SPREP IMO

SRIMP-PAC

Shipping-related introduced marine pests in the Pacific Islands: **A regional strategy**

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Approved by the [insert number] SPREP Meeting held in [insert place, month, year]

Published in [month] 2005 by the
Secretariat of the Pacific Regional Environment Programme
PO Box 240
Apia, Samoa
www.sprep.org.ws

Prepared by
Steve Raaymakers
EcoStrategic Consultants
www.eco-strategic.com

and

Sefanaia Nawadra
Marine Pollution Adviser

IMO Technical Cooperation Project [insert number / code]

SPREP PACPOL Project [insert number / code]

"I do not exaggerate the problem when I compare it (biological invasion) to the scope and devastation wrought by natural disasters like hurricanes. It is less dramatic but just as destructive"

(Admiral James M. Loy, Commandant, United States Coast Guard, 2000).

EXECUTIVE SUMMARY

The Issue

The importance of coastal and marine environments to every aspect of the lives of Pacific Islanders cannot be overstated. Pacific Island Countries and Territories (PICTs) maintain resource rights and management responsibilities over 30 million square kilometres of ocean, equivalent to the total land area of Canada, China and the USA combined. The total population of coastal Pacific Islanders is only 2.6 million. There are 11 square kilometres of ocean for each Pacific Islander. Jurisdictionally, the ocean is 200 times more significant to the average Pacific Islander than it is to the average global citizen (Adams et al 1995). Anthropogenic impacts on coastal and marine resources and ecosystems are a major concern for Pacific Island peoples.

Over the last fifteen years, the introduction of exotic (non-native) species, including aquatic species, to new environments by human activities, both intentionally and accidentally, has been identified by scientists, environmentalists, governments and industry as a major and increasing concern. Marine bio-invasions, including via vessel-related vectors such as ballast water and hull fouling, have been identified as one of the four greatest threats to global marine bio-diversity and ecosystems, and are also a significant threat to coastal economies and even public health. Global economic impacts from invasive aquatic species, including through disruption to fisheries, fouling of coastal industry and infra-structure and interference with human amenity, are estimated to exceed 100 billion US dollars per year (Chisholm, *in prep*). The US General Accounting Office (2003) has identified biological invasions as one of the greatest environmental threats of the 21st Century. The United Nations Environment Programme (UNEP) and World Conservation Union (IUCN), announced at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, that invasive species are the second greatest threat to global bio-diversity after habitat loss. The impacts are set to increase in coming years as global economic activity and therefore the movement of goods and materials around the world increases.

Developing countries are at particular risk as economic globalisation continues and new markets and therefore ports and shipping routes are opened in these areas. Small Island Developing States (SIDS), including PICTs, are also at particular risk as they are totally shipping dependant, are often located adjacent to major trans-oceanic shipping lanes and are often favored destinations for cruising yachts (which present particular problems in relation to transfer of species by hull fouling). There are a large number of shipping routes and a variety of ports throughout the Pacific and the Pacific islands are at risk from both ballast and fouling mediated bio-invasions. A number of introduced species of concern and potentially significant concern have been found in the region, and have become or are threatening to become invasive, including the barnacle *Chthalamus proteus*, several macro-algae species, harmful planktonic algae species and the Black Striped Mussel *Mytolopsis sallei* from the Gulf of Mexico / Caribbean.

The potentially serious threats posed by IMPs, combined with the extremely high value and significance of coastal and marine resources to Pacific islands peoples, highlights the importance of vigilance against marine introductions.

The Strategy

The Secretariat of the Pacific Regional Environment Programme (SPREP), has responded to the threat posed by IMPs, by developing a *Regional Strategy on Shipping-Related Introduced Marine Pests in the Pacific Islands* (SRIMP-PAC).

Development of the Strategy is an activity under SPREP's PACPOL Programme, and is funded by the International Maritime Organization (IMO). It aims in part to assist Pacific island countries to ratify and implement the new IMO Convention on Ballast Water Management (*International Convention for the Control and Management of Ships' Ballast Water and Sediments*).

In addition to the transfer of harmful species by ships' ballast, the SRIMP-PAC Strategy also aims to address vessel fouling, with particular emphasis on cruising yachts, that visit the region in large numbers and which may pose a significant risk of introductions.

The transboundary nature of shipping and the inter-connectedness of the seas and oceans dictate that no one port or country can effectively control the spread of IMPs via shipping. In order to be effective, countries must work cooperatively with both their neighbours and the broader global community to implement harmonized measures. The SRIMP-PAC Strategy provides a regional framework for cooperation between Pacific Island countries and territories and also with Pacific-Rim countries, including through APEC.

The Pacific Islands are fortunate in that three key SPREP members are world leaders in addressing IMPs – including being the major driving force on the issue at IMO - Australia, New Zealand and the USA. The SRIMP-PAC Strategy therefore seeks to maximize links with these three countries, including joint funding and implementation of technical activities in the region.

Aim and objectives

The aim of SRIMP-PAC is:

- To maintain, protect and enhance the quality of coastal and marine environments in the Pacific islands region by preventing, minimising and controlling the introduction of shipping-related marine pests to Pacific Island Countries and Territories (PICTs).

The objectives of SRIMP-PAC are:

- To assess and monitor the current and potential risks of shipping-related Introduced Marine Pests (IMPs) in the Pacific islands region.
- To assist PICTs to develop better capacity to effectively prevent and respond to shipping-related IMPs,
- To provide a financing and sustainability plan, which allows effective implementation of SRIMP-PAC actions and activities.
- To provide a framework and mechanism for regional cooperation, coordination and harmonization of IMP management activities, including links with similar activities that address non-shipping vectors, both within the region and with Pacific-Rim countries.

Layered Defense

The SRIMP-PAC Strategy is based on the principle of 'layered defense', with management arrangements organized along established world's best practice in the fields of bio-security and quarantine, as follows:

- Pre-border (incursion prevention)
- At-Border (incursion interdiction)
- Post-border (incursion response, control and mitigation)

The principle of layered defense is based on the premise that prevention is always better than cure, and that prevention of shipping-related IMPs is best addressed by preventing them from being taken-on / attaching to vessels at their points of origin / source ports, through 'pre-border' management efforts.

The principle recognizes however, that despite best pre-border efforts, some IMPs may well arrive at ports in the Pacific islands region, and 'at-border' interdiction efforts are therefore also required.

Finally, this approach recognizes that some IMPs may still invade past a country's border, and 'post-border' incursion response, control and mitigation plans are therefore needed to supplement pre- and at-border incursion prevention efforts.

Regional & National Coordination

The development and implementation of SRIMP-PAC is being coordinated at the regional level by SPREP, and will involve the establishment of a Regional Task Force comprising SPREP member States and other stakeholders (e.g. port and shipping industries), as well as an Ad-Hoc Technical Advisory Group.

At the National level, each Pacific island country will designate a National Lead Agency and establish an inter-ministerial task force to oversee implementation of in-country activities.

Institutional Strengthening and Capacity Building

The Strategy recognises the current limitations on the capacity of Pacific island countries to manage IMPs, and seeks to address these through capacity building and institutional strengthening, with a long-term view to self-sufficiency in IMP management. All technical activities under SRIMP-PAC include capacity building and institutional strengthening elements.

Technical Activities

Based on experience in other parts of the world, SRIMP-PAC proposes a number of foundation activities, that need to be undertaken in order for the region to begin to address IMPs. These include:

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- Communication and awareness
- Risk assessment
- Port surveys and monitoring
- Legislation and regulations
- Compliance monitoring and enforcement
- Technical training and capacity building
- Information management

Practical Management Measures

In order to allow PICTS to implement practical management measures to prevention shipping-related bio-invasions, SRIMP-PAC includes standard templates outlining what actions countries need to take, in relation to both ballast water and hull-fouling management.

The SRIMP-PAC budget and workplan includes a major capacity building component, aimed at equipping Pacific Island Port State Control agencies with the skills and resources needed to implement these measures.

Funding & Timeline

Full implementation of all SRIMP-PAC projects as outlined in the Workplan requires a core total budget of US$4.2 million over three years. When considering that this applies to 22 separate countries and territories spread over the world's largest ocean, this is not a particularly large amount of money. The benefits that will accrue in terms of increased protection of coastal and marine resources that form the basis of the livelihoods of Pacific islands peoples, make such an investment highly worthwhile. Extension of an IMP management regime over such a large area of the Pacific will also have major benefits for Pacific-Rim countries, in terms of increased protection of their resources and ecosystems.

Given the extremely small economies of PICTs, the extremely large economies of Pacific-Rim countries (such as the USA, Japan, China, Canada, Australia and the Republic of Korea), and the benefits that will accrue to Pacific-Rim countries from the effective implementation of SRIMP-PAC, Pacific-Rim countries should be approached to fund the Strategy and implementation of its Workplan.

It is also important to explore possible links with other multi-lateral funding initiatives, including three relevant GEF proposals:

- the proposed GEF / SPREP project *Pacific Invasive Species Management*,
- the proposed GEF / GISP project *Building Capacity and Raising Awareness in Invasive Alien Species Prevention and Management*; and
- the proposed GEF / IMO project *Building Regional Partnerships for Effective Ballast Water Control and Management in Developing Countries (GloBallast Partnerships)* .

ACKNOWLEDGEMENTS

The following organisations and individuals are thanked for their valuable contributions to the development of SRIMP-PAC:

- The International Maritime Organization (IMO) for funding the development of SRIMP-PAC through its Integrated Technical Cooperation Programme (ITCP).

- The GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast) Programme Coordination Unit (PCU) at IMO for providing supporting information and materials.

- The Governments of all SPREP member countries, through relevant agencies, for contributing to the development of SRIMP-PAC, by facilitating identification of country needs and priorities and reviewing the draft of SRIMP-PAC, and for being key partners for its implementation.

- Staff at the Department of Agriculture, Fisheries and Forestry (DAFF) in Australia and the Ministry of Fisheries (MFish), the National Institute of Water and Atmospheric Science (NIWA) and the Cawthron Institute in New Zealand, as well as at the Bishop Museum in Hawaii, for providing supporting references, information and material and for their specific efforts in reviewing the draft SRIMP-PAC document in detail, and providing extremely useful and constructive inputs.

- The regional shipping and port industries, as represented through the Pacific Maritime Association (PACMA), for reviewing the draft of SRIMP-PAC and being key partners for its implementation.

- SPREP Staff for their support, advice and guidance during the development of the Strategy.

ACRONYMS

AQIS	Australian Quarantine and Inspection Service
AMSA	Australian Maritime Safety Authority
APEC	Asia-Pacific Economic Cooperation
APP	Association of Pacific Ports
ASEAN	Association of South East Asian Nations
ATC	Australian Transport Council (of Ministers)
AusAID	Australian Agency for International Development
BW	Ballast water
BW Convention	International Convention for the Control and Management of Ships' Ballast Water and Sediments
BWM	Ballast water management
BWRA	Ballast Water Risk Assessment
BWRF	Ballast Water Reporting Form (as per IMO BW Guidelines A.868(20))
CBD	Convention on Biological Diversity
CCIMPE	Consultative Committee on Introduced Marine Pest Emergencies (Australia)
CI	Conservation International
CIDA	Canadian International Development Agency
CME	Compliance Monitoring and Enforcement
CRIMP	Centre for Research on Introduced Marine Pests (now CSIRO Marine Research, Hobart, Tasmania)
CROP	Council of Regional Organizations in the Pacific
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DAFF	Department of Agriculture, Fisheries and Forestry (Australia)
DEH	Department of the Environment and Heritage (Australia)
DSS	Decision support system (for BW management)
DWT	Deadweight tonnage (typically reported in metric tonnes)
EEZ	Exclusive Economic Zone
ESD	Ecologically Sustainable Development
EU	European Union
FAO	Food and Agriculture Organization (of the United Nations)

FFA	(Pacific Islands) Forum Fisheries Agency
FORSEC	(Pacific Islands)Forum Secretariat
FSM	Federated States of Micronesia
GEF	Global Environment Facility
GIS	Geographic information system
GISP	Global Invasive Species Programme
GloBallast	GEF/UNDP/IMO Global Ballast Water Management Programme
GT	Gross tonnage (usually recorded in metric tonnes)
HLG	High Level Officials Working Group (Australia)
ICES	International Council for the Exploration of the Seas
IGA	Inter-governmental Agreement (Australia)
IMO	International Maritime Organization
IMP	Introduced Marine Pest
IOC-GOOS	Inter-governmental Oceanographic Commission – Global Ocean Observing System
ITCP	(IMO) Integrated Technical Co-operation Programme
ISSG	Invasive Species Specialist Group (of IUCN)
IUCN	The World Conservation Union
MAF-NZ	Ministry of Agriculture and Forestry – New Zealand
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee (of the IMO)
MERCOSUR	Southern Common Market (Argentina, Brazil, Paraguay and Uruguay)
MFish	Ministry of Fisheries – New Zealand
MPA	Marine Pollution Adviser
NANPACA	National Aquatic Nuisance Species Prevention and Control Act (USA)
NBIC	National Ballast Information Clearinghouse (managed by SERC)
NEMISIS	National Estuarine & Marine Invasive Species Information System (managed by SERC)
NGO	Non-Government Organization
NIMPCG	National Introduced Marine Pests Coordination Group (Australia)
NIMPIS	National Introduced Marine Pests Information System (managed by CSIRO, Australia)
NIS	Non-indigenous species
NISA	National Invasive Speces Act (USA)
NIWA	National Institute of Water and Atmospheric Sceince (NZ)
NRMMC	Natural Resource Management Ministerial Council (Australia)

NTF	National Task Force
NZ	New Zealand
NZAid	New Zealand Agency for International Development
PAC-IMPIS	Pacific Introduced Marine Pests Information System
PACMAR	Pacific Maritime Association
PACPOL	Pacific Ocean Pollution Prevention Programme
PCU	Programme Coordination Unit (of the GloBallast Programme at IMO)
PICTs	Pacific Island Countries and Territories
PNG	Papua New Guinea
PSC	Port State Control
R&D	Research and Development
RMP	Regional Maritime Programme (of SPC)
RTF	Regional Task Force
SERC	Smithsonian Environmental Research Center (USA)
SIDS	Small Island Developing States
SPACHEE	South Pacific Action Committee for Human Ecology and Environment
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
SPREP Convention	Convention for the Protection of the Natural Resources and Environment of the South Pacific Region and related protocols
SRIMP-PAC	(Regional Strategy on) Shipping-Related Introduced Marine Pests in the Pacific Islands
STCW	International Convention on Standards and Training for Crews and Watchkeeping
TNC	The Nature Conservancy
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US	United States (of America)
USA	United States of America
USAid	US Agency for International Development
USP	University of the South Pacific
WSSD	World Summit on Sustainable Development
WWF	World Wide Fund for the Conservation of Nature and Natural Resources

DEFINITIONS

NB: These definitions are for the purposes of SRIMP-PAC only.

Ballast water	Any water and associated sediment used to manipulate the trim and stability of a vessel.
Bio-invasion	A broad based term that refers to both human-assisted introductions and natural range expansions.
Border	The first entrance point into a countries jurisdiction.
Cryptogenic	A species that is not demonstrably native or introduced.
Domestic routes/shipping	Intra-national coastal voyages (between domestic ports).
Established introduction	A non-indigenous species that has produced at least one self-sustaining population in its introduced range.
Foreign routes/shipping	International voyages (between countries).
Fouling organism	Any plant or animal that attaches, during at-least one stage of it's life-cycle, to natural and man-made substrates.
Harmful marine species	A non-indigenous species that threatens human health, economic or environmental values.
Intentional introduction	The purposeful transfer or deliberate release of a non-indigenous species into a natural or semi-natural habitat located beyond its natural range.
Introduced species	A species that has been intentionally or unintentionally transferred by human activity into a region beyond its natural range.
Invasive species	An established introduced species that spreads rapidly through a range of natural or semi-natural habitats and ecosystems, mostly by its own means.
Marine pest	A harmful introduced species (i.e. an introduced species that threatens human health, economic or environmental values).
Non-invasive	An established introduced species that remains localised within its new environment and shows minimal ability to spread despite several decades of opportunity.
Pathogen	A virus, bacteria or other agent that causes disease or illness.
Pathway (Route)	The geographic route or corridor from point A to point B (see Vector).
Risk	The likelihood and magnitude of a harmful event.
Risk assessment	Undertaking the tasks required to determine the level of risk.
Risk analysis	Evaluating a risk to determine if, and what type of, actions are worth taking to reduce the risk.

Risk management	The organisational framework and activities that are directed towards identifying and reducing risks.
Ship (vessel)	Any vessel used by humans for transport, commerce, recreation or any other purpose on the sea, including but not restricted to all types and sizes of cargo vessels, passenger vessels, fishing vessels, research vessels, naval vessels, barges, pontoons, dry-docks, drilling rigs and other floating platforms, boats, yachts, launches, dinghies and canoes.
Translocation	The transfer of an organism or its propagules into a location outside its natural range by a human activity.
Unintentional introduction	An unwitting (and typically unknowing) introduction resulting from a human activity unrelated to the introduced species involved (e.g. via water used for ballasting a ship or for transferring an aquaculture species).
Vector	The physical means or agent by which a species is transferred from one place to another (e.g. BW, a ship's hull, or inside a shipment of commercial oysters)

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APPENDICES

Appendix 1: Standard National Measures for Pacific Island Countries and Territories for the Prevention and Control of Shipping-Related Introduced Marine Pests, incorporating:

- Generic hull fouling management template
- Generic ballast water management template

Appendix 2: Vessel Inspection Reporting Form (from NZ Biosecurity Code of Practice for Vessels Operating Around the Sub-Antarctic Islands)

Appendix 3: Draft Australian National Border Biofouling Protocol for Apprehended and Small International Vessels.

Appendix 4: IMO Ballast Water Reporting Form (From A.868(20)).

Appendix 5: Overview of Shipping Vectors of Introduced Marine Species

a) The natural dispersal of species
b) Human-associated vectors
c) Shipping and other vessel's as vectors
d) Fouling as a vector
e) Ballast water and sediments as a vector

Appendix 6: Overview of Shipping and Other Vessel Vectors in the Pacific

a) Transit shipping
b) Regional and domestic shipping
c) Fishing vessels
d) Cruising yachts
e) Ballast water risks in the region
f) Hull fouling risks in the region

Appendix 7: Overview of Introduced Marine Species In the Pacific Islands

a) General
b) Surveys within the region
c) The Bishop Museum surveys
d) Guam surveys

LIST OF TABLES (in SRIMP-PAC Strategy)

LIST OF TABLES (in Appendices: A1 = Appendix 1 etc)

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LIST OF FIGURES (in Appendices: A1 = Appendix 1 etc)

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THE SRIMP- PAC STRATEGY

1. Introduction – the Issue

The importance of coastal and marine environments to every aspect of the lives of Pacific Islanders cannot be overstated. Pacific Island Countries and Territories (PICTs) (Table 1, Figure 1) maintain resource rights and management responsibilities over 30 million square kilometres of ocean, equivalent to the total land area of Canada, China and the USA combined. The total population of coastal Pacific Islanders is only 2.6 million (Note: to clarify additional PNG pop. 7 million total). There are 11 square kilometres of ocean for each Pacific Islander. Jurisdictionally, the ocean is 200 times more significant to the average Pacific Islander than it is to the average global citizen (Adams et al 1995). Anthropogenic impacts on coastal and marine resources and ecosystems are a major concern for Pacific Island peoples.

Over the last fifteen years, the introduction of exotic (non-native) species, including aquatic species, to new environments by human activities, both intentionally and accidentally, has been identified by scientists, environmentalists, governments and industry as a major and increasing concern. The vectors for aquatic (freshwater and marine) introductions include, *inter alia*, fisheries, aquaculture, releases and escapes from aquariums and research facilities, the opening of canals, the movement of marine structures such as drilling platforms and floating docks and the transfer of species via fouling of vessels and in ships' ballast water (Carlton 2001). Appendix 5 contains a more detailed description of shipping vectors.

The vast majority of aquatic organisms transferred by such vectors do not survive the transfer process, as various environmental conditions experienced during transfer can be hostile to organism survival. Even for those that survive a transfer and arrive in a new environment, the chances of continuing to survive in the receiving environment may be further reduced, depending on environmental conditions and predation by and/or competition from native species. However, when all factors are favourable, an introduced species may establish a reproductive population in the host environment. Introduced species may even become 'invasive', out-competing native species and multiplying into 'pest' proportions.

Marine bio-invasions, including via vessel-related vectors such as ballast water and hull fouling, have been identified as one of the four greatest threats to global marine bio-diversity and ecosystems (Carlton per somms), and are also a significant threat to coastal economies and even public health. Global economic impacts from invasive aquatic species, including through disruption to fisheries, fouling of coastal industry and infra-structure and interference with human amenity, are estimated to exceed 100 billion US dollars per year (Chisholm, *in prep*). The US General Accounting Office (2003) has identified biological invasions as one of the greatest environmental threats of the 21st Century. The United Nations Environment Programme (UNEP) and World Conservation Union (IUCN), announced at the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, that invasive species are the second greatest threat to global bio-diversity after habitat loss. The impacts are set to increase in coming years as global economic activity and therefore the movement of goods and materials around the world increases.

Developing countries are at particular risk as economic globalisation continues and new markets and therefore ports and shipping routes are opened in these areas. Small Island Developing States (SIDS), including PICTs, are also at particular risk as they are totally shipping dependant, are often located adjacent to major trans-oceanic shipping lanes and are often favored destinations for cruising yachts (which present particular problems in relation to transfer of species by hull fouling). There are a large number of shipping routes and a variety of ports throughout the Pacific and the Pacific islands are at risk from both ballast and fouling

mediated bio-invasions (Figure 2). Appendix 6 contains a more detailed description of shipping-related vectors and risks in the Pacific islands region.

Isolated island environments such as those found in the Pacific are considered to be particularly vulnerable to the impacts of biological invasions. Very little is known about the distribution and impacts of Introduced Marine Pests (IMPs) in the Pacific Islands region, with very few sites having been surveyed (some of the US territories). A number of introduced species of concern and potentially significant concern have been found in the region, and have become or are threatening to become invasive, including the barnacle *Chthalamus proteus*, several macro-algae species, harmful planktonic algae species and the Black Striped Mussel *Mytolopsis sallei* from the Gulf of Mexico / Caribbean. Appendix 7 contains more details about introduced marine species in the region.

The potentially serious threats posed by IMPs, combined with the extremely high value and significance of coastal and marine resources to Pacific islands peoples, highlights the importance of vigilance against marine introductions, the need for baseline and monitoring surveys to allow early detection and control and the need for a prevention and management strategy to be implemented, as provided for by this document.

Table One: *SPREP Members*

Pacific Island Countries	Pacific Island Territories	Non-Island Members
Cook Islands	American Samoa (US)	Australia
Fiji Islands	Northern Mariana Islands (US)	France
Kiribati	French Polynesia (France)	New Zealand
Marshall Islands	Guam (US)	United States of America
Fed. States of Micronesia	New Caledonia (France)	
Nauru	Pitcairn Islands (UK)	
Niue	Tokelau Islands (NZ)	
Palau	Wallis & Futuna (France)	
Papua New Guinea		
Samoa		
Solomon Islands		
Tonga		
Tuvalu		
Vanuatu		

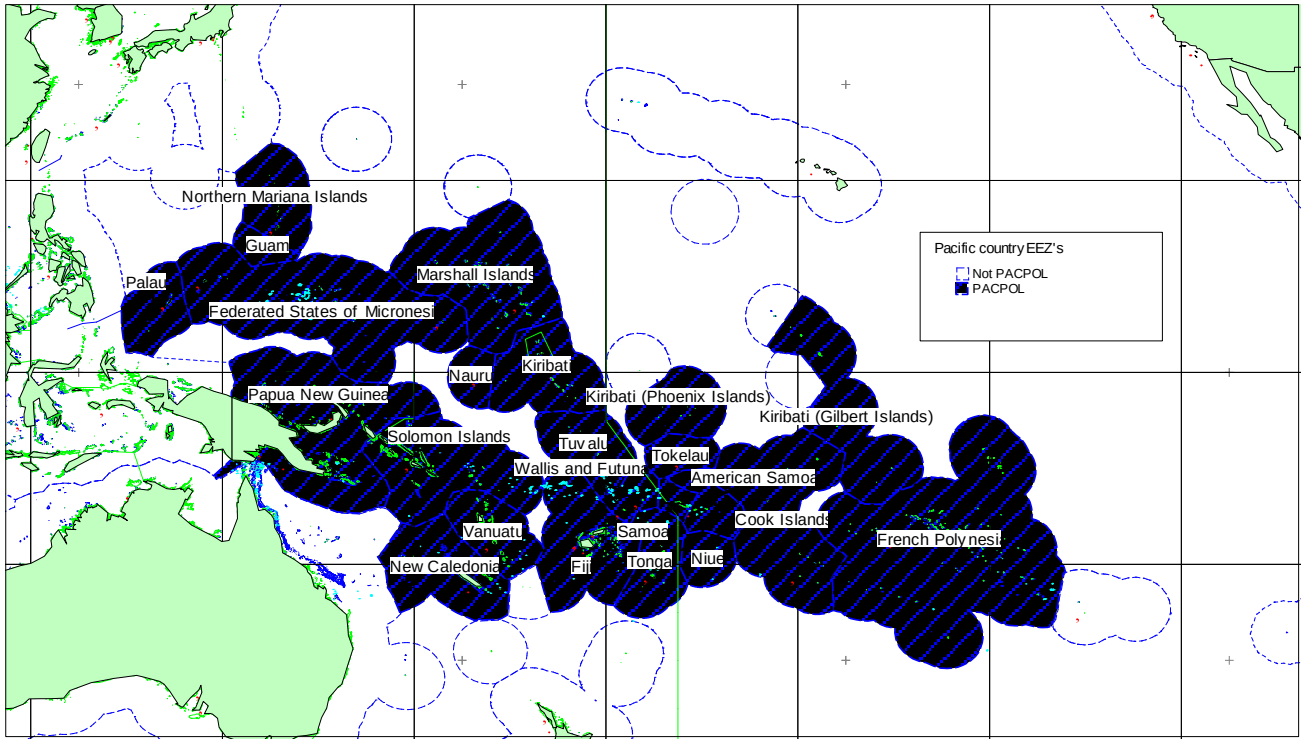

Figure 1: The Pacific Islands Region showing Indicative 200NM EEZ's

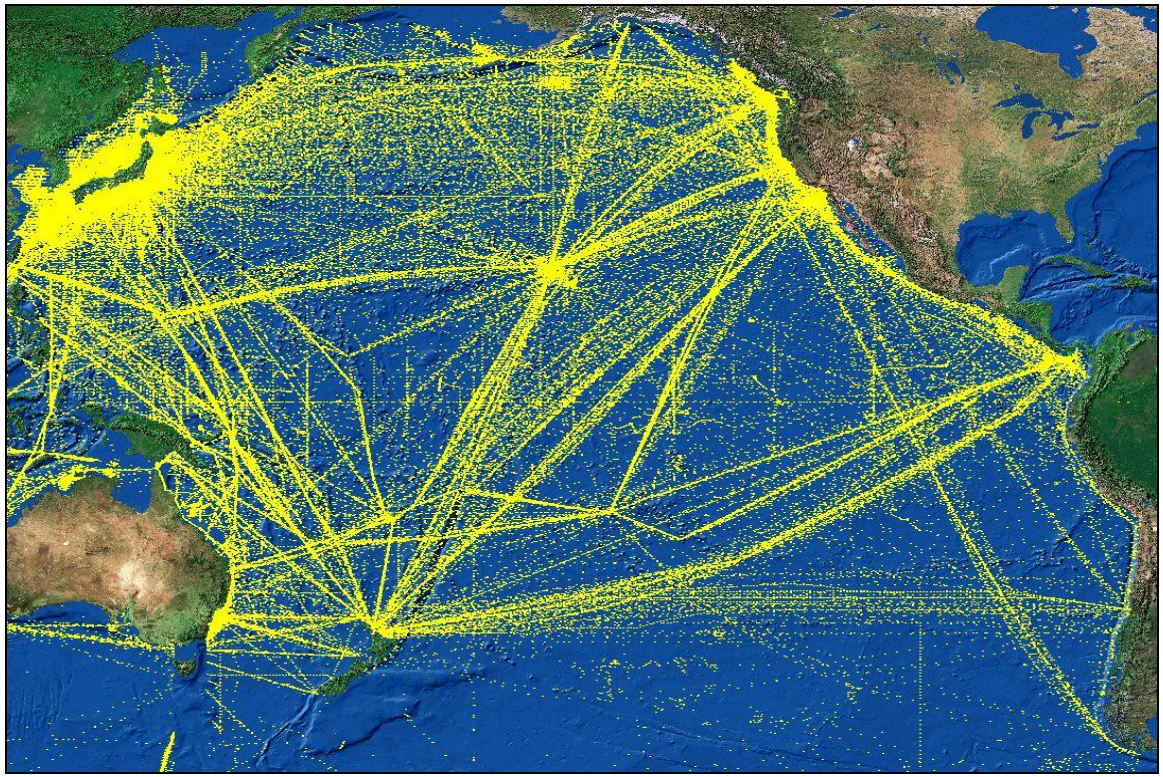

Figure 2: *Overall shipping routes in the Pacific, including ships transiting the Pacific Islands region on voyages between Pacific-Rim countries, as recorded by actual reported ship positions (Source: SPREP - PACPOL).*

2. The SPREP Response

The Secretariat of the Pacific Regional Environment Program (SPREP) in partnership with the International Maritime Organization (IMO) is implementing the Pacific *Ocean Pollution Prevention Programme* (PACPOL). PACPOL addresses shipping related marine environment protection issues throughout the Pacific Islands region. Management of Introduced Marine Pests (IMPs) in Pacific Island ports is one of the focal areas of PACPOL. The PICTs that are participating in PACPOL are shown in Table 1. The SPREP membership also includes four 'metropolitan' or 'non-island' members, also shown in Table 1.

A terrestrially-focused *Regional Invasive Species Strategy* was endorsed by SPREP members in 2000 and is being implemented by SPREP. The Regional Invasive Species Strategy does not address marine species but does have a freshwater component. This *Regional Strategy on Shipping-Related Introduced Marine Pests in the Pacific Islands Region* (SRIMP-PAC), is designed to complement the existing Regional Invasive Species Strategy by filling the important shipping/marine gap.

The SRIMP-PAC Strategy addresses shipping-related vectors (vessel fouling and ballast water) only. Other marine vectors in the region (e.g. fisheries and aquaculture) are addressed by related initiatives, such as those of the Secretariat of the Pacific Community (SPC) Marine Resources Division (see section 9.1 and Appendix 9). Additionally, SRIMP-PAC is restricted to the marine (saltwater) environment, given the overwhelmingly marine nature of the Pacific Islands region, the fact the freshwater ecosystems in the region are highly unlikely to receive biological invasions through shipping vectors and the fact that the existing Regional Invasive Species Strategy covers fresh water species (see section 9.1 and Appendix 9). (check grammar)

SRIMP-PAC is also designed to provide a framework for harmonized regional implementation of the global regime for the control and management of shipping-related IMPs, including the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BW Convention) as adopted by IMO member States in February 2004. It is also intended to link with other relevant initiatives, such as the IMP activities being developed by Pacific-Rim countries through Asia-Pacific Economic Cooperation (APEC), the *IUCN's Cooperative Initiative on Islands* and the proposed *GEF / UNDP / IMO GloBallast Partnerships* project (see Appendices 8 to 10).

3. The Need for a Regional Strategy

The transboundary nature of shipping and the inter-connectedness of the seas and oceans dictate that no one port or country can effectively control the spread of IMPs via shipping. In order for management to be effective, countries must work cooperatively with both their neighbours and the broader global community to implement harmonized measures.

The need for regional cooperation on this issue is recognized in Article 13.3 of the recently adopted *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BW Convention), which states;

> "In order to further the objectives of this Convention, Parties with common interests to protect the environment, human health, property and resources in a given geographical area, in particular, those Parties bordering enclosed and semi-enclosed seas, shall endeavor, taking into account characteristic regional features, to enhance regional co-operation, including through the conclusion of regional agreements consistent with this Convention. Parties shall seek to co-operate with the Parties to regional agreements to develop harmonized procedures."

The countries and territories of the Pacific Islands region have a long history of working cooperatively and multi-laterally to manage and protect their marine resources, particularly fisheries, and have established a number of regional mechanisms and organizations with this objective in mind. They certainly have common interests to protect the environment, human health, property and resources in their given geographical area.

The Pacific Islands also play unwitting host to transit ships trading between the major economies of the Pacific-Rim, which may pass through their 200 nautical mile Exclusive Economic Zones. The need to address biological invasions at their source, requires the SRIMP-PAC Strategy to be coordinated with relevant activities of the Pacific-Rim countries, including through forums such as APEC.

Further, it is worth noting that the 2000-2004 phase of the *GEF / UNDP / IMO Global Ballast Water Management Programme* (GloBallast), *inter alia* assisted several regions of the world to develop and implement regional strategies and action plans similar to that being developed by SPREP under this project. Under the planned future phase of this programme, called GloBallast *Partnership*s, IMO intends to invite the SPREP Member Countries to become a new beneficiary region.

Development of SRIMP-PAC is therefore extremely timely and will place the region in a strong position for the implementation of the BW Convention and to benefit from technical assistance under GloBallast *Partnership*s.

4. Strategy Development – Outline of Approach

(Sefa to change to more accurately reflect the consultation process)

Development of SRIMP-PAC is an activity under SPREP's PACPOL Programme, and was funded by the IMO Integrated Technical Cooperation Programme (ITCP).

Background research and drafting of the strategy document was carried out by a consultant (Steve Raaymakers - EcoStrategic Consultants) on contract to SPREP, supported and managed by the SPREP Marine Pollution Adviser (Sefanaia Nawadra), and with significant input and assistance from the individuals and parties referred to in the Acknowledgements section.

As required by the Terms of Reference (ToR) issued by SPREP for this project, due to budget constraints background research and drafting of the SRIMP-PAC document was undertaken by the consultant using a desk-based approach. The consultant divided strategy development into five discrete tasks, as outlined below.

- Task One: Information gathering / background research

- Task Two: Consultations with countries & other stakeholders
- Task Three: Produce initial drafts of outputs
- Task Four: Review by SPREP
- Task Five: Produce final drafts of outputs

In developing the SRIMP-PAC document , the consultant liaised and consulted with key contacts in other regional organizations (e.g. SPC), APEC, relevant ministries, institutions, organizations and individuals in Pacific-Rim countries (e.g. Australia, New Zealand, Canada and USA) (all of which are very active on the IMP issue), the IMO- GloBallast Demonstration Site in China, and with various UN agencies including IMO, as well as the Global Invasive Species Programme (GISP), IUCN Species Survival Commission Invasive Species Specialist Group (ISSG) and many others, to gain their inputs to the Regional Strategy.

As the SPREP Member Countries are the "owners" of the Regional Strategy, their views, perspectives, priorities and needs are vital, and including the countries in development of the Regional Strategy from the earliest stages was important for generating ownership and "buy-in". The SPREP Marine Pollution Adviser was responsible for contact and consultations with SPREP Member Countries and other regional entities such as the Pacific Maritime Association (PACMAR).

5. Aim & Objectives

The aim of SRIMP-PAC is:

- To maintain, protect and enhance the quality of coastal and marine environments in the Pacific islands region by preventing, minimising and controlling the introduction of shipping-related marine pests to Pacific Island Countries and Territories (PICTs).

The objectives of SRIMP-PAC are:

- To assess and monitor the current and potential risks of shipping-related Introduced Marine Pests (IMPs) in the Pacific islands region.

- To assist PICTs to develop better capacity to effectively prevent and respond to shipping-related IMPs, including:
  - Encouraging ratification and effective implementation of the IMO ballast water Convention and other relevant international conventions.
  - Developing regional and national vessel-fouling management plans and systems.
  - Building the necessary institutional arrangements, both administrative and legislative.
  - Raising awareness about shipping-related IMPs amongst all relevant stakeholders.
  - Developing effective regulatory compliance monitoring and enforcement systems.
  - Providing education and training in ballast and vessel-fouling management practices.
  - Developing information systems to support IMPs management in the region.
  - Targeting projects to address identified high priority IMP problems in the region.

- To provide a financing and sustainability plan, which allows effective implementation of SRIMP-PAC actions and activities.

- To provide a framework and mechanism for regional cooperation, coordination and harmonization of IMP management activities, including links with similar activities that address non-shipping vectors, both within the region and with Pacific-Rim countries.

6. Mandate

The mandate for SRIMP-PAC is derived from a number of sources, including:

Legal mandate:

- The *Convention for the Protection of the Natural Resources and Environment in the South Pacific Region* (SPREP Convention) and in particular [insert relevant section – Sefa, can you do?].

- The *United Nations Convention on the Law of the Sea (*UNCLOS), in particular Article 196 which provides that "States shall take all measures necessary to prevent, reduce and control . . . the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto."

- The *Convention on Biological Diversity* (CBD), in particular Article 8(h) which states "Contracting Parties to the Convention should, as far as possible and appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species."

- The *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BW Convention), in particular Article 13.3 which states "In order to further the objectives of this Convention, Parties with common interests to protect the environment, human health, property and resources in a given geographical area, in particular, those Parties bordering enclosed and semi-enclosed seas, shall endeavor, taking into account characteristic regional features, to enhance regional co-operation, including through the conclusion of regional agreements consistent with this Convention. Parties shall seek to co-operate with the Parties to regional agreements to develop harmonized procedures."

Programmatic mandate:

- The SPREP / IMO *PACPOL Strategy & Workplan*, which was approved by SPREP Members at the 1999 SPREP Meeting in Samoa, which identifies the need to further develop capacity in the area of IMPs management in PICTs, and under which SRIMP-PAC is an initiative.

- The SPREP *Regional Invasive Species Strategy*, which was endorsed by SPREP Members in 2000, and which focuses on terrestrial and freshwater eco-systems and identifies the need to address the marine 'gap'.

7. Scope

7.1 Geographical scope

The geographical scope of SRIMP-PAC is the Pacific islands region, defined as the coastlines and all marine waters within the 200 nautical mile limits of the 22 PICTs which are members of SPREP (Table One and Figure One).

In addition to the PICTs, there are four developed countries which are also members of SPREP (Australia, France, New Zealand and USA - Table One). Although two of these, Australia and New Zealand, are arguably islands, all four developed countries are referred to as SPREP non-island members. They do not constitute part of the Pacific islands region, but play a vital role in supporting SRIMP-PAC.

7.2 Technical scope

SRIMP-PAC is designed to address IMPs carried by shipping-related vectors only (ballast water and fouling). SRIMP-PAC does not address IMPs that may be introduced by other vectors such as fisheries and aquaculture, nor does it address freshwater species. These are addressed by other, related and coordinated initiatives in the region, as part of the integrated 'three-pronged' approach described in Section 8.

For the purposes of SRIMP-PAC, 'ship' is defined as any vessel used by humans for transport, commerce, recreation or any other purpose on the sea, including but not restricted to all types and sizes of cargo vessels, passenger vessels, fishing vessels, research vessels, naval vessels, barges, pontoons, dry-docks, drilling rigs and other floating platforms, boats, yachts, launches, dinghies and canoes. SRIMP-PAC is designed to address IMPS carried by all ship types.

8. Underlying Principles

The SRIMP-PAC Strategy is based on the following underlying principles:

- **Ecosystem Approach:** The majority of major aquatic bio-inavasions documented globally to date have occurred in ecosystems that are already disturbed and degraded by other human impacts, such as physical alteration, pollution and over-fishing. Many invasive species are 'colonisers' which benefit from the reduced competition that follows habitat degradation and reduced native biodiversity. One of the best ways to prevent bio-invasions is therefore to take an 'ecosystem approach', managing marine human activities so as to maintain natural biodiversity and 'healthy' ecosystem function. If PICTs effectively manage and protect their coastal and marine environments and resources in general, including through implementation of the CBD, adoption of integrated coastal and ocean management practices

and application of the Precautionary Principle (see below), they will effectively reduce their vulnerability to IMPs.

- **Prevention is the priority:** While a number of introduced marine species of concern and potentially significant concern have been found in the region, and have become or are threatening to become invasive, the Strategy is based on the assumption that the marine environment in the Pacific islands region is relatively free of IMPs, and that the best approach is to keep it this way, through prevention efforts.

- **Need for data:** The Strategy recognises that the presence, distribution and impacts of IMPs in the region are poorly understood and that detailed studies or surveys have not been conducted for the vast majority of ports and islands in the region. A much larger number of introductions, including potentially invasive pests, would almost certainly be detected with a more comprehensive and systematic survey effort.

- **Precautionary Principle:** The Precautionary Principle, as one of the basic principles of Ecologically Sustainable Development (ESD), states that lack of data should not be used as a reason for avoiding or postponing management actions, where the potential for irreversible ecological impacts exists, even if there is uncertainty about that potential. Because the impacts of biological invasions are very often irreversible, and as it is almost impossible to predict in advance, what marine species may or may not be invasive, and what their impacts might be if introduced to a new environment, in the absence of data all introductions should be treated as potentially harmful.

- **Layered Defense:** The Strategy is based on the principle of 'layered defense' (as used in New Zealand's biosecurity arrangements), with management arrangements organized along established world's best practice in the fields of bio-security and quarantine, as follows:
    - Pre-border (incursion prevention)
    - At-Border (incursion interdiction)
    - Post-border (incursion response, control and mitigation)

  The principle of layered defense is based on the premise that prevention is always better than cure, and that prevention of shipping-related IMPs is best addressed by preventing them from being taken-on / attaching to vessels at their points of origin / source ports, through 'pre-border' management efforts.

  The principle recognizes however, that despite best pre-border efforts, some IMPs may well arrive at ports in the Pacific islands region, and 'at-border' interdiction efforts are therefore also required.

  Finally, this approach recognizes that some IMPs may still invade past a country's border, and 'post-border' incursion response, control and mitigation plans are therefore needed to supplement pre- and at-border incursion prevention efforts.

- **Consistent with Global regime:** The Strategy seeks to implement the global shipping-related IMP management regime at the regional and national level, including the rapid ratification and implementation of the IMO BW Convention by PICTs.

- **Regionally & nationally relevant:** The Strategy reflects the needs and priorities of PICTs. The Strategy considers the regional context but considers the need for national-level implementation, and reflects world's-best-practice adapted for realistic application in PICTs.

- **'Three-pronged' integrated approach:** The Strategy is regionally co-ordinated and integrated with other related programmes and initiatives, and includes collaboration between relevant programmes within SPREP, between SPREP and other regional organisations which are members of the Committee of Regional Organizations in the Pacific (CROP), and with Pacific-Rim countries and broader regional bodies such as APEC. Within the region SRIMP-PAC is one 'prong' of a 'thee-pronged' approach to the overall issue of invasive species, where terrestrial and freshwater vectors are addressed by SPREP's Regional Invasive Species Programme, fisheries and aquaculture vectors are addressed by relevant initiatives of the SPC Marine Resources Division and shipping-related vectors are addressed by SRIMP-PAC, thereby providing a comprehensive, integrated and holistic approach to all vectors and pathways in the region.

- **Industry involvement:** The Strategy is endorsed and supported by the private sector, in particular the shipping and port industries, and seeks to encourage private sector solutions to IMPs. The private sector must be fully integrated into regional and national IMP management plans.

- **Capacity building:** The Strategy recognises the current limitations on the capacity of Pacific island countries to manage IMPs, and seeks to address these through capacity building and institutional strengthening, with a long-term view to self-sufficiency in IMP management.

- **Importance of shipping:** Whilst the over-riding aim of SRIMP-PAC is protection of coastal and marine environments from shipping-related IMPs, the vital role of shipping in the region and the need for the shipping industry to further develop should be considered at all times.

9. Institutional Arrangements

The effective implementation of any natural resource management / environmental protection Strategy such as SRIMP-PAC, requires appropriately designed institutional arrangements, including clearly defined management frameworks and administrative procedures and designation of roles and responsibilities.

The institutional arrangements for the effective coordination and management of SRIMP-PAC are based on those developed and applied successfully in six other regions of the world by the IMO-GloBallast Programme, and are divided into regional and national level arrangements. They include programme management, Regional and National Task Forces (with sectoral and organisational linkages) and reporting requirements, as outlined below.

9.1 Regional arrangements

9.1.1 Overall Strategy Coordination

Responsibility for the development and ongoing management of SRIMP-PAC rests with the SPREP Secretariat in Apia, Samoa, as part of the SPREP / IMO PACPOL Programme.

SPREP's responsibility includes managing the implementation of SRIMP-PAC projects and ensuring the delivery of outputs and benefits to SPREP island members, acting as Secretariat to the SRIMP-PAC Regional Task Force (see below), seeking and managing funding for SRIMP-PAC projects and reporting progress to SPREP members, donors and other stakeholders. The SPREP Marine Pollution Adviser is responsible for day-to-day coordination of these activities within SPREP, and will work with the SPREP Invasive Species Officer to ensure internal coordination between SRIMP-PAC and the terrestrially focused SPREP Invasive Species Programme.

9.1.2 Regional Task Force

It is vital that SRIMP-PAC is not just a SPREP initiative but is truly a regional programme, co-ordinated and consistent with other regional and international activities relating to IMPs. Based on the model applied successfully by the IMO-GloBallast Programme in other regions, this may best be achieved through the formation of a Regional Task Force (RTF), which meets at least annually.

For cost-effectiveness, it is recommended that the RTF be convened in conjunction with and/or as part of other relevant regional groups (e.g. PACMAR, CROP Marine Sector Working Group, Nature Conservation Round Table) (NB. This section subject to further consultations / development by SPREP MPA)

The Terms of Reference for the SRIMP-PAC RTF are:

- To review and approve annual SRIMP-PAC budgets and workplans.
- To coordinate SRIMP-PAC activities across the region and with relevant activities of other bodies (e.g. other regional organizations, APEC and Pacific-Rim countries).
- To provide a forum for PICTs and Pacific-Rim countries to report on progress with IMP issues in their respective jurisdictions, and to share information and news on latest developments.
- To seek and secure funding and support-in-kind for SRIMP-PAC activities.
- To periodically (every two years) review the overall progress of SRIMP-PAC against its stated aim and objectives, and recommend any necessary changes and realignments to the biennial SPREP Meeting.

The membership of the SRIMP-PAC RTF includes:

- SPREP Technical Secretariat
- The Lead Agency from each SPREP Member Government.
- International Maritime Organization (IMO)
- Secretariat of the Pacific Community (SPC)
- Pacific Islands Forum Secretariat (ForSec)
- Pacific Maritime Association (Pac~~AC~~MA~~R~~)
- Shipping, Port & Fishing Industries
- Non-Government Organisations (NGO's) (e.g. Conservation International and IUCN)
- Regional Marine Science Community

The role of each of these RTF members is outlined below:

- **SPREP Technical Secretariat:** The SPREP Marine Pollution Adviser and Invasive Species Officer act as Secretariat to the RTF.

- **Lead Agencies from each SPREP Member Government:** The National-level institutional arrangements outlined below require each SPREP Member Government to designate a Lead Agency for the central coordination of IMP issues. As the SPREP Member Government are the owners of SRIMP-PAC and the primary beneficiaries of SRIMP-PAC activities, they are key members of the RTF.

- **International Maritime Organization (IMO):** The development of the SRIMP-PAC Strategy was funded by IMO and one of the key objectives of SRIMP-PAC is to support rapid ratification and implementation of the IMO BW Convention by PICTs. SRIMP-PAC also provides a framewok for the implementation of the proposed GloBallast Partnerships Programme in the Pacific islands region, and an MoU has been signed between IMO and SPREP for the execution of IMO's Integrated Technical Cooperation Programme (ITCP) in the region, under which technical assistance and seed-funding is provided to developing countries to further IMO's global goals of *Safer Shipping - Cleaner Oceans.*

- **Secretariat of the Pacific Community (SPC):** SPC is an inter-governmental organisation with similar membership to SPREP ~~(with the addition of the United Kingdom)~~ which provides technical assistance to member countries in all areas of social and economic development.

  SPC runs a Regional Maritime Programme (RMP) which focuses on three key areas, the development of maritime training in the region, including implementation of the *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (STCW), assisting member countries to develop maritime legislation in accordance with IMO conventions, and maritime security. The SPC RMP therefore stands to play an important role in SRIMP-PAC, especially the Training and Education and Legislative components (sections 10.4 and 10.6).

  SPC is also responsible for fisheries and aquaculture issues in the region, through its Marine Resources Division, and has the mandate to develop regional arrangements to address IMP vector associated with fisheries and aquaculture, as part of the 'three-pronged' approach to invasive species in general, outlined in section 8.

- **Pacific Islands Forum Secretariat (ForSec):** ForSec is a regional organisation with similar membership to SPREP, minus the Pacific island territories, France and the USA. ForSec's primary role is high level policy and political co-ordination in the interests of Pacific island countries. As the peak policy and political umbrella group for the Pacific islands region, ForSec has a role in ensuring that SRIMP-PAC is coordinated with other regional programmes, in particular through the Marine Sector Working Group of the Council of Regional Organizations in the Pacific (CROP). Importantly, ForSec represents the interests of the Pacific island Countries as an Observer at APEC meetings, and therefore stands to play a role in ensuring linkages between SRIMP-PAC and the IMP initiatives of APEC.

- **Shipping, Port & Fishing Industries:** Involvement of the private sector, in particular the shipping, port and fishing industries, is vital to the success of SRIMP-PAC. The support and cooperation of industry, including assistance with the resourcing of projects, will continue to be developed throughout the implementation of SRIMP-PAC.

- **The Pacific Maritime Association (PACMAR):** PACMAR is a networking organisation for port and maritime authorities in the region. PACMAR has shown a growing interest in the environmental considerations of port planning, development and management, and is an important partner for the implementation of SRIMP-PAC projects relating to ports.

- **Non-Government Organisations (NGO's):** There are five main environmental NGO's active on a regional or semi-regional basis in the Pacific islands region; Greenpeace, the Nature Conservancy (TNC), Conservation International (CI), the South Pacific Action Committee for Human Ecology and the Environment (SPACHEE) and the World Wide Fund for the Conservation of Nature and Natural Resources (WWF).

  None of these currently run significant programmes of direct relevance to SRIMP-PAC, although TNC and CI have a major focus on marine biodiversity conservation in general, and IMPs are of-course a significant threat to marine biodiversity. It is also worth noting that both the IUCN Global Marine Programme and the IUCN-ISSG Cooperative Initiative on Islands have an interest in becoming more involved in the Pacific. Links and co-operative projects will be developed with regional NGO's throughout the implementation of SRIMP-PAC.

The SRIMP-PAC Workplan and Budget (section 13) provides for the establishment and running of the RTF (Table Two: Project IA2).

9.1.3 Ad-hoc Technical Advisory Group

The effective prevention, control and management of IMPs relies significantly on good science, including in the areas of risk assessment, –IMP surveys and monitoring, impact assessment and incursion control and mitigation, and from time to time SPREP may need to seek advice from a Technical Advisory Group to guide the implementation of various SRIMP-PAC activities. This would be drawn from the regional marine science community**.**

There is only one institution with some marine science capacity within the Pacific islands region, the University of the South Pacific (USP) in Fiji, although there are several institutions neighboring the region that are world leaders in the science and biology of IMPs. These include the CSIRO in Australia, NIWA and the Cawthron Institute in New Zealand and the Bishop Museum in Hawaii.

9.1.4 Reporting Requirements

As part of its programme management responsibilities, SPREP will regularly report on progress with the implementation of SRIMP-PAC to SPREP members, to programme donors, to other regional organisations, the IMO, the regional shipping and port industries and the community in general. This will be achieved through:

- The normal SPREP reporting process to members, including publication and distribution of the SPREP Annual Reports.
- The reporting requirements of individual funding arrangements with programme donors.
- Presentations at relevant meetings, conferences, workshops and seminars.
- The regional news media.

9.2 National arrangements

While the regional institutional arrangements outlined above are vital to ensure overall regional coordination, ultimately, practical measures to ensure the prevention, control and management of IMPs need to be implemented by individual governments at the national level. The national-level institutional arrangements recommended by SRIMP-PAC are based on those developed and successfully applied by the IMO-GloBallast Programme and are similar to those in place in countries such as Australia, as follows:

9.2.1 National Responsible Authority

9.2.1 National Lead Agency

Each government should designate a National Lead Agency (NLA) for the central coordination of shipping-related IMP issues in the country. Given that SRIMP-PAC deals with shipping vectors, ideally the NLA should be the transport/shipping administration, although some countries may designate the marine resources/fisheries administration or the environment protection administration.

It should be noted that the primary role of the NLA is one of coordination, as well as representing the government on the SRIMP-PAC RTF. Other government ministries, departments and agencies must also play a role and assume certain responsibilities for IMP prevention, control and management, through the SRIMP-PAC National Task Force (see below).

9.2.2 National Task Forces

So as to ensure an integrated, whole-of-government approach to IMP prevention, control and management, an inter-ministerial, cross-sectoral SRIMP-PAC National Task Force (NTF) should be formed in each country and territory. Recognizing the capacities and resources available in PICTs, the NTF's should be combined with other similar groups such as the nNational marine pollution committees also recommended under the PACPOL Programme. The NTF should comprise, as a minimum.

- The NLA (ideally the transport/shipping administration) (Secretariat to the NTF).
- Thee marine resources/fisheries administration.
- The environment protection administration.
- The health and quarantine administrations.
- The port authority.
- The national shipping industry.
- The main national-level marine environment NGO.
- Any national-level marine science body.
- The Ministry of Finance or equivalent.

The Terms of Reference for the NTF are:

- To review and approve national-level SRIMP-PAC budgets and workplans.
- To coordinate national-level SRIMP-PAC activities with relevant activities of other bodies.

- To provide a forum for all relevant government bodies and other national stakeholders to report on progress with IMP issues in their respective jurisdictions, and to share information and news on latest developments.
- To seek and secure national funding and support-in-kind for SRIMP-PAC activities.
- To periodically (annually) review the overall national-level progress of SRIMP-PAC against its stated aim and objectives, and recommend any necessary changes and realignments to the biennial RTF Meetings.

The SRIMP-PAC Workplan (Section 13) provides for the establishment of National Lead Agencies and running of the NTFs (Table Two: Project IA3), at country cost.

10. Foundation Activities

The experience of the IMO-GloBallast Programme found that once institutional arrangements are established at the national and regional levels, a number of basic and standard 'foundation activities' need to be carried out when providing technical assistance, institutional strengthening and capacity building to developing countries and regions to address shipping related IMPs. These include communication and awareness, risk assessment, surveys and monitoring, legislation and regulations, compliance and enforcement, technical training and education, evaluation and review, research and information management. The development of marine pest management arrangements in countries such as Australia and New Zealand has revealed similar issues.

It is proposed that SRIMP-PAC activities follow a similar approach, while adapting each element to the Pacific islands context as outlined below.

10.1 Communication and awareness

A general lack of awareness amongst all sectors of society about the issue of IMPs has been identified as one of the main barriers to the development and implementation of effective IMP prevention and control measures (IMO-GloBallast Programme, 2000). The 'awareness barrier' is compounded by the fact that IMPs are not a highly visible phenomena which attract major media attention, compared to major oil spill emergencies or similar environmental 'catastrophes' (although the chronic impacts of IMPs can be far more severe than these acute pollution events).

While concerted awareness campaigns such as that carried out internationally by the GloBallast Programme from 2000 to 2004 have significantly reduced this barrier, the lack of awareness still persists in many sectors and in many parts of the world, including in the Pacific islands. Because there has been a significant history of intentional introductions and translocations of aquatic species for fisheries and aquaculture production in the Pacific, there is often a positive perception about introduced species amongst some stakeholders in the region.

A basic starting point for SRIMP-PAC is therefore to carry out a comprehensive communication and awareness campaign, both regionally and in each country. This campaign comprises:

- Establishment of a SRIMP-PAC page on the SPREP web site – linked to other relevant sites such as IMO-GloBallast, SPC and sites in Pacific-Rim countries.
- Production of a set of brochures and posters on both the ballast water and hull fouling issues. These would include materials developed for use in the region, and others specifically designed to target IMP source ports in Pacific-Rim countries (see below and section 11).
- Running a series of awareness and training workshops for all stakeholders throughout the region (linked to the SRIMP-PAC training initiative, see section 10.6).
- Including IMP issues in various regional newsletters of SPREP and SPC.
- Including IMP issues in relevant courses at the University of the South Pacific (USP).
- Including IMP issues in the maritime training curriculum that is coordinated by the SPC RMP.
- Including IMP issues in presentations at various seminars, workshops, conferences and meetings in the region, on an opportunistic basis.

The development of SRIMP-PAC awareness materials will benefit from the excellent global products available from IMO-GloBallast, and those developed by some Pacific-Rim countries, but will also be designed so as to be regionally relevant and culturally appropriate to their target audiences.

The SRIMP-PAC awareness materials aimed specifically at IMP source ports in Pacific-Rim countries, will be designed to make governments, the shipping industry and the yachting fraternity at these source ports, aware of the possibility that they may take on species and transfer them to the Pacific islands. The materials will outline the management practices that they might apply before departure, so as to minimize the possibility of transfer. This is part of the pre-border prevention efforts of SRIMP-PAC (see section 10.6). High priority areas targeted will be the Panama Canal and Pacific coast departure ports in Canada, USA, Mexico, Chile, New Zealand, Australia, China and Japan (in relevant languages).

The SRIMP-PAC Workplan and Budget (section 13) provides for the establishment and running of a significant communication and awareness campaign (Table Two: Projects CA1 to 4, complemented by Projects TCB1 to 3).

10.2 Risk assessment

(Note : Incorporate risk index)

As outlined in Appendices 6 and 7, neither a ballast water nor a hull fouling risk assessment have been carried out for the Pacific islands region or for any country or port within the region.

10.2.1 Overall risk assessment

Risk assessment is a basic first-step for any country contemplating a formal system to prevent, control and manage IMPs. In order to assess the risk of introductions and begin to design a management regime for any given port, it is necessary to first understand the nature of the problem, and define basic parameters such as the volumes of ballast water received and exported, the frequency of ballast discharge and uptake events, the types and frequency of fouled-vessel arrivals, and the locations where ballast water and fouled vessels are received from (source ports) and exported to (destination ports).

Fortunately, standard ballast water risk assessment methods have been developed and successfully applied by the IMO-GloBallast Programme, and NIWA in New Zealand has developed a risk-based predictive tool for assessing the risks posed by hull fouling (Floerl et al 2005). Such standard and readily available methods can be used by SRIMP-PAC to undertake a comprehensive, overall IMP risk assessment for the region and each major port in the region.

An overall risk assessment is included as a component in the SRIMP-PAC Workplan & Budget (section 13, Table Two: Project RA1).

10.2.2 Vessel / voyage-specific risk assessment

In determining the nature and extent of their IMP management measures, port States may wish to assess the relative risk posed by particular trading routes/and or vessels. A risk-based 'selective ' approach could be attractive to PICTs that may not have sufficient resources to target every single vessel calling at its ports, and which therefore need to prioritise their regulatory efforts. Under the BW Convention, risk assessment may be used to determine if a ship can be exempt from requirements. This requires some sort of a Decision Support System (DSS), and would benefit from the overall risk profiles and supporting data generated by the overall risk assessment referred to above.

Australia has developed a DSS which allows the ballast water risks posed by an individual ship on a specific voyage, to be assessed before that ship arrives in Australia, and the Cawthron Institute in New Zealand has a similar tool available (SHIPPING EXPLORER). The Canadian government is currently evaluating these, to develop its own ballast water DSS. The risk-based predictive tool for hull fouling developed by NIWA referred to above, can also be used for vessel / voyage specific risk assessment.

Ultimately, these may be linked with each other and with other regional initiatives, to provide a harmonized, Pacific-wide IMP risk assessment DSS, covering both the Pacific-Rim and the Pacific islands region.

An initial coping study to assess the feasibility of such a Pacific-wide DSS is therefore included as a component in the SRIMP-PAC Workplan & Budget (see section 13, Table Two: Project RA2).

10.3 Surveys & monitoring

As outlined in Appendix 7, the presence and distribution of introduced, non-native marine species in the Pacific Islands region is poorly understood and apart from the US territories, no detailed studies or surveys have been conducted in any port or on any open coastline in the region.

In order to solve any problem, it is first necessary to understand the problem, and researching and documenting the patterns of biological invasions in coastal waters is fundamental to gaining this understanding. It is not possible to prevent and control IMPs unless you know 'what they are' and 'where they are', and these cannot be achieved without an organised survey, monitoring and surveillance effort.

Port surveys and monitoring programmes are needed to assist port States to meet their obligations under the IMO BW Convention, to alert shipping and other interested parties to 'outbreaks' of

harmful aquatic organisms, to assist in preventing their uptake, and to detect invasions as early as possible, thereby increasing the chances of successful response, control and mitigation actions.

Surveys and monitoring are also needed to assess the effectiveness of management responses, including the IMO ballast water Convention, by providing data on changes in the rates and patterns of invasion over time. Establishing a comprehensive, regional network of IMP survey and monitoring programmes, is an essential part of the broader efforts to reduce the spread of IMPs through all vectors. These surveys also bring huge benefits to science and the general understanding of aquatic biodiversity and ecology.

In recent years, initiatives by a number of countries and organizations have seen the development of an extensive global network of a large number of sites where surveys and monitoring for IMPs have been carried out (see Figure 19).

As outlined in section Appendix 7, Australia, through its Commonwealth Scientific and Industrial Research Organization Centre for Research on Introduced Marine Pests (CSIRO-CRIMP), pioneered the development of standard protocols for surveys and monitoring of introduced species in port areas (Hewitt & Martin 1996, 2001). Conducting such surveys according to uniform methods, helps to ensure quality control and a basic minimum standard, and allow inter-comparability of data between sites across the globe.

In 1996 CRIMP together with other Australian marine science bodies, various State agencies and port authorities, commenced the Australian National Port Survey Programme, which by the end of 2003 had completed surveys using the standard CRIMP protocols, in 36 ports around the country (see Figure 19).

These Standard methods have been adopted, adapted and applied at many more ports around the world, including through the IMO GloBallast Programme, and at more than 13 sites in NZ.

As also outlined in Appendix 7, the Bishop Museum in Hawaii has undertaken surveys using more restricted and limited methods, at several sites throughout Hawaii, Johnston Atoll, Midway Is. and American Samoa (see Figures 19 & 20), the Smithsonian Environmental Research Centre (SERC) in the USA has established passive settling plates at a number of sites on the US Pacific Coast, and the California Lands Commission is undertaking surveys in Californian ports.

Clearly, the major gap that still exists throughout the Pacific islands needs to be plugged, and the SRIMP-PAC Workplan and Budget (section 13) includes provision for an IMP Survey and Monitoring Programme, based on a combination of methods, as follows:

- Full-scale, comprehensive, CRIMP-style surveys at four representative ‘high risk’ ports / yacht congregation areas in the region , e.g.
  - Port Vila in Vanuatu,
  - Laeutoka in Fiji,
  - Vavau in Tonga, and
  - Apia in Samoa.

- Reduced-scale, less rigorous ‘surveillance’ surveys using Bishop Museum methods at four representative ‘medium risk’ ports / yacht congregation areas in the region , e.g.
  - Honiara in the Solomons,
  - Suva in Fiji,
  - Tarawa in Kiribati, and
  - Phonpei in Micronesia.

- Establishment of SERC-style passive settling plates at four representative 'low risk' ports / yacht congregation areas in the region, e.g.
    - Majuro in the Marshall Islands,
    - Koror in Palau,
    - Rarotonga in the Cook Islands, and
    - Nukualofa in Tonga.

The spread of these sites throughout the region is shown on Figure 3.

Development and implementation of the Pacific Islands IMP Survey and Monitoring Programme will be coordinated by SPREP and undertaken by a cooperative consortium comprising the regional experts on this issue from CSIRO, NIWA, Bishop Museum and SERC, with active participation by (and training of) marine scientists and students from USP as well as staff from PICT marine resources/fisheries administrations and the SPC Marine Resources Programme. This training and capacity building component to develop regional expertise is a major feature of this programme, and will include establishment of a regional voucher and reference collection and IMP information system at USP.

Limitations in taxonomic expertise will certainly be a constraing factor for this effort (as is the case world-wide), and the programme therefore includes a specific Taxonomy Initiative.

Development of this programme should be initiated by a technical workshop involving the players mentioned above, so as to define roles and responsibilities, agree funding and resource sharing arrangements, and to map-out an action plan to get the surveys up and running.

The SRIMP-PAC Workplan and Budget (section 13) provides for the establishment and running of a the survey and monitoring programme outlined above (Table Two: Projects SM1 to SM5).

Ultimately, the long-term objective of this activity is to establish an effective IMP monitoring and early-warning system, and IMP surveys and monitoring should be 'mainstreamed' into the routine environmental management activities of all ports, harbours, marinas, aquaculture sites and marine protected areas in the region; carried out as ongoing, long-term monitoring programmes; and linked into the regional and any global IMP information system (see section 10.7).

[insert map of region, with symbols for CRIMP Protocol Site (red dots)s, Bishop Museum Site (green dots)s and SERC Settling Plate Sites (blue dots]

CRIMP Protocol Sites - **Red dots**
- Port Vila in Vanuatu,
- Laeutoka in Fiji,
- Vavau in Tonga, and
- Apia in Samoa.

Bishop Museum Sites - **Green dots**
- Honiara in the Solomons,
- Suva in Fiji,
- Tarawa in Kiribati, and
- Phonpei in Micronesia.

SERC Settling Plate Sites - **Blue dots**
- Majuro in the Marshall Islands,
- Koror in Palau,
- Rarotonga in the Cook Islands, and
- Nukualofa in Tonga.

Figure 3: *Locations of the proposed IMP surveys and monitoring sites under SRIMP-PAC*

10.4 Legislation and regulations

Ultimately, for any country to be able to effectively prevent and control IMPs, it must have appropriate legislation and regulations, and to give legal effect to any relevant international Conventions that the country has ratified (e.g. the IMO BW Convention).

Apart from the application of US laws such as NISA and the US Coast Guard ballast water regulations in American Samoa, Guam and the Northern Mariana Islands, to date no PICTs have enacted legislation or regulations relating to IMPs.

As an initiative under the SPREP / IMO PACPOL programme, in 2000 SPREP and the SPC RMP jointly published the *Regional Model Marine Pollution Prevention Act - A Template for Pacific Island Countries.* The intent of this model legislation was to provide Pacific Island Countries with a ready-to-use, all-in-one template by which they could rapidly develop national legislation that was generally consistent with the IMO marine environment protection Conventions, including MARPOL, OPRC, London Convention and the CLC and Fund Conventions.

This model legislation pre-dated adoption of the IMO BW Convention (Feb 2004), and was developed in the absence of an international regulatory regime for the fouling vector (as is still the case in March 2005). Never-the-less, with considerable foresight the model included albeit 'embryonic' sections dealing with these two vectors for shipping-related IMPs (see box). To date, with support from SPREP and SPC RMP the Cook Islands and Tonga have enacted legislation based on the regional model.

It should be noted that now that the IMO BW Convention has been adopted, in order to remain consistent with the BW Convention (a key objective of SRIMP-PAC), PICTs will need more comprehensive legislation and regulations dealing with this issue than is provided for in the 2000 Regional Model. A review should be undertaken to determine amendments required to be consistent with the Convention.

Ideally, IMP legislation and regulations in PICTs should address both the ballast water and fouling vectors in a single Act. The current absence of an international regulatory regime for the fouling vector, means that SPREP Members will be pioneering legislative developments in this area. However, linkages should be developed with other countries such as Australia ands New Zealand which are developing legislative arrangements to address biofouling.

Consideration could also be given to including other aquatic vector, including fisheries and aquaculture, by incorporating regionally relevant aspects of the FAO and ICES guideline (see Appendix 8), in an integrated Aquatic Invasive Species Act. However, there may be sound administrative and technical arguments for keeping the shipping and fisheries vectors legislatively separate.

Extract from:
Regional Model Marine Pollution Prevention Act:
A Template for Pacific Island Countries (SPREP/SPC 2000).

6. Discharge of ballast water

(1) No ballast water containing non-indigenous harmful aquatic organisms and/or pathogens shall be discharged from a vessel into (*Country name*) waters.

(2) If any ballast water containing non-indigenous harmful aquatic organisms and/or pathogens is discharged from any vessel into (*Country name*) waters, the owner and master commit an offence and shall be liable upon conviction to a fine not exceeding (*$150,000*).

(3) The Master of a vessel that discharges ballast water in (*Country name*) waters shall comply with any voluntary or mandatory ballast water management requirements issued by the International Maritime Organization in force at the time of the discharge.

(4) The Master of a vessel that intends to discharge ballast water in (*Country name*) waters shall, prior to such discharge, complete and submit to the *(Minister/Secretary)* a Ballast Water Reporting Form in the form approved for that purpose.

(5) It shall be a defense to show that all reasonable measures to comply with any voluntary or mandatory ballast water management requirements issued by the International Maritime Organization in force at the time were taken to ensure that no ballast water containing non-indigenous harmful aquatic organisms or pathogens were discharged from a vessel into (*Country name*) waters.

7. Hull scraping and cleaning

(1) The scraping and cleaning of the hulls and other external surfaces of vessels in a manner that may result in the introduction of non-indigenous harmful aquatic organisms or pathogens into (*Country name*) waters is prohibited.

(2) Any person who breaches this section commits an offence and shall be liable upon conviction to a fine not exceeding ($150,000).

A Legislative Review and Development Project is included as a significant component in the SRIMP-PAC Workplan & Budget (see section 13), comprising the following phases:

Phase 1: Develop regional model shipping-related IMP legislation that is fully consistent with the IMO BW Convention, UNCLOS and CBD and which also includes the fouling vector, and incorporates practical management measures as outlined in SRIMP-PAC (see section 11).

Phase 2: Provide technical assistance to PICTs to develop their national legislation and regulations, consistent with the regional model.

This activity will be undertaken as a consultancy on contract to SPREP, using both an international consultant to provide overall coordination and a national legal consultant in each

PICT. This approach was used successfully for the Legislative Review conducted by the IMO GloBallast Programme in 2001, and the support of IMO will be sought for the SRIMP-PAC Legislative Review and Development Project.

The SRIMP-PAC Workplan and Budget (section 13) includes these legislative development projects (Table Two: Projects LA1 to LA3).

10.5 Compliance and enforcement

Legislations and regulations are of limited value if compliance with them is not monitored and enforced. Similarly, compliance monitoring and enforcement (CME) efforts are of no relevance if there are no legislation and regulations to enforce.

At the international level, very little progress has been made in developing compliance monitoring and enforcement systems and procedures in relation to IMP regulatory arrangements. In September 2004, the IMO GloBallast Programme held an international workshop in Iran to review the current global state-of-play in relation to ballast water CME systems, and found that this is a very embryonic but rapidly developing field. The report on this workshop is available at http://globallast.imo.org/publications .

Because it will be some years before PICTs will have enforceable IMPs legislation, and because CME systems and methods will develop rapidly in this time, and considering the many other 'baseline' activities that PICTs need to complete under SRIMP-PAC in order to begin to address IMPs, CME activities are not immediately included in the SRIMP-PAC Workplan (section 13), although Projects LA1 to LA3 and Project PSC1 in Table Two (section 13) have relevant components. After two years from the commencement of SRIMP-PAC, the RTF will review this and if appropriate, develop a more detailed CME component for implementation in the region.

10.6 Technical training and capacity building

One of the underling principles of SRIMP-PAC (section 8) is that training and capacity-building are core requirements in order to address the current limitations on the capacity of PICTs to manage IMPs. This is to be achieved in the SRIMP-PAC Strategy through:

- Including training and capacity building as an integral component of all SRIMP-PAC activities (e.g. the IMP surveys and monitoring programme).

- Developing a purpose-made modular training course on shipping-related IMPs prevention and control, targeting government officials and managers in the port and shipping industry, for delivery at regional workshops and in each PICT. This will be based on the standard GloBallast modular training package that is already available from IMO, developed further to include the fouling vector and to suit the Pacific islands region. It should be noted that GISP and UNEP-CBD are developing standard modular training materials for non-ballast marine vectors to complement the GloBallast training package, and this will be assessed by SPREP for use in the SRIMP-PAC training courses.

- Including shipping-related IMP issues in the maritime training curriculum that is coordinated by the SPC RMP.

- Including IMP issues in relevant courses at USP.

The SRIMP-PAC Workplan and Budget (section 13) includes these training and capacity development projects (Table Two: Projects TCB1 to TCB3).

10.7 Information management

In order to be effective, it is important that IMP prevention and control efforts are supported by good information management, and SRIMP-PAC proposes the establishment of a Pacific IMP Information System (PAC-IMPIS). Ideally, such a system should be compatible with and linked to other similar systems, such as the Australian National Introduced Marine Pests Information System (NIMPIS – www.marine.csiro.au/crimp/nimpis) and the US National Exotic Marine and Estuarine Species Information System (NEMESIS – www.serc.si.edu/nemesis). The technical specifications for PAC-IMPIS should therefore be derived directly from NIMPIS and NEMESIS (which are themselves compatible). These databases contain information on the distribution, biology, ecology and impacts of invasive aquatic species, and in the case of PAC-IMPIS would be populated by data from the surveys and monitoring described in sections 10.3 and Appendix 7.

To be complete and comprehensive PAC-IMPIS should also hold and manage information on vessel movements and ballast water and hull fouling management issues (which are not included in systems such as NIMPIS and NEMISIS). The US National Ballast Information Clearing House (www.serc.si.edu/nbic) provides a potential model for this module of PAC-IMPIS. Data derived from the risk assessments described under section 10.2 and collected by PICT Port State Control authorities such as from IMO Ballast Water Reporting Forms (Section 11.2) would assist in populating this database.

PAC-IMPIS would need to be housed at a relevant and suitable regional institution such as USP or SPC.

The SRIMP-PAC Workplan and Budget (section 13) provides for the development of PAC-IMPIS (Table Two: Project IM1).

10.8 Cooperation with Pacific-Rim countries

Because ships, yachts and other vessels that voyage to and through the Pacific Islands most often originate from Pacific-Rim countries, it is important that activities under SRIMP-PAC are coordinated with these countries, including devising strategies to prevent the uptake and carriage of potentially invasive species at Pacific-Rim source ports, with the aim of preventing their spread to the islands, and vice versa. Coordinating and integrating SRIMP-PAC with the IMP strategies and activities of Pacific-Rim countries, including through APEC, will provide a more holistic, 'whole of the Pacific' or 'Total Ocean-Basin' approach to IMP management.

It is therefore important that SPREP should liaise with relevant authorities in these countries to identify opportunities for integration, coordination and synergies as well as co-financing of

common activities, and to endeavour to ensure uniform application of harmonized management measures in the region, including the IMO BW Convention.

Appendix 10 provides an overview of relevant activities of APEC in the Pacific-Rim countries that are most active on IMP issues, along with recommendations for SPREP to seek cooperation with each.

It is also recommended that this be done in part through inviting APEC and Pacific-Rim countries to be members of the SRIMP-PAC Regional Task Force (see section 9.1.2).

11. Practical Management Measures

As outlined in section 8 the SRIMP-PAC Strategy is based on the principle of "layered defence", with management measures organized into three layers as follows:

- Pre-border (incursion prevention)
- At-border (incursion interdiction)
- Post-border (incursion response, control and mitigation)

Each of these three layers is in turn divided into general arrangements which apply irrespective of the vector, followed by a hull fouling and ballast water component which outlines the management measures that apply specifically to these vectors, in each layer.

11.1 Pre-border (incursion prevention)

11.1.1 General pre-border measures

"The most effective strategy for biosecurity control is to focus on minimising the arrival of new non-native species - prevention is better than cure. At-border and post-border controls will not be as effective as pre-border measures due to difficulties in detecting and eradicating introductions. This is especially difficult in the marine environment as the technology to inspect vectors is only in the developmental phase and organisms can rapidly disperse over a wide area by currents and tides." (MAF-NZ 2004).

Two general measures are recommended under SRIMP-PAC as part of pre-border incursion prevention efforts; risk assessment and communication and awareness campaigns at Pacific-Rim source ports.

Risk assessment: The first general pre-border incursion prevention measure is to undertake an overall risk assessment for the region (addressing both the fouling and ballast vectors), as outlined in section 10.2 and included in the SRIMP-PAC Workplan (section 13).

To support such risk assessments, under SRIMP-PAC, SPREP Members should work through the RTF, through regional groups like APEC, and through direct bi-lateral

links with Pacific-Rim countries, to ensure that IMP survey and monitoring programmes are extended to all major Pacific-Rim ports, especially those in Asia and South America where there are currently major survey and monitoring gaps (see Figure 20 and section 10.3).

Communication and awareness: In order to help prevent foreign marine species entering the Pacific islands region a comprehensive communications and awareness strategy as outlined in Section 10.1 and included in the SRIMP-PAC Workplan (section 13) is required. High priority source ports targeted for this communication and awareness effort will be determined by the outcomes of the risk assessment, and may include the Panama Canal and Pacific coast departure ports in Canada, USA, Mexico, Chile, New Zealand, Australia, China and Japan (in relevant languages).

11.1.2 Pre-border fouling management measures

The most effective way to prevent IMPs being introduced to the Pacific islands region through vessel fouling, is for PICTs to work with relevant authorities in Pacific-Rim countries, to ensure that best-practice fouling prevention and control measures are applied in Pacific-Rim ports. Taylor & Rigby (2002) provide a comprehensive synopsis of best-practice fouling management measures, and these are summarised in the Generic Fouling Management Template in Appendix 1.
Such an approach would involve developing a system, in cooperation with Pacific-Rim countries, to ensure that all vessels that depart ports in these countries on voyages destined for PICTs, are free of fouling before they depart. This would involve vessels being inspected for fouling, and should fouling be observed, having it removed before the vessel is authorised to leave port (NB. Ideally, appropriate controls and facilities would need to be available in these ports for such a cleaning operations, so as to ensure that marine pests are not left in the ports after cleaning).

Taylor & Rigby (2002) describe methods for undertaking vessel fouling inspections, including:

- On-board assessment by vessels' crew
- Hull inspection from dockside
- Hull inspection from small boat
- Hull inspection underwater (diver and remote cameras)

Floerl et al (2005), Coutts at al (2003) and Coutts & Taylor (2002) also describe methods for assessing fouling on vessels.

In addition to the hull, high-risk fouling areas including sea-chest grills, areas around the propeller and rudder, and also anchors, anchor chains and anchor lockers, require inspection. Fishing vessels also require inspection of fishing nets, ropes, traps, floats and other gear that may host fouling species.

An example of such an approach (albeit a domestic one implemented within a single country's jurisdiction), can be found in NZ, where a *Biosecurity Code of Practice for Vessels Operating Around the Sub-Antarctic Islands* (MFish 2005) has been developed. This code establishes guidelines to reduce the risk of hull fouling introductions to the Sub-Antarctic islands; and in particular the highly invasive Northern Pacific seaweed *Undaria pinnatafida*, which is has been introduced to mainland NZ. A sample *Vessel Inspection Reporting Form* as used by this Code of Practice is included in Appendix 3, and may be adapted for use under SRIMP-PAC.

The prevent translocation of marine species between PICTs within the region, similar arrangements should be agreed between PICTs.

Of course, this approach would involve a high degree of international cooperation, and traditionally, source-ports are reluctant to take action to prevent the export of species, simply to protect another country's interests. In the absence of an international regulatory regime for the fouling vector, such international cooperation which involves management action by foreign governments in Pacific-Rim countries may well be difficult to achieve.

It is therefore recommended that under SRIMP-PAC, SPREP Members should work through the RTF, through regional groups like APEC, and through direct bi-lateral links with Pacific-Rim countries, to ensure that effective fouling prevention and control measures are put in place at Pacific-Rim ports, so as to prevent the spread of fouling species from these ports into the Pacific islands region.

One high-priority target area for this approach, could be the Pacific end of the Panama Canal. Because this concentrates a large number of vessels, from merchant vessels to small private yachts, in one clearly defined area before they head into the Pacific, it may be feasible to require vessels to undergo a fouling inspection here before they are authorised to enter the Pacific. This would capture a considerable percentage of vessels that voyage to PICTs, and potentially prevent a significant number of marine bio-invasions (e.g. the introduction of the Black Striped mussel from the Gulf of Mexico / Caribbean). SPREP and SPREP members, in coordination with IMO, should seek to work with the Government of Panama towards establishing such a system.

As an enticement to Pacific-Rim countries, PICTs should also work through SRIMP-PAC, to implement the same fouling prevention and control measures in their own ports, to prevent the spread of IMPs from their ports to Pacific-Rim ports.

To improve the impetus for all countries to implement such measures, PICTs should work through IMO, to initiate and accelerate the development of an international regulatory regime for the fouling vector, which complements the IMO BW Convention.

11.1.3 Pre-border ballast management measures

One of the main objectives of SRIMP-PAC is to ensure rapid ratification and harmonized implementation of the IMO BW Convention in PICTs, and all ballast management practices outlined in SRIMP-PAC are derived from and are intended to be consistent with the BW Convention.

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As with the fouling vector, one of the main thrusts of pre-border ballast management measures under SRIMP-PAC is to prevent IMPs from being taken up by ships in Pacific-Rim ports, thereby preventing their transfer into the Pacific islands region.

Under the Regulation C2 of the BW Convention, it is recommended that port Sates advise ships of areas where there are known outbreaks of harmful aquatic organisms and pathogens (e.g. harmful algae blooms), sewage outfalls and areas of poor tidal flushing, so that ships may avoid taking on ballast in these areas, so as to prevent the uptake of potentially harmful aquatic organisms and pathogens at the source port.

As described above for pre-border fouling management measures, this approach would involve a high degree of international cooperation, in order to ensure that source ports around the

Pacific-Rim implement the necessary surveys, monitoring and reporting systems so as to be able detect outbreaks of harmful aquatic organisms and pathogens, and communicate areas and times to be avoided to the shipping industry.

It is therefore recommended that under SRIMP-PAC, SPREP Members should work through the RTF, through regional groups like APEC, and through direct bi-lateral links with Pacific-Rim countries, to ensure that these measures are put in place at Pacific-Rim ports (see also sections 10.2 and 10.3).

Once a ship commences its voyage, there are a number of pre-border ballast management measures that can be applied during the voyage, in accordance with Regulation B-3 of the Convention (see Appendix 8.a), including:

- Undertaking ballast water exchange at sea in accordance with Regulations B-3 and D-1 of the Convention.

- Undertaking shipboard treatment of ballast water en route to PICTs in accordance with Regulation D-2 of the Convention.

It should be noted that there are significant limitations on the practice of ballast water exchange at sea, including the fact that it may be unsafe for some vessels during certain weather and sea conditions, the fact that some voyages may not pass beyond 200Nm or even 50nm of the coast in accordance with Regulation B-3 of the Convention, the fact that some voyages may be too short to allow sufficient time to undertake complete exchange in compliance with Regulation D-1 of the Convention, and the fact that even when complete exchange is able to be undertaken in full compliance with the Convention, species may still be transferred. The implementation of requirements for arriving ships to undertake ballast water exchange at sea before discharging ballast in PICT ports, therefore constitutes a 'risk-reduction' measure only.

It should also be noted that in relation to shipboard treatment of ballast water, there are currently no commercially viable and practically feasible technologies available that can meet Regulation D-2 of the Convention, although there are a large number of R&D projects underway which promise to deliver such technologies in the near future.

11.2 At-border (incursion interdiction)

11.2.1 General at-border measures

For the purposes of SRIMP-PAC, the border of PICTs in relation to IMPs is the EEZ, although in actual practice many at-border management measures can only be applied to vessels just prior to port entry. At-border measures primarily involve an inspection regime to ensure that arriving vessels have complied with pre-border incursion prevention requirements.

11.2.2 At-border fouling management measures

As a result of the Black Striped Mussel incursion in Darwin in 1999, Australia has developed a National Border Bio-fouling Protocol for Apprehended and Small International Vessels (see

Appendix 3). This provides a possible model for PICTs to implement at-border fouling management measures. Essentially, such measures involve:

- Scrutiny of high risk vessels and other floating facilities before allowing their entry or detention in, and movement from or between PICT ports;
- Inspection of international yachts and other pleasure craft at their first port of call to ensure they are free of exotic organisms, and prompt action to remove these vessels from the water for cleaning should exotics be detected; and
- Promotion of good maintenance and antifouling practices to small boat owners, including actions to ensure boats do not continue to operate, or move outside their home port when the predicted life of the paint scheme has been exceeded or the antifouling has lost its effectiveness.
- A ban on the scraping and cleaning of the hulls and other external surfaces of vessels in a manner that may result in the introduction of IMPs into PICT waters (e.g. in-water cleaning and scraping).
- A requirement that when hulls and other external surfaces of vessels are scraped and/or cleaned in dry-dock / on slipways / when careened ashore, any organisms removed are disposed of appropriately ashore.

Implementation of such measures requires adequate resourcing and training of port State inspection and quarantine authorities in PICTs, and this is provided for in the SRIMP-PAC Workplan (see section 13, Table Two: Project PSC1).

11.2.3 At-border ballast management measures

The main at-border ballast management measure to be implemented by PICTs involves port State control inspections to assess whether relevant ships have undertaken ballast water exchange at sea or other ballast water management measures as required by the IMO BW Convention.

The simplest and most useful at-border tool that can be implemented by PICTs is to require all arriving ships to submit Ballast Water Reporting Forms as per the IMO ballast water Guidelines (A.868(20)) (Appendix 4). While the new BW Convention only requires ships to record, and not necessarily report, ballast water information, experience gained at the six GloBallast Demonstration Sites between 2000 and 2005, showed that the basic data generated by these forms, while often fraught with errors and incompleteness, proved invaluable in allowing Port State authorities to begin to assess and understand the nature and magnitude of the ballast water issue in their country. Until such time as the BW Convention enters into force, the A.868(20) guidelines continue to apply. Even after entry-into-force of the Convention, port States may continue to require ships to submit Ballast Water Reporting Forms.

The collection of these forms is considered a fundamental starting point for any country beginning to address the issue. Collection of these forms must be supported by the establishment of a national information system to store, manage and assess the resulting data, and the data should be provided to the regional information system established under SRMP-PAC (section 10.7). Considering the resource limitations of PICTs, collection of these forms

should be integrated with the routine collection of other information from ships by PICT PSC agencies such as customs and quarantine.

Under Article 9 of the BW Convention (*Inspection of Ships*) port State Control inspectors can verify that the ship has a valid certificate; inspect the Ballast Water Record Book; and/or sample the ballast water. If there are concerns, then a detailed inspection may be carried out and "the Party carrying out the inspection shall take such steps as will ensure that the ship shall not discharge Ballast Water until it can do so without presenting a threat of harm to the environment, human health, property or resources." All possible efforts shall be made to avoid a ship being unduly detained or delayed (Article 12 *Undue Delay to Ships).*

Should such inspections indicate that a ship has not undertaken ballast water exchange at sea, or applied alternative ballast water management measures as outlined in the BW Convention, contingency arrangements are required, whereby the ship may be requested to steam offshore into deep oceanic waters to undertake exchange prior to ballast discharge in port. In the case of PICTs, which in most cases have water deeper than 200m relatively close to shore, such a requirement may not be particularly onerous.

Implementation of such an inspection capability requires adequate resourcing and training of port State inspection and quarantine authorities in PICTs, and this is provided for in the SRIMP-PAC Workplan (see section 13, Table Two: Project PSC1).

11.2.4 Ballast tank sediments

Another important at-border ballast management measure relates to preventing the disposal of ballast tank sediments in PICT ports. Under Article 5 *Sediment Reception Facilities*, Parties undertake to ensure that ports and terminals where cleaning or repair of ballast tanks occurs, have adequate reception facilities for the reception of sediments. The SRIMP-PAC therefore includes an activity to identify and assess those ports in the region where cleaning or repair of ballast tanks occurs, and to develop a ballast tank sediment management plan for each (see section 13, Table Two, Project BSM1).

11.3 Post-border (incursion response, control & mitigation)

Once a foreign marine species establishes in a new environment, efforts need to undertaken to respond to the incursion, including in order to control its further spread and mitigate its impacts, and if possible to eliminate it from the invaded environment.

It should be noted that in the vast majority of cases, once a marine bio-invasion is discovered, very little can be done to stop its spread. One notable exception is the incursion of the Black Striped Mussel in a Darwin marina in 1999, where the incursion was successfully eliminated. Following from the Darwin experience, as outlined in Appendix 10.b, the Australian National System for the Prevention and Management of Introduced Marine Pests, includes an ongoing management and control element coordinated by the Department of Environment and Heritage. This element aims to contain and control any introduced marine pests that have established viable populations within Australia and are having, or are expected to have a significant impact on the marine environment, industry or human health, through nationally agreed Control Plans. National Control Plans are currently being developed for 11 species that have been identified as having a potential or actual significant impact on the marine environment or industry. Also

in Australia the CSIRO has published a tool-kit outlining control options for various IMP species (www.marine.csiro.au/crimp/nimpis/controls.htm).

New Zealand is also active in this area, including the development of a control plan for the northern Pacific seaweed *Undaria pinnatifida*.

While the primary focus of SRIMP-PAC is the prevention of marine bio-invasions through the pre- and at-border measures outlined above, in anticipation that such measures do sometimes fail, it is necessary for PICTs to develop regional and national IMP incursion response, control and mitigation plans, and the SRIMP-PAC Workplan provides for this (section 13, Table Two: Project IRC1). The incursion response, control and mitigation efforts being undertaken in Australia and NZ as outlined above provide models and templates for this activity.

12. Transit Shipping

As clearly evident on Figure 2, the Pacific Islands play unwitting host to transit ships trading between the major economies of the Pacific-Rim, passing through their 200 nautical mile (NM) Exclusive Economic Zones (EEZ).

In terms of ballast water and IMPs, this creates a potential (and as yet un-assessed) problem for Pacific Island marine environments. Transit ships en-route from Japan to Australia, Singapore to South America or New Zealand to California, for example, may pass through PICT waters. In order to comply with the ballast water management requirements of Pacific-Rim ports, such ships may undertake ballast water exchange in the vicinity of small island States, and therefore potentially (and inadvertently) threaten PICTs with these ballast water discharges.

The IMO BW Convention requires that ships that undertake ballast water exchange at sea, should do so at a distance of more than 200 NM from land and in waters with a depth greater than 200 metres. Reductions to 50 NM from land and in waters with a depth greater 200 metres or in other areas designated for the purpose by Port States are provided for, where operational factors, voyage route and/or safety considerations prevent the greater distance being complied with.

In order to assess and address the potential ballast water threat posed by transit shipping, the SRIMP-PAC Workplan includes a Transit Shipping Assessment project (section 13, Table Two: Project TS1).

Through their National ballast water management regimes, Australia, Canada, Chile, NZ and the USA require ships to record and in some cases report their mid-ocean ballast water exchange locations. Several countries have plotted these on Geographic Information System (GIS) and Australia and NZ have undertaken an evaluation of areas suitable for ballast water exchange at sea. The Transit Shipping Assessment includes using this data to identify and map the locations in the Pacific where ships report undertaking mid-ocean ballast exchange. These will be assessed with regard to proximity to Pacific island coastal and marine resources, prevailing oceanographic conditions, and compliance with the distance from shore and depth requirements of the BW Convention, to enable an enlightened assessment of the potential risks posed (or not posed) by transit ballast exchange.

Without pre-empting the findings of this assessment, given the rapid increase in ocean depths and the highly oceanic conditions that prevail close to most Pacific island coastlines (especially the more isolated islands in eastern Polynesia and eastern Micronesia), the assessment may well find that risks are not that high. However, simple distance from the coast and water depth may not be the best indicators of risk. Bio-physical -oceanographic parameters including temperature gradients and phytoplankton concentrations throughout the region, will also be used in the assessment.

Again, without pre-empting the findings of the assessment, those PICTs that have coastal-type oceanographic conditions extending further seaward, and which are comprised of larger, continental islands that are close together and which host larger numbers of ballasted transit ships, may well be at risk from these ships conducting ballast exchange at sea (e.g. the western Melanesian islands of PNG and the Solomons).

Should the assessment indicate such high risk zones, it may be necessary to consider a process for PICTs to require "additional measures' to be applied in these zones in accordance with Regulation C-1 of the IMO BW Convention, and also the possibility of designating these as Particularly Sensitive Sea Areas (PSSAs) through IMO, thereby allowing the relevant PICT to implement more stringent control measures in these areas.

13. Workplan & Budget

The SRIMP-PAC Workplan forms the 'backbone' of the Strategy, outlining the projects that need to be implemented in order to reduce shipping-related IMPs in the region. Projects are grouped into the following categories (in no particular order of priority):

- Institutional Arrangements (IA)
- Communication and Awareness (CA)
- Risk Assessment (RA)
- Surveys and Monitoring (SM)
- Legislation and Regulations (LA)
- Training & Capacity Building (TCB)
- Port State Control (PSC)
- Ballast Sediments Management (BSM)
- Incursion Response and Control (IRC)
- Transit Shipping (TA)
- Information management (IA)

The projects contained within the Workplan reflect the needs and priorities of PICTs, as identified through country consultations during the development SRIMP-PAC in early 2005

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Table Two*: SRIMP-PAC Workplan*

Project Area	Project Code & Title	Description	Budget (US$)	Funding source*	Models / Expertise sources	Time-line
Institutional Arrangements (IA)	IA1: Programme Coordination	Undertaken by SPREP Marine Pollution Adviser supported by Invasive Species Officer.	-	Funded separately as SPREP positions with broader responsibilities.		Ongoing
	IA2: Regional Task Force (RTF)	Airfares and DSA for annual meetings of the RTF as outlined in section 2.4.2	50K	IMO ITCP?	IMO-GloBallast	1st meeting 2005. Annual meetings.
	IA3: National Tasks Forces (NTFs)	Regular meetings of the NTF s in each PICT as outlined in section 2.4.2.	-	Internal PICT responsibility.	IMO-GloBallast	1st meeting 2005. Regular meetings
Communication & Awareness (CA)	CA1: SRIMP-PAC web site.	Establish and maintain IMP page on SPREP web site linked to other relevant sites.	20K to establish. Ongoing maintenance by SPREP.	AusAID? NZAID?	IMO-GloBallast	Establish 2005. Ongoing.
	CA2: Pac-Rim Source Port brochures/posters	Develop and distribute awareness materials at Pacific-Rim source ports aimed at preventing uptake of IMPs before departure for PICTs.	50K. to design and develop + ongoing production and distribution (long-term programme).	APEC? Pacific-Rim countries?	IMO-GloBallast	Design and develop late 2005. Ongoing.
	CA3: In-region brochures/posters.	Develop and distribute awareness materials within the region.	50K	AusAID? NZAID?	IMO-GloBallast	Design and develop late 2005.
	CA4: Awareness seminars / workshops	Hold 3 sub-regional awareness seminars / workshops (Micronesia,/Melanesia/Polynesia) based on standard GloBallast and GISP courses.	150K (50K per workshop)	IMO ITCP?	IMO-GloBallast	2nd half 2005

Table Two continued

Project Area	**Project Code & Title**	**Description**	**Budget (US$)**	**Funding source***	**Models / Expertise sources**	**Time-line**
Risk Assessment (RA)	RA1: Overall regional risk assessment.	Carry out an overall ballast water an d hull fouling risk assessment to identify high risk source ports, using environmental similarity as the primary risk factor. Include capacity building of experts from PICTs.	150K	AusAID? NZAID? CIDA?	DAFF CSIRO Cawthron-NZ IMO-GloBallast	1st half 2007
	RA2: Pac-wide DSS Scoping Study	Undertake a scoping study to determine the utility and feasibility of extending the Australian and Canadian ballast water DSS to become a linked Pacific-wide system	70K	AusAID? CIDA? APEC?	DAFF CSIRO Cawthron-NZ TransCanada	1st half 2007
Surveys & Monitoring (SM)	SM1: CRIMP port surveys	Survey 4 high priority ports using the full CRIMP port survey protocols. Include capacity building of experts from PICTs.	240K. (60k per port)	AusAID? NZAID? IMO ITCP? IUCN?	CSIRO NIWA-NZ JCU IMO-GloBallast	2nd half 2007 to 2nd half 2006
	SM2: Bishop Museum surveys.	Survey 4 medium priority reef sites using the Bishop Museum survey protocols. Include capacity building of experts from PICTs.	160K (40K per site)	US sources?	Bishop Museum Univ. of Guam	2nd half 2007 to 2nd half 2008
	SM3: SERC Settling Plates	Establish SERC-style passive settling plates at 4 low priority ports. Include capacity building of experts from PICTs.	80K (20K per port)	US sources?	SERC	2nd half 2007 to 2nd half 2008
	SM4: Regional voucher/reference collection	Establish a regional voucher and reference collection at USP in Fiji to house and manage samples collected from SM1, 2 and 3.	50K to establish	Census of Marine Life? BioNET?	CSIRO NIWA-NZ JCU	1st half 2008
	SM5: Regional IMP taxonomy initiative.	Hold one marine taxonomy training workshop per year for 5 years	250K (50K per workshop)	Census of Marine Life? BioNET?	CSIRO NIWA-NZ JCU Universities.	1st half 2008

Table Two continued

Project Area	Project Code & Title	Description	Budget (US$)	Funding source*	Models / Expertise sources	Time-line
Legislation &Regulations (LA)	LA1: Regional model IMP legislation	Develop regional model IMP legislation consistent with the IMO BW Convention and including the fouling vector.	70K	IMO ITCP? IMO-GloBallast?	IMO-GloBallast SPC RMP	1st half 2008
	LA2: National legislative reviews	Review national legislation in each PICT to assess reforms required to enact and implement the regional model. Include capacity building of national experts.	120K	IMO ITCP? IMO-GloBallast?	IMO-GloBallast SPC RMP	1st half 2008
	LA3: National legislative reforms	Assist each PICT to enact and implement national IMP legislation consistent with the regional model.	120K	SPC RMP?	IMO-GloBallast SPC RMP	
Port State Control (PSC)	PSC1: At-border interdiction enhancement project	Provide institutional strengthening, capacity building and technical assistance in each PICT to implement at-border incursion interdiction arrangements for both ballast water and hull fouling. Includes training of insperctors.	1.5M	AusAID? NZAID? US sources?	DAFF AQIS MAF-NZ USCG	1st half 2007
Ballast Sediments Management (BSM)	BSM1: Ballast sediments review.	Identify and assess those ports in the region where cleaning or repair of ballast tanks occurs, and develop a sediment management plan for each.	50K	IMO ITCP?	Singapore? Rotterdam?	2nd half 2007
Training & Capacity Building (TCB)	TCB1: Develop regional model training course	Adapt the standard IMO-GloBallast and GISP-UNEP marine invasive training courses to a regional model training course suitable for use in the Pacific islands region.	70K	IMO-GloBallast? GISP? China? Singapore?	IMO-GloBallast GISP	2nd half 2006
	TCB2: Deliver regional model training course	Deliver the regional model training course in each sub-region (Micronesia,/Melanesia/Polynesia) (NB. this is separate from and more technically focused than the awareness seminars in CA4). Include training of PICT course deliverers.	180K (60K per workshop)	IMO ITCP?	IMO-GloBallast	1st half 2007
	TCB3: Maritime curriculum IMP module	Adapt the regional model training course as a module for inclusion in the curriculum of regional maritime training institutes through SPC RMP.	50K	IMO ITCP? IMO-GloBallast?	IMO-GloBallast SPC RMP	2nd half 2007

Table Two continued

Project Area	Project Code & Title	Description	Budget (US$)	Funding source*	Models / Expertise sources	Time-line
Incursion Response, & Control (IRC)	IRC1: Regional and national IMP response & control plans.	Develop a regional template for an IMP response and control plan and assist PICTs to develop national plans.	200K	AusAID? NZAID? US sources?	CSIRO DEH NIWA-NZ MAF-NZ	2nd half 2008
Transit Shipping (TS)	TS1: Transit Shipping Assessment	Identify and map the locations in the Pacific where ships report undertaking mid-ocean ballast exchange. Assess with regard to risks posed (or not posed) to PICTs. Should the assessment indicate such high risk zones, consider a process for PICTs to require 'additional measures' in accordance with Regulation C-1 of the IMO BW Convention, and also the possibility of designating PSSAs.	120K	Japan? China? AusAID? NZAID? US sources?	DAFF MAF-NZ USCG CSIRO NIWA-NZ IMO-GloBallast Japan Chile Canada	1st half 2007
Information Management (IM)	IM1: Regional IMP Information System (PAC-IMPIS)	Establish a Regional IMP Information System (PAC-IMPIS) compatible with and linked to the Australian NIMPIS and US NEMESIS and other relevant information systems in the region.	100K to establish. Funds required to maintain.	APEC? AusAID? NZAID?	CSIRO SERC	1st half 2007

*NB as potentially proposed in this consultation draft only - based on 'perceived relevance' to proposed sponsors' experience and interests - subject to agreement by the proposed sponsors - inclusion in this draft table in no way obliges the proposed sponsors.

Table 3: *Differentiation of Initiation vs Ongoing Costs and Regional vs In-country Costs*

Project Area	Project Code & Title	Budget (US$)	One-off	Ongoing	Regional	In-country
Institutional Arrangements (IA)	IA1: Programme Coordination	-				
	IA2: Regional Task Force (RTF)	50K / meeting		x	x	
	IA3: National Tasks Forces (NTFs)	-		x		x
Communication & Awareness (CA)	CA1: SRIMP-PAC web site.	20K to establish. Ongoing maintenance by SPREP.	x		x	
	CA2: Pac-Rim Source Port brochures/posters	50K. to design and develop + ongoing production and distribution (long-term programme).	x		x	x
	CA3: In-region brochures/posters.	50K	x		x	
	CA4: Awareness seminars / workshops	150K (50K per workshop)	x		Sub-regional	
Risk Assessment (RA)	RA1: Overall regional risk assessment.	150K	x		x	
	RA2: Pac-wide DSS Scoping Study	70K	x		x	
Surveys & Monitoring (SM)	SM1: CRIMP port surveys	240K. (60k per port)	x			x
	SM2: Bishop Museum surveys.	160K (40K per site)	x			x
	SM3: SERC Settling Plates	80K (20K per port)	x			x
	SM4: Regional voucher/reference collection	50K to establish	x		x	
	SM5: Regional IMP taxonomy initiative.	250K (50K per workshop)	x		x	

Table 3 continued:

Project Area	Project Code & Title	Budget (US$)	One-off	Ongoing	Regional	In-country
Legislation &Regulations (LA)	LA1: Regional model IMP legislation	70K	X		X	
	LA2: National legislative reviews	120K	X			X
	LA3: National legislative reforms	120K	X			X
Port State Control (PSC)	PSC1: At-border interdiction enhancement project	1.5M		X		X
Ballast Sediments Management (BSM)	BSM1: Ballast sediments review.	50K	X		X	
Training & Capacity Building (TCB)	TCB1: Develop regional model training course	70K	X		X	
	TCB2: Deliver regional model training course	180K (60K per workshop)		X		X
	TCB3: Maritime curriculum IMP module	50K	X		X	
Incursion Response, & Control (IRC)	IRC1: Regional and national IMP response & control plans.	200K	X		X	
Transit Shipping (TS)	TS1: Transit Shipping Assessment	120K	X		X	
Information Management (IM)	IM1: Regional IMP Information System (PAC-IMPIS)	100K to establish. Funds required to maintain.		X	X	

14. Financing & Sustainability Plan

Any Regional Strategy is of limited use if it simply exists as a document and is not actually implemented. This of-course requires adequate financing and resourcing to allow full and effective implementation on an on-going, sustainable basis. Ideally, the implementation of environmental protection and maritime regulatory regimes such as those proposed in SRIMP-PAC, should be self-sustaining and based on the 'user pays' principle.

Further development and finalisation of the Workplan and Budget contained in section 13, and especially Table 3, should include refined differentiation of initiation costs (e.g. conducting an overall regional risk assessment) and ongoing/operational costs (e.g. maintaining a regional information system), as well as refined differentiation of central/regional costs (e.g. for SPREP to undertake its overall Strategy coordination role) from in-country costs (e.g. for Port State Control activities). These differentiations will further assist the development of the financing and sustainability plan.

In 2004 the IMO GloBallast Programme undertook a *Global Review of Self Financing Mechanisms for Ballast Water Management Regimes*. This review identified three basic models for funding and resourcing such regimes, as follows;

- Reliance on external donors through official development assistance.
- The taxpayer of the country pays through government funding.
- The user (shipping industry) pays through port fees, levies or duties.

The review identified a number of examples of 'user pays' systems, including the Californian example where each visiting ship pays a set flat fee to a central ballast water management fund, and an earlier Australian example where visiting ships paid a fee per tonne of cargo carried.

While these funding schemes have proven highly successful in their particular settings, unfortunately, the relatively low volumes of shipping in Pacific island ports are unlikely to make similar approaches viable in the Pacific islands context.

Similarly, given their extremely small, aid-dependant economies, very limited tax bases and numerous competing development priorities, it is highly unlikely that PICT governments would be able to fund IMP control and management programmes from their own government revenues.

This means that effective implementation of SRIMP-PAC is unavoidably dependant on the provision of funding and support from external donors, through bilateral official development assistance (e.g. AusAID, NZAID, USAID, CIDA etc), and multi-lateral technical cooperation programmes such as the IMO-ITCP, GEF and World Bank and regional bodies such as APEC.

Full implementation of all SRIMP-PAC projects as outlined in the Workplan in Section 13 requires a core total budget of US$4.2 million over three years. When considering that this applies to 22 separate countries and territories spread over the world's largest ocean, this is not a particularly large amount of money. The benefits that will accrue in terms of increased protection of coastal and marine resources that form the basis of the livelihoods of Pacific islands peoples, make such an investment highly worthwhile. Extension of an IMP management regime over such a large area of the Pacific will also have major benefits for Pacific-Rim countries, in terms of increased protection of their resources and ecosystems.

Given the extremely small economies of PICTs, the extremely large economies of Pacific-Rim countries (such as the USA, Japan, China, Canada, Australia and the Republic of Korea), and the benefits that will accrue to Pacific-Rim countries from the effective implementation of SRIMP-PAC, Pacific-Rim countries should be approached to fund the Strategy and implementation of its Workplan.

It is also important to explore possible links with other multi-lateral funding initiatives, including three relevant GEF proposals:

- the proposed GEF / SPREP project *Pacific Invasive Species Management*,
- the proposed GEF / GISP project *Building Capacity and Raising Awareness in Invasive Alien Species Prevention and Management*; and
- the proposed GEF / IMO project *Building Regional Partnerships for Effective Ballast Water Control and Management in Developing Countries (GloBallast Partnerships)*

The GloBallast *Partnerships* proposal is of particular relevance, and SRIMP-PAC provides an excellent framework for the implementation of GloBallast activities in the region, including replication of the experiences gained at the GloBallast Demonstration Site in Dalian, China.

NB: The Financing & Sustainability Plan should be further developed based on responses received to this consultation draft from potential donors. These consultations should include seeking funding commitments from donors for specific projects under SRIMP-PAC as contained in Section 13, Table Two, and these funding commitments should be reflected in the final Strategy document.

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Kahoolawe
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http://hbs.bishopmuseum.org/pdf/southshore.pdf

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APPENDICES

Appendix 1: Standard National Measures for Pacific Island Countries and Territories for the Prevention and Control of Shipping-Related Introduced Marine Pests, incorporating:

- Generic hull fouling management template
- Generic ballast water management template

Appendix 2: Vessel Inspection Reporting Form (from NZ Biosecurity Code of Practice for Vessels Operating Around the Sub-Antarctic Islands)

Appendix 3: Draft Australian National Border Biofouling Protocol for Apprehended and Small International Vessels.

Appendix 4: IMO Ballast Water Reporting Form (From A.868(20)).

Appendix 5: Overview of Shipping Vectors of Introduced Marine Species

f) The natural dispersal of species

g) Human-associated vectors

h) Shipping and other vessel's as vectors

i) Fouling as a vector

j) Ballast water and sediments as a vector

Appendix 6: Overview of Shipping and Other Vessel Vectors in the Pacific

g) Transit shipping

h) Regional and domestic shipping

i) Fishing vessels

j) Cruising yachts

k) Ballast water risks in the region

l) Hull fouling risks in the region

Appendix 7: Overview of Introduced Marine Species In the Pacific Islands

h) General

i) Surveys within the region

Appendix 1:

Standard National Measures for Pacific Island Countries and Territories
for the
Prevention and Control of Shipping-Related Introduced Marine Pests

Incorporating:

- *Generic hull fouling management template*
- *Generic ballast water management template*

SPREP / IMO Regional Strategy on Shipping-Related Introduced Marine Pests in the Pacific Islands (SRIMP- PAC)

Standard National Measures for Pacific Island Countries & Territories
Prevention and Control of Shipping-Related Introduced Marine Pests

Standard National Measures:

1. Designate a Lead Agency which has central responsibility within the government for coordinating the national response to Introduced Marine Pests (IMPs). This might be the national maritime administration or environment administration.

2. Form a National Task Force (NTF) to oversee the implementation of these Standard National Measures. The NTF should be inter-ministerial and cross-sectoral in membership, including the government administrations for:
   - maritime & port authorities,
   - environment,
   - fisheries/marine resources,
   - health/quarantine

   plus
   - marine science community,
   - the shipping industry and other main industries (e.g. oil and other bulk exporters),
   - fisheries, aquaculture and coastal tourism industries
   - environmental NGOs.

3. Conduct a national communication and awareness campaign, using materials available from SPREP, IMO and other sources through SRIMP-PAC.

4. Carry out an IMP risk assessment for each port in the country (using standard methodology and support from SRIMP-PAC).

5. Conduct IMP surveys/monitoring in each port in the country (using standard methodology and support from SRIMP-PAC).

6. Link the port surveys and monitoring to an early- warning system, whereby ships in the country's ports can be alerted to outbreaks of harmful species.

7. Address hull fouling risks by implementing the Generic Hull Fouling Management Template (Attachment One).

8. Address ballast water and sediment risks by implementing the Generic Ballast Water Management Template (Attachment Two).

9. Develop a National IMP Incursion Response and Control Plan (using standard methodology and support from SRIMP-PAC).

10. Develop and implement National policy, legislation and regulations on IMPs, using standard methodology and support from SRIMP-PAC, and consistent with the IMO ballast water convention and any developing international regime for hull fouling.

11. Work cooperatively with neighbouring countries and territories and Pacific-Rim countries through the SRIMP-PAC Regional Task Force and other regional mechanisms.

Attachment One: Generic Hull Fouling Management Template

1. Pre-border fouling management measures (incursion prevention)

1.1 Work with Pacific-Rim countries (esp. high risk source ports and Panama Canal authorities) to ensure that vessels (including floating docks, barges and similar vessels) are inspected and cleared as being free of bio-fouling BEFORE leaving those source ports and entering the Pacific islands region.

1.2 Work through SRIMP-PAC to distribute educational and awareness materials to vessel operators and owners (esp. for cruising yachts) at Pacific-Rim source-ports and at Panama Canal, making them aware of the bio-fouling issue and the applicable management regime.

1.3 To address the issue of vessels movements between Pacific countries and territories, implement the 1.1 and 1.2 arrangements within the region.

1.4 Require all vessels registered or operated in the country or territory to have properly applied and maintained anti-fouling systems.

2. At-border fouling management measures (incursion interdiction)

2.1 Implement a system where arriving vessels are inspected for bio-fouling (including hulls and high risk areas such as seachests, anchors chains and lockers and fishing equipment), before being granted pratique / clearance to enter port.

2.2 If unacceptable fouling is detected, enact response measures as outlined in the *Draft Australian National Border Bio-fouling Protocol for Apprehended and Small International Vessels* (see Appendix 3 of SRIMP-PAC Strategy). This may involve removal from the water and cleaning on-shore for smaller vessels, and sending larger vessels out to deep oceanic water for in-water cleaning and further inspection before clearance to enter port.

2.3 Ban in-water cleaning of vessel hulls within coastal waters.

2.4 Require that any biological material removed from vessels in drydocks, on slipways or while careened ashore be disposed of by burial in approved facilities ashore, and ban the disposal of such material below the high water mark.

(NB. such measures require legislative / regulatory backing as well as training and capacity building of Port State Control inspectors and other personnel in PICTs, as outlined in the SRIMP-PAC Strategy).

Attachment Two: Generic Ballast Water Management Template

1. Pre-border ballast management measures (incursion prevention)

1.1 Work with Pacific-Rim countries (esp. high risk source ports) to ensure that they have IMP survey and monitoring programmes in place in their ports, as well procedures for alerting ships to outbreaks of potentially harmful species, so as to minimize the chances of vessels taking-up organisms during ballasting, BEFORE leaving those source ports and entering the Pacific islands region.

1.2 Work through SRIMP-PAC to distribute educational and awareness materials to vessel operators and owners at Pacific-Rim source-ports, making them aware of the ballast water issue and the applicable management regime.

1.3 Require all relevant ships seeking to enter your ports, and all vessels registered or operated in the country or territory, to comply with the IMO BW Convention, including carrying and implementing a shipboard Ballast Water Management Plan and undertaking ballast water exchange at sea and/or other management practices, in accordance with Regulations B-3, D-1 and D-2 of the Convention.

1.4 Provide ships' crews with training in ballast water issues (through national maritime training academies and consistent with the training component of SRIMP-PAC).

2. At-border ballast management measures (incursion interdiction)

2.1 Request arriving ships to submit Ballast Water Reporting Forms (IMO template), establish a national information system for these, and provide the data to the regional information system established under SRMP-PAC.

2.2 During Port State Control (PSC) inspections, review the ships' onboard Ballast Water Management Plan, Ballast Water Record Book and other relevant documentation, using techniques provided to PSC inspectors through the SRIMP-PAC capacity-building project.

2.3 Where concerns arise, sample the ballast water of ships calling at your country's ports, using techniques provided to PSC inspectors through the SRIMP-PAC capacity-building project, and consistent with the IMO BW Convention and relevant guidelines.

2.4 Where relevant ships have not complied with 1.3 above, require them to sail to oceanic water greater than 200m deep and undertake complete ballast exchange prior to discharging ballast in port.

3. Ballast tank sediments

3.1.1 If the country/territory has ports and terminals where cleaning or repair of ballast tanks occurs, develop a ballast tank sediment management plan for each. While the BW Convention requires that such sediments should be disposed of at approved reception and treatment facilities on-shore, this may not be feasible or environmentally desirable in small Pacific island countries. The sediment management plans may therefore provide for disposing of ballast sediments in offshore waters deeper than 200m.

(NB. such measures require legislative / regulatory backing as well as training and capacity building of Port State Control inspectors and other personnel in PICTs, as outlined in the SRIMP-PAC Strategy).

Appendix 2:

Vessel Inspection Reporting Form (from NZ Biosecurity Code of Practice for Vessels Operating Around the Sub-Antarctic Islands)

VESSEL INSPECTION REPORTING FORM (SUBANTARCTIC ISLANDS)

Please send reporting form and preserved samples to: FREEPOST *UNDARIA*, Vessel Inspection Programme, C/o Incursion and surveillance technical advisor—marine), Biosecurity New Zealand, PO Box 2526, Wellington.

Name of inspecting diver(s):

Date Inspected:

Location where Inspected:

Vessel Name:

***Undaria* found (please tick)** **Yes** ☐ **No** ☐

COMPLETE ONLY IF *UNDARIA* FOUND

Region of Hull where *Undaria* found (please tick)

Bow (bulb and stem)	☐
Transom	☐
Rudder and/or propeller	☐
Anodes	☐
Keel	☐
Port Fore Quarter	☐
Port Mid Section	☐
Port Aft Quarter	☐
Starboard Fore Quarter	☐
Starboard Mid Section	☐
Starboard Aft Quarter	☐

Notes:

Appendix 3:

Draft Australian National Border Biofouling Protocol for Apprehended and Small International Vessels(Source: DAFF)

Draft Australian National Border Bio-fouling Protocol for Apprehended and Small International Vessels

The protocol:

1. The port of entry (Schedule A) is notified of incoming apprehended vessels and small international vessels.

2. A risk assessment is undertaken while the vessel is at a suitable identified location within a proclaimed port (guidelines outlined in Attachment 1). The following factors will determine the biofouling risk associated with entry of the vessel:

    - inspection of anchor well, strainers, etc and other equipment in contact with seawater;
    - inspection of the vessel hull and sea chest if applicable or acceptable documentation/declaration of current, effective antifouling; and
    - inspection and/or assessment of internal seawater systems, including pipe work.

3. All of the following conditions must be met in order for the vessel to be deemed low risk and issued with a certificate of pratique:

    - the anchor well, strainers, etc and other equipment are free of fouling material; and
    - the vessel is voluntarily slipped and cleaned, or has acceptable evidence of being slipped and cleaned within the appropriate time frame, or has acceptable evidence of effective antifouling; and
    - the inspection and/or acceptable treatment of internal seawater systems has been completed;

4. In the event that not all of the conditions (as in 3 above) have been met, further assessment through a visual inspection (e.g underwater camera inspection of the hull) and/or treatment may be required.

5. The level of biofouling should be assessed against the following:

    - clean or slime (primary fouling) layer only, or
    - not clean or secondary fouling of hull.

6. In the event that the level of hull fouling would be deemed as i), ie 'clean' for the purposes of this protocol, then the vessel is deemed low risk and permitted entry.

7. In the event that the hull fouling is rated as ii), ie 'not clean' or 'fouled' for the purposes of this protocol, then the vessel will need to be slipped at the closest suitable facility as soon as possible to be assessed for appropriate action:

    - Small international vessels would be subject to one of three options:
        i. Cleaned and/or treated at owners expense, or
        ii. Refused entry, or
        iii. Impounded at a suitable location;

    - Apprehended vessels deemed to be high risk would be subject to one of three options at the discretion of the apprehending authority:
        i. Cleaned and/or treated at the expense of the apprehending authority,
        ii. Destroyed at the expense of the apprehending authority, or

iii. Returned to its port of origin (this option is only valid with respect to foreign fishing vessels in the rare instance that evidence collected by the apprehending authority is deemed to be potentially insufficient to achieve a prosecution).

iv. If an apprehended vessel is to be destroyed then it must be done under the relevant legislation. An apprehended vessel may be disposed of at sea, either by burning or dumping the vessel in an approved area.

Note: To date this option has had difficulties due to the lack of ability to contain debris created during destruction and/or the preparation required to meet the criteria of permits granted by Department of Environment and Heritage.

Appendix 4:

IMO Ballast Water Reporting Form (from A.868(20))

Can be downloaded from http://globallast.imo.org/guidelines

NB. Once the IMO BW Convention enter-into-force this Reporting Form will be superceded by the requirements of the Convention. Under the Convention the ship-board recording format for ballast water information will be the Ballast Water Record Book and the Ballast Water Management Plan as required under the Convention. However, until entry-into-force of the Convention, the IMO BW Guidelines (A.868(20)) remain applicable.

A requirement for ships visiting Pacific island ports to submit completed Reporting Form to PSC authorities, constitutes one of the most useful, fundamental starting points for PICTs to begin to address the ballast water issue, providing basic, essential information to allow characterisation of the issue and risk assessment.

BALLAST WATER REPORTING FORM (TO BE PROVIDED TO PORT STATE AUTHORITY UPON REQUEST)

1. VESSEL INFORMATION **2. BALLAST WATER**

Vessel Name:	Type:	IMO Number:	Specify Units: m³, MT, LT, ST
Owner:	GT:	Call Sign:	Total Ballast Water on Board:
Flag:	Arrival Date:	Agent:	
Last Port and Country:		Arrival Port:	Total Ballast Water Capacity:
Next Port and Country:			

3. BALLAST WATER TANKS BALLAST WATER MANAGEMENT PLAN ON BOARD? YES_____ NO_____ IMPLEMENTED? YES_____ NO_____

TOTAL NO. OF TANKS ON BOARD _____ NO. OF TANKS IN BALLAST_____ IF NONE IN BALLAST GO TO NO. 5

NO. OF TANKS EXCHANGED _____ NO. OF TANKS NOT EXCHANGED _____

4. BALLAST WATER HISTORY: RECORD ALL TANKS THAT WILL BE DEBALLASTED IN PORT STATE OF ARRIVAL; IF NONE GO TO NO. 5

Tanks/Holds (list multiple sources/tanks separately)	BW SOURCE				BW EXCHANGE : circle one: Empty/Refill or Flow Through					BW DISCHARGE			
	DATE dd/mm/yy	PORT or LAT. LONG	VOLUME (units)	TEMP (units)	DATE dd/mm/yy	END POINT LAT. LONG.	VOLUME (units)	% Exch.	SEA Hgt. (m)	DATE dd/mm/yy	PORT or LAT. LONG.	VOLUME (units)	SALINITY (units)

Ballast Water Tank Codes: Forepeak=FP, Aftpeak=AP, Double Bottom=DB, Wing=WT, Topside=TS, Cargo Hold=CH, O=Other

IF EXCHANGES WERE NOT CONDUCTED, STATE OTHER CONTROL ACTION(S) TAKEN: _____

IF NONE, STATE REASON WHY NOT: _____

5. IMO BALLAST WATER GUIDELINES ON BOARD (RES A.868(20))? YES_____ NO_____

RESPONSIBLE OFFICER'S NAME AND TITLE (PRINTED) AND SIGNATURE _____

Appendix 5:

Overview of shipping vectors of introduced marine species

Overview of shipping vectors of introduced marine species

a) The natural dispersal of marine species

Over the past millennia, marine species have dispersed throughout the oceans by natural means, carried by currents, ocean surface winds and attached to floating logs and debris (Figure A5-1). Natural barriers, including environmental barriers such as temperature and salinity regimes and physical barriers such as landmasses, have prevented many species from dispersing into certain areas. This has resulted in the natural patterns of biogeography observed in the oceans today.

In particular, the pan-global tropical zone has separated the northern and southern temperate and cold-water zones. This has allowed many species to evolve quite independently in these latter zones, resulting in quite different marine biodiversity between the north and the south.

In tropical areas, including the Pacific islands, marine species have not faced the same barriers. This is exemplified by the relatively homogenous marine biodiversity spanning the huge area of the Indo-Pacific, from the east coast of Africa to the west coast of South America (Figure A5-2). The main barriers to species dispersal in the Pacific include physical distance and organism survival times.

As ocean currents, climatic conditions and other environmental conditions change over time, and as species evolve, the natural patterns of dispersal and the resulting patterns of biogeography and bi-diversity also change, as part of a larger, ever-changing global eco-system.

In the Pacific, marine biodiversity for almost all taxa, from the largest mangrove trees to the smallest invertebrates, shows a general decrease in the number of species as one moves eastwards from the epicentre of coral reef evolution in South East Asia, as exemplified by the coral species diversity contours in Figure A5-2 (Veron 1998).

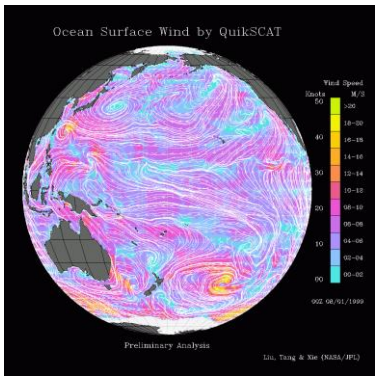

Figure A5-1: *Ocean surface winds and circulation for the Pacific Ocean, an example of natural phenomena which along with other factors such as ocean currents, influence the natural dispersal of marine species (Source: IOC - GOOS).*

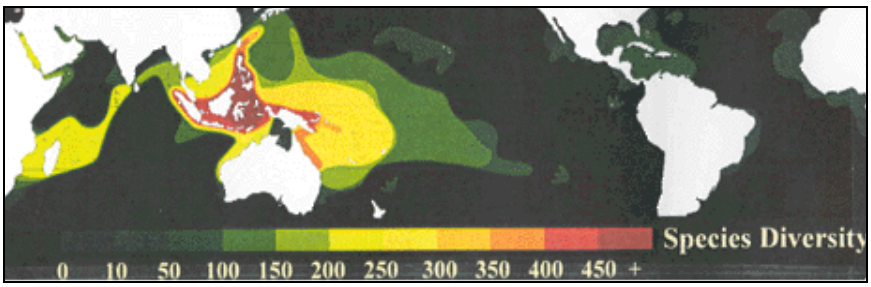

Figure A5-2: *An example of natural bio-diversity and bio-geography in the Pacific, in this case for corals (Source: Veron 1988).*

b) Human-associated vectors

Humans have of course aided the process of species dispersal for as long as they have moved from place to place and sailed across the seas. Historically, human mediated dispersal of marine species has been mainly through their attachment to the hulls of vessels. Over time, maritime activities via which aquatic species can be transferred to new areas have continued to expand. In modern times these include:

- canal developments - opening 'transfer corridors' through which species can invade new areas (e.g. the Suez canal),
- the escape or release of species from private and public aquaria,
- intentional and accidental introductions for fisheries and aquaculture purposes,
- the movement of vessels between water bodies by land-transport (e.g. private recreational craft on trailers),
- species range expansion due to global climate change from the burning of fossil fuels (e.g. the spread of tropical species into the Mediterranean),
- floating marine debris (e.g. discarded/lost fishing gear and plastics),
- the movement of marine structures such as drilling platforms and floating-docks; and
- shipping.

Given the focus of SRIMP-PAC on shipping-related vectors, only these will be considered further in here. For the purposes of SRIMP-PAC, marine structures such as drilling platforms and floating-docks are included.

c) Shipping and other vessels as vectors

Modern shipping presents an array of opportunities for species to be transported to new environments, which may be grouped into four main categories; ship-borne water, fouling, ship-borne sediments and bio-films, as outlined in Table A5-1 and Figure A5-3. Fouling and ships' ballast water and sediments are considered to be the major shipping-related vectors.

Table A5-1: *Ship-based vectors for the transfer of aquatic species.*

Ship-borne Water	Fouling	Ship-borne Sediments	Bio-film
▪ Ballast water. ▪ Bilge water. ▪ Engine cooling water. ▪ Propeller shaft cooling water. ▪ Fire-control water. ▪ Sanitary system water. ▪ Chain locker water. ▪ Incidental water (e.g. deck wash).	▪ Hull fouling. ▪ Sea chest/ water intake fouling. ▪ Internal pipe fouling. ▪ Anchor and chain fouling. ▪ Propeller shaft fouling.	▪ Ballast tank sediments. ▪ Bilge sediments. ▪ Chain locker sediments.	▪ Ballast tank surfaces. ▪ Bilge surfaces. ▪ Internal pipe surfaces.

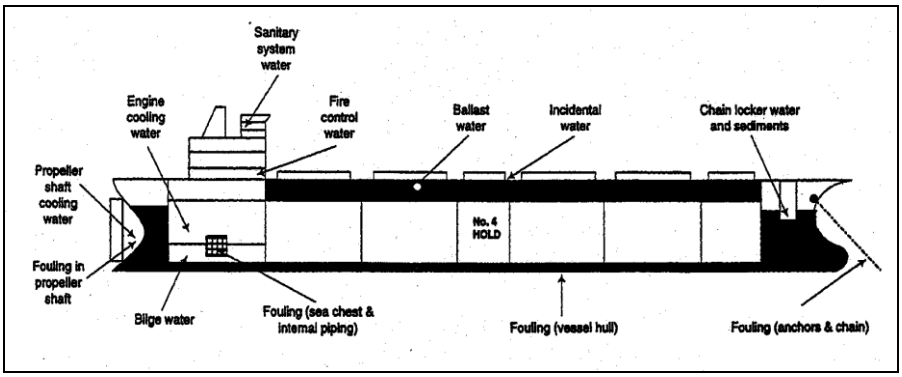

Figure A5-3: *Some ship-based vectors for the transfer of aquatic species (Source: AQIS)*

d) Fouling as a vector

Fouling assemblages develop on the submerged surfaces of commercial and private vessels (for comprehensive reviews refer to AMOG Consulting (2002). All marine vessels are potential vectors for the transfer of fouling species as they have surfaces beneath their water lines upon which such species can settle. These include the relatively smooth and exposed surfaces of the vessel's hulls as well as various 'nooks and crannies' or niche areas such as water intakes and outlets and areas around propellers and rudders, which provide more complex habitat and increase the survivability of certain fouling species (Figure A5-3).

Over the last 60 years or so highly effective anti-fouling paints and other anti-fouling systems have been developed that can significantly reduce bio-fouling on vessels, driven primarily by the desire of the military and commercial shipping to reduce drag and improve fuel efficiency. Despite such efforts, DAFF (2001) found that hull fouling continues to be a major vector for the translocation of marine organisms and considered fouling to pose a risk as high or even higher than ballast water. Evidence supporting this conclusion can was summarised by DAFF (2001) as follows:

- Most cargo vessels, including those with well-maintained antifouling paint systems, continue to carry fouling organisms in unprotected niches such as around rudders and propellers, on intake grates and in sea-chests, and on docking support strips.

- The antifouling effectiveness of a coating diminishes between dockings, and hull surfaces can be significantly fouled towards the end of their inter-docking cycle, or if coatings fail prematurely.

- Recreational yachts and other vessels stationary for extended periods of time foul relatively rapidly.

- Not only attached organisms, but also epibenthic species such as crabs and other mobile crustacea, worms, molluscs, echinoderms and fish, can be carried on hulls associated with fouling growth, or in protected areas such as sea chests.

- A single fertile, fouling organism has the potential to release many thousands of eggs, spores or larvae into the water with the capacity to found new populations, and that changes in environmental conditions occurring close to, or in a new port can stimulate egg, spore or larval release.

The fouling factor is additionally compounded by the fact that many anti-fouling paints are based on highly toxic (and therefore highly effective) organo-tins and copper substances such as Tributyl-Tin (TBT). Concerns about the toxicity of these substances has caused some countries to ban there use and culminated in the adoption of the International Convention on Antifouling Systems (AFS Convention) by IMO member States in 2001, which bans their use internationally (this Convention has not yet entered into force internationally). There are concerns that alternative anti-fouling systems may not be as effective as the organo-tin based paints, and that the rate of fouling-mediated marine bio-invasions may therefore begin to increase.

Fouling can be a more significant vector on vessels that have less of a commercial or military imperative to maintain operational and fuel efficiency, especially smaller private vessels, yachts and even fishing vessels, on which antifouling efforts may be less rigorously applied.

Ocean going cruising yachts and modern fishing vessels can also be significant vectors for the transfer of marine species. Ocean going cruising yachts often spend extended periods anchored or moored in specific locations, where they may accumulate hull fouling assemblages, which may then be transported to new areas. It is not uncommon for ‘yachties’ to clean their hulls in-water, using a brush and/or scraper while on SCUBA or snorkel, thereby causing any foreign species attached to their hulls to be dislodged into the surrounding environment.

In addition to hull fouling, fishing vessels can also transfer marine species entrapped in their fishing gear, including nets, traps, floats, bouys, ropes and lines.

A significant source of fouling transfers is believed to be the movement of marine structures such as drilling platforms, dumb-barges, pontoons and floating-docks. These can spend extended periods anchored or moored in specific locations, where they may accumulate hull fouling assemblages (Figure A5-4). When transported to new areas, the voyage can last extended time periods (weeks/months), thereby allowing some species to adapt to any environmental gradients encountered during the voyage, and for new species to join the fouling community

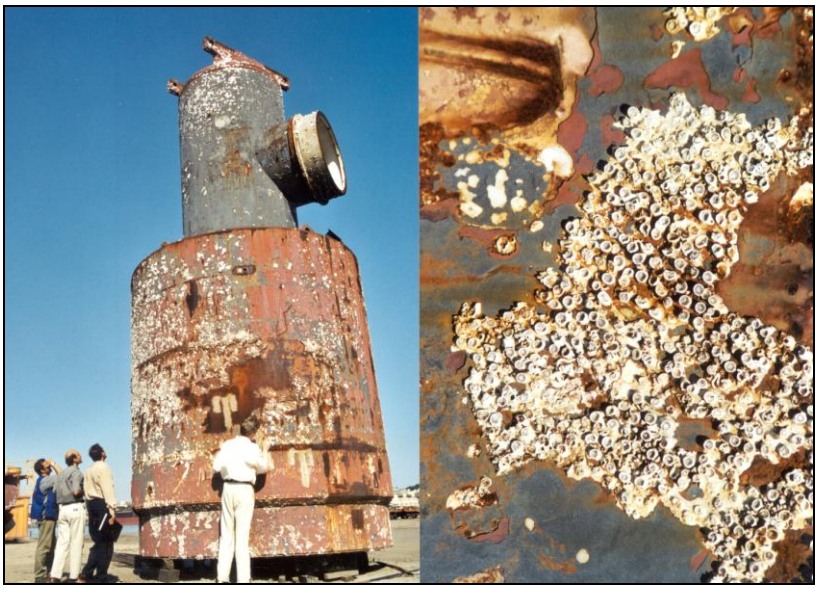

Figure A5-4: *Examples of fouling species on floating infrastructure associated with offshore industries (Source: S Raaymakers).*

e) Ballast water and sediments as a vector

Modern shipping cannot operate without ballast water, which provides balance and stability to un-laden ships. When a ship is empty of cargo, it fills with ballast to maintain stability, trim and structural integrity. The ballast is discharged when the ship loads cargo (Figures A5-5 & A5-6).

A potentially serious environmental problem arises when this ballast water contains aquatic life. There are thousands of aquatic species that may be carried in ships' ballast water; basically anything that is small enough to pass through ship's ballast water intake ports and pumps. These include bacteria and other microbes, micro-algae, small invertebrates and the eggs, spores, seeds, cysts and larvae of various aquatic plant and animal species.

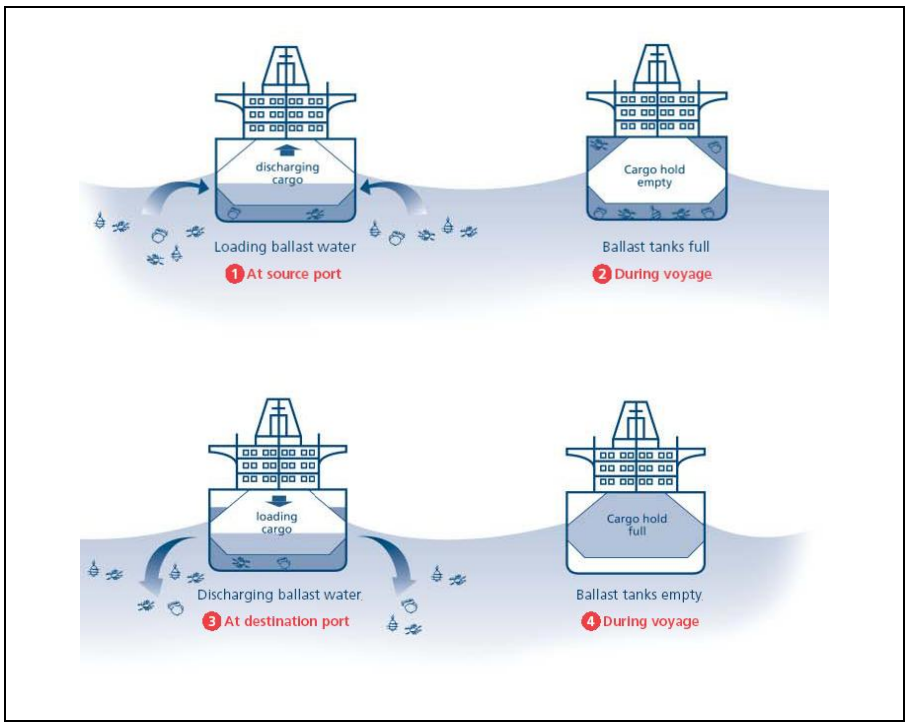

Figure A5-5: *The ballast water cycle (Source: GloBallast Programme, IMO).*

Figure A5-6 *Routine ballast water discharges from bulk carrier in port (Source: CSIRO Australia)*

The problem is compounded by the fact that virtually all marine species have life cycles that include a planktonic stage or stages. Even species in which the adults are unlikely to be taken on in ballast water, for example because they are too large or live attached to the seabed, may be transferred in ballast during their planktonic phase (Figure A5-7).

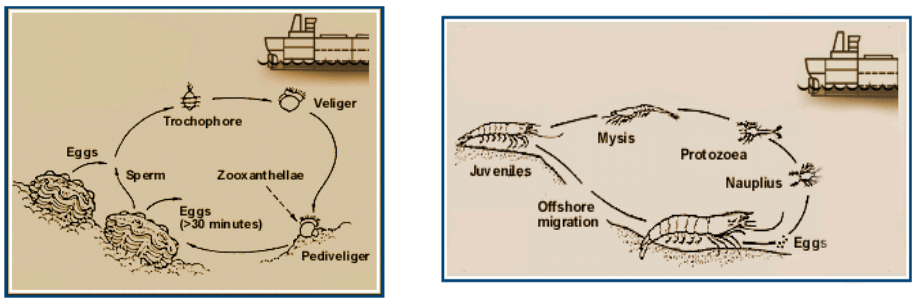

Figure A5-7: *Clam and prawn life cycles showing examples of planktonic stages that can be entrained when a ship takes on ballast water (Source: GloBallast Programme, IMO).*

As a result, it is estimated that at least 7,000 to possibly more than 10,000 different species of marine microbes, plants and animals may be carried globally in ballast water each day (Carlton 1999).

The commencement of the use of water as ballast, and the development of larger, faster ships completing their voyages in ever shorter times, combined with rapidly increasing world trade, means that the natural barriers to the dispersal of species across the oceans are being reduced. In particular, ships provide a way for temperate marine species to pierce the tropical zones, and some of the most spectacular introductions have involved northern temperate species invading southern temperate waters, and vice versa.

A compounding aspect of the ballast water vector, are the sediments which accumulate in ships' ballast tanks (Figure A5-8), thereby providing additional habitat for certain species and increasing the chances of species transfer, even when management measures such as ballast water exchange at sea, have been applied during a voyage.

Figure A5-8: *Sediments accumulated in a ship's ballast tank (Source: D Oemcke).*

Appendix 6:

Overview of shipping and other vessel vectors in the Pacific

Overview of shipping and other vessel vectors in the Pacific

The Pacific islands have an extremely rich maritime heritage. The islands themselves were first populated by what are arguably the greatest mariners in human history. Originating from South East Asia, in pre-European times the fore-fathers of the Melanesians, Micronesians and Polynesians navigated wooden canoes held together with coconut fibre, across thousands of miles of open-ocean, with nothing but the stars and their intimate knowledge of the sea to aid navigation. They brought with them a number of terrestrial plant and animal species, including coconuts, taro, bananas, pigs, chickens, dogs and rats, which they introduced to nearly every island throughout the region. Undoubtedly, various marine species would have also been carried inadvertently, attached to the hulls of their wooden canoes.

There are also the epic voyages of European exploration, with seafarers such as Magellan, Tasman, Cook and Bligh carving their places into history with their own outstanding feats of navigation, followed by the 'invasion' of the Pacific by European and American whalers, missionaries and colonists in the 18 and 19ththcenturies. Their wooden-hulled sailing ships would also have transferred various fouling and boring marine species into and throughout the region. World War II heralded another major section in maritime history. The largest naval battles ever fought took place in the Pacific, and the mass movement of all types of naval and supply vessels throughout the region would again have provided vectors for the introduction and transfer of marine species.

In modern times, as island States located within the world's largest ocean, the Pacific islands are overwhelmingly dependant on shipping for economic survival. The Strategy and Workplan of the Pacific Ocean Pollution Prevention Programme (PACPOL), published by SPREP in 1999 (and under which this SRIMP-PAC Strategy is being developed), groups shipping in the region into the following broad categories:

- Transit shipping: Ships which pass through the region without stopping, en-route to other destinations.
- International shipping (as distinct from transit shipping): Ships calling at the major ports of the region from outside the region, either with incoming cargo or tourists (cruise ships) or to take out exports.
- Regional shipping: Ships trading (both cargo and passengers) between the countries and territories within the region.
- Domestic shipping: Ships trading (both cargo and passengers) within each country in the region.
- Foreign fishing fleet: Fishing vessels from distant water fishing nations operating within the region.
- Domestic fishing fleet: Fishing vessels from the Pacific islands themselves.
- Miscellaneous: Special purpose vessels such as warships, research vessels, tourist vessels and private yachts and pleasure and fishing craft.

Under PACPOL, in 2003 SPREP published a *Marine Pollution Risk Assessment* for the region (Anderson et al 2003). This comprehensive study clearly describes and maps shipping lanes, including types and tonnage of cargo carried and frequency of voyages. Overall shipping patterns in the Pacific islands region can be summarized from Anderson et al (2003).

a) Transit shipping

Ships transiting through the Pacific islands involve larger ships, including tankers, bulk carriers and container ships, trading between the Americas and Asia/Australia/New Zealand (Figure A6-1). This Figure clearly shows the main shipping lanes eminating from the Panama Canal, identifies Hawaii as a major hub and illustrates the significant shipping that transits western Melanesia and Micronesia enroute between Australia/ New Zealand and Asia. Such transit shipping may have implications for marine bio-invasions in the Pacific islands (see section 12).

b) International shipping

International trade in manufactured products and small loads of agricultural products and other raw materials were once shipped mainly in small break-bulk freighters. Over the past 20 years, these have been replaced by larger container liners of about 20,000 Gross Tonnes (GT) traveling scheduled routes between continental ports with calls at major island distribution centers (Forsyth and Systo 1999; Heathcote 1996; CIA 2001).

The movement to standardised containers has brought increased efficiency and dependability of service, but container liners only call at appropriately-equipped larger ports in the region, where there is sufficient volume to make a stop economic. This has implications for the transfer of species, especially via ballast water (see below).

The major commercial influences in the Pacific Islands are Australia and New Zealand. Shipping services to/from these countries are often integrated with east-west long distance routes to North America, Europe and South Asia. Trade linkages to the USA are strongest in the North Pacific (all of the ex-UN Trust Territories of Micronesia) and in American Samoa. French influence is strong in French Polynesia, New Caledonia and Wallis and Futuna. The second major axis of maritime trade is north/south, with connections northward to Hong Kong, Taiwan, Korea and southward through the Pacific Islands to New Zealand.

These patterns have important implications for marine bio-invasions in the Pacific islands, determining the source ports where invasive species may originate from and the ports within the region where they may be introduced. Figure A6-2 shows total vessel traffic by frequency in the Pacific islands region.

c) Regional & domestic shipping

Regional freight or mixed passenger/freight vessels may carry a limited number of containers to remote islands. Distances may be very large, even among the islands of a single nation. Many of the vessels in local and regional service are old and in poor repair, largely because revenues can seldom support new construction. The average age of all ships registered in, and owned by nationals of the Small Island Developing States was 18.3 years in 1995 (UNEP

1996). Older vessels may be less well maintained, which may have implications for hull fouling as a vector. Figure A6-2 includes regional and domestic shipping routes in the Pacific islands region.

d) Fishing vessels

A large number of foreign fishing vessels operate in the Pacific islands region, including pole-and-line, long liners and tuna purse seiners, from distant water fishing nations (China, EU, Japan, South Korea, Philipines, Taiwan and USA). These tend to focus their fishing activities in areas with higher tuna concentrations (Figures A6-3 & A6-4) , and base at specific ports in the region, including several ports in PNG, Pago Pago in American Samoa, Honiara in the Solomon islands, Tarawa in Kiribati, Funafuti in Tuvalu and most of the Micronesian ports.

The patterns of distribution of domestic fishing vessels are less clear, but these are less likely to pose a problem in relation to transferring invasive species, as they tend to operate within restricted areas closer to shore.

e) Cruising yachts

Cruising yachts are a major feature of maritime traffic in the Pacific islands region, with many modern-day 'adventurers' setting out in yachts from the west coasts of Canada and the US and from Australia and New Zealand each year, to 'discover' their own Pacific island paradise. Major points of departure on the American west coast are Vancouver, Seattle, San Francisco (a highly invaded site), Los Angeles and San Diego. Source ports in Australia are primarily the east coast ports (including tropical ports in the north with similar environments and species to the Pacific islands) and in New Zealand yachts depart for the Pacific islands primarily from northern ports (Aucklannd, Whangarei). Yachts also arrive in the Pacific from Europe and the American east coast via the Caribbean and Panama Canal (the Caribbean contains many species that may become invasive in the Pacific islands, e.g. the black striped mussel *M. sallei* is believed to have been introduced to Fiji and northern Australia on yachts from the Caribbean, although it is believed to have been successfully eradicated in Australia).

The sailing season coincides with the period of South East trade winds from April to September, and avoids the cyclone period from October to March. While ocean-going cruising yachts range all over the region, larger numbers may concentrate at favourite destinations with special attractions, safe harbours and/or good re-supply facilities; including Papaette in Tahiti, Rarotonga in the Cook Islands, Pago Pago in American Samoa, Vavau in Tonga, Suva in Fiji and Port Vila in Vanuatu. Several isolated, pristine islands are also favoured destinations, such as Suwarrow in the Cook Islands. Cruising yachts are of particular concern in relation to the transfer of fouling species (see below).

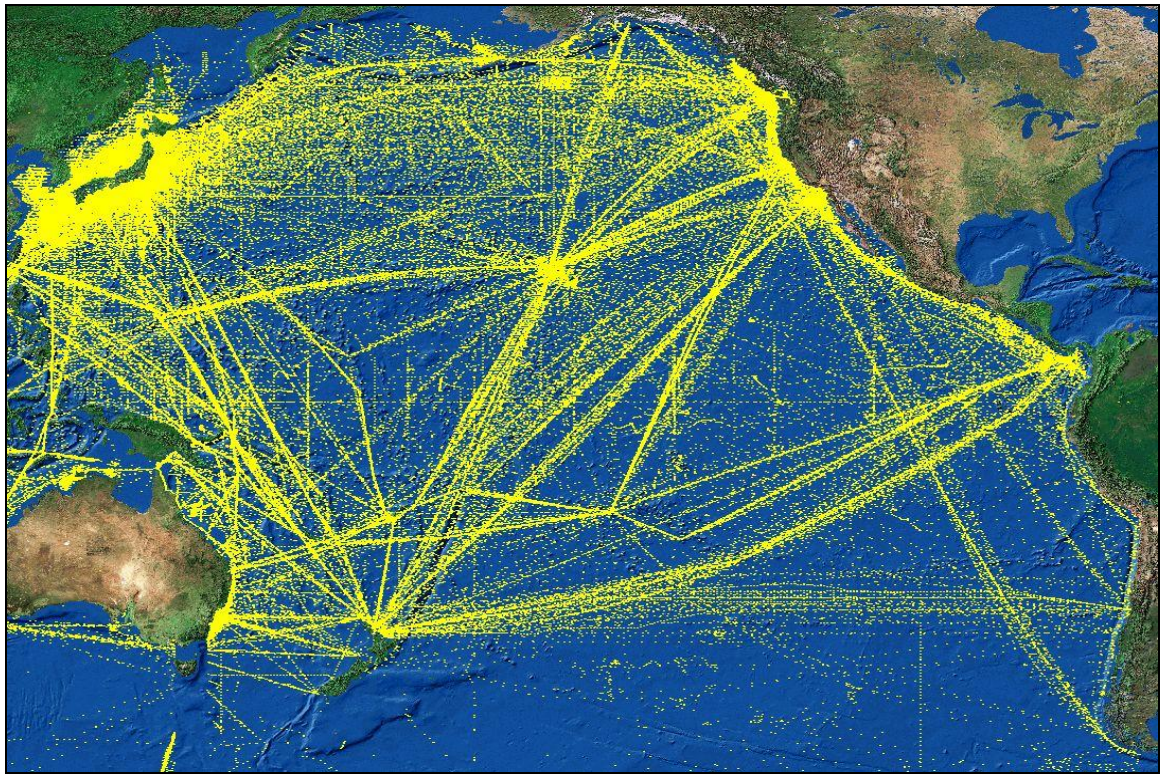

Figure A6-1: *Overall shipping routes in the Pacific, including ships transiting the Pacific Islands region on voyages between Pacific-Rim countries, as recorded by actual reported ship positions (Source: SPREP - PACPOL).*

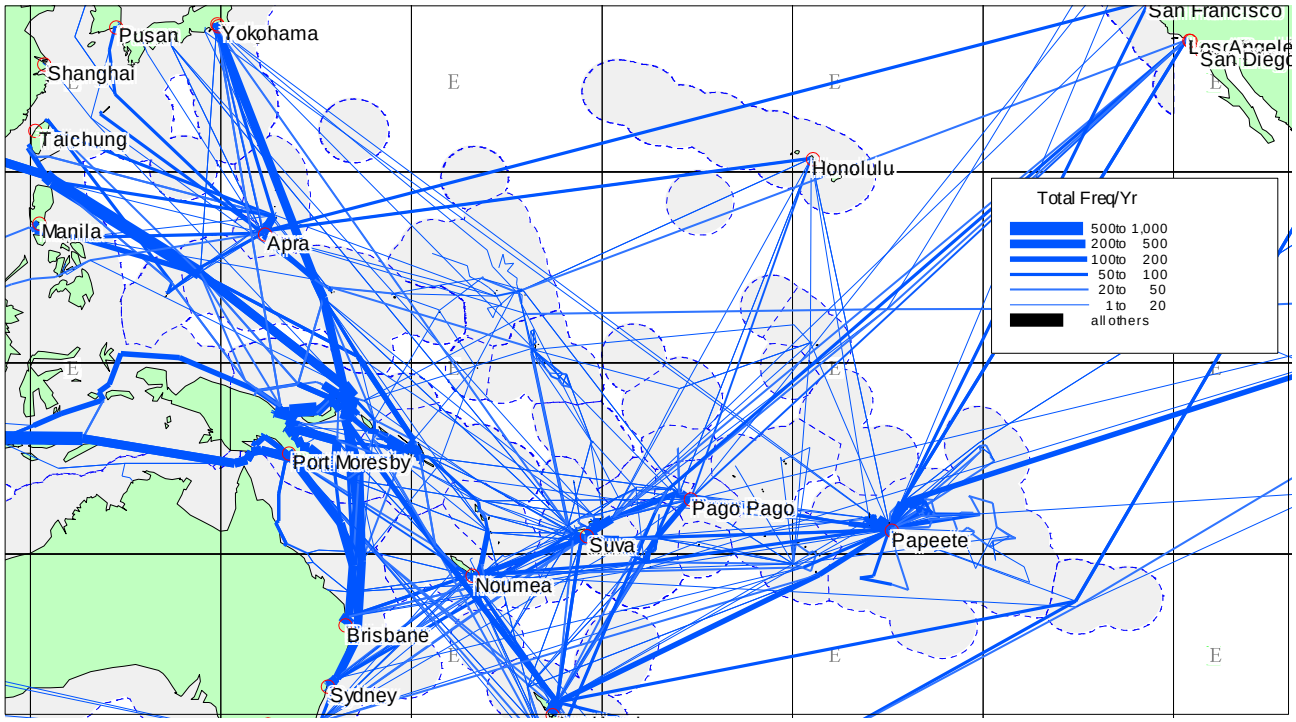

Figure A6-2: *Total vessel traffic by frequency in the Pacific islands region (Source: Anderson et al 2003)*

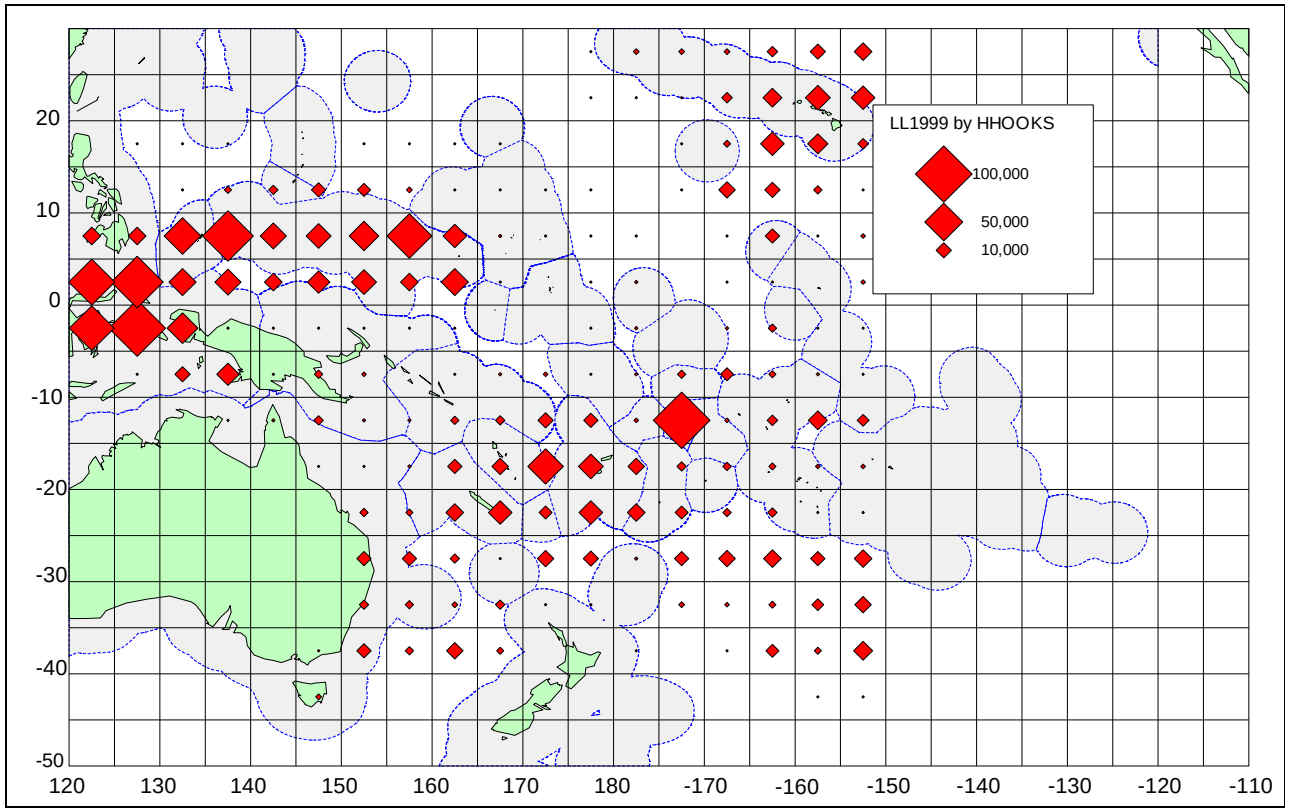

Figure A6-3: *Fishing effort by longline tuna vessel 1999(Source: Anderson et al 2003)*

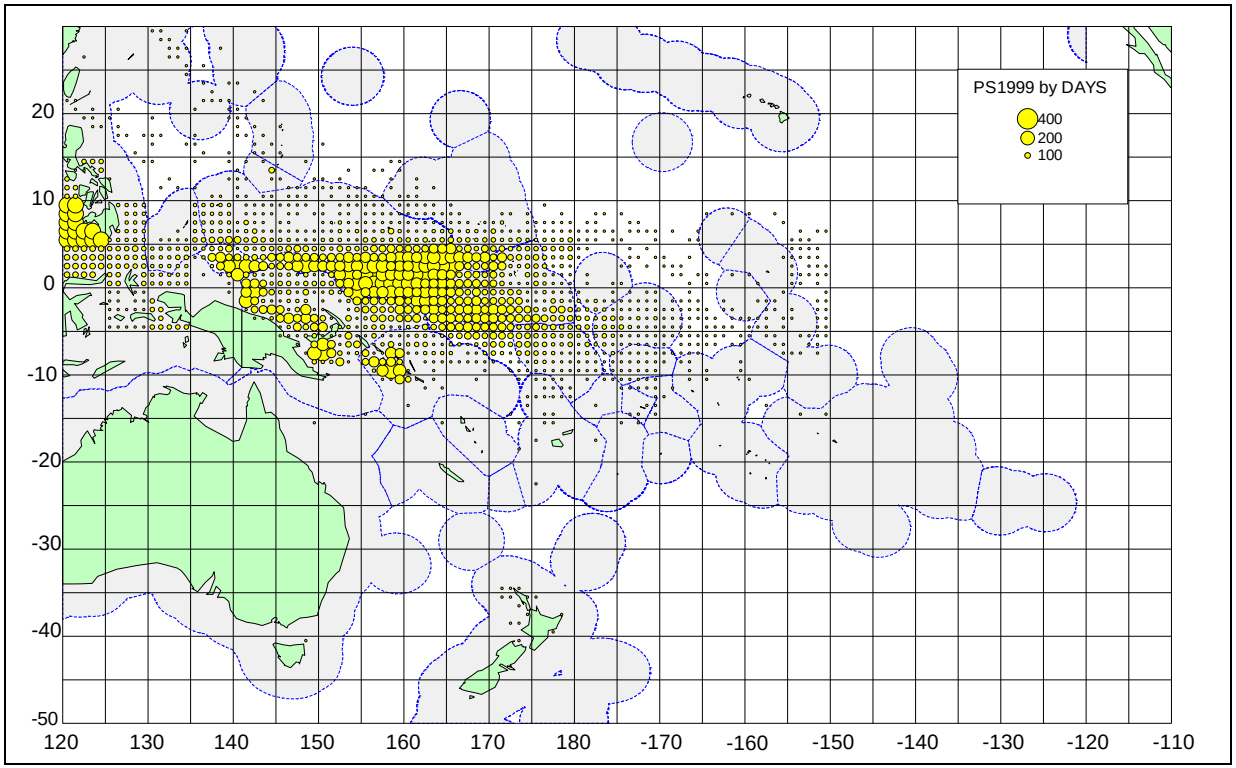

Figure A6-4: *Fishing effort by purse seine tuna vessels1999 (Source: Anderson et al 2003)*

f) Ballast water risks in the region

A risk assessment of ballast water coming into the Pacific islands region has not been carried out, nor for any country or port within the region, and is one of the actions proposed in this Strategy (see section 10.2). However, the information on shipping and other vessel vectors in the Pacific presented above allows a general picture of ballast water risks to be gained, as follows:

- There are a number of bulk export ports in the region that receive / have received frequent and relatively large volumes of ballast water discharges (Figure A6-5), these being:
  - several timber and bulk-ore export ports in PNG;
  - the Kumul crude oil export terminal in PNG,
  - timber export ports in the Solomon Islands,
  - sugar, molasses, woodchip and timber export ports in Fiji (Lautoka and Labasa),
  - the phosphate export facility in Nauru, and
  - the nickel export facility in New Caledonia;

- Regional hub-ports in the region frequently receive and export 'packets' of ballast water from transshipment of break-bulk cargo, containers and petroleum products (Figure A6-5). These include, *inter alia*:
  - Port Moresby and Rabaul in PNG,
  - Honiara in the Solomon Islands,
  - Port Vila in Vanuatu,
  - Suva in Fiji,
  - Apia in Samoa,
  - Pago Pago in American Samoa,
  - Nukualofa in Tonga,
  - Papaette in Tahiti,
  - Tarawa in Kiribati,
  - Apra in Guam,
  - Majuro in the Marshall Islands,
  - Phonpei, Chuk and Yap in the Federated States of Micronesia, and
  - Koror in Palau.

Figure needs to be developed and inserted

Red dots = bulk export ports that receive relatively large volumes of ballast from set source ports (see list above)

Blue dots = regional hub ports that receive and export 'packets' of ballast water from and to a variety of other ports (see list above)

Figure A6-5: Main ports that receive ballast water discharges in the Pacific islands region.

It is important to note that, contrary to 'popular opinion', the volume of ballast water that a particular port receives may not necessarily be the best or only indication of bio-invasion risk. Other risk factors include the frequency of ship visits/ballast water discharges, voyage times and ballast tank size, any management measures applied during the voyage, and perhaps most importantly, the 'environmental similarity' of the ballast discharge port to the ballast source port (Clarke et al 2003).

It can be argued that the more a ballast water discharge port is environmentally similar to a ballast water source port, the greater the chance that organisms discharged with arriving ballast can tolerate and remain in their new environment to grow, reproduce and develop a viable population. Comparing port-to-port environmental similarities therefore provides a relative measure of the risk of organism survival and establishment. This is the basis of the 'environmental matching' method of bio-invasion risk assessment, as used in the Ballast Water Risk Assessment procedures developed and applied by the IMO-GloBallast Programme (Clarke et al 2003).

An example of how environmental similarity can have a greater influence on bio-invasion risk than the volume or even frequency of ballast water discharges, can be found in Australia. Ports in northern Australia that have relatively high risk factors in terms of frequency and volumes of ballast water discharges (the very large bulk export ports of Port Hedland, Dampier and Hay Point and the smaller bulk export ports like Weipa and Abbot Point), have not experienced any significant harmful invasions (due to a low environmental matching with their ballast water source ports). Conversely, in southern Australia and in particular Tasmania, ports which have relatively low risk factors in terms of frequency and volumes of ballast water discharges, have been the entry points of some of the most harmful aquatic bio-invasions (which could be attributed to a higher environmental matching with their source ports). Similar results are found in other parts of the world (Clarke et al 2003).

The implication of this for the Pacific islands is that the bulk export ports listed above, which receive relatively high volumes and frequencies of ballast water discharges, may not necessarily have a high risk of marine bio-invasion (depending on the source ports that they receive ballast water from). The hub-ports that receive and export smaller 'packets' of ballast water from and to a variety of source and destination ports, may indeed have much higher risk profiles.

Only by conducting a systematic risk assessment for the region and each port in the region, using a method that includes all risk factors, such as that developed by the IMO-GloBallast Programme, can a clearer and more precise picture of ballast water risk be gained for the region (Section 10.2).

g) Hull fouling risks in the region

As all Pacific island ports receive vessels which may have fouling on their hulls and other surfaces, they are all potentially at risk from this vector. The limited studies and surveys of introduced marine species that have been conducted in the region to date, indicate that the majority of vessel-related introduced species in the region are likely to have been introduced by fouling (see Appendix 7). Floerl et al (in prep) report that more than half (60 – 69 %) of the introduced marine species recorded in Australia, New Zealand and Hawaii are fouling organisms that are thought to have been introduced accidentally on the hulls of ships and other floating structures (Cranfield et al 1998, Thresher et al 1999, Eldredge and Carlton 2002). It should be noted that intentional and accidental introductions associated with fisheries and

aquaculture production are also important in the Pacific islands (Eldredge1992), but are not considered in detail in this shipping-related Strategy.

As stated above, ocean-going yachts may pose a greater hull fouling risk than commercial vessels, especially because they travel more slowly, spend more time in more ports, and may have less rigorous anti-fouling procedures. In New Zealand, the National Institute of Water and Atmospheric Research's (NIWA) has been researching the development of better predictive tools to identify and manage the marine biosecurity risks posed by ocean-going yachts.

NIWA and the New Zealand Ministry of Agriculture and Forestry (MAF) Quarantine Service have been working together to assess the recent travel and maintenance history of yachts entering New Zealand from overseas, and the amount and diversity of fouling organisms they carry. Fouling can be estimated by using 'HullCam', a purpose-built sampling device with a remote underwater video lens mounted on a wheeled frame that rolls along or across a yacht hull while being steered from the surface by a telescopic arm. The remote lens, aided by twin underwater lights, transmits to a digital video camera at the surface. Still images can then be captured to determine the composition and abundance of fouling assemblages. NIWA scientists have developed a risk-based predictive tool to assist management of fouling introductions (Floerl et al in prep).

So far NIWA has sampled over 780 yachts, and found a high diversity and abundance of fouling species on a large proportion of them. They also found that 90% of the yachts sampled in New Zealand arrived from Pacific island ports such as Fiji, Tonga and French Polynesia (Floerl et al, in prep).

Figure A6-6: *NIWA scientists using the 'HullCam' in an Auckland marina (Source: NIWA)*

Figure A6-7: *A look at a yacht's hull through the HullCam's 'eye' – showing a high diversity and abundance of fouling species (Source: NIWA).*

Also in New Zealand, scientists at the Cawthron Institute have been examining the contents of sea chests (sea water intakes) in ocean going fishing vessels that are slipped for repairs in Nelson. They have found a variety of organisms in the sea chests of a number of vessels, including live shellfish, crabs, worms and amphipods. Sea chests may well be an under recognised source of potential marine invaders, and one that should be considered during the development of management measures aimed at preventing the introduction of foreign marine organisms.

Figure A6-8: *Marine species found in a sea chest of a vessel servicing the Fiji islands slipped in Nelson in June 2000 (Source: Cawthron Institute).*

Finally, as stated above and below, a significant source of fouling transfers in parts of the Pacific is believed to be the movement of marine structures such as dumb-barges, pontoons and floating-docks. Paulay et al (2002) reference examples from Micronesia and the Hawaiian islands.

While a fouling-vector risk assessment has not been carried out for the Pacific islands region, nor for any country or port within the region, the risks from this vector may be much higher than from ballast water, given the huge diversity of fouling vectors, from small private yachts to fishing vessels to commercial shipping to floating barges and pontoons. The fouling vector is certainly more complex and more difficult to assess and to manage, and requires significant management effort, as outlined in section 11 .

Appendix 7:

Overview of introduced marine species in the Pacific Islands

Overview of introduced marine species in the Pacific Islands

a) General

Overall, the presence and distribution of introduced, non-native marine species in the Pacific Islands region is poorly understood and apart from the US territories, no detailed studies or surveys have been conducted in any port or on any open coastline in the region.

Eldridge (1994) undertook for SPC and SPREP a desk-top review of introductions of commercially significant aquatic organisms (including freshwater species) in the Pacific Islands. This review included the Hawaiian islands (outside the SPREP Region) and found that five species of clams, nine species of oysters, three species of pearl oysters, two gastropods (trochus and green snail), several species of penaeid ships, several strains of *Euchema* seaweeds and more than 60 species of fish (these being primarily introduced to Hawaii and including many freshwater species), were known to have been introduced into and/or translocated between locations within the Pacific islands.

Most of these species were intentionally introduced to the region or translocated within the region by humans for commercial fisheries and aquaculture production, as opposed to being accidental, shipping-related introductions (the focus of this Strategy). None of them are believed to have attained "invasive" status or become marine "pests" in their new environments (although no scientific assessments of their ecological impacts have been conducted).

Eldridge (1994) did identify the potential for shipping-related introductions through both fouling and ballast water, and referred to the introduction of fouling species to Hawaii on ships hulls and dry-docks, citing Doty (1961) and Myers and Paulay (pers comm.). With regard to marine fishes, Eldridge (1994) cited several examples in the region where introductions were believed to have been caused via shipping – including *inter alia*, the blenny *Petroscirtes breviceps* in Port Moresby, Papua New Guinea (citing Springer and Gamon, 1975), the damsel fish *Neopomacentris violascens* in Apra harbor, Guam (citing Myers, 1989) and the fish *Mugiligobius parvus* that is thought to have been introduced to Hawaii from Japan in ships' ballast (citing Randell et al, 1993).

Significantly, Eldridge (1994) raised concerns about the transfer of toxic algae species in ships' ballast water, and identified a number of penaeid shrimp diseases (e.g. infectious hematopoietic necrosis virus) that had been introduced to Tahiti, Guam and Hawaii via aquaculture, as well as other examples of pathogen transfer. These examples further raise concerns that such harmful organisms may also be transferred and introduced through ships' ballast. Coles et al (1998) report blooms of an introduced harmful algae that have caused ecological impacts in Maui, Hawaii, and Coles et al 2002 report harmful ecological impacts from invasive macro-algae in Kanehoe Bay, Hawaii.

Eldridge (1994) identified the urgent need for more surveys and monitoring and for better management and regulatory measures to address these vectors in the Pacific Islands region.

Studies of the invasive black striped mussel (*Mytolopsis sallei*) (native to the Gulf of Mexico / Carribbean region), which was found in a Darwin marina in 1999 (and subsequently eradicated), indicate that it was likely to have been transported to Australia attached to the hulls of vessels (most likely cruising yachts), voyaging from the Panama Canal through the Pacific islands to Australasia. This species has been introduced to Suva harbour, Fiji, a popular stop-off point for trans-Pacific cruising yachts (Sefa – this was in the TOR – do you

have Reference?). A blennid fish, *Omobranchus punctatus* that is known to spread in ship's ballast water has also been observed to be common in the Suva area, but not outside of Suva (same – Reference?).

b) Surveys within the region

As stated above, the only sites were specific surveys have been undertaken for introduced marine species in the Pacific Islands are some of the US territories, including surveys by the Bishop Museum at several sites in the Hawaiian Islands, at Johnston Atoll in the central Pacific and in American Samoa, and surveys conducted by Paulay et al in Guam.

The Hawaiian Islands and Johnston Atoll lie outside the SPREP Region while American Samoa and Guam are members of SPREP, although they are US territories rather than countries in their own right. As the only scientific data currently available on the distribution of introduced marine species in the region, the findings of these surveys are of significant relevance to SRIMP-PAC and are therefore reviewed and summarized below.

The Bishop Museum surveys

The Bishop Museum in Hawaii began a series of field surveys for introduced marine species throughout the US Pacific islands in the mid 1990's. Several sites throughout the Hawaiian Islands have now been surveyed, these being Pearl Harbor (Coles et al 1997), Kaho' olawe Island (Coles et al 1998), Midway Atoll at the western end of the Hawaiian Chain (DeFelice et al 1998), the south and west coast of Oahu (Coles et al 1999), Kanehoe Bay on Oahu (Coles et al 2002) and Johnston Atoll (Coles et al 2001) and sites at Tutuila Island in American Samoa (Coles et al 2003) have also been surveyed. The general locations of these sites in a global context are shown as green stars on Figure A7-1. These surveys focused on port and harbor areas as well as adjacent coral reefs, and revealed a number of interesting findings, as follows:

Pearl Harbour (Coles et al 1997)

- Pearl Harbor is a highly modified and ecologically disturbed environment with a high percentage of artificial substrate/habitat, and significant vessel activity providing many opportunities for non-native marine species to be introduced, especially fouling species.
- A total of 434 species / higher taxa were identified from the survey, and a total of 1,141 marine taxa are known from Pearl Harbor from historical studies.
- Of the 434 taxa identified in the survey, 96 (or 22%) were identified as introduced or cryptogenic (of uncertain origin but with indications of being introduced, as per Chapman and Carlton 1991).
- The majority of the introduced / cryptogenic species were fouling species.
- The majority of the introduced / cryptogenic species were found in the most highly disturbed parts of the harbor associated with artificial substrates and in areas with lower native bio-diversity.
- Apart from the barnacle *Chthalamus proteus*, none of the introduced /cryptogenic species appear to have become invasive or to have reached 'pest' status.

- The introduced barnacle *C. proteus* has become the most abundant, dominant species in the inter-tidal zone of Pearl Harbor (as it has in several other Hawaiian embayments).

Kaho' olawe Island (Coles et al 1998)

- As a defence site Kaho' olawe Island has been closed to high levels of human access and use and has suffered very little ecological and environmental disturbance, and has experienced extremely limited shipping activity providing very few opportunities for non-native marine species to be introduced.

- The survey found three non-indigenous fishes and no introduced / cryptogenic benthic species, a unique result in the US Pacific Island surveys.

Midway Atoll (DeFelice et al 1998)

- Midway Atoll at the western end of the Hawaiian chain is a reasonably intact and extremely isolated natural coral atoll with associated reef and lagoon, and some modified and ecologically disturbed environments where infrastructure has been developed as part of the US defense facility. There is moderate, defense-related vessel activity presenting some opportunity for species introductions, especially fouling species. No commercial shipping carrying ballast water visits Midway Atoll.

- A total of 444 species / higher taxa were identified from the survey, and only 4 of these were identified as being introduced. (1.5 % of the total number of surveyed species at the atoll).

- All of the introduced species were benthic species, found in the most highly disturbed parts of the atoll associated with artificial substrates and in areas with lower native bio-diversity.

South and west coast of Oahu (Coles et al 1999)

- The south and west coasts of Oahu are highly modified and ecologically disturbed environment with a high percentage of artificial substrate/habitat, with significant vessel activity (including ballasted commercial shipping) providing many opportunities for non-native marine species to be introduced, especially fouling species.

- A total of 728 species / higher taxa were identified from the survey.

- Of the 728 taxa identified in the survey, 52 were identified as being introduced and 27 as cryptogenic (17% of the total).

- As with Pearl Harbor, the majority of the introduced / cryptogenic species were fouling species.

- As with Pearl Harbor, the majority of the introduced / cryptogenic species were found in the most highly disturbed parts of the coast, associated with artificial substrates and in areas with lower native bio-diversity.

- As with Pearl Harbor and several other Hawaiian embayments, the introduced barnacle *C. proteus* has become the most abundant, dominant species in the inter-tidal zone of the south and west coast of Oahu.

Kanehoe Bay, Oahu (Coles et al 2002)

- Kanehoe Bay is a highly modified and ecologically disturbed environment with a history of eutrophication and other human impacts, and some small private vessel activity. No commercial shipping carrying ballast water visits Kanehoe Bay.

- A total of 786 species / higher taxa were identified from the survey.

- Of the 786 taxa identified in the survey, 116 were identified as being introduced or cryptogenic. Including previous studies, a total of 204 introduced or cryptogenic species are known from Kanehoe Bay (18.8% of the total number of known species in the bay).

- The majority of the introduced / cryptogenic species were benthic species.

- The majority of the introduced / cryptogenic species were found in the most highly disturbed parts of the harbor associated with artificial substrates and in areas with lower native bio-diversity.

- Of the 204 known introduced / cryptogenic species in the bay, five macro-algae species have become invasive pests, four of these having been introduced to Hawaii for aquaculture.

Johnston Atoll (Coles et al 2001)

- Johnston Atoll in the central Pacific is a reasonably intact and extremely isolated natural coral atoll with associated reef and lagoon, and some modified and ecologically disturbed environments where infrastructure has been developed as part of the US defense facility. There is moderate, defense-related vessel activity presenting some opportunity for species introductions, especially fouling species. No commercial shipping carrying ballast water visits Johnston Atoll.

- A total of 668 species / higher taxa were identified from the survey, and a total of 805 marine taxa are known from Johnston Atoll from historical studies.

- Of the 668 taxa identified in the survey, 10 were identified as being introduced or cryptogenic. (1.5 % of the total number of surveyed species at the atoll).

- All of the introduced / cryptogenic species were fouling benthic species.

- The majority of the introduced / cryptogenic species were found in the most highly disturbed parts of the atoll associated with artificial substrates and in areas with lower native bio-diversity.

American Samoa (Coles et al 2003)

- The areas surveyed at Tutuila Island included Pago Pago harbour, the main port in American Samoa which handles commercial shipping and significant numbers of distant water fishing vessels (tuna purse seiners and long liners) as well as large

numbers of cruising yachts on trans-Pacific voyages, as well as less disturbed Fagatele Bay and National Park coast dominated by coral reef.

- A total of 1,256 species / higher taxa were identified from the survey, and 28 were identified as being introduced or cryptogenic (2% of the total number of surveyed species).
- All of the introduced / cryptogenic species were benthic species.
- The majority of the introduced / cryptogenic species were found in the most highly disturbed parts of the Pago Pago harbour associated with artificial substrates and in areas with lower native bio-diversity.

Guam Surveys

Five major marine bio-diversity surveys have been undertaken at Guam (Paulay et al 2002) with two focusing on introduced species, one focusing on bivalves in 1995-96 and one focusing on hard bottom fauna during 1998-2000. The findings in Guam can be summarised from Paulay et al (2002) as follows:

- Guam is the major hub-port of Micronesia in the north-west of the SPREP Region, and hosts one of the largest US Naval bases in the Pacific. It handles significant numbers of Naval vessels, commercial shipping, tourism vessels and cruising yachts. Due to the predominance of imported cargo and relatively small amounts of cargo exports, limited volumes of ballast water are discharged by ships visiting Guam.*
- There are significant areas of modified and ecologically disturbed environments where infrastructure has been developed as part of the US defense facilities as well as commercial port facilities.
- Of a total recorded marine biodiversity of 5,500 species, 85 species are recognized as introduced or cryptogenic in Guam, and there are likely to be many more as more surveys are carried out and further taxanomic work is completed.
- The majority of introduced marine species in Guam are sessile and vessel fouling is likely to be the main vector. Studies of two floating dry-docks demonstrating the significant role these can play as vectors.
- As with the Hawaiian surveys, the majority of introduced marine species in Guam have remained confined to artificial substrates in areas disturbed for port infrastructure development, and in areas with lower native bio-diversity.
- A few of the introduced marine species found in Guam have established outside of developed areas, including the Trochus shell introduced for fishery purposes. Major impacts on coral reefs in Guam remain to be identified.

Limits on survey methods

It should be noted that the Bishop Museum and Guam surveys utilize relatively limited sampling methods involving two to a few SCUBA divers / snorkellers undertaking direct in-field observations and collection of restricted organism types (focusing mainly on benthic species), at a limited number of sub-sites, in restricted habitat types, and do not include

quantitative sampling nor any consideration of statistical power in sampling design. Additionally, sampling strategies and methods are not necessarily standardized for each site and survey. Such an approach has the advantage of being relatively cost-effective, but the disadvantage of being less rigorous and more prone to error than more comprehensive and systematic (and more expensive) approaches. The Bishop Museum and Guam surveys are likely to present under-estimates of the presence and distribution of introduced marine species,

More comprehensive, systematic and rigorous surveys methods include the protocols developed by the Centre for Research on Introduced Marine Pests (CRIMP) at the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia (Hewitt & Martin 1996, 2001) (see below). More targeted ongoing monitoring approaches are being developed collaboratively by Australia and New Zealand.

c) Surveys around the Pacific-Rim

In addition to the restricted surveys carried out at a limited number of Pacific island sites described above, four Pacific-Rim countries (Australia, China, New Zealand and the USA) have been undertaking surveys and monitoring of introduced marine species.

A large number of ports in Australia and New Zealand and one site in China (the IMO-GloBallast demonstration site at Dalian), have been surveyed using methods based on the Hewitt & Martin (1996, 2001) protocols. The general locations of these sites in a global context are shown as purple dots (Australia), red dot (China) and green dots (New Zealand) on Figure A7-1.

Under the CRIMP Protocols, surveys are designed so as to target specific high-risk 'inoculation' areas within a given port or survey area, as well as to minimize Type II errors as much as possible (whereby a site might be declared free of introduced species when such species are actually present). The CRIMP Protocols involve sampling all inter-tidal and sub-tidal habitats for all organism types using a wide range of both quantitative and qualitative sampling methods and relatively large field teams. They are therefore relatively expensive.

Of particular relevance to the Pacific Islands are surveys carried out at ports in tropical northern Australia, which have environments and species similar to those in the Pacific. The results of these surveys indicate similar patterns to the Pacific Island surveys described above. Two outstanding cases of concern, are the near outbreak (and subsequent eradication) of an introduced mussel (*Mytilopsis sallei*) in Darwin, Australia in 1999 and the continuing presence of the introduced (and potentially invasive) mussel (*Perna Viridis)* in Cairns port in Queensland.

Further complementing the Pacific-Rim survey network, in the USA the Smithsonian Environmental Research Centre (SERC), has established an introduced marine species survey programme at a large number of sites throughout the continental USA and Alaska, including a number of sites on the US Pacific coast, plus two sites in Australia for comparative purposes, with plans for a further 9 sites, including one in Hawaii. The general locations of these sites in a global context are shown as red diamonds on Figure A7-1. The SERC programme is based on passive settling plates, and therefore only samples benthic fouling species. The California Lands Commission also has a programme of more comprehensive surveys at several sites on the Pacific coast.

As ships, yachts and other vessels such as floating dry-docks that voyage to and through the Pacific Islands most often originate from Pacific-Rim countries, the data from Pacific-Rim introduced marine species surveys will prove useful in undertaking risk assessments for the

islands, and in devising strategies to prevent the uptake and carriage of potentially invasive species at Pacific-Rim source ports, with the aim of preventing their spread to the islands (see Section 2.7).

Further information about the surveys in Australia can be obtained by contacting the CSIRO Marine Laboratories in Hobart, Tasmania (www.cmar.csiro.au), in China by contacting the IMO-GloBallast Programme (http://globalllast.imo.org) and in New Zealand by contacting the Biosecurity Authority of New Zealand (www.maf.govt.nz). Further information about the surveys on the US West Coast can be obtained by contacting SERC (www.serc.si.edu/labs/marine_invasions) and the California Lands Commission (www.slc.ca.gov).

g) Summary of survey results

There are clearly major gaps in our knowledge of the presence, distribution and impacts of introduced marine species in the Pacific Islands region. The vast majority of ports in the region have not been surveyed or studied. These include:

- ports which receive frequent and relatively large volumes of ballast water discharges (e.g. several timber and bulk-ore export ports in PNG; timber and bulk-ore export ports in the Solomon Islands, bulk sugar, woodchip and timber export ports in Fiji; the phosphate export port in Nauru and the nickel export ports in New Caledonia);

- regional hub ports which frequently which receive and export 'packets' of ballast water from transshipment of break-bulk cargo, containers and petroleum products (e.g. Port Moresby and Rabaul in PNG, Honiara in the Solomon Islands, Port Vila in Vanuatu, Suva in Fiji, Apia in Samoa, Nukualofa in Tonga, Papaette in Tahiti, Tarawa in Kiribati, Majuro in the Marshall Islands, Phonpei in the Federated States of Micronesia and [insert main port) in Palau;, and

- concentration points for cruising yachts (a particular concern for fouling species), including Papaette in Tahiti, Rarotonga in the Cook Islands, Vavau in Tonga, Suva in Fiji and Port Vila in Vanuatu.

- concentration points for distant water fishing vessels, including several ports in PNG, Honiara in the Solomon islands, Tarawa in Kiribati, Funafuti in Tuvalu and most of the Micronesian ports.

Clearly, a more comprehensive and complete picture of introduced marine species in the region requires at least a representative sub-set of these ports and adjacent areas to be surveyed (see section 10.7).

The limited surveys that have been conducted in the US islands, combined with the more systematic and comprehensive surveys in tropical Australian ports, along with desk-top reviews, indicate some general trends. These include:

- A not insignificant number of introduced species have been found at almost every site surveyed in the region.

- The largest number of introduced species are found at the sites with the highest volumes of vessel traffic and/or the greatest amount of human disturbance (96 at Pearl

Harbour and 204 at Kanehoe Bay in Hawaii), and in areas with lower native bio-diversity.

- The majority of the introduced species found to date are fouling species.
- The majority of the introduced species found to date appear not to have become invasive or to have reached 'pest' status.
- A number of introduced species of concern and potentially significant concern have been found in the region, and have become or are threatening to become invasive, including the barnacle *Chthalamus proteus*, several macro-algae species, harmful planktonic algae species and the Black Striped Mussel *Mytolopsis sallei* from the Gulf of Mexico / Caribbean.

These results must be considered in light of the extremely limited and biased sampling effort conducted to date, and likely that a much larger number of introductions, including potentially invasive pests, would be detected with a more comprehensive and systematic survey effort addressing the major gaps in the regional port system outlined above. This highlights the importance of vigilance against marine introductions, the need for baseline and monitoring surveys to allow early detection and control and the need for a prevention and management strategy to be implemented, as provided for by this document.

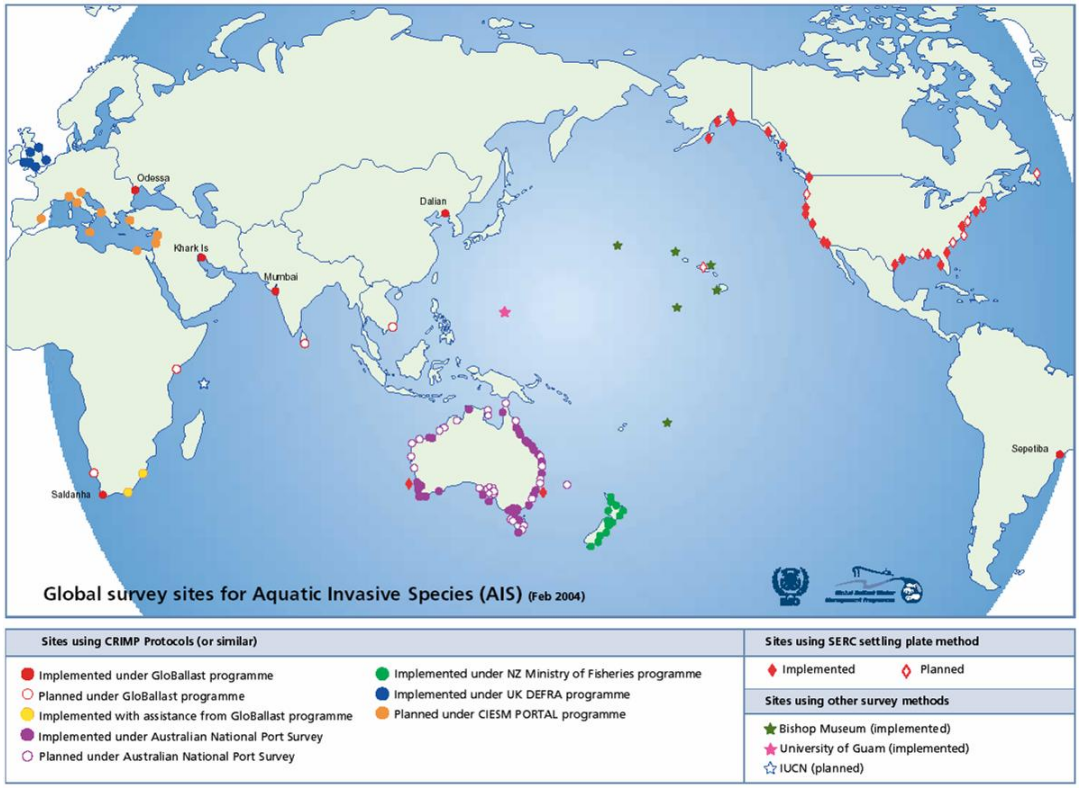

Figure A7-1: *Global survey sites for introduced marine species* (Source: IMO GloBallast Programme)

Appendix 8:

Existing international initiatives

Existing international initiatives

At the global, international level, the only vector for invasive aquatic species for which a regulatory regime currently exists is ships' ballast water and sediments, through the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BW Convention). There is currently no international regulatory regime in place or under development for the fouling vector, and nor for the non-shipping vectors such as fisheries and aquaculture.

There are however, a number of non-regulatory international initiatives that aim to address invasive aquatic species in various ways. These include guidelines and codes-of-practice for industry, and international technical cooperation programmes aimed at assisting mainly developing countries, to be able to better manage this issue. The international regulatory regime and other initiatives and their relevance and implications for SRIMP-PAC are reviewed below.

a) The IMO Ballast Water Convention

The BW Convention was adopted by IMO member States in February 2004 and provides a comprehensive international regulatory regime to reduce the transfer of harmful aquatic organisms and pathogens through ships' ballast water and sediments.

The Convention provides flexible options and builds on the complimentary roles of coastal, port and flag States in protecting the marine environment. Currently the main ship-board management measure to reduce the transfer of species that is required by the Convention, is ballast water exchange at sea (see Section 2.6). In recognition of the limitations of ballast water exchange, the Convention also provides for continuous improvement by setting ballast water management standards, with target dates, to stimulate the development of alternative, more effective ballast water treatment technologies and management methods over time.

The Convention is divided into Articles; and an Annex which includes technical standards and requirements in the *Regulations for the control and management of ships' ballast water and sediments.* The main features of the Convention are outlined below (from IMO):

Entry into force: The Convention will enter into force 12 months after ratification by 30 States, representing 35 per cent of world merchant shipping tonnage (Article 18 *Entry into force*).

General Obligations: Under Article 2 *General Obligations* Parties undertake to give full and complete effect to the provisions of the Convention and the Annex in order to prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments.
Parties are given the right to take, individually or jointly with other Parties, more stringent measures with respect to the prevention, reduction or elimination of the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments, consistent with international law. Parties should ensure that ballast water management practices do not cause greater harm than they prevent to their environment, human health, property or resources, or those of other States.

Reception facilities: Under Article 5 *Sediment Reception Facilities* Parties undertake to ensure that ports and terminals where cleaning or repair of ballast tanks occurs, have adequate reception facilities for the reception of sediments.

Research and monitoring: Article 6 *Scientific and Technical Research and Monitoring* calls for Parties individually or jointly to promote and facilitate scientific and technical research on ballast

water management; and monitor the effects of ballast water management in waters under their jurisdiction.

Survey, certification and inspection: Ships are required to be surveyed and certified (Article 7 *Survey and certification*) and may be inspected by port State control officers (Article 9 *Inspection of Ships*) who can verify that the ship has a valid certificate; inspect the Ballast Water Record Book; and/or sample the ballast water. If there are concerns, then a detailed inspection may be carried out and "the Party carrying out the inspection shall take such steps as will ensure that the ship shall not discharge Ballast Water until it can do so without presenting a threat of harm to the environment, human health, property or resources." All possible efforts shall be made to avoid a ship being unduly detained or delayed (Article 12 *Undue Delay to Ships).*

Technical assistance: Under Article 13 *Technical Assistance, Co-operation and Regional Co-operation*, Parties undertake, directly or through the Organization and other international bodies, as appropriate, in respect of the control and management of ships' ballast water and sediments, to provide support for those Parties which request technical assistance to train personnel; to ensure the availability of relevant technology, equipment and facilities; to initiate joint research and development programmes; and to undertake other action aimed at the effective implementation of this Convention and of guidance developed by the Organization related thereto.

Annex – Section A : General Provisions: This includes definitions, application and exemptions. Under Regulation A-2 General Applicability: "Except where expressly provided otherwise, the discharge of Ballast Water shall only be conducted through Ballast Water Management, in accordance with the provisions of this Annex."

Annex – Section B: Management and Control Requirements for Ships: Ships are required to have on board and implement a Ballast Water Management Plan approved by the Administration (Regulation B-1). The Ballast Water Management Plan is specific to each ship and includes a detailed description of the actions to be taken to implement the Ballast Water Management requirements and supplemental Ballast Water Management practices.

Ships must have a Ballast Water Record Book (Regulation B-2) to record when ballast water is taken on board; circulated or treated for Ballast Water Management purposes; and discharged into the sea. It should also record when Ballast Water is discharged to a reception facility and accidental or other exceptional discharges of Ballast Water

The specific requirements for ballast water management are contained in regulation B-3 *Ballast Water Management for Ships:*

- Ships constructed before 2009 with a ballast water capacity of between 1500 and 5000 cubic metres must conduct ballast water management that at least meets the ballast water exchange standards or the ballast water performance standards until 2014, after which time it shall at least meet the ballast water performance standard.

- Ships constructed before 2009 with a ballast water capacity of less than 1500 or greater than 5000 cubic metres must conduct ballast water management that at least meets the ballast water exchange standards or the ballast water performance standards until 2016, after which time it shall at least meet the ballast water performance standard.

- Ships constructed in or after 2009 with a ballast water capacity of less than 5000 cubic metres must conduct ballast water management that at least meets the ballast water performance standard.

- Ships constructed in or after 2009 but before 2012, with a ballast water capacity of 5000 cubic metres or more shall conduct ballast water management that at least meets the ballast water performance standard.

- Ships constructed in or after 2012, with a ballast water capacity of 5000 cubic metres or more shall conduct ballast water management that at least meets the ballast water performance standard.

Other methods of ballast water management may also be accepted as alternatives to the ballast water exchange standard and ballast water performance standard, provided that such methods ensure at least the same level of protection to the environment, human health, property or resources, and are approved in principle by IMO's Marine Environment Protection Committee (MEPC).

Under Regulation B-4 *Ballast Water Exchange*, all ships using ballast water exchange should:

- whenever possible, conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account Guidelines developed by IMO;

- in cases where the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.

When these requirements cannot be met areas may be designated where ships can conduct ballast water exchange. All ships shall remove and dispose of sediments from spaces designated to carry ballast water in accordance with the provisions of the ships' ballast water management plan (Regulation B-4).

Annex - Section C Additional measures: A Party, individually or jointly with other Parties, may require ships additional measures to prevent, reduce, or eliminate the transfer of Harmful Aquatic Organisms and Pathogens through ships' Ballast Water and Sediments.

In these cases, the Party or Parties should consult with adjoining or nearby States that may be affected by such standards or requirements and should communicate their intention to establish additional measure(s) to the Organization at least 6 months, except in emergency or epidemic situations, prior to the projected date of implementation of the measure(s). When appropriate, Parties will have to obtain the approval of IMO.

Annex – Section D Standards for Ballast Water Management: There is a ballast water exchange standard and a ballast water performance standard.

Regulation D-1 *Ballast Water Exchange Standard* - Ships performing Ballast Water exchange shall do so with an efficiency of 95 per cent volumetric exchange of Ballast Water. For ships exchanging ballast water by the pumping-through method, pumping through three times the volume of each ballast water tank shall be considered to meet the standard described. Pumping through less than three times the volume may be accepted provided the ship can demonstrate that at least 95 percent volumetric exchange is met.

Regulation D-2 *Ballast Water Performance Standard* - Ships conducting ballast water management shall discharge less than 10 viable organisms per cubic metre greater than or equal to 50 micrometres in minimum dimension and less than 10 viable organisms per millilitre less than 50 micrometres in minimum dimension and greater than or equal to 10 micro-metres in minimum

dimension; and discharge of the indicator microbes shall not exceed the specified concentrations. The indicator microbes, as a human health standard, include, but are not be limited to:

a. Toxicogenic *Vibrio cholerae* (O1 and O139) with less than 1 colony forming unit (cfu) per 100 milliliters or less than 1 cfu per 1 gram (wet weight) zooplankton samples ;

b. *Escherichia coli* less than 250 cfu per 100 milliliters;

c. Intestinal Enterococci less than 100 cfu per 100 milliliters.

Ballast Water Management systems must be approved by the Administration in accordance with IMO Guidelines (Regulation D-3 *Approval requirements for Ballast Water Management systems*). These include systems which make use of chemicals or biocides; make use of organisms or biological mechanisms; or which alter the chemical or physical characteristics of the Ballast Water.

Prototype technologies: Regulation D-4 covers *Prototype Ballast Water Treatment Technologies.* It allows for ships participating in a programme approved by the Administration to test and evaluate promising Ballast Water treatment technologies to have a leeway of five years before having to comply with the requirements.

Review of standards: Under regulation D-5 *Review of Standards by the Organization*, IMO is required to review the Ballast Water Performance Standard, taking into account a number of criteria including safety considerations; environmental acceptability, i.e., not causing more or greater environmental impacts than it solves; practicability, i.e., compatibility with ship design and operations; cost effectiveness; and biological effectiveness in terms of removing, or otherwise rendering inactive harmful aquatic organisms and pathogens in ballast water. The review should include a determination of whether appropriate technologies are available to achieve the standard, an assessment of the above mentioned criteria, and an assessment of the socio-economic effect(s) specifically in relation to the developmental needs of developing countries, particularly small island developing States.

Annex- Section E Survey and Certification Requirements for Ballast Water Management: This annex gives requirements for initial renewal, annual, intermediate and renewal surveys and certification requirements. Appendices give form of Ballast Water Management Certificate and Form of Ballast Water Record Book.

Table A8-1: *Schedule for ballast water management under section B of the BW Convention (BWES = BW Exchange Standard, BWPS = BW Performance Standard)*

Ship construction	Ballast capacity (m^3)	Control required
Before 2009	1500-5000	At least meet BWES or BWPS up to 2014 then BWPS
Before 2009	<1500 or >5000	At least meet BWES or BWPS up to 2016 then BWPS
In or after 2009	<5000	At least meet BWPS
In or after 2009 but before 2012	5000 or more	At least meet BWES or BWPS up to 2016 then BWPS
In or after 2012	5000 or more	At least meet BWPS

b) The GloBallast Programme

In parallel with development of the BW Convention, over a five year period from the beginning of 2000 to the end of 2004, IMO provided technical assistance, institutional strengthening and capacity building to developing countries to implement pre-Convention IMO ballast water guidelines and to prepare for the Convention. This effort was undertaken through a project funded by the Global Environment Facility (GEF), entitled *Removing Barriers to the Effective Implementation of Ballast Water Control and Management Measures in Developing Countries*. This was later renamed the *Global Ballast Water Management Programme* and shortened to *GloBallast*. Under GEF project management arrangements, GloBallast was implemented by the United Nations Development Programme (UNDP) and executed by IMO.

The GloBallast Programme worked through a three-person Programme Coordination Unit (PCU) based at IMO in London and six initial Demonstration Sites, located in six Pilot Countries. These represent the main developing regions of the world, as follows:

Table A8-2: *GloBallast Demonstration Sites*

Demonstration Site	Pilot Country	Region Represented
Dalian	China	Asia/Pacific
Khark Island	IR Iran	The Gulf (ROPME Sea Area)
Odessa	Ukraine	Eastern Europe
Mumbai	India	South Asia
Saldanha	South Africa	Africa
Sepetiba	Brasil	South America

Activities carried out at these sites focussed on institutional strengthening and capacity building and included, *inter alia*:

- Establishment of National Lead Agencies and Focal Points for ballast water issues.

- Formation of cross-sectoral/inter-ministerial National Task Forces.
- Communication and awareness-raising activities.
- Ballast water risk assessments.
- Port biota baseline surveys.
- Ballast water sampling.
- Development of a global, generic, modular training course for government and industry.
- Assistance with national ballast water legislation and regulations.
- Training and technical assistance with compliance monitoring and enforcement.
- Assistance with developing national ballast water management strategies and policies.
- Assistance with developing self-financing and resourcing mechanisms.

Many of these activities resulted in the establishment of standard methods and protocols for certain technical activities, including for ballast water risk assessments, port biota baseline surveys and education and training, which are available for adoption by other parties around the world (http://globallast.imo.org).

As the programme developed, frameworks were established to allow the successes at the initial Demonstration Sites to be replicated at additional countries in each region, through the establishment multi-lateral Regional Task Forces and the development of Regional Action Plans.

The programme was widely acknowledged as a major success and IMO is currently preparing a funding proposal to GEF for a follow-up project, aimed at replicating GloBallast successes throughout the six pilot regions and in new regions of the world. This project is called:

> *Building Partnerships to Assist Developing Countries to Implement Ballast Water Control and Management Measures*, or GloBallast *Partnership*s for short.

Under GloBallast *Partnership*s, IMO intends to invite the SPREP member Countries to become a new beneficiary region. Development of SRIMP-PAC is therefore extremely timely and will place the region in a strong position for the implementation of the BW Convention and to benefit from technical assistance under GloBallast *Partnership*s. Many of the activities outlined under Sections 2.5 and 2.6 are drawn directly from the standard GloBallast approaches and the financing and sustainability plan in Section 5 includes securing funding for some of these activities from GloBallast *Partnerships*.

The GloBallast web site is at http://globallast.imo.org

c) The Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) was adopted in 1992 and entered into force in [insert year], providing for the first time a global regime for the protection, conservation and management of the world's biological resources, including marine species and ecosystems.

The CBD recognizes invasive alien species as being an important threat to biological diversity, a serious impediment to conservation and sustainable use of global, regional and local biodiversity, with significant undesirable impacts on the goods and services provided by ecosystems.

The CBD also recognizes the urgent need to address the impact of invasive species on native ecosystems. Eradication, control and mitigation of their impacts combined with legislation and guidelines at national, regional and international levels are some of the ways in which the Convention is addressing this issue. Article 8(h) of the Convention states that:

> ' Contracting Parties to the Convention should, as far as possible and appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.'

In the programme of work of the Convention, invasive alien species are a key cross-cutting issue of relevance to all five thematic areas; addressing marine and coastal biodiversity, agricultural biodiversity, forest biodiversity, the biodiversity of inland waters, and dry and sub-humid lands.

The programme of work of the CBD's 'Jakarta Mandate on Marine and Coastal Biological Diversity' identifies key operational objectives and priority activities within five key programme elements, among them 'alien species and genotypes'. The three operational objectives identified under programme element five on alien species and genotypes, aim to:

- achieve better understanding of the causes of the introduction of alien species and genotypes and the impact of such introductions on biological diversity;
- identify gaps in existing or proposed legal instruments, guidelines and procedures to counteract the introduction of and the adverse effects exerted by alien species and genotypes; paying particular attention to transboundary effects;
- collect information on national and international actions to address these problems, with a view to prepare for the development of a scientifically-based global strategy for dealing with the prevention, control and eradication of those alien species which threaten marine and coastal ecosystems, habitats and species; and
- establish an 'incident list' on introductions of alien species and genotypes, through the national reporting process or any other appropriate means.

During its 8th meeting, the CBD's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), reviewed the programme of work on marine and coastal biodiversity, and recommended that the COP confirm that the level of priority of its elements still corresponds to global priorities. SBSTTA also recognized that some refinement to the programme of work was needed as a result of recent developments and new priorities, and requested the CBD Executive Secretary to set clear targets for the implementation of activities, taking into account the Plan of Implementation of the World Summit on Sustainable Development and the Strategic Plan of the CBD. In regard to invasive alien species, the target set for marine and coastal ecosystems is:

> 'All major pathways for potential alien invasive species in the marine and coastal environment controlled'.

Certainly, the development, adoption and implementation of SRIMP-PAC, including ratification and effective implementation of the IMO ballast water Convention by PICTs, will be a key contribution to this target, addressing the shipping vector. Development, adoption and implementation of a similar Strategy for non-shipping vectors in the region (see section below), would help to ensure that PICTs meet this CBD target by addressing 'all major pathways'.

Finally, under the CBD 'Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Invasive Alien Species' have been developed. These have been assessed for relevance to shipping vectors and to the Pacific islands, and relevant principles are included in SRIMP-PAC (sees section 2.3).

The CBD web site is at www.biodiv.org.

d) The Global Invasive Species Programme (GISP)

The Global Invasive Species Programme (GISP) is a partnership of the United Nations Environment Programme (UNEP) and its CBD Secretariat, the World Conservation Union (IUCN), Conservation International, the Scientific Committee on Problems of the Environment (SCOPE) and CABI International. GISP acts as a global information clearing house and project coordination facility to develop technical guidelines, carry out studies and to undertake international technical cooperation projects to assist countries to address invasive species. Parties to the CBD (see above) have designated GISP as the central coordinating body for invasive species issues under the CBD. To date GISP has focused primarily on terrestrial environments, including agricultural pests and weeds (the latter being reflection of the involvement of CABI International, which is primarily an agricultural research body).

However, recently the GISP Secretariat in Cape Town, South Africa, has moved to begin to include a more aquatic (including marine) focus in GISP's work. In 2004 GISP commissioned consultant's to undertake a compilation of information on *Best Practices for the Management of Introduced Marine Pests* (Hilliard et al in prep). The draft report on this study covers all marine vectors, the sections on hull fouling are of particular interest to SRIMP-PAC, and relevant management measures identified in the report are included in Section 2.6.

The GISP Secretariat has recognized that other than the IMO BW Convention, there are major gaps in the global regulatory regime for other aquatic vectors, including fouling. GISP in conjunction with UNEP and the CBD Secretariat is therefore held a workshop of relevant international stakeholders in June 2005, to more clearly identify and define these gaps and develop a strategy to address them, including definition of roles and responsibilities for different vectors between UN agencies and other bodies. The outcomes of this workshop will be of interest to SPREP member States, and the future development of management arrangements for non-ballast marine vectors in the Pacific islands region should ideally be consistent with any international arrangements agreed and developed from that workshop.

Finally, GISP is currently preparing a funding proposal for submission to the GEF for a project on *Building Capacity and Raising Awareness in Invasive Alien Species Prevention and Management.* If approved and funded by GEF, this project will undertake capacity-building and awareness activities at several demonstration sites in developing countries around the world. SPREP should liaise with the GISP Secretariat to identify opportunities for including a marine component in at a Pacific island site, and to identify opportunities for integration, coordination and synergies as well as co-financing opportunities between GISP and SRIMP-PAC.

The GISP website is at www.gisp.org.

e) The World Conservation Union (IUCN)

Created in 1948, IUCN - The World Conservation Union brings together 72 States, 107 government agencies, 750-plus Non Government Organizations (NGOs), 34 affiliates, and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership. IUCN is the world's largest environmental knowledge network and has helped over 75 countries to prepare and implement national conservation and biodiversity strategies. It focuses on species and biodiversity conservation and the management of habitats and natural resources.

IUCN has identified the problem of invasive species as one of its major initiatives at the global level, and takes an integrated, ecosystem perspective, recognizing that many invasives are 'colonising' species that benefit from the reduced competition that follows habitat degradation.

IUCN is a partner in GISP and all components of IUCN – including its Commissions, Programmes and Regional Offices – act together to support the Union's Global Initiative on Invasive Species.

IUCN's Commission on Environment Law and the Environmental Law Programme are playing a key role in supporting the development of legal and institutional framework for addressing alien invasive species. The Environmental Law Programme published *A Guide to designing Legal and Institutional Framework on Alien Invasive Species*. This has been assessed for relevance to shipping vectors and to the Pacific islands, and relevant principles are included in SRIMP-PAC (sees Section 2.3).

The Invasive Species Specialist Group (ISSG), part of IUCN's Species Survival Commission, is a global group of 146 scientific and policy experts on invasive species from 41 countries. The group provides expertise and advice on a broad range of issues and coordinates the *Cooperative Initiative on Invasive Alien Species on Islands*, manages the *Global Invasive Species Database*, publishes the newsletter *Aliens* and runs the listserver *Aliens-L* (www.issg.org).

The IUCN Global Marine Programme is particularly concerned about the problem of invasive marine species and is developing various activities and projects to address this issue, including surveys for introduced marine species at selected coral reef sites in sensitive areas.

The IUCN-ISSG Cooperative Initiative on Islands and the invasive species activities of the IUCN Global Marine Programme are the most relevant to SRIMP-PAC and SPREP should liaise with the IUCN Secretariat to identify opportunities for integration, coordination and synergies as well as co-financing of common activities.

f) The FAO and ICES Guidelines

The Food and Agriculture Organization (FAO) of the UN has developed a non-regulatory code of practice for the assessment and management of the intentional introduction of aquatic (including marine) species for fisheries and aquaculture purposes. Additionally, the International Council for the Exploration of the Seas (ICES), comprising North-Atlantic countries, has developed similar guidelines. The FAO and ICES guidelines do not address the accidental introduction of species via shipping vectors, and are therefore not relevant to SRIMP-PAC. However, given the considerable number of non-native species that have been introduced to the Pacific islands region for fisheries and aquaculture, and the likelihood of further such introductions, they provide a good framework for the development of a much needed management framework for intentional introductions in the Pacific islands. The development of such a framework would complement SRIMP-PAC by ensuring that both shipping and non-shipping vectors are addressed in the region, and would help ensure that PICTs meet their marine invasive species targets under the CBD.

Appendix 9:

Existing regional initiatives

Existing regional initiatives

As stated in section 2, the development of SRIMP-PAC falls under the auspices of SPREP's PACPOL Programme. The PACPOL Strategy & Workplan published in 1999, includes two activities in relation to introduced marine species; i) risk assessment and ii) surveys and monitoring in Pacific island ports. Due to funding limitations and the initial priority focus of PACPOL on other shipping-related environmental issues, such as oil pollution and ships' waste management, these activities have not been implemented to date and are now rolled into the SRIMP-PAC Workplan and Budget (see section 13).

Apart from SRIMP-PAC, the surveys conducted in US Pacific islands reviewed in Appendix 7 as well as some other US-related activities in the US Pacific islands (see below), there are currently no initiatives in the Pacific Islands region addressing shipping-related IMPs.

Development and implementation of SRIMP-PAC fills the important shipping/marine gap in invasive species management. The SPREP Secretariat will ensure coordination and cooperation between its terrestrial/freshwater initiatives and SRIMP-PAC, providing an integrated approach to invasive species in general.

The Secretariat of the Pacific Community (SPC) Marine Resources Division is responsible for fisheries and aquaculture issues in the region, and SPREP should work with SPC to ensure that appropriate arrangements are developed and implemented to assess, control and manage the introduction of aquatic species through these very significant vectors, ideally by developing a regional initiative to implement an appropriate version of the FAO and/or ICES guidelines.

Such a 'thee pronged' approach, where terrestrial and freshwater vectors are addressed by SPREP's Regional Invasive Species Programme, shipping-elated vectors are addressed by SRIMP-PAC and fisheries and aquaculture vectors are addressed by relevant initiatives of the SPC Marine Resources Division, would provide a comprehensive, integrated and holistic approach to all invasive species issues in the region.

Appendix 10:

Initiatives in Pacific-Rim countries

Initiatives in Pacific-Rim countries

While, prior to SRIMP-PAC, there has been no concerted action to address shipping-related IMPs in the Pacific islands, a number of Pacific-Rim countries are world leaders in addressing this issue, including those that pioneered the development of the BW Convention at IMO and which now have formal management regimes, including regulatory measures, for ballast water and/or other vectors (Australia, Canada, New Zealand and the USA).

Pacific-Rim countries have also been working to address IMPs on a regional basis, through the APEC Marine Resources Conservation Working Group (MRC-WG). The membership of APEC comprises all Pacific-Rim 'economies' as well as one SPREP 'island member' (PNG). No other Pacific Island Countries are members of APEC, although the Secretariat of the Pacific Islands Forum (ForSec) has observer status at APEC meetings.

Relevant initiatives of APEC and those Pacific-Rim countries that are active on IMPs are summarized below.

a) APEC

In November 2001 the APEC MRC-WG convened a *Workshop on the Development of a Risk Management Framework for the Control and Prevention of Introduced Marine Pests in the APEC Region*, in Hobart, Australia. The workshop initiated IMP activities by APEC and was attended by representatives from APEC Economies, SPREP, IMO and other relevant international organizations. A *Risk Management Framework* was produced as an output of the workshop.

This was followed-up by a second APEC IMP workshop held in Puerto Varas, Chile in May 2004. Prior to the workshop, APEC commissioned a consultancy study to identify IMP management gaps in each APEC Economy and to recommend actions to address these gaps. The draft report of this study was considered by the workshop and a number of recommendations were made by the workshop in order to progress the necessary actions and is being finalised.

As ships, yachts and other vessels that voyage to and through the Pacific Islands most often originate from Pacific-Rim countries, it is important that activities under SRIMP-PAC are coordinated with those of APEC, including devising strategies to prevent the uptake and carriage of potentially invasive species at Pacific-Rim source ports, with the aim of preventing their spread to the islands, and vice versa. Coordinating and integrating SRIMP-PAC with the IMP strategies and activities of APEC and its member Economies will provide a more holistic, 'whole of the Pacific' or 'Total Ocean-Basin' approach to IMP management.

It is therefore important that SPREP liaise with APEC to identify opportunities for integration, coordination and synergies as well as co-financing of common activities.

b) Australia

Concerns about the introduction of IMPs via shipping-related vectors began to arise in Australia in the 1980s with the discovery in Tasmanian waters of exotic species of harmful algae by Hallegraeff et al (ref?), as well as other invaders from the northern Pacific such as the seastar *Asterias amurensis*. The initial focus was on the ballast water vector and a national Scientific Working Group was formed and a number of studies undertaken. In the 1990s voluntary ballast water management guidelines were developed for ships coming to Australia, similar to those developed during the same time by Canada and the USA. Australia also joined Canada and the

USA in carrying the issue forward at IMO, including the adoption in 1987 of the IMO BW Guidelines through Assembly Resolution A.868(20) and the subsequent development of the IMO BW Convention. The Centre for Research on Introduced Marine Pests (CRIMP) was established at the CSIRO Marine laboratories in Hobart, Tasmania in the mid 1990's. Significant research was undertaken by CRIMP into a variety of ballast water and other IMP issues, and a national port survey programme was implemented in the late 1990's / early 2000's. Over time the Australian approach to IMPs evolved to a more holistic, integrated approach addressing all vectors, with the establishment of the National Taskforce on the Prevention and Management of Marine Pest Incursions (the National Taskforce) in August 1999, and the development of a National System for the Prevention and Management of Marine Pest Incursions (the National System). The National System is a collaboration between the Australian Government, State and Northern Territory governments, marine industries, researchers, conservation groups and the wider community.

The National System

The National System consists of three components:

- Prevention: Prevention systems to reduce the risk of introduction and translocation of marine pests;
- Emergency response: A coordinated emergency response to new incursions and translocations;
- Ongoing control and management: Managing introduced marine pests already in Australia.

Prevention: The prevention element of the National System has two main aspects: international or incursion risks to Australia and domestic or translocation risks within Australia. Strategies to minimise these risks are aimed at managing all potential vectors by addressing the ballast water and biofouling risks for commercial shipping; biofouling risks for all vessels, including recreational and fishing vessels, marine aquaculture operations, the aquarium trade and port, harbour and marina facilities.

Emergency response: The emergency preparedness and response element aims to contain or eradicate any new marine pest incursions to Australia. These efforts are coordinated by the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE). CCIMPE responds to new incursions or significant new translocations of introduced marine pests of concern. It does not cover freshwater pests or native (non-introduced) marine pests. Funding for these eradication responses are split on a 50/50 basis between the Australian Government and the State and Northern Territory Governments.

Ongoing management and control: The development of the ongoing management and control element of the National System is coordinated by the Department of the Environment and Heritage. This element aims to contain and control any introduced marine pests that have established viable populations within Australia and are having, or are expected to have a significant impact on the marine environment, industry or human health. A key element of ongoing management and control is the development of National Control Plans that are administered and funded by the State and Northern Territory Governments, but whose development is coordinated at a national level. A tender process has commenced under the National System to select consultants to develop business cases for Control Plans for 11 species that have been identified as having a potential or actual significant impact on the marine environment or industry. These business cases will outline the elements of each potential Control Plan and will be part of intergovernmental decision–making about which species will be controlled. The National Control Plans will provide key information for managing marine pests including control measures, objectives and actions for

pest control, research and development and administrative arrangements for implementing a national approach. The implementation of National Control Plans will ensure that the environmental, social and economic impacts associated with a pest introduction, are managed cost effectively.

Supporting activities: The National System includes a number of other components required to support the development of the three main elements. These include the statutory framework, funding arrangements and strategies for:

- Research and Development: targeted research to underpin policy and management
- Ongoing monitoring
- Communications: industry and community awareness and education
- Evaluation and Review: evaluating the effectiveness of the National System

High Level Officials Working Group (HLG)

To agree overall funding, governance and legislative structures for the proposed National System, a High Level Officials Working Group (HLG) was formed in November 2002. The HLG was charged with recommending a way forward on governance and funding for consideration by the Natural Resource Management Ministerial Council (NRMMC) and the Australian Transport Council (ATC). The HLG comprised high-level officials in the Australian, State and Northern Territory Governments as well as a representative from the CSIRO.

The HLG recommendations on governance, funding, legislation and stakeholder elements were endorsed by the NRMMC in October 2003. The key recommendations of the Group included:

- the Australian Government will be responsible for the management of international incursions;
- the State and Northern Territory Governments will be responsible for the management of domestic translocations through agreed model legislation for domestically sourced ballast water, or agreed codes of conduct, protocols and guidelines for other vectors;
- the National System will describe management for all vectors of marine pests;
- the current interim arrangements for emergency management will become the permanent arrangements, although the basis for calculating state and territory government and industry cost sharing arrangements is to be finalised and will reflect the approximate public and private benefit derived;
- responsibility for ongoing management and control of introduced marine pests will rest with the state and Northern Territory Governments and will be funded on a beneficiary pays basis, underpinned where relevant with joint industry and government partnership funding, reflecting the approximate public and private benefit derived;
- ongoing monitoring, research and development and communications, and education and awareness are an important part of the National System and should be developed further; and
- there should be an Intergovernmental Agreement to formalise all government responsibilities.

The recommendations are to be implemented by the National Introduced Marine Pests Coordination Group (NIMPCG).

Intergovernmental Agreement

An Intergovernmental Agreement (IGA) on the National System has been signed by the Australian Government and the governments of the states of Victoria, Tasmania, South Australia and the

Northern Territory. The IGA provides a framework for the development of the National System, particularly the allocation of roles and responsibilities between jurisdictions. Implementation of the National System, through the IGA will give effect to the HLG recommendations.

The National Introduced Marine Pests Coordination Group (NIMPCG)

At the National Government level, responsibilities for these matters are shared between DAFF (for incursion prevention and emergency preparedness and response) and DEH (for ongoing management and control of established pest populations). Development of the system for implementation is the responsibility of the National Introduced Marine Pests Coordination Group (NIMPCG). This Group is chaired by DAFF and comprises representatives from:

- State and Northern Territory Governments
- Australian Government Departments (the Departments of Agriculture, Fisheries and Forestry (including the Australian Quarantine and Inspection Service), Transport and Regional Services (including the Australian Maritime Safety Authority), Environment and Heritage and Defence)
- Industry stakeholders such as the ports, shipping and fishing industries
- Scientific and research institutions (including CSIRO)
- Conservation and environmental groups

The Invasive Marine Species Program (IMSP)

Within DAFF, the IMSP is primarily responsible for policy development for the arrangements for minimising the risk of marine pest introductions to Australia. The IMSP is assisting AQIS with the refinement of ballast water management for international shipping through the Australian Government *Quarantine Act 1908*. Together with AQIS, the IMSP is also developing proposals and regulations for the management of international incursion biofouling risks from commercial shipping, recreational vessels and apprehended and suspected illegal entry vessels and foreign fishing vessels. The IMSP is also addressing the management of aquaculture food and product imports and aquarium trade risks.

Australia's national ballast water management arrangements

Regulations for the management of internationally sourced ballast water including port-to-port trade are in place through the Australian Government *Quarantine Act 1908* and apply to all ships arriving from overseas. Compliance with requirements is examined at the proclaimed first port of entry for ships. These arrangements provide for management of the discharge of ballast water of international origin in ports identified in the voyage plan. The management arrangements include ballast water exchange (in accordance with the IMO Guidelines) en route or undertaking a marine pests risk assessment of the voyage and exchange of ballast water assessed as high risk. Information and instructions on how Australia's ballast water management requirements operate is contained in the "Maritime Awareness Kit" that is available through the DAFF website pages relating to AQIS – www.daff.gov.au/corporate_docs/publications/html/quarantine.

The risk assessment assesses the risk of a marine pest introduction through a ship's ballast water. The assessment is provided by the International Ballast Water Decision Support System (DSS) which bases the risk on a number of factors including species present at origin and destination ports, journey survival and species survivability. The DSS currently assesses the risk for 12 pests that are listed as pests of concern for Australia.

Domestic ballast water arrangements are not yet in place and when implemented they will be consistent with the International Convention for the Control and Management of Ships' Ballast

Water and Sediments. A risk assessment is also likely to become part of new arrangements for the management of ballast water between Australian ports being developed under the National System. A Single National Interface will be established to provide a single point of contact for all ships entering Australian waters and operating on voyages between Australian ports. The interface will allow them to access and obtain guidance regarding the ballast water management requirements for their voyage to and within Australia. This interface will remove any need for ships to contact each state whose ports they will visit to determine the exchange requirements.

At present ballast water exchange areas are not recorded however Australia will be investigating the designation of areas for ballast water exchange in the context of the IMO ballast water Convention. The CSIRO have completed a report: *Mapping the Australian Ballast Water Uptake and Discharge Contingency Zones* that considers where it might be appropriate to establish designated areas for exchange within Australian Waters (an electronic version is included as an attachment). However, consideration of this issue is still at a preliminary stage in Australia and no decisions have yet been taken.

Australia has signed the Convention, subject to ratification, and is considering ratification of the Convention through the normal ratification procedures. Australian Government agencies are currently examining changes that may be required to legislation and administrative provisions to give full effect to the Convention.

Australia's management of biofouling risks

Measures to manage the risks of international incursions of biofouling pests from recreational vessels, apprehended and suspected illegal entry vessels and foreign fishing vessels are being developed under Australian Government law. They will be based on an appropriate range of regulations, biofouling certification, codes of conduct, protocols and guidelines, which will aim to manage the risk posed by biofouling.

Australia believes that there may be benefit in considering an international instrument to manage the risks of biofouling pests being translocated via international commercial shipping and other vessels moving internationally. Other vector risks such as aquaculture food and product imports and aquarium trade risks will also be addressed and will be managed through the development of appropriate instruments.

Draft protocols and guidelines have been developed to cover some of the potential biofouling vectors. The protocols for international vessels less than 25 metres, aquaculture and fishing are likely to be of interest in developing the SPREP strategy.

A risk assessment will be undertaken to analyse biofouling risks for commercial shipping. Collaboration with New Zealand will be an important component of managing biofouling of commercial ships.

To manage biofouling risks associated with the international yachts and other small international vessels, protocols have been developed and a brochure has been produced (available through AQIS on the DAFF website). Australia is currently considering regulatory requirements to be able to implement the guidelines through the *Quarantine Act 1908*. A further project will investigate management options for biofouling of the internal seawater systems of international vessels less than 25 metres.

Draft guidelines for the management of biofouling risks have been developed for the fishing industry. These guidelines deal with biofouling risks from both fishing vessels and the associated

gear and equipment used in the fishing industry. The guidelines cover best management practices that should be implemented to minimise marine pest translocation risks in these areas.

Australia also has a *National Policy for the Translocation of Live Aquatic Organisms* that establishes arrangements to reduce the risk of aquatic species becoming established as pests.

c) Canada

The introduction of IMPs into waters under Canadian jurisdiction by the shipping vector has been an issue for the Canadian Public and Transport Canada since zebra mussels and ruffe were first found in the Great Lakes in the mid 1980's. As a direct answer to these introductions, Transport Canada, after consultation with the United States Coast Guard (USCG), the Great Lakes Fisheries Commission, scientists and other stakeholders, brought forth non-regulatory *Ballast Exchange Guidelines for the Ships heading for the Fresh Waters of the St. Lawrence River and the Great Lakes*. In these guidelines, ships were asked to exchange ballast outside the 200 nautical mile Exclusive Economic Zone (EEZ) prior to entry into Canadian waters and report to Vessel Traffic Services that they had done so. These Guidelines became the basis for the USCG's mandatory regime for the Great Lakes, promulgated in 1993 and still in effect. On the international front Canada, Australia and the US presented the problem to IMO. In 2001, Canada expanded its non-regulatory Guidelines to include all waters under Canadian jurisdiction.

Since adoption of the IMO BW Convention in February 2004, Transport Canada is taking action to incorporate its Guidelines into a regulatory format under the *Canada Shipping Act*, and a number of the provisions of the BW Convention are to be incorporated into this regulation.

As part of these initiatives, Transport Canada is conducting an overall ballast water risk assessment for the Great Lakes and Gulf of St Lawrence, using methods similar to those developed by the IMO – GloBallast Programme, and is also developing a Decision Support System (DSS) that can be used to assess the risks associated with individual ships on specific voyages, similar to that used by Australia (see above).

Various groups in Canada have also been active in research and development (R&D) of ballast water treatment technologies and in researching the biology, ecology and impacts of IMPs.

At present Canada does not have a national management regime for the fouling vector.

Port of Vancouver

In the absence of a national management regime for shipping-related vectors, in 1996 the Vancouver Port Corporation (VPC) unilaterally implemented a Standing Order which makes it mandatory for all vessels destined to arrive at the Port of Vancouver in ballast condition to carry out mid-ocean ballast water exchange prior to arriving in Canadian waters.

Other features of the VPC regime are:

- The Harbour Master (or representative) can inspect log books to check relevant details, including the position of ballast exchange and the amount and source of ballast water.

- Ships which do not comply with the requirements may not discharge ballast into the port until testing of the ballast is conducted. If the ballast water is found to not meet VPC standards the ship must leave port and exchange ballast on the outgoing tide outside the port.

- Certain exemptions apply (eg. ships from the local region, safety factors).

d) Chile

Motivated primarily by concerns over increasing observations of harmful algae blooms off its coasts and the potential threats these pose to the country's extremely valuable and rapidly expanding aquaculture industry, in [insert year] Chile enacted [insert name of act / reg]. These regulations require ballasted ships to undertake ballast water exchange at sea prior to entering Chilian ports, and to record and report relevant data, consistent with IMO requirements. Chile is also an Observer on the GloBallast Regional Task Force established for the MERCOSUR Region on the east coast of South America (Brazil, Paraguay, Uruguay and Argentina), and co-hosted with Australia the two APEC IMP workshops referred above. At present Chile does not have a national management regime for the fouling vector.

e) China

As with most countries in the world, prior to the late 1990's IMPs were generally not considered to be a significant issue by authorities in the People's Republic of China. However, China's active participation in IMO affairs in general, its status as one of the World's major maritime Nations and its strategic geo-political position in Asia, led in 1998 to an invitation for the country to take part as a Pilot Country in the GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast), together with five other countries in similar positions in their respective regions (Brazil, India, Iran, South Africa and Ukraine) (see Section 1.6). The GloBallast demonstration site was established at the port of Dalian in north-east China and the activities outlined in section 1.6 ran over a five year period from the beginning of 2000 to the end of 2004.

As a result of the GloBallast Programme, the ballast water issue is now a high priority in China. The China Maritime Safety Agency is designated as the Lead Agency for the issue, an enduring inter-ministerial, cross-sectoral National Task Force has been formed to develop and coordinate a National Strategy and Action Plan, and Central Government has allocated funds to replicate the technical demonstration activities carried out at Dalian, at other ports in China (including biological baselines surveys, risk assessment, ballast water sampling and education and training). The Chinese Government is also moving to ratify the IMO BW Convention and develop relevant National legislation.

Of significant relevance to SRIMP-PAC, in 2004 China moved from being a recipient of funding and technical assistance from the IMO-GloBallast Programme, to become regional donor, using its own resources to fund representatives from the 10 ASEAN countries to participate in a standard GloBallast training course in Beijing. In 2003, a representative from the GloBallast Progarmme in China attended the SPREP-PACPOL workshop in Tahiti, to share experience and perspectives with PICTs. China has also spearheaded, through GloBallast, the formation of a Regional Task Force and the development and adoption of a Regional Action Plan for ballast water control and management, involving the countries of East Asia.

The experience gained by China through the GloBallast Programme may be of significant value to PICTs, and SPREP should work with IMO and the Chinese Government to identify and develop cooperative activities under SRIMP-PAC.

At present China does not have a national management regime for the fouling vector.

China and its surrounding seas are a major concentration point for shipping activity, with perhaps some of the highest densities of shipping in the Pacific Region (Figure 2). China is also a major importer of bulk products, including large quantities of oil, coal, iron ore and other raw materials, and is therefore a major exporter of ballast water. The frequency and volumes of ballast water exports from China are increasing rapidly, as the import of raw materials increases to fuel the rapidly growing Chinese economy. A large number of marine species have been introduced from north-east Asian waters to other parts of the world, including to other Pacific-Rim countries with similar environments (Southern Australia, New Zealand, Chile and north-west North America), ands a number of these have become invasive pests. North-east Asia is therefore an important focal area for efforts to prevent the uptake of marine species at their points of origin / source ports.

f) Japan

Japan currently does not have a national regime specifically addressing shipping-related IMP vectors, however in June 2004 legislation dealing with invasive species in general was passed by the Japanese Parliament - the Diet – in the form of the *Invasive Alien Species Act* .

The Act is terrestrially-focused but does include aquatic species and impacts on aquatic ecosystems. It explicitly includes impacts on fisheries, although it is not clear how it might apply to shipping, hull fouling and ballast water.

The Act addresses *officially designated Invasive Alien Species.* These are stipulated by Cabinet Ordinance, to exist outside their original habitats as a result of introduction into Japan, and that are recognized or feared to cause adverse effects on Japanese ecosystems, because of their different properties from organisms having original habitats in Japan.

Given the huge range of aquatic organisms that are potentially introduced through shipping (including hull fouling and ballast water), and the limited understanding of their taxonomy, biogeography and potential impacts, it is not clear how such designation might be carried out in relation to Invasive Alien Species transferred by these aquatic vectors.

The Act includes a ban on "importing" designated Invasive Alien Species, although it is not clear if introduction through ballast water discharge or hull fouling would be considered "importing." Further information is available at www.env.go.jp/en/topic/as.html.

Additionally, Japan was very active in the IMO negotiations to develop the BW Convention, is a member of the Regional Tasks Force established by GloBallast for East Asia and has also been active in research and development (R&D) of ballast water treatment technologies. The Ministry of Environment in Japan commenced a major project in 2004, aimed at researching the presence, distribution and impacts of IMPs in Japanese waters.

As with China, Japan and its surrounding seas are a major concentration point of shipping activity, with perhaps some of the highest densities of shipping in the Pacific Region (Figure 12). Japan is also a major importer of bulk products, including large quantities of oil, coal, iron ore and other raw materials, and is therefore a major exporter of ballast water. A large number of marine species have been introduced from Japan and other north east Asian waters to other parts of the world, including to other Pacific-Rim countries with similar environments (Southern Australia, New Zealand, Chile and north-west North America), and a number of these have become invasive pests. As outlined for China above, Japan is therefore an important focal area for efforts to prevent the uptake of marine species at their points of origin / source ports (see Section 2.6.1).

g) New Zealand

Like Australia, New Zealand has suffered a number of significant marine bio-invasions, including several north-Asian species such as the Wakeme kelp *Undaria pinnatafida* and several introduced species of harmful planktonic algae. The New Zealand response to marine bio-invasions has been developed within an integrated biosecurity framework, addressing all vectors and adopting a logical, "layered defense", involving:

- Pre-border management measures (incursion prevention)
- At-border management measures (incursion interdiction)
- Post-border management measures (incursion response, control and mitigation)

(SRIMP-PAC proposes that "layered defence" be adopted by PICTs).

Ballast water discharges are regulated in New Zealand under the *Biosecurity Act*. Relevant vessels are required to undertake ballast water exchange at sea (or equivalent treatment), arriving ships must submit Ballast Water Reporting Forms and Port State Control inspectors have relatively strong powers, including to sample ships' ballast tanks.

New Zealand has undertaken major research into the fouling vector and is now developing a national fouling management regime.

The Ministry of Fisheries, through the National Institute for Water and Atmospheric Science (NIWA – www.niwa.co.nz), has implemented a major national programme of IMP surveys and monitoring, and the Cawthron Institute in Nelson (www.cawthron.org.nz) has been active in aquatic biosecurity research, including the development alternative ballast water treatment methods. New Zealand was one of the fist countries in the world to begin to develop control plans for existing marine bio-invasions, in particular the *Undaria* seaweed.

In August 2003 the NZ Government began to implement the *Biosecurity Strategy for New Zealand*, and the Ministry of Agriculture and Forestry (MAF) was assigned responsibility for "end-to-end" management of the national biosecurity system. Accordingly, marine biosecurity functions were transferred from the Ministry of Fisheries to MAF in late 2004. Priority activities include:

- Implementing the IMO Ballast Water Convention in New Zealand
- Increasing capacity and capability for marine biosecurity, by way of:
    - Species and vector-based risk profiling and mapping
    - Research to support development of ballast water compliance verification tools
    - Research to substantiate the risk from hull fouling
    - Development of databases
    - Additional surveillance and baseline survey activity.

h) Singapore

Singapore currently does not have a national regime specifically addressing shipping-related IMP vectors. However, Singapore was very active in the IMO negotiations to develop the BW Convention, is a strong supporter (including co-sponsor) of the IMO – GloBallast Programme, is a member of the Regional Tasks Forces established by GloBallast for both South and East Asia, has been and continues to be very active in R&D of ballast water treatment technologies, and is working to include ballast water activities on the agenda of the ASEAN Marine Science Committee.

Singapore is one of the largest and busiest ports in the World located at the cross-rods between the Pacific and Indian Oceans, and many ships trading to and from the Pacific call at Singapore. As a major maritime centre Singapore is uniquely placed to play a major role in addressing the issue of

shipping-related IMPS, including through regional frameworks such as those of the IMO-GloBallast Programme, ASEAN, APEC and SRIMP-PAC.

i) USA

The USA has been particularly hard-hit by IMPs. At least 4,500 species of foreign origin have established free-living populations in the US since European colonisation (Office of Technology Assessment 1993). Local examples of the severity of the problem include 30 foreign species identified from just a single, small estuary in Coos Bay, Oregon (Carlton 1991) and at least 136 foreign species being present in the Great Lakes, including the now infamous the European zebra mussel (Mills et al 1991). The economically significant Gulf of Mexico shellfish industry was recently threatened when cholera was transported to Alabama in ship's ballast. Kiernan (1993) estimates that the total damages bill for all foreign marine species introduced to the United States this century amounts to US$97 billion.

The US has developed specific legislative responses to this issue, the *Non-indigenous Aquatic Nuisance Prevention and Control Act 1990* (NANPACA), passed primarily in response to concerns about the zebra mussel infestations in the Great Lakes and the *National Invasive Species Act 1996*, which takes a national approach and which amends the former Act. A significant feature of the US approach is its holistic nature, where all potential vectors, not just ships vectors such as ballast and fouling, are considered. From a scientific, ecological and management perspective this may be the most logical and effective approach.

Under NANPACA a National Aquatic Nuisance Species *Task Force* and a National Aquatic Nuisance Species *Program* have been established. The role of the Task Force is to coordinate Federal government efforts with those of the states and private sector. It is chaired jointly by the US Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, with the US Coast Guard also playing a key role as the primary regulator of shipping.

The goals of the Aquatic Nuisance Species Program are:

- Reduce the risk of or prevent the unintentional introduction and dispersal of non-indigenous aquatic species.
- Ensure prompt detection of the presence of and monitor changes in the distribution of non-indigenous aquatic species that may become nuisances.
- Control established aquatic nuisance species in a cost-effective, environmentally sound manner.

In order to achieve these three goals, the Program consists of four main components; Core Elements, Support Elements, Zebra Mussel Program and Related Activities. Each of these is summarised below.

Core Elements.

> **Prevention:** Establish a systematic risk identification, assessment and management process to identify and modify *pathways* by which non-indigenous aquatic species can be introduced and spread.
>
> **Detection & Monitoring:** Create a National Information Centre to coordinate efforts to detect the presence and monitor distributional changes of all non-indigenous aquatic

species, identify and monitor native species and their effects, and serve as a repository for that information.

Control: The Task Force or any other potentially affected entity may recommend initiation of a non-indigenous aquatic species control program.

Support Elements

Research: Coordinate research, including identification of priorities. Establish and implement research protocols and allocate funding for competitive university research grants consistent with national needs and priorities.

Education: Encourage and facilitate efforts to inform and educate a wide range of audiences about the issue.

Technical Assistance: Ensure coordinated application of existing capabilities.

Zebra Mussel Program

National Program: Ensure coordination between the wide range of governments and other entities and interests addressing the infestation and timely synthesis and dissemination of information about zebra mussel control.

Public Facility Research & Development Program: Develop methods, through the US Army Corps of Engineers, to prevent and control infestations associated with public facilities.

Related Activities

State Management Plans & Grants: Review aquatic nuisance species management plans submitted by States according to nationally consistent guidelines. Fund matching grants for the States to implement approved management plans.

Ballast Water & Shipping Initiatives: *Voluntary* ballast exchange guidelines for ships entering the St Lawrence River from the high seas were jointly issued by the US and Canadian Coast Guards in March 1991. *Mandatory* ballast water regulations for vessels entering US ports in the Great Lakes after operating on the high seas took effect in May 1993. A study to evaluate introduction of foreign species by shipping into US waters other than the Great Lakes was completed in 1994. The US Coast Guard requested voluntary compliance with the IMO ballast water guidelines for all ships entering US waters other than the Great Lakes and this was strengthened in 1996 with the introduction of the NISA in 1996, which introduces specific controls on ships ballast water management (see below).

Some important features of the US Aquatic Nuisance Species Program are:

- The fact that it is mandated by Federal legislation (ie NANPACA).
- A focus on all non-indigenous aquatic nuisance species, not just marine species nor just species carried in by ships' ballast water.
- An initial focus on the Great Lakes, followed by an expansion to all shipping entering all US waters.

- An initial reliance on voluntary guidelines, both for the Great Lakes and for broader US waters, followed by a move to mandatory controls.

- Reliance on reballasting/ballast exchange, under both the initial voluntary guidelines and subsequent mandatory controls, as the primary ballast water management measure, as per the IMO approach.

- A focus on "nuisance" species, with nuisance species defined as those that "threaten the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural or recreational activities dependant on those waters" (Aquatic Nuisance Species Task Force 1994).

With the introduction of NISA in 1996, NANPACA was amended and strengthened in relation to shipping and the ballast water vector. NISA generally confirms the Ballast Water & Shipping Initiatives under the National Aquatic Nuisance Species Program, in that ships entering US ports from outside the US Exclusive Economic Zone were initially subject to voluntary guidelines requiring reballasting/ballast exchange at sea, and stringent record keeping and reporting. Ships may submit alternative methods of ballast management to the US Coast Guard for approval, and substitute these for ballast exchange at sea if approved.

Under NISA, compliance with the voluntary guidelines was closely monitored for several years (from 1996), and in 2004 the guidelines became mandatory regulations administered by the US Coast Guard with significant criminal penalties.

Other significant features of NISA include mandating the funding of education and research and the establishment of a ballast water treatment R&D projects. The US has been particularly active in R&D of new and more effective ballast water treatment technologies, with large number of both Government-funded and private projects underway. The US has also been very active in seeking to establish ballast water treatment standards, both within the US and through the IMO BW Convention, and to develop standardized testing protocols and verification procedures for new treatment technologies. If this R&D effort is successful, it promises to offer an actual technological solution to the ballast water problem, which could be adopted as compulsory treatment methods under NISA.

In addition, significant scientific research on the ecological aspects of biological introductions is being undertaken in the US by institutions such as the Smithsonian Environmental Research Centre (SERC), and SERC administers the National Ballast Information Clearing House (www.serc.si.edu/labs /marine_invasions).

j) US West Coast States, Hawaii & Pacific Island Territories

In addition to the overall National approach, NISA requires individual States to develop aquatic nuisance species management plans according to nationally consistent guidelines, and over and over and above this, a number of US States, including those on the West Coast (California, Oregon and Washington) have developed their own legislation and/or programmes on ballast control and management.

These are by and large consistent with both the US National and IMO regimes, requiring *inter alia*, ships to carry out ballast water exchange at sea and to record and report certain details to State authorities.

As a US State, Hawaii has an aquatic nuisance species programme (http://anstaskforce.gov/hawaii), and the US National ballast water requirements are applied there by the US Coast Guard (as they are in the US Pacific island territories that are direct members of SPREP – American Samoa, Guam and Northern Mariana Islands). The proximity of Hawaii to the SPREP region and the presence of US Coast Guard regulatory functions in the US Pacific island territories present a significant opportunity for cooperation and coordination with the rest of the region, through SRIMP-PAC.