age at time of incident: 13 YEARS
Incident details: STRANDED AT APIA, WESTERN SAMOA, ON 3/2/90 DURING CYCLONE 'OFA'. REFLOATED 4/7/90 AND TOWED TO NELSON, WHERE ARRIVED9/8/90. REPAIRS EFFECTED AND VESSEL RETURNED TO WESTERN SAMOA.

Vessel name: FOTU O SAMOA
Type: LANDING CRAFT (271 GRT)
Built: 1979
Date of incident: MARCH 1991
Age at time of incident: 12 YEARS
Incident details: STRANDED ON REEF AT FAASOUGA POINT, TAU ISLAND, AMERICAN SAMOA ON 22/3/91. REFLOATED 1/4/91. SUBSEQUENTLY TAKEN TO PAGO PAGO FOR SURVEY AND REPAIR. BOTTOM BUCKLED AND DISTORTED. SUSTAINED DAMAGE TO NO. 2 TANK AND RUDDER.

Vessel name: KWANG MYUNG No. 51
Type: FISHING (347 GRT)
Built: 1967
Date of incident: DECEMBER 1991
Age at time of incident: 24 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/91 DURING CYCLONE 'VAL'.

AMERICAN/ WESTERN SAMOA (continued)

Vessel name: KWANG MYUNG No. 58
Type: FISHING (347 GRT)
Built: 1968
Date of incident: DECEMBER 1991
Age at time of incident: 23 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/92 DURING CYCLONE 'VAL'.

Vessel name: KWANG MYUNG No. 72
Type: FISHING (346 GRT)
Built: 1969
Date of incident: DECEMBER 1991
Age at time of incident: 22 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/91 DURING CYCLONE 'VAL'.

Vessel name: AMIGA No. 5
Type: FISHING (284 GRT)
Built: 1970
Date of incident: DECEMBER 1991
Age at time of incident: 21 YEARS
Incident details: REPORTED 10/12/91; STRANDED AT PAGO PAGO DURING CYCLONE 'VAL'.

Vessel name: KWANG MYUNG No. 63
Type: FISHING (352 GRT)
Built: 1968
Date of incident: DECEMBER 1991
Age at time of incident: 23 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/91 DURING CYCLONE 'VAL'.

Vessel name: KORAM No. 1
Type: FISHING (304 GRT)
Built: 1973
Date of incident: DECEMBER 1991
Age at time of incident: 18 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/91 DURING CYCLONE 'VAL'.

Vessel name: KORBEE No. 7
Type: FISHING (304 GRT)
Built: 1974
Date of incident: DECEMBER 1991
Age at time of incident: 17 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/91 DURING CYCLONE 'VAL'.

Vessel name: KORAM No. 3
Type: FISHING (304 GRT)
Built: 1973
Date of incident: DECEMBER 1991
Age at time of incident: 18 YEARS
Incident details: WRECKED AT PAGO PAGO BETWEEN 6-10/12/91 DURING CYCLONE 'VAL'.

AMERICAN/ WESTERN SAMOA (continued)

Vessel name: JIN SHIANG FA
Type: FISHING (363 GRT)
Built: 1985
Date of incident: OCTOBER 1993
Age at time of incident: 8 YEARS
Cargo: DIESEL FUEL
Pollution: OIL
Incident details: STRUCK A REEF AT ROSE ISLAND, 400 KM E. OF PAGO PAGO, ON 14/10/93. SCUTTLED.

COOK ISLANDS

Vessel name: SHOTOKU MARU NO. 65
Type: FISHING (339 GRT)
Built: 1962
Date of incident: AUGUST 1978
Age at time of incident: 16 YEARS
Incident details: STRANDED IN LAT. 11 33S. LONG. 165 25W. NASSAU ISLAND, COOK ISLANDS ON 24/8/78; SUBSEQUENTLY REFLOATED AND TOWED TO SUVA. CONDEMNED.

Vessel name: LIEN HO NO. 1
Type: FISHING (162 GRT)
Date of incident: MARCH 1981
Incident details: WRECKED ON REEF, OFF PUKAPUKA ISLAND IN LAT. 10 55S. LONG.165 51W. ON 2/3/81 IN HEAVY WEATHER. CREW RESCUED FROM PUKAPUKA ISLAND.

Vessel name: MANUVAI
Type: GENERAL CARGO (284 GRT)
Built: 1960
Date of incident: DECEMBER 1988
Age at time of incident: 28 YEARS
Incident details: STRANDED ON REEF AT NASSAU ISLAND, COOK ISLANDS, IN LAT. 12S., LONG. 168W., AT 0030 HRS, LT, ON 28/12/88. HOLED DURING REFLOATING ATTEMPTS.

Vessel name: EDNA
Type: GENERAL CARGO, SAILING (132 GRT)
Built: 1918
Date of incident: NOVEMBER 1990
Age at time of incident: 72 YEARS
Cargo: CEMENT
Incident details: STRANDED AT ATUI ISLAND, COOK ISLANDS, ON 28/11/90 AFTER DRAGGING ANCHORS IN HEAVY WEATHER.

FEDERATED STATES OF MICRONESIA

Vessel name: MEIHO MARU NO. 7
Type: FISHING (349 GRT)
Built: 1962
Date of incident: APRIL 1979
Age at time of incident: 17 YEARS
Cargo: SQUID
Incident details: STRANDED IN LAT 08 03N LONG 146 44E ON 22/4/79; SUBSEQUENTLY REFLOATED & TAKEN TO ISHINOMAKI, REPAIRED & RETURNED TO SERVICE. REPAIRED AT YAMANISHI ZOSEN, JUNE 1979.

FEDERATED STATES OF MICRONESIA (continued)

Vessel name: ETNA
Type: GENERAL CARGO (3654 GRT)
Built: 1972
Date of incident: MAY 1979
Age at time of incident: 7 YEARS
Incident details: STRANDED AT YAP HARBOUR ON 25/5/79. REFLOATED WITH TUG ASSISTANCE AND BERTHED AT YAP.

Vessel name: MICRO SPIRIT
Type: GENERAL CARGO (790 GRT)
Built: 1978
Date of incident: MAY 1980
Age at time of incident: 2 YEARS
Incident details: AGROUND ON SANDBAR NEAR WOLEAI 14/5/80. REFLOATED AND REPORTED BACK IN SERVICE.

Vessel name: CURACAO
Type: FISHING (367 GRT)
Built: 1960
Date of incident: JANUARY 1982
Age at time of incident: 22 YEARS
Cargo: FROZEN BAIT
Incident details: WRECKED ON NGULU ATOLL, CAROLINE ISLANDS IN LAT. 08 33N., LONG. 137 28E., ON 16/1/82 IN HEAVY WEATHER. CREW RESCUED. ENGINE ROOM FLOODED AND TIDAL. RUDDER CARRIER BOLTS SHEARED AND RUDDER STOCK LIFTED 15 CM, SKEG SET UP.

Vessel name: HINODE MARU NO. 56
Type: FISHING (344 GRT)
Built: 1972
Date of incident: SEPTEMBER 1982
Age at time of incident: 10 YEARS
Incident details: STRANDED AND SANK OFF TRUK ISLAND, CAROLINE ISLANDS, ON 12/9/82. NO FURTHER DETAILS REPORTED.

Vessel name: KITCHO MARU NO. 28
Type: FISHING (404 GRT)
Built: 1968
Date of incident: NOVEMBER 1982
Age at time of incident: 14 YEARS
Incident details: WRECKED ON MINT REEF, CAROLINE ISLANDS, IN LAT. 08 05N., LONG. 154 14E., ON 27/11/82. EXTENSIVELY DAMAGED BY STRANDING. OWNERS STATE VESSEL IS NOT TO BE REMOVED DUE TO EXTENT OF DAMAGES. IT IS THOUGHT A POSSIBLE CAUSE IS DUE TO CAPTAIN NOT MAKING SUFFICIENT ADJUSTMENT FOR FAST MOVING EAST TIDE OVER THE REEF. MFV 'FUKUWA MARU NO. 1' APPROACHED TO GIVE ASSISTANCE TO VSL, BUT ALSO STRANDED ON THE REEF.

Vessel name: FUKUWA MARU NO. 1
Type: FISHING (306 GRT)
Built: 1969
Date of incident: NOVEMBER 1982
Age at time of incident: 13 YEARS
Incident details: WRECKED IN THE PACIFIC OCEAN IN LAT. 08 05N., LONG. 154 14E., AT 1225 HRS ON 28/11/82. DECLARED A TOTAL LOSS AND NOT REMOVED. NO DETAILS OF DAMAGE REPORTED. VESSEL ABANDONED.

FEDERATED STATES OF MICRONESIA (continued)

Vessel name: CONIC NO. 1
Type: FISHING (908 GRT)
Built: 1983
Date of incident: MAY 1984
Age at time of incident: 1 YEARS
Incident details: STRANDED ON SOROL ISLAND IN LAT. 08 04N., LONG. 140 28E., ON 30/5/84 AND PRESUMED TO HAVE SANK.

Vessel name: TONG WHA NO. 71
Type: FISHING (221 GRT)
Built: 1963
Date of incident: MARCH 1985
Age at time of incident: 22 YEARS
Incident details: STRANDED IN LAT. 07 15N. LONG. 144 27E. ON 17/3/85, REFLOATED 22/3/85 AND TAKEN IN TOW TO GUAM; SUBSEQUENTLY SOLD. TOWED TO MANILA.

Vessel name: MEIHO MARU NO. 17
Type: FISHING (432 GRT)
Built: 1972
Date of incident: APRIL 1985
Age at time of incident: 13 YEARS
Cargo: FISH
Incident details: STRANDED IN LAT. 05 48 53N, LONG. 157 13 21E, E. CAROLINE ISLANDS 29/4/85. REFLOATED WITH ASSISTANCE AFTER SEVERAL ATTEMPTS AT 0300, 9/5/85 & TOWED PONAPE WHERE ARR 10/5/85.TOWED HACHINOHE THENCE ISHINOMAKI WHERE REPAIRED & SD. BOTTOM PLATE DAMAGED.

Vessel name: MICRONESIAN COMMERCE
Type: CONTAINER SHIP (5730 GRT)
Built: 1982
Date of incident: NOVEMBER 1988
Age at time of incident: 6 YEARS
Incident details: STRANDED AT YAP, W.C.I., ON 2/11/88. SUBSEQUENTLY REFLOATED AND BERTHED AT YAP PIER. SAILED 4/11/88 TO PALAU ISLANDS AND THENCE TO MANILA WHERE ARRIVED 15/12/88. SUSTAINED HEAVY BOTTOM DAMAGE TO FUEL OIL TANKS AND HULL WITH CRACKS 24' BY 4 AND 6' BY 4.

Vessel name: OCEANUS
Type: BULK CARRIER (38891 GRT)
Built: 1993
Date of incident: MARCH 1994
Age at time of incident: 1 YEARS
Cargo: PHOSPHATE
Incident details: STRANDED AT SATAWAL ISLAND, IN LAT. 07 22N., LONG. 147 02E., ON 18/3/94. REFLOATED WITH ASSISTANCE 3/5/94 AFTER PART CARGO TRANSFERRED TO BARGES. PROCEEDED TO GUAM FOR DIVER INSPECTION; ARRIVED ULSAN FOR REPAIRS. SAILED. INGRESS OF WATER IN FOREPEAK TANK.

FEDERATED STATES OF MICRONESIA (continued)

Vessel name: DANG DELIMA
Type: GENERAL CARGO (5903 GRT)
Built: 1985
Date of incident: JUNE 1994
Age at time of incident: 9 YEARS
Pollution: OIL
Incident details: REPORTED 16/6/94; STRANDED OFF PONAPE, MICRONESIA. REFLOATED 9/7/94 AND ANCHORED AT PONAPE. SAILED 17/7/94, IN TOW, TO BUSAN AFTER REPAIRS. SAILED BUSAN 1/8/94. FUEL TANKS HOLED.

FIJI

Vessel name: IKA-VUKA
Type: GENERAL CARGO, SAILING (180 GRT)
Built: 1944
Date of incident: FEBRUARY 1977
Age at time of incident: 33 YEARS
Cargo: COPRA
Incident details: STRANDED ON A REEF OFF TOBERU ISLAND, S.E. OF VITI LEVU ISLAND ON 27/2/77. REFLOATED 20/3/77 AND TAKEN TO SAVU SAVU BAY. CONDEMNED.

Vessel name: JI NAM NO. 22
Type: FISHING (194 GRT)
Built: 1965
Date of incident: FEBRUARY 1978
Age at time of incident: 13 YEARS
Incident details: GROUNDED IN LAT. 18 30S., LONG. 177 55E. ON 16.2.78 GROUNDED 16.2.78 IN SOUTHERN REEF IN APPROX. LAT. 18 30S.,LONG. 177 55E. SUBSEQUENTLY REFLOATED AND TOWED TO SUVA FOR REPAIRS.

Vessel name: NAM HAI NO 231
Type: FISHING (159 GRT)
Built: 1965
Date of incident: MARCH 1978
Age at time of incident: 13 YEARS
Cargo: BULK FERTILIZER
Incident details: GROUNDED OFF SUVA HARBOUR 14/3/78-SUBSEQUENTLY SANK, GROUNDED IN HEAVY RAIN ON DARK NIGHT ON CORAL REEF. CAPSIZED IN HEAVY SEAS DURING 2ND SALVAGE ATTEMPT.SALVAGE CREW RESCUED.MASTER SIGNED L.O.F. FORM WITH SALVAGE PACIFIC WHO WILL RETAIN WRECK IN ABSENCE OF ANY SALVAGE BOND. SEAS.CREW TAKEN OFF & VESSEL ABANDONED.CAPT.STATES CAUSE AS UNKNOWN CURRENTS.ATTEMPTS TO BE MADE TO SALVAGE REMAINING CARGO.

Vessel name: MOBIL PRODUCER
Type: TANKER (18258 GRT)
Built: 1974
Date of incident: JUNE 1978
Age at time of incident: 4 YEARS
Incident details: STRANDED ON SOFT MUD PATCH IN LAT. 17 12 54S., LONG. 177 33 24E., AT SUNRISE ABOUT 0600 HOURS ON 9/6/78 WITH PILOT ON BOARD. REFLOATED WITHOUT ASSISTANCE, EXAMINED AND PROCEEDED. INTERNAL EXAMINATION OF DB TANKS NOT POSSIBLE. DIVER REPORTED MINIMAL DAMAGE. SAILED FOR SINGAPORE FOR ANNUAL DD VIA ESPIRITU SANTO BEING FINAL PORT OF DISCHARGE EN ROUTE.

FIJI (continued)

Vessel name: AKHILLES
Type: FACTORY FISHING (2654 GRT)
Built: 1970
Date of incident: NOVEMBER 1978
Age at time of incident: 8 YEARS
Incident details: GROUNDED ON REEF SUVA HARBOUR 15.11.78, REFLOATED 22.11.78WITH ASSISTANCE OF SISTER SHIPS.& CONTINUED ON VOYAGE.

Vessel name: CENPAC ROUNDER
Type: PASSENGER/GENERAL CARGO/FERRY (3179 GRT)
Built: 1961
Date of incident: MARCH 1979
Age at time of incident: 18 YEARS
Incident details: STRANDED ON VOTUALAILAI REEF, OFF SUVA, IN LAT.18 30S., LONG. 177 40E., ON 28/3/79 IN HEAVY WEATHER. SUBSEQUENTLY REFLOATED, TOWED TO SUVA AND THENCE TAKEN TO BUSAN AND BROKEN UP. STRANDED IN 60 KNOT WINDS FROM PASSING CYCLONE.

Vessel name: COLVILLE
Type: GENERAL CARGO (123 GRT)
Built: 1943
Date of incident: APRIL 1979
Age at time of incident: 36 YEARS
Cargo: COPRA
Incident details: STRANDED & SANK ON REEF OFF TAVUA, FIJI, ON 18/4/79. RAISED REPAIRED & REFITTED.

Vessel name: TUI CAKAU II
Type: RORO CARGO (1965 GRT)
Built: 1961
Date of incident: JULY 1979
Age at time of incident: 18 YEARS
Incident details: STRANDED OFF LAUTOKA AT 2400 HOURS 26/7/79. REFLOATED WITHOUT ASSISTANCE AT 0165 HOURS 27/7/79 AND CONTINUED ON VOYAGE. SOME BOTTOM DAMAGE REPORTED.

Vessel name: KWANG MYUNG NO. 9
Type: FISHING (236 GRT)
Built: 1966
Date of incident: MARCH 1980
Age at time of incident: 14 YEARS
Cargo: FISH
Incident details: STRANDED ON THAKAULEKALEKA REEF, 10 MLS SW OF VATULELE IS.IN LAT.18 28S., LONG.177 37E., AT 0115 HOURS 22/3/80. REFLOATED 1715 HOURS 29/3/80 AND ARR. SUVA 30/3/80 AND EFFECTED REPAIRS WHICH COMPLETED IN JULY 1980. LLOYD'S STANDARD FORM SIGNED WITH SALVORS WHO, PRIOR TO REFLOATING REMOVED 70 TONNES OF FISH & 20 TONNES OF BAIT BY HELICOPTER TO MFV RYOYO MARU NO.8. AFTER REFLOATING SURVEYOR REPORTED MODERATE DAMAGES TO 80% OF BOTTOM EXTENDING TO P & S BILGE KEELS. NO DAMAGE TO STERN GEAR AND SKEG. REPAIRED BY CARPENTERS INDUSTRIAL. COST OF REPAIRS ABOUT USD60,000.

FIJI (continued)

Vessel name: PACIFIC GAS
Type: LIQUEFIED GAS TANKER (903 GRT)
Built: 1967
Date of incident: NOVEMBER 1980
Age at time of incident: 13 YEARS
Incident details: STRANDED 1 MILE N. OF NAVULA LIGHT, FIJI AT 2030 HRS ON 8/11/80. REFLOATED WITHOUT ASSISTANCE AT 1930 HRS ON 9/11/80 AND PROCEEDED TO SUVA FOR DISCHARGE. SHELL PLATING SET UP IN ISOLATED PLACES.

Vessel name: NAM PYUNG NO. 5
Type: FISHING (218 GRT)
Built: 1962
Date of incident: NOVEMBER 1980
Age at time of incident: 18 YEARS
Incident details: STRANDED ON REEF IN SUVA HARBOUR ON 24/11/80; SUBSEQUENTLY REFLOATED WITH TUG ASSISTANCE & PROCEEDED FOR INSPECTION. NO REPAIR WAS NECESSARY & VSL RETURNED TO SERVICE.

Vessel name: TOKERAU
Type: GENERAL CARGO (349 GRT)
Built: 1937
Date of incident: DECEMBER 1980
Age at time of incident: 43 YEARS
Incident details: STRANDED ON A REEF 37 KM NNW OF YANDUA ISLAND, S.W. OF VANVA LEVU, FIJI ON 24/12/80; SUBSEQUENTLY REFLOATED WITH ASSISTANCE AND TOWED TO SUVA WHERE BROKEN UP. ENTIRE BOTTOM HULL CORRUGATED, KEEL STRAKE SET UP AND BUCKLED, 3 PROPELLER BLADES BENT, MAIN ENGINE AND AUX. ENGINE WATER DAMAGED.

Vessel name: STARDUST II
Type: FERRY (159 GRT)
Built: 1945
Date of incident: JANUARY 1981
Age at time of incident: 36 YEARS
Incident details: STRANDED AT SUVA HARBOUR OFF NADI ON 15/1/81 AFTER 73-KNOTWINDS. SUBSEQUENTLY RETURNED TO SERVICE IN MID FEBRUARY. RENEWALS INCLUDE PORT PROPELLER SHAFT & MINOR REPAIRS TO THE TIMBER HULL.

Vessel name: TAONIU
Type: GENERAL CARGO (514 GRT)
Built: 1958
Date of incident: JANUARY 1981
Age at time of incident: 23 YEARS
Incident details: STRANDED IN SUVA HARBOUR ON 15/1/81 DURING CYCLONE ARTHURREFLOATED THE NEXT DAY WITH NO SERIOUS DAMAGE.

Vessel name: DAE YANG NO. 10
Type: FISHING (192 GRT)
Built: 1964
Date of incident: DECEMBER 1981
Age at time of incident: 17 YEARS
Pollution: OIL
Incident details: STRANDED OFF SUVA HARBOUR AT 2145HRS., 30/12/81 DURING CYCLONE 'ERIC'. REFLOATED THE FOLLOWING DAY AND TAKEN TO SUVA; SUBSEQUENTLY SCUTTLED. REPORTED AT LEAST ONE DOUBLE BOTTOM FUEL TANK BREACHED AND OIL LEAKED TO SEA.

FIJI (continued)

Vessel name: VITI
Type: FERRY (114 GRT)
Built: 1941
Date of incident: AUGUST 1982
Age at time of incident: 41 YEARS
Cargo: PASSENGERS
Incident details: STRUCK TIVOA REEF AND SANK APPROXIMATELY 5 MILES OFF LAUTOKA IN LAT. 17 37 06S. LONG. 177 21 30E. 27/8/82. ALL CREW MEMBERS AND PASSENGERS RESCUED.

Vessel name: KEKANUI
Type: GENERAL CARGO (400 GRT)
Built: 1954
Date of incident: MARCH 1983
Age at time of incident: 29 YEARS
Incident details: STRANDED AFTER DRAGGED ANCHOR IN SUVA HARBOUR, FIJI, DURING CYCLONE 'OSCAR' ON 1-2/3/83. REFLOATED BY OWN MEANS AND TOWED BACK TO ANCHORAGE BY PORTS AUTHORITY TUG WHERE RE-ANCHORED.

Vessel name: FIJI GAS
Type: LIQUEFIED GAS TANKER (1587 GRT)
Built: 1972
Date of incident: OCTOBER 1983
Age at time of incident: 11 YEARS
Incident details: STRANDED ON REEF NORTH OF LAUTOKA AT 0500 HRS ON 22/10/83.REFLOATED, WITHOUT ASSISTANCE, AT 0900 HRS ON 23/10/83. INSPECTION BY CREW INDICATED NO MAJOR BOTTOM DAMAGE SUSTAINED. CONTINUED ON VOYAGE TO LAMBASA.

Vessel name: PACIFIC SHELL
Type: TANKER (493 GRT)
Built: 1975
Date of incident: JANUARY 1984
Age at time of incident: 9 YEARS
Incident details: TOUCHED BOTTOM IN THE RIVER LABASA DURING JANUARY 1984. CONTINUED ON VOYAGE. SURVEYED AT SUVA 28/3/84, WHERE REPAIRS EFFECTED. DAMAGES CONFINED TO FOUR MINOR INDENTATIONS TOGETHER WITH MINOR REPAIRS WHICH REQUIRED TO PORT PROPELLER AND STARBOARD PROPELLER REPLACED WITH SPARE.

Vessel name: IKA NO. 5
Type: FISHING (105 GRT)
Built: 1980
Date of incident: APRIL 1984
Age at time of incident: 4 YEARS
Incident details: STRANDED ON CAKAULEVU REEF, IN LAU WATERS, OFF SUVA AT 0330 HRS, ON 27/4/84. SUBSEQUENTLY TOWED TO SUVA ON 28/5/84, REPAIRED AND RETURNED TO SERVICE. ALL PASSENGERS AND CREW RESCUED AND NO INJURIES REPORTED. VESSEL'S HULL EXTENSIVELY DAMAGED, OIL TANKS LEAKING. IN ORDER TO REFLOAT THE VESSEL THE 'ST PEDRO NO. 56' WAS SUNK IN A CAVITY NEARBY AND USED AS A PURCHASE POINT FOR GROUND TACKLE AND PULLEYS.

FIJI (continued)

Vessel name: INDEPENDENCE
Type: FISHING (125 GRT)
Built: 1983
Date of incident: MAY 1984
Age at time of incident: 1 YEARS
Incident details: STRANDED AT VATU VULA REEF, NEAR MAKONGAI ISLAND, OFF SUVA MORNING OF 7/5/84. REFLOATED WITH ASSISTANCE 15/5/84 AND TOWED TO SUVA; LATER REPAIRED AND RETURNED TO SERVICE. SENT DISTRESS SIGNAL WHICH PICKED UP BY MFV' IKA NO. 7' WHICH WENT TO VESSELS AID AND PICKED UP ALL CREW. HULL REPORTEDLY HOLED.

Vessel name: NA MATAISAU
Type: FERRY/GENERAL CARGO (274 GRT)
Built: 1978
Date of incident: JANUARY 1985
Age at time of incident: 7 YEARS
Incident details: SUSTAINED MAIN ENGINE BREAKDOWN 6 MLS S.W. OF MOALA ISLANDFIJI ON 17/1/85; SUBSEQUENTLY STRUCK REEF AND SANK OFF MOALA ISLAND ON 18/1/85 AFTER DRAGGING ANCHOR DURING CYCLONE 'ERIC'. 2 DEAD. MASTS AND OTHER GEAR REMOVED AND RECOVERED AND VSLLEFT 'AS LIES' IN 15-18 METRES OF WATER. VESSEL WAS FITTED WITH SAIL EQUIPMENT FOR TESTS TO ASSESS THE VIABILITY OF SAIL ASSISTANCE.

Vessel name: KEKANUI
Type: GENERAL CARGO (400 GRT)
Built: 1954
Date of incident: JANUARY 1985
Age at time of incident: 31 YEARS
Incident details: REPORTED 18/1/85; STRANDED WHILST ANCHORED AT SUVA DURING CYCLONE 'NIGEL'. REPORTED 18/4/86; SANK IN NORTHERN ANCHORAGE IN LAT. 18 07S., LONG. 178 25E., IN HEAVY WEATHER. VESSEL WAS LOOTED BY LOCAL FISHERMEN.

Vessel name: MATTHEW FLINDERS
Type: FERRY (1002 GRT)
Built: 1954
Date of incident: MARCH 1985
Age at time of incident: 31 YEARS
Incident details: DRAGGED ANCHOR AND STRANDED ON REEF IN SAWENI BAY, LAUTOKAAT 0400 L.T., 5/3/85 DURING CYCLONE 'GAVIN'; SUBSEQUENTLY REFLOATED 10/3/85 AND PROCEEDED TO LAUTOKA. REFLOATING ATTEMPTS HAMPERED BY HEAVY WINDS AND ROUGH SEAS TUG 'PACIFIC SALVOR' ASSISTING. LLOYDS STANDARD FORM 'NO CURE - NO PAY' BASIS SIGNED. SUSTAINED SOME BOTTOM AND PROPELLER DAMAGE.

Vessel name: YOUNG KWANG NO. 1
Type: FISHING (233 GRT)
Built: 1963
Date of incident: APRIL 1985
Age at time of incident: 22 YEARS
Incident details: STRANDED WHILST DEPARTING SUVA ON 13/4/85 IN HEAVY WEATHER, REFLOATED WITHOUT ASSISTANCE SAME DAY AND ANCHORED. RETURNED TO SERVICE. PORT BILGE KEEL BUCKLED.

FIJI (continued)

Vessel name: PACIFIC SHELL
Type: TANKER (493 GRT)
Built: 1975
Date of incident: MAY 1985
Age at time of incident: 10 YEARS
Incident details: STRANDED ON CORAL REEF WHILST ON VOYAGE FROM LABASA TO LAUTOKA ON 4/5/85. REFLOATED WITHOUT ASSISTANCE AFTER 40 MINUTES AND PROCEEDED ON VOYAGE. MINOR DAMAGE. SUSTAINED MINOR BUCKLING OF STARBOARD PROPELLER BLADE AND SCRATCHING OF BOTTOM PAINT.

Vessel name: IKA NO. 1
Type: FISHING (114 GRT)
Built: 1972
Date of incident: FEBRUARY 1986
Age at time of incident: 14 YEARS
Cargo: FRESH WATER, 81 TONNES
Incident details: STRANDED WHILST MANOEUVRING THROUGH MANA ISLAND CHANNEL, FIJI, IN LAT. 17 40S., LONG. 177 07E., ON 11/2/86. REFLOATED UNDER OWN POWER AND RETURNED TO LAUTOKA. SUBSEQUENTLY FLOODED, TOWED AND BEACHED N. OF LAUTOKA. HULL PLANKING PORT SIDE FORWARD AT LEVEL OF BILGE KEEL HEAVILY DAMAGED OVER 2 M IN LENGTH, BILGE KEEL IN WAY OF ABOVE SHEARED, PROPELLER BLADE SHEARED AND HEAVILY BUCKLED, WILL REQUIRE REPLACEMENT, PROPELLER SHAFT DISTORTED AND STERN GLAND LEAKING.

Vessel name: TALOFA
Type: LANDING CRAFT (141 GRT)
Built: 1984
Date of incident: APRIL 1986
Age at time of incident: 2 YEARS
Incident details: CAPSIZED AND STRANDED ON REEF AT YASAWA ISLAND, IN LAT. 16 42W. LONG. 177 35E. ON 15/4/86 AFTER SUSTAINING STEERING TROUBLE; SUBSEQUENTLY REFLOATED AND TOWED TO SUVA FOR REPAIRS. REPORTED 8 CREW MEMBERS MISSING.

Vessel name: KAUNITONI
Type: PASSENGER/GENERAL CARGO/FERRY (384 GRT)
Built: 1975
Date of incident: AUGUST 1986
Age at time of incident: 11 YEARS
Cargo: PASSENGERS
Incident details: STRANDED ON MAMBULITHI REEF, SOUTH OF NGAU ISLAND AT 0200,LT, ON 8/8/86 IN GOOD WEATHER. REFLOATED AND TAKEN TO SUVA ON 23/8/86 FOR REPAIRS. ALL PASSENGERS AND CREW SAFELY RESCUED AND TAKEN TO SUVA. REPAIRS TO COMMENCE WHEN GOVERNMENT SLIPWAY REOPENS AFTER REPAIRS. UNDERSTOOD HULL BOTTOM HOLED.

Vessel name: CORAL GAS
Type: LIQUEFIED GAS TANKER (1897 GRT)
Built: 1970
Date of incident: APRIL 1987
Age at time of incident: 17 YEARS
Incident details: STRANDED IN THE ENTRANCE TO THE NAVULA PASSAGE, MOMI BAY, NADI, ON 19/4/87. REFLOATED THE FOLLOWING DAY WITHOUT AID AND ARRIVED SUVA ON 21/4/87. IN SERVICE THE FOLLOWING DAY. BILGE KEELS SLIGHTLY DAMAAGED, BOTTOM SET UP TO A MAX. OF 4CM. AND PAINT/FOULING STRIPPED. NO CRACKS SUSTAINED.

FIJI (continued)

Vessel name: SHIN CHYUN No. 7
Type: FISHING (163 GRT)
Built: 1974
Date of incident: JUNE 1988
Age at time of incident: 14 YEARS
Cargo: FISH
Incident details: STRANDED APPROXIMATELY 300 MILES S.W. OF FIJI ON 22/6/88; SUBSEQUENTLY REFLOATED AND TOWED TO SUVA FOR REPAIRS, SOLD. RENAMED 'TASU NO 2'. ENGINE ROOM FLOODED.

Vessel name: MATTHEW FLINDERS
Type: FERRY (1002 GRT)
Built: 1954
Date of incident: JULY 1989
Age at time of incident: 35 YEARS
Cargo: PASSENGERS
Incident details: WRECKED ON NAVATU REEF, S.E. OF MOALA ISLAND, FIJI, ON 11/7/89. PASSENGERS AND CREW RESCUED. HOLD AND ENGINE ROOM FLOODED.

Vessel name: WAIRUA
Type: FERRY/GENERAL CARGO (618 GRT)
Built: 1961
Date of incident: AUGUST 1993
Age at time of incident: 32 YEARS
Cargo: PASSENGERS
Incident details: WRECKED NEAR NAMALATA REEFS, 13 MILES N.E. OF CAPE WASHINGTON, OFF NAIKOROKORO ON 8/8/93.

Vessel name: ARAUCO
Type: BULK CARRIER (15080 GRT)
Built: 1979
Date of incident: FEBRUARY 1994
Age at time of incident: 15 YEARS
Cargo: CONTAINERS
Incident details: STRANDED ON A REEF OFF LAMBASA IN LAT. 16 34S., LONG. 179 23E., ON 15/2/94. REFLOATED WITH TUG ASSISTANCE ON 20/2/94AND TAKEN TO SAVUSAVU FOR TEMPORARY REPAIRS. SUBSEQUENTLY ARRIVED SINGAPORE 30/3/94 FOR REPAIRS. SUSTAINED DAMAGE TO FOREPEAK DOUBLE BOTTOM TANK AND WATER IN NO. 5 HOLD.

FRENCH POLYNESIA

Vessel name: TAI NUI
Type: FISHING (120 GRT)
Built: 1973
Date of incident: DECEMBER 1983
Age at time of incident: 10 YEARS
Incident details: STRANDED AND SANK OFF PAPEETE ON 21/12/83.

Vessel name: TAPORO II
Type: GENERAL CARGO (343 GRT)
Built: 1963
Date of incident: NOVEMBER 1984
Age at time of incident: 21 YEARS
Incident details: SPRANG LEAK IN ENGINE ROOM AND BEACHED ON REEF OFF NUKUTAVAKE, TUAMOTU ARCHIPELAGO ON 25/11/84. VESSEL BEACHED IN ORDER TO SAVE BOTH THE CARGO AND LIVES OF PASSENGERS AND CREW.

FRENCH POLYNESIA (continued)

Vessel name: BYRON No. 16
Type: REFRIGERATED CGO/FISH CARRIER (1872 GRT)
Built: 1970
Date of incident: SEPTEMBER 1988
Age at time of incident: 18 YEARS
Cargo: ALBACORE-1576 TONNES
Incident details: STRANDED AT TETIAROA ISLAND, IN LAT. 17 00S., LONG. 149 00W., AT 0200LT., ON 8/9/88. REFLOATED AFTER CARGO OFFLOADED AND TOWED TO JAPAN WHERE REPAIRS EFFECTED. LATER REPORTED IN SERVICE. HULL BOTTOM AND STEERING GEAR DAMAGED, RUDDER BENT AND 1 PROP. BLADE TWISTED. VESSEL LATER REPORTED TRADING UNDER NEW NAME "SKY FROST'.

GUAM/ NORTHERN MARIANAS

Vessel name: MICRONESIA SUNRISE
Type: TANKER (3535 GRT)
Built: 1971
Date of incident: OCTOBER 1980
Age at time of incident: 9 YEARS
Cargo: JET FUEL
Pollution: OIL
Incident details: REPORTED STRANDED AT IBAY, OFF GUAM ON 19/10/80. REFLOATEDAND PROCEEDED TO GUAM. ETA 28/10/80 FOR TEMPORARY REPAIRS. SUSTAINED A SMALL HOLE IN NO.3 TANK, FUEL TRANSFERRED TO NO.2 TANK WITH SLIGHT LOSS OF CARGO.

Vessel name: BRIGHT PEAK
Type: BULK CARRIER (9735 GRT)
Built: 1978
Date of incident: APRIL 1981
Age at time of incident: 3 YEARS
Cargo: WHEAT
Incident details: STRANDED SOUTH OF GUAM ON 7/4/81. REFLOATED AND DIVERTED TO GUAM WHERE TEMPORARY REPAIRS EFFECTED; SUBSEQUENTLY TOWED TO ONISHI FOR PERMANENT REPAIRS. RETURNED TO SERVICE.

Vessel name: FENTRESS
Type: GENERAL CARGO (3805 GRT)
Built: 1945
Date of incident: NOVEMBER 1981
Age at time of incident: 36 YEARS
Incident details: STRANDED AT SAIPAN ISLAND ON 15/11/81 DURING TYPHOON 'HAZEN'. REFLOATED WITH ASSISTANCE END OF DECEMBER AFTER LIGHTENING; SUBSEQUENTLY ARRIVED OSAKA 2/3/82 FOR REPAIRS AND RESUMED TRADING ON COMPLETION. DETAILS OF DAMAGES NOT REPORTED.

GUAM/ NORTHERN MARIANAS (continued)

Vessel name: NAM SUNG NO. 62
Type: FISHING (287 GRT)
Built: 1962
Date of incident: JULY 1982
Age at time of incident: 20 YEARS
Cargo: FISH 90 TONNES
Incident details: WRECKED AT ROTA ISLAND IN LAT. 14 10N., LONG. 145 09E., ON 20/7/82 DUE TO FAILURE OF GYROCOMPASS AND RADAR IN HEAVY WEATHER. VESSEL WILL BE LEFT AS LIES DUE TO HEAVY DAMAGE SUSTAINED.

Vessel name: AMERICAN LEGION
Type: CONTAINER SHIP (19157 GRT)
Built: 1968
Date of incident: DECEMBER 1985
Age at time of incident: 17 YEARS
Cargo: CONTAINERS
Pollution: OIL
Incident details: STRANDED AT ENTRANCE TO APRA HARBOUR, GUAM AT 2000LT., 13/12/85. REFLOATED WITH TUG AID AND ENTERED PORT WHERE TEMPORARY REPAIRS EFFECTED. SAILED TO KAOHSIUNG WHERE PERMANENT REPAIRS COMPLETED. LATER REPORTED TRADING. 80000 GALLONS OF BUNKER FUEL SPILLED INTO SEA AFTER NO.1 OIL TANK AND A CARGO HOLD WERE RUPTURED.

Vessel name: SUN LONG NO. 8
Type: REFRIGERATED CARGO (3662 GRT)
Built: 1968
Date of incident: AUGUST 1986
Age at time of incident: 18 YEARS
Cargo: FROZEN FISH
Incident details: STRANDED WHILST ENTERING TINIAN HARBOUR ON 23/8/86. NO 2 HOLD AND ENGINE ROOM FLOODED.

Vessel name: PETRO SERVICE
Type: SUPPLY SHIP (O.R.S.V.) (573 GRT)
Built: 1968
Date of incident: DECEMBER 1986
Age at time of incident: 18 YEARS
Cargo: MARINE DIESEL
Pollution: OIL
Incident details: STRANDED ON REEF OFF SAIPAN ISLAND IN LAT. 15 15N. LONG. 145 44 15E. ON 3/12/86 DURING TYPHOON 'KIM'.

Vessel name: TOROS BAY
Type: GENERAL CARGO (8931 GRT)
Built: 1973
Date of incident: DECEMBER 1986
Age at time of incident: 13 YEARS
Cargo: TYRES
Incident details: STRANDED ON REEF IN LAT. 13 15N. LONG. 144 38E. ON 22/12/86. REFLOATED 2/1/87 AND TAKEN TO APRA; SUBSEQUENTLY TAKEN TO KAOHSIUNG, SOLD AND BROKEN UP. BOTTOM PLATING SET UP IN WAY OF NOS 1, 2 AND 3 HOLDS. STEERING GEAR EXTENSIVELY DAMAGED DUE VESSEL'S STERN CONTACTING REEF DURING REFLOATING.

GUAM/ NORTHERN MARIANAS (continued)

Vessel name: KOTOBUKI MARU No. 1
Type: FISHING (253 GRT)
Built: 1966
Date of incident: JANUARY 1988
Age at time of incident: 22 YEARS
Incident details: STRANDED AT GUAM ON 12/1/88 DURING TYPHOON 'ROY'.

Vessel name: ISLA GRANDE
Type: TANKER (2915 GRT)
Built: 1979
Date of incident: MARCH 1990
Age at time of incident: 11 YEARS
Cargo: OIL
Incident details: TOUCHED BOTTOM WHILST MANOEUVRING AT SAIPAN ISLAND ON 17/3/90. SAILED 26/3/90 FOR P.R. OF CHINA. SUSTAINED PROPELLER DAMAGE.

Vessel name: BELAIT KINGFISHER
Type: LANDING CRAFT (253 GRT)
Built: 1974
Date of incident: SEPTEMBER 1990
Age at time of incident: 16 YEARS
Incident details: STRANDED AT ROTA ISLAND, MARIANAS ISLANDS, ON 15/9/90. REFLOATED WITH TUG ASSISTANCE ON 20/9/90. TOWED TO GUAM AFTER TEMPORARY REPAIR. SUBSEQUENTLY TOWED TO CEBU FOR REPAIRS. HULL BOTTOM 50% DAMAGED. TAILSHAFT, PROPELLER AND BOTH RUDDERS BADLY BENT. SOME MACHINERY DAMAGE.

Vessel name: TUMON 2
Type: GENERAL CARGO (194 GRT)
Built: 1970
Date of incident: OCTOBER 1991
Age at time of incident: 21 YEARS
Incident details: STRANDED 14 MILES N.E. OF SAIPAN ON 6/10/91; SUBSEQUENTLY BROKE IN TWO AND SANK 5/11/91 DURING TYPHOON 'SETH'.

KIRIBATI

Vessel name: KWANG MYUNG NO. 62
Type: FISHING (352 GRT)
Built: 1968
Date of incident: MARCH 1980
Age at time of incident: 12 YEARS
Incident details: WRECKED ON TAMANA ISLAND IN LAT. 02 30S., LONG. 175 59E., ON 25/3/80. CREW RESCUED.

Vessel name: NAM CHANG
Type: FISHING (227 GRT)
Built: 1971
Date of incident: FEBRUARY 1982
Age at time of incident: 11 YEARS
Cargo: FISH
Incident details: WRECKED OFF STARBUCK ISLAND IN LAT. 05 35S. LONG. 155 35W. ON 23/2/82. CREW RESCUED.

KIRIBATI (continued)

Vessel name: YOUNG KWANG NO. 5
Type: FISHING (243 GRT)
Built: 1964
Date of incident: NOVEMBER 1982
Age at time of incident: 18 YEARS
Incident details: STRUCK REEF IN LAT. 01 47N. LONG. 157 26W. ON 17/11/82, REFLOATED 18/11/82 BUT SUBSEQUENTLY SANK OFF CHRISTMAS ISLAND IN LAT. 01 41 05N. LONG. 156 40 05W. ON 22/11/82. ALL CREW RESCUED. SANK DUE TO SEVERE LEAKAGE OF SEAWATER THROUGH FRACTURED HOLES OF BOTTOM AND NO 3 OIL TANK AREA.

Vessel name: FENTRESS
Type: GENERAL CARGO (3805 GRT)
Built: 1945
Date of incident: NOVEMBER 1983
Age at time of incident: 38 YEARS
Cargo: GENERAL
Incident details: STRANDED OFF CHRISTMAS ISLAND ON 3/11/83 WHILST ON LOADED VOYAGE FROM HONOLULU TO FANNING ISLAND. REFLOATED 11/11/83AND RESUMED VOYAGE. NO DETAILS OF DAMAGE, IF ANY, REPORTED.

Vessel name: EVELYN DA ROSA
Type: FISHING (966 GRT)
Built: 1974
Date of incident: MAY 1993
Age at time of incident: 19 YEARS
Incident details: STRUCK SUBMERGED OBJECT IN THE GILBERT ISLANDS, IN LAT. 02 14N., LONG. 171 10E., ON 3/5/93 AND SUBSEQUENTLY FOUNDERED. 18 PERSONS RESCUED.

MARSHALL ISLANDS

Vessel name: MARSHALL ISLANDS
Type: GENERAL CARGO (798 GRT)
Built: 1976
Date of incident: DECEMBER 1979
Age at time of incident: 3 YEARS
Incident details: WRECKED OFF JEMO ISLAND, MARSHALL ISLAND, ON 16/12/79. SALVAGE ATTEMPTS UNSUCCESSFUL. CTL.

Vessel name: TONG WHA NO. 101
Type: FISHING (215 GRT)
Built: 1965
Date of incident: JUNE 1983
Age at time of incident: 18 YEARS
Cargo: FISH 182 TONNES
Incident details: WRECKED OFF KWAJALEIN ATOLL, MARSHALL ISLANDS ON 13/6/83.

Vessel name: SEIFUKU MARU No. 1
Type: FISHING (119 GRT)
Built: 1985
Date of incident: JANUARY 1994
Age at time of incident: 9 YEARS
Incident details: STRUCK A ROCK AND SANK IN LAT. 07 06N., LONG. 171 07E., ON 16/1/94.

Nauru

Vessel name: VICTOR EOAEO
Type: FISHING (948 GRT)
Built: 1977
Date of incident: JANUARY 1986
Age at time of incident: 9 YEARS
Incident details: STRUCK REEF AND SANK OFF NAURU ON 29/1/86 AFTER MOORINGS PARTED IN HEAVY WEATHER. 9 CREW MEMBERS RESCUED.

New Caledonia

Vessel name: PURAU
Type: TUG (247 GRT)
Built: 1986
Date of incident: AUGUST 1986
Age at time of incident: 0 YEARS
Incident details: STRANDED ON CORAL REEF IN LAT. 19 21S., LONG. 163 12E., ON7/8/86. REFLOATED BY OWN POWER AND TAKEN TO POUME. TOWED TO NOUMEA, WHERE TEMPORARY REPAIRS EFFECTED, AND THENCE TONAGASAKI SHIPYARD FOR PERMANENT REPAIRS. TEMPORARY REPAIRS CONSISTED OF FITTING PLATE BRACKETS TO SUPPORT NOZZLE/PROPELLER SEGMENTS OF DRIVE UNITS TO PREVENT FALLING OFF IN EVENT OF COMPLETE FAILURE OF ATTACHMENTS BOLTS (MAJORITY CONSIDERED FRACTURED) AND BLANKING OF MAIN AUXILIARY ENGINE EXHAUSTS AT TRANSOM. BOTH PROPELLERS NEED REPLACING AND ABOUT 15 M OF DAMAGED PLATES REQUIRE REPAIR. THE VESSEL WAS ON DELIVERY VOYAGE WHEN SHE STRANDED.

Other (minor US possessions)

Vessel name: RYOYU MARU NO. 8
Type: FISHING (134 GRT)
Built: 1973
Date of incident: NOVEMBER 1979
Age at time of incident: 6 YEARS
Incident details: STRANDED ON A REEF NEAR PALMYRA ISLAND ON 22/11/79 AFTER AN ELECTRICAL FAULT. OWNERS ABANDONED VSL TO SALVORS WHO REFLOATED & EFFECTED REPAIRS. SUBSEQUENTLY RENAMED JUCY & USED AS A AUXILIARY SALVAGE VSL BY SALVORS. KINGMAN REEF IS 40 MILES NW OF PALMYRA ISLAND. HULL REPAIRS WERE NEGLIGIBLE. NOW REGISTERED IN SUVA & CLASSED WITH FIJI MARINE BOARD.

Vessel name: SHANTA SHIBANI
Type: BULK CARRIER (15387 GRT)
Built: 1971
Date of incident: JANUARY 1984
Age at time of incident: 13 YEARS
Incident details: STRANDED ON ROCKS, WAKE ISLAND ON 25/1/84 AFTER MOORINGS BROKE IN HEAVY WEATHER, REFLOATED 29/1/84 AND TAKEN TO GUAM AND THENCE TO ULSAN WHERE TEMPORARY REPAIRS EFFECTED. VESSEL ARRIVED WAKE ISLAND 16/1/84 WITH MAIN ENGINE TROUBLE.

OTHER (MINOR US POSSESSIONS) (continued)

Vessel name: HUI FENG No. 1
Type: FISHING (280 GRT)
Built: 1969
Date of incident: JUNE 1991
Age at time of incident: 22 YEARS
Pollution: OIL
Incident details: STRANDED AT PALMYRA ISLAND ATOLL, 1000 N MLS S.W. OF HONOLULU ON 14/6/91. CREW RESCUED. DIESEL FUEL LEAKAGE.

PALAU

Vessel name: BOWOON NO. 7
Type: TANKER (3084 GRT)
Built: 1969
Date of incident: APRIL 1980
Age at time of incident: 11 YEARS
Cargo: COCONUT OIL
Pollution: OIL
Incident details: REPORTED STRANDED IN LAT.07 14 51N. LONG.134 28 39E. ON 22/4/80. REFLOATED AFTER JETTISONING PART CARGO AND ANCHORED KOROR, PALAU ISLANDS. ARRIVED ULSAN 21/5/80 FROM BUSAN.

Vessel name: BLUEFIN ENDEAVOUR
Type: FISHING (1010 GRT)
Built: 1977
Date of incident: JUNE 1992
Age at time of incident: 15 YEARS
Incident details: STRUCK HELEN REEF, N. PAPUA NEW GUINEA AND SANK EARLY 1992.

PAPUA NEW GUINEA

Vessel name: MALUKA
Type: GENERAL CARGO (584 GRT)
Built: 1950
Date of incident: JUNE 1977
Age at time of incident: 27 YEARS
Cargo: SILICA SAND 600 T
Incident details: DAMAGED BY STRANDING AT RAGAVE POINT, CAPE VOGEL, IN LAT. 09 41 00S., LONG. 150 03 24E., ON 1/6/77 IN HAZY CONDITIONS. SUBSEQUENTLY REFLOATED, ANCHORED AT SALAMAUA BAY, SOLD AND BROKEN UP. VESSEL STRANDED ON REEF AND IN TWO RESCUE ATTEMPTS FROM MT 'SEPIK ENERGY' AND MV 'HEBE' BOTH VESSELS STRANDED ON SAME REEF AND CONSIDERED TOTAL LOSSES.

Vessel name: HEBE
Type: GENERAL CARGO (296 GRT)
Built: 1946
Date of incident: JUNE 1977
Age at time of incident: 31 YEARS
Incident details: STRANDED AT RAGAVE POINT, CAPE VOGEL, PAPUA NEW GUINEA, INLAT 09 41 05S, LONG 150 03 24E, ON 6/6/77 WHILE ATTEMPTINGTO REFLOAT STRANDED MV 'MALUKA'; SUBSEQUENTLY REFLOATED, TOWED TO SAMARAI AND SCUTTLED OFF SALAMAUA ON 10/4/82. NO DETAILS OF DAMAGE REPORTED.

PAPUA NEW GUINEA (continued)

Vessel name: CARLA MANUS
Type: LANDING CRAFT (174 GRT)
Built: 1970
Date of incident: MARCH 1979
Age at time of incident: 9 YEARS
Incident details: STRANDED ON REEF NEAR WILLAUMEZ PENINSULAR, NEW BRITAIN ON9.3.79; SUBSEQUENTLY REFLOATED & RESUMED SERVICE REFLOATED 14.3.79. DAMAGE PRESUMED MINOR DUE TO LACK OF LATER DATA.

Vessel name: RUDOLPH WAHLEN
Type: GENERAL CARGO (115 GRT)
Built: 1964
Date of incident: JUNE 1979
Age at time of incident: 15 YEARS
Cargo: FLOUR
Incident details: WRECKED ON CIRCULAR REEF, 70 MILES S.E. OF MANUS ISLAND, BISMARCK ARCHIPELAGO, ON 27/6/79. WEATHER GOOD AT TIME OF CASUALTY. AFTER SEVERAL ATTEMPTS TO REFLOAT, VESSEL ABANDONED. SOME OF CARGO WAS SAVED.

Vessel name: IDUN
Type: GENERAL CARGO (300 GRT)
Built: 1971
Date of incident: AUGUST 1979
Age at time of incident: 8 YEARS
Incident details: GROUNDED AT DOVE IS IN 09 59S 143 08E ON 2.8.79 REFLOATED UNDER OWN POWER.

Vessel name: AMBUSA
Type: LANDING CRAFT (180 GRT)
Built: 1972
Date of incident: AUGUST 1979
Age at time of incident: 7 YEARS
Cargo: SAWN TIMBER
Incident details: STRANDED AT CAPE GLOUCESTER, NEW BRITAIN, ON 2.8.79, REFLOATED & CONTINUED ON VOYAGE. REPAIRS DEFERRED TO END SEPTEMBER.

Vessel name: CHIANG WEI
Type: GENERAL CARGO (3981 GRT)
Built: 1979
Date of incident: JANUARY 1980
Age at time of incident: 1 YEARS
Cargo: LOGS
Incident details: STRANDED AT KALILI HARBOUR, NEW IRELAND IN LAT.03 26 43S. LONG.151 55 00E. AT 1018 GMT. 1.1.80 REFLOATED WITH ASSISTANCE AFTER CARGO JETTISONED & CONTINUED SERVICE. PROBABLE CAUSE STRONG CURRENT, ALSO BUOY AT HARBOUR ENTRANCE

Vessel name: DAI WANG NO. 105
Type: FISHING (299 GRT)
Built: 1964
Date of incident: JANUARY 1980
Age at time of incident: 16 YEARS
Incident details: STRANDED ON CORAL ISLAND IN LAT. 02 28S., LONG. 149 57E., ON 15/1/80 IN POOR VISIBILITY. REFLOATED AM 6/6/80 BY TUG AND TOWED TO RABAUL WHERE ARRIVED 1900 HOURS 8/6/80. LLOYD'S OPEN FORM SIGNED WITH SALVORS.

PAPUA NEW GUINEA (continued)

Vessel name: WAIGANI EXPRESS
Type: GENERAL CARGO (5084 GRT)
Built: 1971
Date of incident: JULY 1981
Age at time of incident: 10 YEARS
Cargo: CONTAINERS
Incident details: STRANDED OFF HOOD POINT 65 KM S.E OF PORT MORESBY AT 2345 HRS 4/7/81; REFLOATED AT 2007 HRS 31/7/81 AFTER PART CARGO DISCHARGED AND TOWED TO PORT MORESBY 1/8/81, THENCE SINGAPORE, SOLD, RENAMED 'PAPUA' AND RETURNED TO SERVICE. INITIAL BOTTOM INSPECTION REVEALS AREA'S OF DAMAGE PORT FORWARD AND STARBOARD AMIDSHIPS VERY INDENTED AND SET UP. NO DETAILS OF REPAIRS REPORTED.

Vessel name: SEIHA MARU
Type: TUG/SALVAGE SHIP (1033 GRT)
Built: 1969
Date of incident: NOVEMBER 1982
Age at time of incident: 13 YEARS
Incident details: STRANDED ON REEF, OFF RABAUL, NEW BRITAIN IN LAT. 04 12 48S. LONG. 152 30 00E. ON 8/11/82, AFTER TOW-WIRE FOULED PROPELLER WHILST TOWING FV 'HINODE MARU NO. 8', REFLOATED,TOWED TO MOJI AND THENCE TO SAKOSHI, SOLD AND BROKEN UP.

Vessel name: MANHATTAN DUKE
Type: TANKER (39349 GRT)
Built: 1976
Date of incident: JULY 1983
Age at time of incident: 7 YEARS
Pollution: OIL
Incident details: STRANDED ON BASILISK REEF OFF PORT MORESBY AT 0255 HRS, LT, ON 16/7/83 IN HEAVY WEATHER, WHILST HOVE-TO AWAITING PILOT. REFLOATED WITH TUG ASSISTANCE AT 1736 HRS LT ON 25/7/83. TOWED TO SINGAPORE WHERE AR 21/11/83 FOR REPAIRS. HULL ONE-THIRD AGROUND BY HEAD. 15 DEGREE STARBOARD LIST. EXTENSIVELY DAMAGED IN ALL STARBOARD TANKS WITH A 10FT SPLIT IN WAY OF BILGE STARBOARD SIDE. FOREPEAK CROSS BALLAST TANKS, SLOP TANKS, STARBOARD PUMP ROOM AND STAR- BOARD ENGINE ROOM DOUBLE BOTTOM FUEL TANKS ALL BREACHED. WATERTIGHT INTEGRITY MAINTAINED WITH COMPRESSED INERT GAS.TEMPORARY PATCHES TO DAMAGED FUEL TANKS AND PUMP-ROOM FITTED BY SALVORS AT PORT MORESBY.

Vessel name: COSMARIS
Type: RORO CARGO (340 GRT)
Built: 1978
Date of incident: NOVEMBER 1983
Age at time of incident: 5 YEARS
Incident details: STRANDED ON CORAL REEF OFF TINGWON GROUP 70 NAUTICAL MILESDUE WEST OF KAVIENG, IN LAT. 02 37S., LONG. 149 39E., ON 27/11/83 DURING HEAVY WEATHER. REFLOATED WITH TUG ASSISTANCE AND RE-DELIVERED TO OWNERS AT RABAUL 19/12/83. SUSTAINED PROPELLER, RUDDER AND PLATING DAMAGE.

PAPUA NEW GUINEA (continued)

Vessel name: LONGAN
Type: GENERAL CARGO (4660 GRT)
Built: 1977
Date of incident: MARCH 1984
Age at time of incident: 7 YEARS
Cargo: LOGS
Incident details: STRANDED 30 MILES SOUTH OF KIETA, BOUGAINVILLE ISLAND, ON 27/3/84. M TUG 'PACIFIC SALVOR' ASSISTED AND VESSEL SUBSEQUENTLY LEFT ARRIVED KIETA UNDER OWN POWER. ONLY DAMAGE REPORTED WAS A BEND IN THE RUDDER.

Vessel name: TANGIR
Type: LANDING CRAFT (170 GRT)
Built: 1971
Date of incident: JANUARY 1985
Age at time of incident: 14 YEARS
Cargo: MINING EQUIPMENT
Incident details: STRANDED ON REEF OFF PORT MORESBY, PAPUA NEW GUINEA ON 16/1/85; SUBSEQUENTLY CAPSIZED AND SANK ON 17/1/85 AFTER CARGO SHIFTED. VESSEL CAPSIZED AND SANK DURING ATTEMPTS TO REFLOAT WITH ASSISTANCE. VESSEL DECLARED A CONSTRUCTIVE TOTAL LOSS.

Vessel name: MOALE CHIEF
Type: LANDING CRAFT (262 GRT)
Built: 1981
Date of incident: FEBRUARY 1985
Age at time of incident: 4 YEARS
Incident details: STRANDED ON REEF AT GADAISU POINT, ORANGERIE BAY, SOUTH COAST OF PAPUA NEW GUINEA, ON 28/2/85. SUBSEQUENTLY TAKEN TO SLIPWAY AT PORT MORESBY, REPAIRED AND RETURNED TO SERVICE. REPORTED HULL PLATING, RUDDER PINTLES AND PROPELLER BLADESDAMAGED.

Vessel name: BOW'S BROTHER
Type: GENERAL CARGO (4719 GRT)
Built: 1977
Date of incident: JUNE 1985
Age at time of incident: 8 YEARS
Cargo: LOGS-493 CU. M.
Incident details: STRANDED BETWEEN RABAUL AND NEW IRELAND ON 23/6/85 AFTER DRAGGING ANCHOR IN HEAVY WEATHER. REFLOATED WITH TUG AID, TOWED TO RABAUL, THENCE KOBE WHERE REPAIRS EFFECTED. VESSEL LATER REPORTED RETURNED TO SERVICE. SUSTAINED HULL DENTED, SKEG SET UP, RUDDER DAMAGED AND STEERING GEAR RAMS DAMAGED.

PAPUA NEW GUINEA (continued)

Vessel name: OK TARIM
Type: TUG (126 GRT)
Built: 1982
Date of incident: AUGUST 1985
Age at time of incident: 3 YEARS
Incident details: STRANDED AND MAIN TOWING LINE BECAME ENTANGLED IN PORT PROPELLER OFF PORT MORESBY AT 2000, 19/8/85. TAKEN TO PORTWHERE SURVEYED 23/8/85, REPAIRED AND RETURNED TO SERVICE 7/9/85. 1 AIR VENT FROM STEERING GEAR ROOM TORN OFF. (P) & (S) PROPELLERS MINOR DAMS TO VARIOUS BLADE TIPS, AFT COVER OF (P) ME. GEARBOX CRACKED IN 3 PLACES IWO POWER OUTPUT SHAFTAFTER BEARING HOUSING. (P) GEARBOX REMOVED & INSPECTED, FOLLOWING FOUND: POWER OUTPUT SHAFT INNER & OUTER THRUST BEARINGS SLIGHTLY DAMD., 3 CRACKS IN AFT COVER & AHEAD CLUTCH PLATES WORN. REPS: (P) REDUCTION GEARCASE RENEWED, (P) & (S) PROPELLER BLADES FAIRED.

Vessel name: BRIGHT ACE
Type: VEHICLES CARRIER (7666 GRT)
Built: 1978
Date of incident: OCTOBER 1986
Age at time of incident: 8 YEARS
Cargo: CARS - 1700
Incident details: STRANDED 33 MILES N.E. OF CAPE NELSON, OFF NORTHERN COAST OF PAPUA, AT 0400LT., ON 11/10/86; SUBSEQUENTLY REFLOATED TAKEN TO PORT MORESBY, THENCE ULSAN AND JAPAN. LATER REPORTED RETURNED TO SERVICE AFTER REPAIRS EFFECTED. VESSEL REPORTED STRANDED ON A REEF AND SUSTAINED BOTTOM DAMAGE EXTENDING FROM BOW TO 20 METRES AFT. FOREPEAK TANK PLATING AND INTERNALS AND BULBOUS BOW MISSING, NO.1 WATER BALLAST DEEP TANK BOTTOM PLATING MISSING AND OTHER INTERNAL DAMAGES IN WAY SUSTAINED.

Vessel name: SMILAX
Type: GENERAL CARGO (3810 GRT)
Built: 1982
Date of incident: JANUARY 1987
Age at time of incident: 5 YEARS
Cargo: GENERAL
Incident details: STRANDED IN LAT. 08 47S. LONG. 150 11E. AT 1530 HRS. ON 3/1/87. REFLAOTED 13/1/87 AND PROCEEDED TUFI ANCHORAGE FOR INSPECTION. RETURNED TO SERVICE. DAMAGE MINOR.

Vessel name: WITBRIDGE
Type: LANDING CRAFT (718 GRT)
Built: 1977
Date of incident: MARCH 1987
Age at time of incident: 10 YEARS
Incident details: STRANDED 20 MILES E. OF CAPE WARD HUNT, IN LAT. 08S. LONG. 148 30E. ON 2/3/87. REFLOATED 8/3/87 AND TAKEN IN TOW TO CAIRNS WHERE REPAIRS EFFECTED AND VESSEL SAILED 19/5/87 FOR NEW BRITAIN. REPORTED VESSEL HOLED IN PORT AND STARBOARD FUEL OIL TANKS, ENGINE ROOM FLOODED AND RUDDERS AND PROPELLERS DAMAGED.

PAPUA NEW GUINEA (continued)

Vessel name: HURIS
Type: LANDING CRAFT (354 GRT)
Built: 1977
Date of incident: OCTOBER 1987
Age at time of incident: 10 YEARS
Cargo: SUPPLIES
Incident details: REPORTED 5/10/87; STRANDED WHILST UNLOADING AT LIHIR ISLAND, E. OF NEW IRELAND IN HEAVY SWELL. REFLOATED WITH TUG ASSISTANCE 11/10/87 AND TOWED TO RABAUL. REPAIRED. PORT PROPELLER, PORT SHAFT AND STARBOARD PROPELLER DAMAGED. THREE HOLES IN SHELL PLATE IN E.R.

Vessel name: SUN ISLAND
Type: GENERAL CARGO (3931 GRT)
Built: 1974
Date of incident: MARCH 1989
Age at time of incident: 15 YEARS
Incident details: STRANDED OFF WOODLAND ISLAND ON 9/3/89. REFLOATED WITHOUT ASSISTANCE BUT SUSTAINED DAMAGE TO LUBRICATING OIL SUCTION; SUBSEQUENTLY TOWED TO PORT MORESBY. TEMPORARY REPAIRS EFFECTED. SAILED 1/5/89 FOR DARU.

Vessel name: KIM LIEN
Type: GENERAL CARGO (6020 GRT)
Built: 1977
Date of incident: JULY 1990
Age at time of incident: 13 YEARS
Incident details: STRANDED ON REEF APPROXIMATELY 2 MILES OFF PORT MORESBY HARBOUR ENTRANCE ON 18/7/90 AFTER SUSTAINING ENGINE FAILURE. REFLOATED WITH TUG ASSISTANCE LATER SAME DAY AND TAKEN TO PORT MORESBY ANCHORAGE. SAILED 27/7/90.

Vessel name: GLOMARIS
Type: LANDING CRAFT (371 GRT)
Built: 1981
Date of incident: JULY 1990
Age at time of incident: 9 YEARS
Incident details: STRANDED OFF JACQUINOT BAR, NEW BRITAIN ISLAND ON 26/7/90. CAPSIZED AND SANK ON 28/7/90. SUBSEQUENTLY RAISEDAND REPAIRED. VESSEL HOLED AND TOOK WATER.

Vessel name: ADHIGUNA NUGRAHA 1
Type: GENERAL CARGO (4928 GRT)
Built: 1980
Date of incident: SEPTEMBER 1991
Age at time of incident: 11 YEARS
Cargo: LOGS
Incident details: STRANDED AT LAK, NEW IRELAND ON 6/9/91 IN HEAVY WEATHER. REFLOATED WITH TUG ASSISTANCE ON 13/9/91. TOWED TO RABAUL AND THENCE TO SINGAPORE WHERE ARRIVED 7/11/91. SAILED 24/1/92 FOR SUNGEI REJANG AFTER REPAIRS. RUDDER BROKEN/LOST.

PAPUA NEW GUINEA (continued)

Vessel name: SHENG FU No. 16
Type: FISHING (311 GRT)
Built: 1972
Date of incident: MAY 1992
Age at time of incident: 20 YEARS
Cargo: FISH
Incident details: WRECKED IN LAT. 09 49S., LONG. 142 12E., ON 6/5/92 AFTER SUSTAINING STEERING FAILURE IN LAT. 09 40S, LONG. 141 26E.

Vessel name: HAND CHEONG
Type: GENERAL CARGO (5030 GRT)
Built: 1978
Date of incident: MAY 1992
Age at time of incident: 14 YEARS
Cargo: LOGS
Incident details: STRANDED OFF KARU, NEW IRELAND IN LAT. 03 27S., LONG. 152 13E., ON 7/5/92 IN STRONG WIND AND CURRENT. REFLOATED 23/5/92 AND TOWED TO RABAUL FOR REPAIRS. ARRIVED HUANGPU 26/6/92. INGRESS OF SEAWATER IS REPORTED TO NOS. 1, 2, 3 & 4 PORT BALLAST TANKS, NOS. 3 & 4 STARBOARD TANKS, AND NOS. 3 & 4 FUEL OIL TANKS.

Vessel name: ARKTIS OCEAN
Type: GENERAL CARGO (1598 GRT)
Built: 1987
Date of incident: MARCH 1993
Age at time of incident: 6 YEARS
Cargo: COPPER CONCENTRATE
Incident details: TOUCHED BOTTOM IN THE RIVER FLY ON 4/3/93 AFTER LOG CAUGHT IN PROPELLER. REPORTED WAITING FOR TUG ASSISTANCE. ARRIVED PORT MORESBY 26/3/93.

Vessel name: PIXY MAY
Type: GENERAL CARGO (2820 GRT)
Built: 1986
Date of incident: MARCH 1993
Age at time of incident: 7 YEARS
Incident details: STRANDED IN LAT. 06 19S., LONG. 149 52E., ON 22/3/93. REFLOATED 26/3/93 AND TOWED TO RABUAL. REPAIRS EFFECTED AND VESSEL SAILED 30/3/93 FOR JAPAN.

Vessel name: ARMSTRONG
Type: GENERAL CARGO (6719 GRT)
Built: 1970
Date of incident: AUGUST 1993
Age at time of incident: 23 YEARS
Cargo: LOGS
Incident details: STRANDED AT AUMO, WEST NEW BRITAIN, IN LAT. 06 58S., LONG.148 36E., ON 13/8/93 AND ARRIVED RABAUL WITH SALVOR ASSISTANCE. SUBSEQUENTLY ARRIVED ALANG ON 9/8/94 AND BROKEN UP. HULL BOTTOM HOLED 7M BY 2M.

PAPUA NEW GUINEA (continued)

Vessel name: SAMSUN BRAVE
Type: FISHING (1247 GRT)
Built: 1983
Date of incident: MARCH 1994
Age at time of incident: 11 YEARS
Cargo: TUNA
Incident details: STRANDED ON REEF OFF CARTERET ISLAND, NORTH SOLOMON ISLANDS ON 6/3/94; SUBSEQUENTLY SLIPPED OFF REEF, CAPSIZED AND SANK ON 10/3/94. CREW RESCUED. 10 ISLANDERS ON BOARD THE VESSEL WHEN SHE SLIPPED OFF THE REEF ARE MISSING.

Vessel name: PAPUAN CHIEF
Type: CONTAINER SHIP (7914 GRT)
Built: 1991
Date of incident: JUNE 1994
Age at time of incident: 3 YEARS
Incident details: GROUNDED ON EAST ISLAND, IN LAT. 10 23S., LONG. 152 07E., 25/6/94. REFLOATED WITH ASSISTANCE 29/6/94 AND PROCEEDED TO ALOTAU FOR UNDERWATER INSPECTION/MINOR REPAIRS. ARRIVEDSINGAPORE 15/7/94. REPAIRED. SAILED 5/8/94 FOR JAKARTA.

Vessel name: GRAND FORTUNE
Type: GENERAL CARGO (7913 GRT)
Built: 1976
Date of incident: SEPTEMBER 1995
Age at time of incident: 19 YEARS
Incident details: REPORTED 25/9/95; STRANDED ON A REEF IN LAT. 06 18S., LONG. 149 50E. REFLOATED WITH ASSISTANCE ON 25/9/95 AND PROCEEDED TO LAE WHERE ARRIVED 11/10/95 FOR REPAIRS. FOREPEAK HOLED.

SOLOMON ISLANDS

Vessel name: PACIFIC TRADER
Type: TANKER (970 GRT)
Built: 1972
Date of incident: MARCH 1979
Age at time of incident: 7 YEARS
Incident details: STRANDED IN VIRU HARBOUR ON 23.3.79., REFLOATED WITHOUT ASSISTANCE 25.3.79 & PROCEEDED TO HONIARA FOR SURVEY, ARR. HONIARA 27.3.79 UNDER OWN POWER & SAILED FOR PORT MORESBY 28.3.79.

Vessel name: PACIFIC VOYAGER
Type: TANKER (674 GRT)
Built: 1970
Date of incident: JUNE 1979
Age at time of incident: 9 YEARS
Incident details: STRANDED AT GIZO HARBOUR, NEW HEBRIDES AT 0642 HRS ON 20/6/79. REFLOATED WITH TUG ASSISTANCE AND REPAIRED AT RABAUL. 3 PROPELLER BLADES DAMAGED. CEMENT BOX NOS.1 2 & 3 (S) TANKS. 20 PER CENT BOTTOM PLATING & TURN OF BILGE BUCKLED.* *

SOLOMON ISLANDS (continued)

Vessel name: YU HSING
Type: FISHING
Date of incident: JULY 1979
Incident details: STRANDED IN LAT. 05 08S., LONG. 159 09E., ON 2/7/79. SUBSEQUENTLY REFLOATED ABOUT 13/7/79 AND TAKEN TO HONIARA WHERE REPAIRED AND REPLACED IN COMMISSION. DAM. TO (S) SIDE KEEL STRAKES A,B&C, & AFT END OF BILGE KEEL BUCKLED. (P) SIDE KEEL STRAKES A&B SET UP, BAR KEEL PART TORN OFF.

Vessel name: SOLOMON FISHER
Type: FISHING (121 GRT)
Built: 1979
Date of incident: SEPTEMBER 1979
Age at time of incident: 0 YEARS
Incident details: STRANDED ON REEF AT TULAGI ON 16/9/79. REFLOATED THE SAME DAY AND SUBSEQUENTLY EFFECTED REPAIRS TO BOTTOM, RUDDER, PROPELLER AND MACHINERY AT LISAKU SHIPYARD, SHIZUOKA.

Vessel name: TENRYU MARU NO. 22
Type: FISHING (194 GRT)
Built: 1969
Date of incident: MARCH 1980
Age at time of incident: 11 YEARS
Incident details: STRANDED IN THE SOLOMAN SEA ON 11/3/80 & DECLARED A CTL.

Vessel name: SOLTAI NO. 6
Type: FISHING (103 GRT)
Date of incident: AUGUST 1980
Incident details: STRANDED OFF MUNDA LIGHTHOUSE, NEW GEORGIA ISLAND,ON 8/8/ 80. REFLOATED 20 MINUTES LATER WITH ASSISTANCE & TOWED TO TULAGI. SLIPPED AT TULAGI, & SURVEYOR RECOMMENDS REPS NOT NECESSARY AT THIS TIME. NOW PRESUMED TRADING. VSL REPORTEDLY SUSTAINED DAMAGE TO HER PROPELLER & BOTTOM PLATES.

Vessel name: IU-MI-NAO
Type: FERRY (518 GRT)
Built: 1965
Date of incident: AUGUST 1980
Age at time of incident: 15 YEARS
Incident details: STRANDED ON REEF IN LAT 08 55S. LONG 159 10E. ON 13/8/80. SUBSEQUENTLY REFLOATED, REPAIRED AND RETURNED TO SERVICE. UNDERWATER SURVEY REVEALED SLIGHT BUCKLING.

Vessel name: MIKOLAJ REJ
Type: GENERAL CARGO (9397 GRT)
Built: 1969
Date of incident: AUGUST 1983
Age at time of incident: 14 YEARS
Incident details: LISTED AFTER STRANDING IN HONIARA HARBOUR, GUADALCANAL ISLAND LAT. 09 26S., LONG. 159 58E., AT 1200 HRS ON 16/8/83. VESSEL SUBSEQUENTLY LIGHTENED BY DISCHARGING 1000 TONNES CARGO AND REFLOATED 0400 HRS, ON 17/8/83. PILOT WAS ON BOARD AT TIME OF STRANDING AND IT WAS ALLEGEDLY HIS ERROR WHICH CAUSED THE CASUALTY. THE FIRST ATTEMPT TO REFLOAT FAILED ON 18/8/83. MV 'JUSTANIA BOR' ASSISTED IN BOTH ATTEMPTS.

SOLOMON ISLANDS (continued)

Vessel name: HANLIM MASTER
Type: BULK CARRIER (9808 GRT)
Built: 1969
Date of incident: FEBRUARY 1984
Age at time of incident: 15 YEARS
Cargo: PINE LOGS 5,600 CU M
Pollution: OIL
Incident details: STRANDED ON BEACH 3 MILES WEST OF TAWARE POINT, SAN CRISTOBAL, SOLOMAN ISLANDS, LAT. 10 22 36S., LONG. 161 46 30E., ON 15/2/84. SUBSEQUENTLY REFLOATED 6/3/84 AND ARRIVED HONIARA 7/3/84. STRANDED WHILST MANOEUVRING CLOSER TO SHORE TO LOAD LOGS. REPORTED THAT FOREPEAK HOLED, RUDDER DAMAGED AND VESSEL EMBEDDED IN 3 METRES OF SAND. REPORTED STARBOARD OIL TANK RUPTURED AND LEAKING.

Vessel name: ANN
Type: GENERAL CARGO (262 GRT)
Built: 1958
Date of incident: MARCH 1985
Age at time of incident: 27 YEARS
Incident details: STRANDED ABOUT 1 MILE E. OF POINT CRUZ, HONIARA AT APPROX.0230HRS., 3/3/85 IN HEAVY WEATHER; SUBSEQUENTLY REFLOATED WITH NO DAMAGE SUSTAINED. PRESUMED RETURNED TO SERVICE. 1 CREW MISSING.

Vessel name: SOLOMAN PRINCESS
Type: PASSENGER/FERRY (121 GRT)
Built: 1969
Date of incident: MARCH 1985
Age at time of incident: 16 YEARS
Incident details: WRECKED ON ROCKS APPROXIMATELY 1 MILE E. OF POINT CRUZ, HONIARA ON 3/3/85 IN HEAVY WEATHER.

Vessel name: REGINA M
Type: GENERAL CARGO (500 GRT)
Built: 1956
Date of incident: MAY 1986
Age at time of incident: 30 YEARS
Incident details: STRANDED AT HONIARA ON 19/5/86 AFTER DRAGGING ANCHORS DURING CYCLONE 'NAMU'; SUBSEQUENTLY BROKEN UP IN SITU.

Vessel name: ISLAND TRADER
Type: GENERAL CARGO (199 GRT)
Built: 1969
Date of incident: JANUARY 1988
Age at time of incident: 19 YEARS
Incident details: REPORTED 20/1/88; STRANDED AT RUA NDIKA REEF IN LAT. 08 43S., LONG. 159 56E; SUBSEQUENTLY REFLOATED AND TAKEN TO SHIPYARD. REPAIRED.

SOLOMON ISLANDS (continued)

Vessel name: LARIX
Type: GENERAL CARGO (3810 GRT)
Built: 1981
Date of incident: APRIL 1991
Age at time of incident: 10 YEARS
Incident details: TOUCHED BOTTOM WHILST ENTERING ARURAHA BAY LOG LOADING POINT, MAKIRA ISLAND, SAN CRISTOBAL, ON 17/4/91. TOWED TO HONIARA AND THENCE TO AIOI, HYOGO PREF., WHERE ARRIVED 14/6/91 FOR DRYDOCKING AND REPAIRS. SAILED 27/8/91. SUSTAINED RUDDER DAMAGE.

Vessel name: ISLAND TRADER
Type: GENERAL CARGO (199 GRT)
Built: 1969
Date of incident: FEBRUARY 1992
Age at time of incident: 23 YEARS
Incident details: STRANDED AT RANADI BEACH ON 17/2/92 DURING CYCLONE 'DAMAN'. REFLOATED 19/3/92 AND BERTHED AT HONIARA. SUBSEQUENTLY SCUTTLED.

Vessel name: PRINCESS II
Type: PASSENGER/FERRY (133 GRT)
Built: 1963
Date of incident: JULY 1992
Age at time of incident: 29 YEARS
Cargo: PASSENGERS
Incident details: SUSTAINED ENGINE TROUBLE AND STRANDED FLORIDA ISLANDS, IN LAT. 09 09S., LONG. 160 23E., ON 27/7/92; SUBSEQUENTLY SANK 28/7/92.

Vessel name: TROPICAL DAMSEL
Type: GENERAL CARGO (5451 GRT)
Built: 1985
Date of incident: OCTOBER 1992
Age at time of incident: 7 YEARS
Cargo: LOGS
Incident details: TOUCHED BOTTOM AT WILSON HARBOUR, SOLOMON ISLANDS 13/10/92AND ADRIFT IN LAT. 07 49S., LONG. 157 18E., 14/10/92. TOWED TO NORO. TEMPORARY REPAIRS EFFECTED. SAILED. FURTHER TEMPORARY & PART PERMANENT REPAIRS EFFECTED AT INNOSHHIMA. RUDDER DAMAGED.

Vessel name: PELAWAN
Type: GENERAL CARGO (4815 GRT)
Built: 1975
Date of incident: APRIL 1993
Age at time of incident: 18 YEARS
Incident details: STRUCK SUBMERGED REEF WHILST MANOEUVRING AT KENEKO, IN LAT. 08 28S., LONG. 157 16E., ON 21/4/93 AND SUSTAINED DAMAGE TO RUDDER AND PROPELLER. VESSEL TOWED TO NORO AND THENCE TO BATANGAS WHERE REPAIRS EFFECTED. SAILED 1/8/93.

TOKELAU

Vessel name: TAI YANG NO. 103
Type: FISHING (133 GRT)
Built: 1967
Date of incident: FEBRUARY 1978
Age at time of incident: 11 YEARS
Incident details: ON REEF ON S.W. SIDE OF ATAFU ISLAND IN LAT 08.34.00S., LO172.28.30W. ON 19/2/78.

Vessel name: NAM HAE NO. 217
Type: FISHING (159 GRT)
Built: 1965
Date of incident: APRIL 1978
Age at time of incident: 13 YEARS
Incident details: STRANDED OFF ATAFU ISLAND, TOKELAU GROUP, IN LAT.08 31S., LONG. 172 30W., ON 9/4/78 IN POOR VISIBILITY.

Vessel name: SUNLIGHT NO. 22
Type: FISHING (291 GRT)
Built: 1963
Date of incident: JUNE 1979
Age at time of incident: 16 YEARS
Incident details: STRANDED AT NUKUNONO, IN LAT.09 10S, LONG.171 50W. ON 20.6.79; SUBSEQUENTLY REFLOATED 3.7.79 & TOWED TO SUVA. NOW REPAIRED & RETURNED TO SERVICE. DAMAGES MODERATE. SOME WATER DAMAGE TO ER ELECTRICS CAUSED BY MISSING SOUNDING PIPE CAP TO BREACHED BOTTOM TANK. REPAIRED AT SUVA.

Vessel name: AI SOKULA
Type: GENERAL CARGO (400 GRT)
Built: 1961
Date of incident: FEBRUARY 1981
Age at time of incident: 20 YEARS
Cargo: GENERAL
Incident details: WRECKED ON REEF OFF FAKAOFO ATOLL, TOKELAU ISLANDS IN LAT.09 19 55S., LONG. 171 12 90W., ON 26/2/81. HOLES IN FUEL AND WATER BALLAST TANKS. CARGO HOLD FLOODED.SALVORS ABANDONED SALVAGE ATTEMPTS DUE TO LOW VALUE OF VESSEL AND DAMAGE TO HULL. CARGO PLUNDERED BY ISLANDERS.

TUVALU

Vessel name: NAM HAE 203
Type: FISHING (159 GRT)
Built: 1965
Date of incident: NOVEMBER 1978
Age at time of incident: 13 YEARS
Incident details: GROUNDED AT NANUMANGA, ELLICE ISLANDS, IN LAT. 06 20S., LONG. 176 17E., ON 10.11.78, REFLOATED & REPAIRED AT SUVA. DAMAGES SUSTAINED TO SHELL PLATING I.W.O. ER & STEERING GEAR INOPERABLE.

Vessel name: AOI MARU
Type: GENERAL CARGO (223 GRT)
Built: 1972
Date of incident: JANUARY 1979
Age at time of incident: 7 YEARS
Incident details: STRANDED AT FUNAFUTI ISLAND ON OR ABOUT 18/1/79. REFLOATED WITHOUT ASSISTANCE AND SOLD. CASUALTY OCCURRED IN HEAVY WEATHER. SPLIT IN STARBOARD SIDE CAUSED SOME LEAKAGE. TAKEN TO SUVA.

TUVALU (continued)

Vessel name: SIEH TSIN JUNG
Type: FISHING (187 GRT)
Date of incident: FEBRUARY 1981
Incident details: STRANDED AT NUKUFETAU IN LAT 08 00S., LONG 178 30E., ON 8/2/81; SUBSEQUENTLY LEFT-AS-LIES. VSL LEFT-AS-LIES AS SALVAGE & REPAIRS WOULD EXCEED INSURED VALUE. ENGINE ROOM & NO. 3 FISH HOLD FLOODED & TIDAL WITH AFT END SETTLED. ALL ELECTRONIC EQUIP. & FISH GEAR REMOVED. 30 TONNES FISH NO. 3 HOLD, 3-4 TONNES BAIT & 30 TONNES FUEL ON BOARD. CHARGES OF ILLEGAL FISHING WERE BROUGHT BY TUVALU GOVT.

Vessel name: SISCO
Type: GENERAL CARGO (481 GRT)
Built: 1949
Date of incident: APRIL 1981
Age at time of incident: 32 YEARS
Incident details: WRECKED ON VAITUPU ISLAND, APPROXIMATELY 70 MILES N.N.W. OF FUNAFUTI ON 20/4/81 BOTTOM EXTENSIVELY DAMAGED & SALVORS DID NOT ATTEMPT TO REFLOAT VSL DUE TO SEVERE DAMAGES. OWNERS DID ATTEMPT TO REFLOAT VSL, BUT WITHOUT SUCCESS, REPORTED CASUALTY OCCURRED NIGHT OF 20-21/4/81

VANUATU

Vessel name: KALILI
Type: FERRY/GENERAL CARGO (227 GRT)
Built: 1961
Date of incident: JANUARY 1985
Age at time of incident: 24 YEARS
Incident details: STRANDED AT PALIKULO BAY, ESPIRITU SANTO ISLAND ON 16/1/85; SUBSEQUENTLY SANK FOLLOWING CYCLONES 'ERIC' AND 'NIGEL'.

Vessel name: FEDERESEN NALKUTAN
Type: GENERAL CARGO (341 GRT)
Built: 1958
Date of incident: JANUARY 1985
Age at time of incident: 27 YEARS
Cargo: COPRA
Incident details: WRECKED IN SEGOND CHANNEL, OFF ESPIRITU SANTO, IN LAT. 15 33S., LONG. 167 08E., ON 18/1/85 DURING CYCLONE 'NIGEL'. VESSEL REPORTED 'HOLED' IN PORT SHELL PLATING FROM BOW TO AMIDSHIPS.

Vessel name: FETUKAI
Type: GENERAL CARGO (115 GRT)
Built: 1971
Date of incident: JUNE 1987
Age at time of incident: 16 YEARS
Incident details: REPORTED TOOK WATER AND BEACHED AT TANNA ISLAND, NEW HEBRIDES, ON 16/6/87. LATER REFLOATED AFTER TEMPORARY REPAIRS EFFECTED, TAKEN TO PORT VILA, THENCE PALIKULO, ESPIRITU SANTO WHERE REPAIRS PRESUMED EFFECTED.

ANNEX 4 ENVIRONMENTAL IMPACTS OF SELECTED SHIP GROUNDING AND RELATED EVENTS

The following accounts of ship grounding and related events are based on a review of scientific literature. The events examined are:

- The grounding of the bulk carrier Wellwood in Florida in 1984;
- The grounding of the Safir, a freighter which ran aground in the Red Sea in 1989;
- The grounding of the longliner Jin Shiang Fa in American Samoa in 1993;
- The grounding of the bulk carrier Florida in Australia's Great Barrier Reef area in 1976;
- A tropical oil spill in Panama in 1988.

The impacts and consequences of these events are quite varied. They serve both to illustrate the range of possible outcomes that might arise from a ship grounding, and to underline the difficulties of predicting what these consequences might be.

3A THE WELLWOOD

The bulk carrier *Wellwood* went aground at Molasses Reef, Key Largo National Marine Sanctuary, Florida on August 3, 1984, and to date constitutes the best studied grounding of a vessel on a coral reef. The 122m freighter ran hard aground but was finally 13 days later re-floated by off-loading the cargo and was removed from the reef. The hull remained intact, there was no loss of cargo or contamination by debris or fuel, and damage to the reef was restricted to physical abrasion (Curtis, 1985).

The grounding of the *Wellwood* resulted in destruction to living corals and reef structure. 644 sq. m. of underlying reef framework was fractured by the weight of the ship. (Reef framework is that portion of the coral reef composed of naturally cemented accumulations of living and dead carbonate materials that resist movement or destruction by severe natural forces such as hurricanes). Of the area affected, the reef close to the bow section suffered the greatest damage. The reef framework was fractured but damage was confined primarily to elevated segments of reef which lay beneath and supported the ship after collision. The impact areas resulted in sheared off and flattened reef projections. The damage incurred was characterised by massive *Montastraea annularis* being removed from their growth position on the reef, overturned, and in several cases broken into mounds of living and dead coral debris (Hudson and Diaz 1988).

Impact of rubble and sediment: The crushing of the reef resulted in the presence of large quantities of fine sediment and rubble. This “new substrate” inhibited coral recruitment due to its unstable nature. It was also potentially damaging due to its mobility with wave action. Gittings et al. (1988) reported that the presence of sediment and large amounts of rubble seriously inhibited the "substrate conditioning" necessary for successful recolonisation to occur.

Fifteen months after the grounding a minor hurricane passed through the area removing much of the sediment and loose rock. Subsequently levels of recruitment began to improve. This recovery was attributed to reduced effects of potentially stressful sediment re-suspension, to bottom re-stabilisation and to increased micro-habitat complexity.

Acute or chronic pollution: This was not a problem due to the removal of the vessel without loss of cargo or fuel.

Impacts on corals and other attached organisms (after Gittings et al., 1988): The ship caused damage to a 1,282 sq. m. area of reef which sustained 70-100% loss of live coral cover as a result of the grounding (Hudson and Diaz 1988). The grounding and the wreck's removal caused substantial damage to both substrate and epifauna. The hull crushed nearly all of the epifauna under the forward section. The stern area damaged only the tops of the coral heads. In the removal process, the propeller wash destroyed most of the erect alcyonarians. After 27 months of monitoring, hard coral and gorgonian population in the area of complete destruction were 13% and 10%, respectively, of pre-grounding numbers.

Algal response: There was no proliferation of macro-algae. Filamentous algae colonised the damaged area in the impact zone.

Effect on fish (after Dennis and Bright, 1988): The presence of the ship's hull after grounding acted as an “artificial reef” attracting fishes not generally found in the area. Atherinids became common in the waters around the vessel. Other species not characteristic of the area were also attracted. With the removal of the ship, these species left the area. Planktivorous species from undamaged zones colonised the area after the ship was re-floated. Within two weeks herbivorous fishes began to browse the filamentous algae growing in the damaged zone. The number of taxa, abundance, and biomass of fish were reduced in the impacted area. The area progressively recovered when compared to control areas but still remained less diverse, with lower biomass, after two years. Several species unique to the impacted area exploited the damage (e.g. burrowing species such as wrasse occupied the rubble). Habitat relief caused by the adjacent coral stands of *Acropora palmata* gave rise to the areas of highest species richness in the damaged areas.

Diversity was affected by hurricane Kate, which removed much of the rubble and disrupted the fish assemblage. Although there was no major change in the fish fauna, the hurricane may have slowed recovery.

Natural recolonisation: Gorgonians, primarily *Pseudopterogorgia americana,* have subsequently colonised large areas of the impact site. Some colonies were 10-15 cm high with densities of as much as 5 per sq.m. The size classes were estimated to be 2-3 years old (Hudson and Diaz, 1988).

Restoration (after Hudson and Diaz,1988): Restoration was initiated by experimental transplants of hard and soft corals, stabilisation of reef fractures, and rebuilding of the reef topography by transplanting massive corals. Fractured reef framework was repaired by clearing the area of fragments and applying cement, a method which was successful in re-stabilising the reef but required a 43 kg bag of cement and 4.5 kg of grout per square metre treated. Transplanted hard and soft corals were secured to the reef by cement. Transplanted hard corals survived and appeared to be in excellent health, while soft corals suffered a 50% loss, due mainly to large swells generated by hurricane Kate. Although the cementing was successful, the soft corals were twisted off at the base as the result of wave action. Rebuilding reef topography was accomplished by the use of air bags to lift large corals and transport them to the site of greatest damage, where they were cemented permanently to the reef framework.

3B THE SAFIR

The freighter *Safir* ran aground in the Red Sea in 1989, dumping several hundred tonnes of phosphate powder on the reef. It was pulled off and scuttled without the immediate loss of fuel or debris. The following account is based on Hawkins et al. (1991).

Effect on the reef structure: Damage was severe but limited. The nature of the damage caused by impact was that of pulverising the reef. Subsequent collapse of the bow of the ship caused a cascade of coral blocks down the reef slope destroying everything in its path. The area of damage was a V-shape of 500 sq. m. from 2m – 60m deep. A peripheral zone of 4m either side of the impact zone suffered intermediate damage.

Impact of rubble and sediments: Eight months after the event the areas within and below the impact zone were characterised by finer sediments and rubble than the peripheral, consolidated reef area. Phosphate powder was included in the sediments, and it plus other mobile sediments were considered to retard recruitment. The steep slope probably contributed to the disappearance of loose material from the damaged area.

Acute pollution: Powdered phosphate (fluorapatite) poured out onto the reef when the bow collapsed. Subsequently, the vessel was removed and disposed of into deeper water, reducing the potential for chronic pollution from the vessel. There was no subsequent fuel or oil spill. The level of dissolved phosphorous was highest a week after the event but declined in the first month, though still remaining high. The initial increase in pollution by the phosphate cargo was the result of the most soluble fractions dissolving and dispersing. The residual presence of the cargo may have affected resettlement and reduced the rate of calcification by reef-building organisms (Simkiss, 1964; Kinsey and Davies, 1979).

Impacts on corals and other attached organisms: Benthic life was virtually eliminated within an area of approximately 500 sq. m. due to the crushing effect of the ship and smothering by the phosphate powder. Effects of the grounding were localised to the impact area and limited signs of regeneration were seen seven months later. Large amounts of phosphate powder still remained and may have inhibited benthic settlement and coral growth. Coral in the impact zone was almost totally destroyed, with the coral 4m either side of this area damaged to a lesser extent. Though a few coral larvae had settled within four to six months of the event, there was little evidence of other recovery. Broken colonies were initially numerous but after four months were less common due to either their death or recovery. Similarly the bleaching of coral colonies near the impact zone was also more pronounced during the initial period, but had decreased markedly after four months, after which it remained constant to the eight month period. In the edge zone, loose fragments of the corals were highest after four months but decreased by more than 50% in eight months. Natural levels of reattachment were low.

Algal response: There was no discernible increase in the macroalgal abundance. A thin layer of filamentous and coralline algae had grown over much of the rubble in the areas worst affected. Within eight months this had died back and the algal cover was much the same as the surrounding area in appearance. The algal cover in the zone greatest affected remained higher in percentage cover than the adjacent areas.

3C THE JIN SHIANG FA

The Taiwanese longliner *Jin Shiang Fa* ran aground on the southwest ocean reef margin of Rose Atoll in American Samoa in October 1993. The ship collided with the reef, skipping over several reef buttresses before settling hard aground in a groove between two buttresses. It subsequently broke into three pieces, two of which were removed by tug. This grounding resulted in 100,000 gallons (325 tonnes) of diesel fuel, 500 gallons (1.6 tonnes) of lubricating oil and 2,500 lb. (1,130 kg) of ammonia being spilled on to the reef.

The grounding site was surveyed five months after the event, with the survey being confined to the impacts of the shipwreck on the coral reef communities (Maragos, in press).

Effect on the reef zones: Damage was widespread with coral exhibiting injury or death on the reef flat, reef terrace, talus, lagoon floor, lagoon pinnacle and patch reefs, and the ocean reef slope habitats along the southwest quadrant of the atoll. Effects from the grounding incident were still conspicuous and severe 5.5 months after the event. The potential for peripheral chronic damage still existed due to fouling by debris. Examples of refuse left from the grounding included fishing line, scrap metal, wood and clothing.

Effect on the reef structure: The collision and subsequent movement of the vessel on the reef was evident from scraped or damaged areas and crushing of the coral rock. This was particularly severe at the point of impact and on top of the spurs.

Rubble and sediments: The hull movement created sediment and rubble which was transported off the reef towards the deep reef terrace. Currents refracting around the wreck resulted in sediment accumulation in the "wave shadow" of the wreckage. This material buried normal reef flat communities, reduced water circulation and led to decomposition and anoxia in the area of the deposit.

Acute pollution and anoxic conditions: Conditions of anoxia were observed in the sand floor of the lagoon, partly because of the decomposition of organic refuse (fuel, fish cargo and food) partly because of the death of marine organisms. Coral death resulted from the anoxic conditions, which were observed up to 0.5 km from the wreck in the lagoonal area. Fuel and oil were spilled from the wreck and migrated across and around the reef, and were thought to be partially responsible for the presence of dead and bleached corals in the lagoon and elsewhere (although other factors such as a more widespread bleaching event which had affected Samoa generally, may also have caused or contributed to the bleaching).

Impacts on corals and other attached organisms: Corals and other benthos experienced localised damage from the crushing effect of the initial impact and the subsequent movement of the stranded vessel. More widespread and chronic effects resulted from the wreck's subsequent break-up and the dispersal of wreckage, and from destruction caused by removal attempts. It is also likely that corals were stressed by circumstances related to the grounding, including smothering or abrasion by clothing or fishing line, whose influence extended more than a km away from the wreck site.

Algal response: Bleached corals were found to be in the process of being colonised by filamentous algae.

Restoration: Most of the wreck was removed by the owners and the insurance company. By the time of removal it had been broken into three pieces. The stern remains on the reef as does much of the debris, and these will cause chronic damage as the result of their movement within the reef system due to currents and waves.

3D THE FLORIDA

The bulk carrier *Florida* grounded on Myrmidon Reef on the Great Barrier Reef, Australia in June, 1976. The vessel initial impact was on the windward reef margin where it grounded on the reef crest, coming to rest on the reef flat. 700 tonnes of pozzalin (coal-based fly ash used in cement manufacture) poured onto the reef as the wreck broke up due to wave action within a few weeks. The cargo had washed from the wreck site after three months. Documentation of the effect of the wreck was in April, 1980, four years after the event. This grounding led to a permanent change in the algal community on the reef flat.

Effect on the reef structure: After five years the only visible damage that remained was a shallow groove less than 1m deep extending from the wreck seaward.

Algal response: An area of 65m by 35m, formerly characterised by a microalgal environment (uni-layered assemblage of turf and coralline algae), developed a macroalgal assemblage (fleshy red algae, *Asparogopsis taxiformis*). Due to its size and general unpalatability to grazers, the macroalgal community persisted as an alternative stable state.

The macroalgal overstory shaded out the live coral resulting in less than 1% coral cover. Micro-invertebrates (primarily amphipods and crabs) were much more abundant in the macroalgal-dominated community than previously (Hatcher, 1984).

3E TROPICAL OIL SPILL

The following account of an oil spill and its effect on a tropical reef and its biota is based on Jackson et al. (1989). The spill was not due to a ship grounding but to the collapse of a storage tank at a refinery. It is, however, indicative of the effect that might be expected after a ship grounding involving a spillage of crude oil.

This was the largest recorded oil spill into coastal habitats in the tropical Americas, involving the spillage of approximately 8,000 t of crude oil. This amount is nevertheless small relative to the quantities released by the more well known spills resulting from the groundings of the *Amoco Cadiz* (223,000 t) and *Exxon Valdez* (35,000 t). It is of interest because it was so well documented (both in the immediate description and with respect to longer term considerations) and because there was very good baseline information since the area of the spill was adjacent to the Galeta Marine Laboratory (Smithsonian Tropical Research Institute) in Panama.

Within two weeks of the spill oil had swept across fringing reefs and entered mangrove forests, small estuaries, and sand beaches within 10 km of the refinery. Plants and animals in intertidal mangrove, sea-grass, and algal communities were covered with oil, and died. There was high mortality of subtidal reef corals and marine life living in sea-grass beds. Only some organisms in the areas exposed to the open sea recovered after 1.5 years.

The slick: The progress of the slick and its effect on marine communities were monitored immediately. The type and magnitude of effects varied greatly with coastal topography and location, as well as among habitats and taxa. A combination of onshore winds and low tide caused the oil to amass along the seaward edge of the reef flat, directly coating and killing plants and animals. Conspicuous mortality was noted among the zoanthid *Palythoa* sp. and the hydrocoral *Millepora* sp. At high tide oil fouled the sand beaches and at low tide it coated the shoreward reef flat, killing sea-grasses, algae, and invertebrates. Corals were covered and killed, with subsequent recolonisation of the surfaces by algae. Oil covered the prop roots of mangroves, killing oysters and other epibiota. Subsequently the death of the trees caused their leaves to fall and this resulted in the lighter branches flexing upward, lifting roots out of the water and killing subtidal epibiota that had previously escaped direct contact with floating oil.

Mangroves: Defoliated trees were apparent within 2 months after the spill. After five months, dead red mangrove trees, *Rhizophora mangle*, formed a band from 8 to 100m wide marking the area where oil was concentrated as it entered the mangrove forests. At seven months, the area of dead mangroves spread along an estimated 27 km of the coast. The pollution prevented seedlings transplanted to heavily oiled sites from producing new leaves, in contrast to transplants at un-oiled sites.

Sea-grasses: Large areas of the sea-grass *Thalassia testudinum* in the intertidal area were killed on some of the most affected areas. In contrast, all subtidal *Thalassia* survived the spill, although leaves were heavily fouled by epiphytic algae for months in heavily oiled areas. At the oiled sites, marine organisms were significantly less abundant in oiled grass beds after the spill, but for other sites showed no such difference. The abundance of most taxa subsequently increased due to recruitment and recolonisation. The abundance of hermit crabs increased in oiled sites relative to un-oiled areas, possibly because of an abundance of surplus shells of snails initially killed by the spill.

Coral reefs: Damage was greatest on the seaward border, where the oil concentrated at low tide. Subsequent to the spill, a bloom of microalgae occurred covering areas where benthos had been killed by the oil. With the spill, the levels of macroalgae were reduced but regained or exceeded typical abundance within 12 to 18 months, out-competing the microalgae. Zoanthids, hydrocorals and scleractinian corals (*Porites* sp.) were severely reduced in abundance and only *Zoanthus* returned to pre-spill numbers after 18 months. Sea urchins on the reef flat were substantially reduced. *Echinometra* sp. was reduced by 80%. On subtidal reefs the most common scleractinian coral genera in depths less than 3 m decreased in number in the worst affected oiled spots by 51 to 96%. Total coral cover decreased by 76%, with a drop of 45% at 9 to 12 m. Sub-lethal effects were widespread and most of the scleractinians still alive in depths less than 3 m showed signs of recent stress. Oiling increased the frequency and size of recently dead lesions on the commonest massive corals.

Overall effect: Jackson et al. (1989) summarise by stating the spill harmed prominent organisms in all intertidal and subtidal environments examined, in-fauna and epifauna (organisms living in and around the particular environment), and members of all parts of the food web including primary producers, herbivores, carnivores and detritivores. Oil slicks in the mangroves were still common after 2.5 years. Numbers of coral, total coral cover, and species diversity based on cover decreased significantly with increased amounts of oiling. Cover of the larger branching coral *Acropora palmata* decreased most. Frequency and size of recent injuries on massive corals increased with level of oiling, particularly for *Siderastrea siderea.* Growth of three massive species was less on oiled reefs in the year of the spill than during the 9 previous years.

ANNEX 5 CASE STUDY: ISSUES ARISING DURING A RECENT PACIFIC ISLAND SHIP GROUNDING EVENT

Description of the event

On March 10, 1994 the 225 m bulk carrier *Oceanus*, loaded with 67,000 tonnes of coal, left Newcastle, New South Wales for Japan. On March 18 at approximately 2:15 PM the vessel ran aground in clear weather on the northeastern fringing reef of Satawal Island, Yap State, Federated Sates of Micronesia (FSM).

The *Oceanus* had been built in a South Korean shipyard only a year prior to the grounding, and was well-equipped and manned by a professional crew. At the time of the grounding it was reported to be carrying, in addition to its cargo, about 300 metric tonnes of heavy fuel oil and around 90 tonnes of diesel oil for the ship's own needs. During later salvage operations the owner's representative reported that the vessel did not carry an oil containment boom, chemical dispersants or other oil spill equipment on board. It was fortunate that the impact resulted in water ingress only in the fore peak, while the integrity of the hull and fuel tanks was not affected enough to cause any fuel leakage.

Satawal is located at approximately 7 degrees north latitude and 147 degrees east longitude, very near to the major north-south shipping lane from Australia to Japan and other locations in east Asia. This being the case, large ships pass within sight of the island on almost a daily basis. However this was the first grounding of this magnitude at the island, and for that matter the first for a ship so large anywhere within Yap State.

The isolation of Satawal from the administrative centre of Yap, which lies 550 miles to the west, and the irregular scheduling of inter-island shipping made logistics in response to the grounding extremely difficult for the Government. Salvors and owners representatives were also at a disadvantage, but were able to use Guam as a base of operations and dispatch supplies from that island, which is approximately 400 miles NNW of Satawal.

There was no death or injury caused by the grounding to the ship's personnel. Shortly after the ship went aground it was reported that it unsuccessfully tried to back itself off the reef using its own power. After the grounding, the people of the island contacted the Yap Governor's office by high frequency radio and reported the incident, although they did not know any details or particulars of the ship. Much normal activity on the island of approximately 750 inhabitants ceased, and this continued to be the case for the next 46 days.

Once the appropriate authorities were notified, and as soon as it was evident from reports from the ship's captain that the vessel could not be moved under its own power, events began to happen quickly. The insurers arranged for a salvage survey and retained an attorney in Guam to represent their interests.

With representatives of the owner in contact with Government authorities, both the FSM and Yap State Governments convened meetings and decided on several courses of action. Because the grounding location was at a very isolated island and not a legal port of entry, an emergency regulation was promulgated by the FSM President which designated the island as a temporary official port of entry to facilitate salvage. The overriding concern of the Government at this stage was to have the vessel successfully freed before any large scale disaster, such as an oil spill, occurred.

A "port clearing party", consisting of officials from Immigration, Customs, FSM Marine Resources, and Agricultural Quarantine, was assembled in the capital of Pohnpei. The clearing party departed Pohnpei four days after the grounding aboard an FSM patrol vessel, arriving at Satawal three days later.

Upon arrival, the Government officials granted entry to a 31 m tug boat from Guam that had arrived approximately eight hours prior to the patrol boat. On board were salvage divers and representatives of the Dutch salvage company involved. Although all were issued immigration entry permits, they were advised not to go ashore unless permission was granted by the island chiefs. During the course of operations this tug made two round trips between Satawal and Guam for re-provisioning and supplying the salvage crew.

Leaving the FSM National Government clearing party on the island, the patrol boat traveled to Woleai 185 miles west where the Yap State Marine Emergency Intervention Team (two representatives of the Resources Management Division and one from the state Environmental Protection Agency [EPA]) were waiting, having flown from Yap to Woleai on March 23.

The team, which had been designated by the Yap State Government, was tasked with assessing and surveying the extent of the reef damage caused by the ship grounding, monitoring pollution resulting from either the grounding or the salvage activities, and collecting information from the people of the island about the reef area itself. The team had had to wait in Woleai for four days before the patrol boat was able to transport them the final 185 miles to Satawal.

On March 24, a much larger 93 m salvage tug registered in the Ukraine arrived from Manila. During its involvement in the salvage effort, this vessel also made a round trip to Guam for the purpose of re-provisioning and bringing additional supplies.

A third tug arrived from Guam on April 1 with food and additional salvage equipment, as well as a marine biologist from the University of Guam's Marine Laboratory. The Marine Lab had been contacted by the ship's owners to assist the Marine Resources Management Division of Yap's Department of Resources and Development in assessing the damage, and offering technical advice on how to minimise the environmental impacts of the salvage activities.

Thus personnel on the site approximately one week after the grounding consisted of:

- the FSM port clearance group from Pohnpei;
- a salvage master and his crew, including one large and one smaller tugboat;
- an independent salvage support group of divers from Guam;
- a representative of the ship's owner whose job was to liaise with the Government officials, salvors, island chiefs and others involved on the scene;
- Yap State EPA and Marine Resources personnel;
- A University of Guam marine biologist, present at the request of the owners but cooperating fully (and sympathetically) with Government officials.

Such a large number of visitors to the island, not to mention the presence of the salvage tugs and the *Oceanus* itself, caused great disruption in the daily lives of the islanders. With the grounding at a site farthest from the island's one village but close to the taro gardens, most women were afraid to enter their gardens and little work was done. While members of the salvage teams and crew members stayed for the most part on the ship and support vessels, the island hosted the Government personnel while salvage operations were undertaken.

The representatives from Yap State and the marine biologist from Guam attempted a damage assessment of the reef at the grounding site. This was hampered by a lack of cooperation from the salvage master, and the inability of either Government officials or the biologist to delay one of the smaller tug boats which was the marine biologist's return transportation to Guam.

The grounded vessel had not actually been boarded or inspected by any Government official until April 5, almost two weeks after the grounding. The reason for this is not clear, but reports from officials on the scene indicate that they were instructed by the Yap Attorney General's office to allow salvage to proceed without any interference by port authorities. This order may have been given at the request of the owner or his attorney in Guam who was in contact with the Attorney General's office.

In retrospect, this may have been a dangerous course to follow, because the Letter of Undertaking relating to civil damages was not issued by the ship's insurer until April 21. Had the tugs been successful in freeing the *Oceanus* before this time, there would have been little the assembled Government officials could have done to prevent the ship's departure.

As it was, the Immigration Inspector on board reported that the chart the *Oceanus* used to plot its course was not available on the vessel at the time the clearance was issued. He reported that the chart was being sent to the ship's attorney in Guam on board the tug which had left three days earlier. Again, it is not known, but this may have been pre-arranged between the owners' attorney and the Yap Attorney General's office as an expedient way to obtain the chart.

When the *Oceanus* was finally boarded, the captain's passport was confiscated, also on instruction of the Yap Attorney General's office. A further order from the Attorney General instructed the clearing party not to interrogate the captain.

After repeated attempts to re-float the vessel proved unsuccessful, the salvors arranged for another bulk carrier of approximately 180 m in length to come to the grounding site from Singapore and take on a portion of the cargo. The arrival of this vessel required a fourth tug (based in Saipan) to transport three crane operators from Guam.

Once the second bulk carrier arrived, it came alongside the stranded ship and began to transfer the coal cargo. The EPA representative was present on board during the transfer process, and had canvas or plastic tarpaulins rigged between the vessels to stop any of the coal from entering the water. After several spills from one of the cranes, the ship owner's representative was instructed to halt operations and arrange for further tarps to be rigged. This transfer operation, involving 10,000 or 18,000 tonnes of coal depending on which report is referenced, lasted about ten days. It was estimated that from 20 to 50 tonnes were dropped into the ocean during the transfer process.

After a sufficient amount of coal had been transferred and sea conditions were favourable, the vessel was finally freed from the reef on May 3, 1994. It was allowed to proceed to Guam for inspection and possible repairs.

With regards to the environmental damage, the Yap State Government Marine Resources Management Division report on the grounding stated that, "The damage to the reef caused by the grounding, stranding, and towing of the vessel off the reef is profound and extensive for such a small island with limited reef resources. The catastrophic destruction on this reef would undoubtedly alter the reef and populations of related resources."

The report listed distinct types of damage to and impacts on the reef:

> **Impact damage** caused by the initial grounding and subsequent shifting. The ship had originally grounded on a coral shelf extending off the northeast tip of the island at a heading of approximately 346 degrees, or roughly parallel to the fringing reef. Wind and wave action "bounced" the vessel to a heading of approximately 042 degrees, scouring the reef causing further reef destruction. Subsequent efforts to free the vessel, as well as the final successful tow, concentrated on pointing the stern farther to seaward, which swung the bow and caused further reef damage. Estimates of the total affected area, including that area of the reef directly damaged by the grounding, have been in the hundreds of thousands of square meters.
>
> **Pollution** caused by:

- the spillage of coal overboard during the lightening operation;
- the dumping of garbage and waste overboard from the grounded vessel and support ships;
- the release of ballast water from the support vessels (also potential introduction of unwanted or harmful species);
- the release of oil and bilge waste from the vessels.

Lessons to be learned

This particular incident has still not been concluded, as a civil action for damages is currently pending. However from events so far, some issues raised during this incident may be relevant to ship groundings elsewhere in the region:

- the insurers, in addition to any in-house specialised expertise they may have had on maritime law, moved swiftly and obtained legal counsel familiar with the region;
- the insurers' legal counsel arranged for an early preliminary environmental assessment and engaged professionals with more extensive qualifications than the Government's employees charged with the same task;
- the Government's lawyers had never visited the grounding site and had little background in maritime matters to enable them to appreciate the magnitude of the problems involved;
- the process of lightening the vessel by transfer of cargo to another vessel resulted in substantial amounts of the cargo being spilled overboard;
- the ship owner placed his own qualified representative on the vessel to deal with local people on the island and Government officials detailed to the scene. This freed the salvage master to concentrate on salvage issues only;
- the inhabitants of the island suffered damages but there are no administrative procedures for them to utilise any portion of the criminal fines imposed to assist them in making a civil claim against the ship's owners;
- the residents of the island were aware that salvage was being undertaken on a “no cure, no pay” basis and therefore the salvor had the successful salvage of the vessel as his sole concern. The islanders were not totally satisfied that their interests were being adequately considered or protected during the salvage operation;
- the Government's initial discussions regarding courses of action to take as well as monitoring salvage activities were undertaken without the involvement of expertise available at their own Governmental department responsible for shipping and maritime matters;
- inadequate Government manpower resulted in several salvage vessels not undergoing agriculture and quarantine inspection;
- while the salvage master and owner's representative had international communications capability available to them at all times via the ship's INMARSAT terminal, Government officials often had to rely on the island's SSB radio. Messages were sometimes delayed and any security which might have been required could have been compromised.

ANNEX 6 BIBLIOGRAPHY AND REFERENCES

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