



SPREP



IMO

## SRIMP-PAC

# Shipping-related Introduced Marine Pests In the Pacific Islands: **A regional strategy**

(As Endorsed by the 17<sup>th</sup> SPREP Meeting,  
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*“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

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### 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 infrastructure 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 21<sup>st</sup> 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 favoured 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 *Chthamalus proteus*, several macro-algae species, harmful planktonic algae species and the Black Striped Mussel *Mytilopsis 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 Members of the Pacific Regional Environment Programme have 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 Pacific Ocean Pollution Prevention Programme (PACPOL), and is funded by the International Maritime Organization (IMO). It aims to assist PICTs to protect their marine environments from shipping related marine bio-invasions. The two key vectors that are being targeted are ships' ballast water and vessel fouling, with particular emphasis on cruising yachts, that visit the region in significant numbers.

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 assist Pacific Island Countries to ratify and implement the new IMO Convention on Ballast Water Management
- 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 Defence**

The SRIMP-PAC Strategy is based on the 'layered defence' approach, 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 layered defence approach 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. However it is recognised that despite best pre-border efforts, some IMPs will arrive at Pacific island ports, and 'at-border' interdiction efforts are 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 Co-ordination Body 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-disciplinary 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 to address IMPs. These include:

- 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\$3.9 million over five 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 make such an investment highly worthwhile.

Extension of an IMP management regime over the Pacific Islands region will also have major benefits for the larger economies of the Pacific-Rim, in terms of increased protection of their resources and ecosystems. Pacific-Rim countries will be approached to become active partners in 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**

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The following organisations 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.
- Council of Regional Organisations in the Pacific (CROP) colleagues.
- SPREP Staff for their support, advice and guidance during the development of the Strategy.



## ACRONYMS

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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)

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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 Species Act (USA)
NIWA	National Institute of Water and Atmospheric Science (NZ)
NRMMC	Natural Resource Management Ministerial Council (Australia)

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NTF	National Task Force
NZ	New Zealand
NZAid	New Zealand Agency for International Development
PAC-IMPIS	Pacific Introduced Marine Pests Information System
PacMA	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

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

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

<b>Risk management</b>	The organisational framework and activities that are directed towards identifying and reducing risks.
<b>Ship (vessel)</b>	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.
<b>Translocation</b>	The transfer of an organism or its propagules into a location outside its natural range by a human activity.
<b>Unintentional introduction</b>	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).
<b>Vector</b>	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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# **THE SRIMP- PAC STRATEGY**

## **1. Introduction – the Issue**

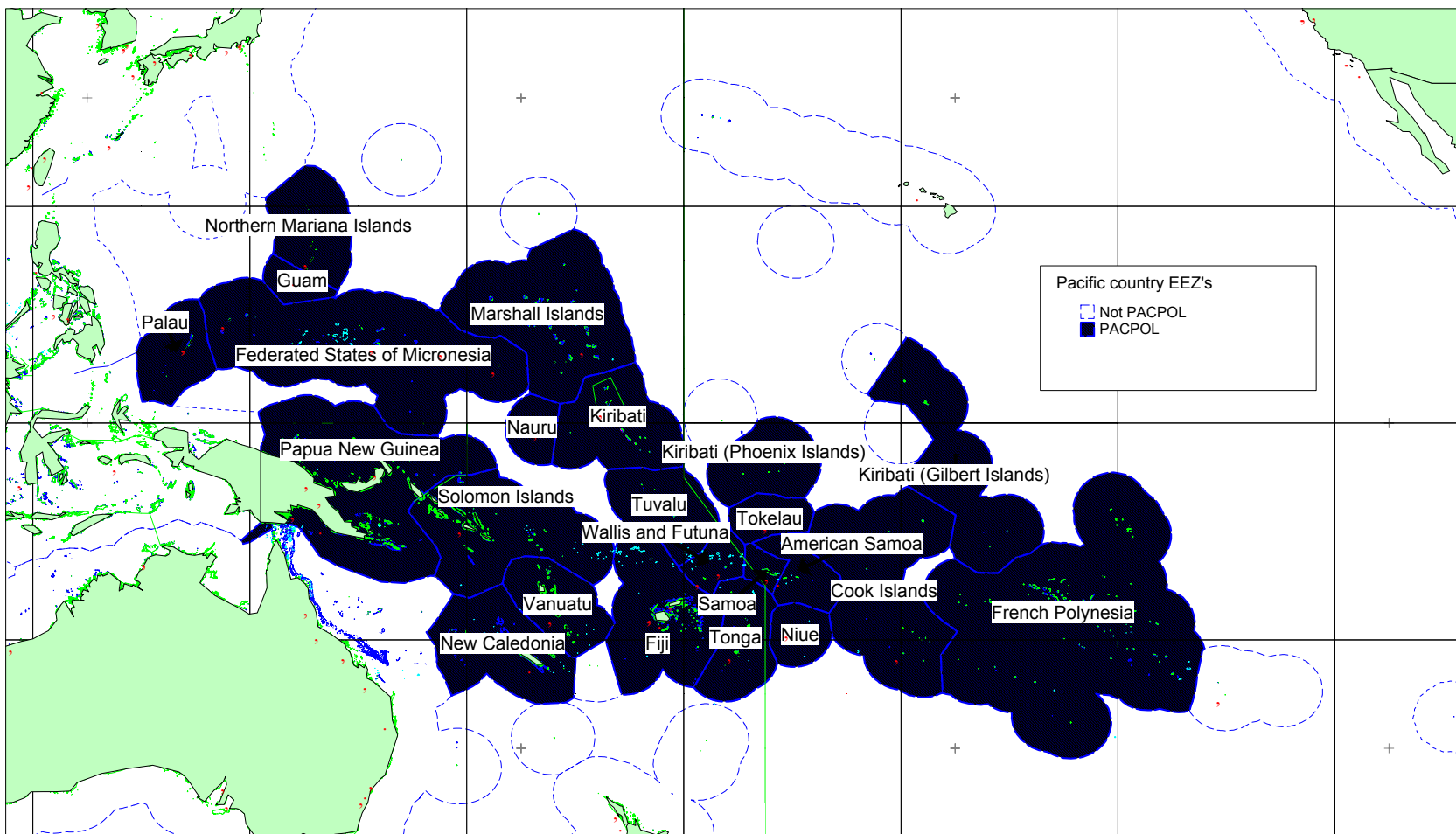
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The importance of coastal and marine environments to every aspect of the lives of Pacific Islanders cannot be overstated. Pacific Island Countries and Territories (PICTs) maintain resource rights and management responsibilities over 30 million square 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.

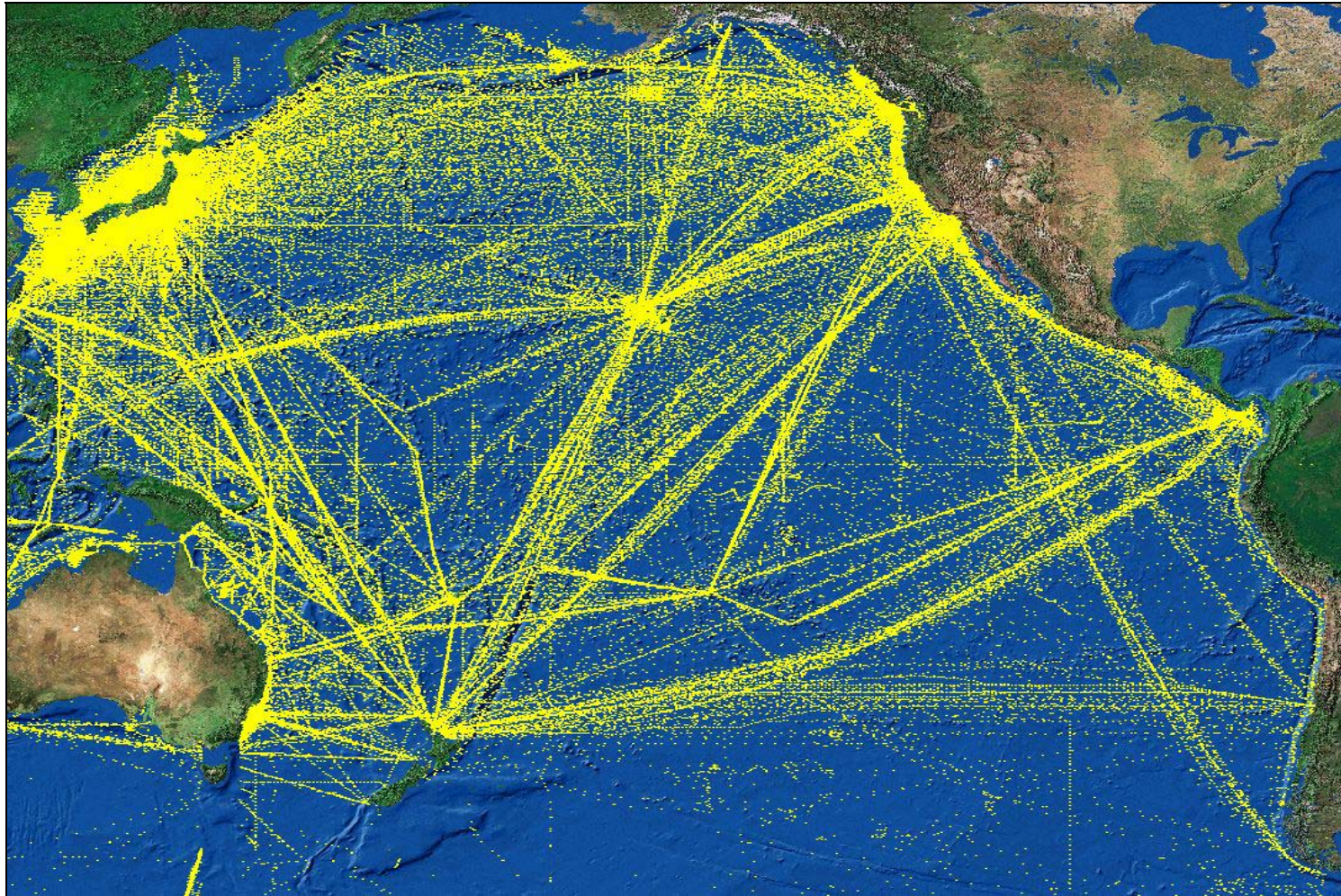
Over the last fifteen years, the introduction of exotic (non-native) species to new environments by human activities, both intentionally and accidentally, has been identified as a major and increasing concern. Marine bio-invasions, including via vessel-related vectors such as ballast water and hull fouling, have been identified as one of the four greatest threats to global marine bio-diversity and ecosystems (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 infrastructure 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 21<sup>st</sup> 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.

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 *Mytilopsis 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 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 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.

**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	Tokelau Islands (NZ)	
Niue	Wallis & Futuna (France)	
Palau		
Papua New Guinea		
Samoa		
Solomon Islands		
Tonga		
Tuvalu		
Vanuatu		

SPREP members endorsed the Regional Invasive Species Strategy in 2000. The Regional Invasive Species Strategy does not address marine species but it recognized the need to develop a separate but complementary Strategy for marine invasive species. This *Regional Strategy on Shipping-Related Introduced Marine Pests in the Pacific Islands Region* (SRIMP-PAC) is designed to fill that gap and to complement the existing Regional Invasive Species Strategy.

The SRIMP-PAC Strategy addresses shipping-related vectors only (vessel fouling and ballast water). 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. Additionally, SRIMP-PAC is restricted to the marine (saltwater) environment, given the overwhelmingly marine nature of the Pacific Islands region, the fact that the freshwater ecosystems in the region are highly unlikely to receive biological invasions through shipping vectors and that the existing Regional Invasive Species Strategy covers fresh water species.

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 GEF / UNDP / IMO *GloBallast Partnerships* project.

### **3. The Need for a Regional Strategy**

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The trans-boundary nature of shipping and the inter-connectedness of seas and oceans dictate that no one port or country can on its own effectively control the spread of shipping related IMPs. 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 endeavour, 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 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 of the region.

A significant feature of shipping in the Pacific Islands is transit ships trading between the major economies of the Pacific-Rim, that pass through their 200 nautical mile Exclusive Economic Zones. The need to address biological invasions at-source, requires the SRIMP-PAC Strategy to be coordinated with relevant activities of the Pacific-Rim countries, including through forums such as APEC Heads of Maritime Meetings.

Further, it is worth noting that the 2000-2004 1<sup>st</sup> 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 2<sup>nd</sup> phase of this programme, called *GloBallast Partnerships*, 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 Partnerships*.

### **4. Strategy Development – Outline of Approach**

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

The background research and drafting of the strategy document was carried out by a SPREP consultant (Steve Raaymakers - EcoStrategic Consultants) with support from and managed by the SPREP Marine Pollution Adviser (Sefanaia Nawadra). There was significant input and assistance from individuals and parties consulted during the drafting process.

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”. Technical consultations with the responsible maritime sector authorities in SPREP Member Countries were carried out through a joint working group of the Pacific Maritime Association (PacMA) and the Association of Pacific Ports (APP).

Given that the management of marine invasives is a relatively new issue for PICTs, development of the Strategy also involved wide consultations with organisations that have management and technical expertise in this area. These included other regional organizations, APEC, relevant ministries, institutions, organizations and individuals in Pacific-Rim countries, the IMO- GloBallast Demonstration Site in China, various UN agencies including IMO, 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.

Strategy development was divided into eight discrete steps, as outlined below.

- Step One: Information gathering / background research
- Step Two: Initial Consultations with individuals and agencies
- Step Three: Produce First Draft
- Step Four: Review by SPREP
- Step Five: Produce Second Draft
- Step Six: Review by Technical Groups and agencies
- Step Seven: Produce Final Draft and formally circulate to countries
- Step Eight: Formal Discussion with view to endorsement at 17<sup>th</sup> SPREP Meeting

## **5. Aim & Objectives**

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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**

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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) has a general provision in Article 4 that “*Parties shall endeavour to conclude agreements.... for the protection, development and management of the marine and coastal environment*” and Article 6 addresses discharges from vessels.
- 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 endeavour, 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**

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### **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 Exclusive Economic Zones (EEZs) of the 21 PICTs that are members of SPREP.

In addition to the PICTs, there are four developed countries that are members of SPREP (Australia, France, New Zealand and USA - Table One). These countries are referred to as SPREP non-island or metropolitan members and are key partners in 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**

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

- **Ecosystem Approach:** The majority of major aquatic bio-invasions 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 Approach (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 Approach:** As agreed in the Rio Principle 15 and at the World Summit for Sustainable Development (WSSD) the Precautionary Approach shall be applied by countries according to their capabilities, so that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation by marine pests.
- **Layered Defence:** The Strategy is based on the approach of ‘layered defence’ (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 layered defence approach 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 approach 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 'three-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**

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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, coordination at the regional level, 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 Co-ordination**

It is vital that SRIMP-PAC is not just a SPREP initiative but 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 is best achieved through the formation of a co-ordinating body, which meets at least annually.

For cost-effectiveness oversight of SRIMP-PAC would be through the SPREP Meeting. Regional co-ordination of activities would be carried out in conjunction with and/or as part of other relevant regional groups such as PacMa, APP, the CROP Marine Sector Working Group, APEC Heads of Maritime Meeting and the Nature Conservation Round Table. The SPREP Marine Pollution Adviser would be responsible for co-ordinating submissions and making presentations to these groups.

Regional co-ordination functions 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 review the overall progress of SRIMP-PAC against its stated aim and objectives, and recommend any necessary changes and realignments to the SPREP Meeting.

### **9.1.3 Ad-hoc Technical Advisory Group**

Issues may arise that necessitate the convening of ad-hoc technical advisory groups to guide the implementation of various SRIMP-PAC activities. The composition of the Advisory Group will be approved by the SPREP Meeting and would depend on the technical and management needs of the issues at hand. Membership of the Group would be drawn from all stakeholders including member governments, CROP, UN agencies, academic and research institutions, industry associations and NGOs. The recommendations of the Advisory Group are to be submitted to the SPREP Meeting.

#### ***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) as the focal point for 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. Other government ministries, departments and agencies must also play a role and assume certain responsibilities for IMP prevention, control and management.

##### ***9.2.2 National Task Forces***

To ensure an integrated approach to IMP prevention, control and management, a multi-disciplinary National Task Force (NTF) should be formed in each country and territory. Recognizing the capacities and resources available in PICTs, the NTF could be integrated into

existing groups such as the national marine pollution committees. The NTF should comprise agencies such as:

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

The functions of 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 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.

## **10. Foundation Activities**

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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.

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.
- Development of awareness materials on both the ballast water and hull fouling issues.
- Running a series of awareness and training workshops for all stakeholders throughout the region.
- Including IMP issues in various regional newsletters and print media.
- 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.

## **10.2 Risk assessment**

No invasive marine pests risk assessment has been carried out for the Pacific islands region or for any country or port within the region. These need to be carried out to provide a baseline in order to guide required interventions and against which to measure the effectiveness of SRIMP-PAC activities.

### **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.

### ***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 that 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.

## ***10.3 Surveys & monitoring***

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.

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). 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.

The CRIMP protocols 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.

The Bishop Museum in Hawaii has developed its own methodology to undertake surveys throughout Hawaii, Johnston Atoll, Midway Is. and American Samoa. 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 data gap that exists throughout the Pacific islands needs to be plugged, and the SRIMP-PAC Workplan and Budget includes provision for an IMP Survey and Monitoring Programme, based on a combination of methods, as follows:

- Full-scale, comprehensive, CRIMP-style surveys at 'high risk' ports / yacht congregation areas in the region,
- Reduced-scale, less rigorous 'surveillance' surveys using Bishop Museum methods at representative 'medium risk' ports / yacht congregation areas in the region,
- Establishment of SERC-style passive settling plates at representative 'low risk' ports / yacht congregation areas in the region,

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 and the University of Guam 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 constraining 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.

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.

#### **10.4 Legislation and regulations**

Ultimately, for any country to be able to effectively prevent and control IMPs, it must have appropriate national legislation and regulations, and to enable the provisions of international Conventions that it has become a Party. 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 specific legislation or regulations relating to IMPs.

As an initiative under the SPREP / IMO PACPOL programme SPREP and the SPC RMP developed a *Regional Model Marine Pollution Prevention Act - A Template for Pacific Island Countries*. This model legislation was last revised in 2003. 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). However with considerable foresight the model included 'embryonic' sections dealing with these two vectors for shipping-related IMPs (see box).

Now that the IMO BW Convention has been adopted it provides the standard for national legislation. Ideally, IMP legislation and regulations 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 other countries such as Australia and New Zealand are developing legislative arrangements to address biofouling and these will provide guidance for our efforts.

A review of the regional model legislation to bring it up to date with current IMP legal developments is a key activity of SRIMP-PAC. This activity will be carried out in two 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.

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

**Extract from:**

**Regional Model Marine Pollution Prevention Act:  
A Template for Pacific Island Countries.**

**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 (\$250,000).
- (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 defence 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 (\$250,000).

## **10.5 Compliance and enforcement**

Legislations and regulations are of limited value if compliance and enforcement is not effective. 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, we 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 underlying principles of SRIMP-PAC 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.

## **10.7 Information management**

In order for the Strategy to be effective, it is important that good information management supports IMP prevention and control efforts. 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](http://www.marine.csiro.au/crimp/nimpis)) and the US National Exotic Marine and Estuarine Species Information System (NEMESIS – [www.serc.si.edu/nemesis](http://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 section 10.3.

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](http://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.

## **10.8 Cooperation with Pacific-Rim countries**

Most ships, yachts and other vessels that voyage to and through the Pacific Islands originate from Pacific-Rim countries. It is important that activities under SRIMP-PAC are coordinated with these countries, in particular 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.

A review has been carried out to provide an overview of relevant activities of the Pacific-Rim countries that are most active on IMP issues, along with recommendations for. It is recommended that SPREP to seek cooperation with these countries individually or through APEC, this will be done in part through inviting APEC and Pacific-Rim countries to be members of the SRIMP-PAC Ad-hoc Technical Advisory Groups or to attend relevant regional meetings.

## **11. Practical Management Measures**

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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.

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 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 pinnatifida*, which is has been introduced to mainland NZ. While the above Code of Practice is a domestic one there is nothing to prevent PICTs putting in place a regional one. There is a long history of regional co-operation that should assist this approach. Consideration should be given to extension of this into pacific-rim countries though in the absence of an international regulatory regime for the fouling vector, such international cooperation with Pacific-Rim countries may well be difficult to achieve.

It is therefore recommended that under SRIMP-PAC, SPREP Members should work 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.

To demonstrate our commitment to Pacific-Rim countries, PICTs should work to implement fouling prevention and control measures in their own ports, to prevent the spread of IMPs from our own 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.

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 States 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 to 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 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, 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. 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.

### ***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)). 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.

#### **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.

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

Once a foreign marine species establishes in a new environment, efforts need to be 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 could 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, 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](http://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. 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**

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Transit shipping is shipping that travels through our region but does not call at any of our regional ports. 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 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. 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.

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 than 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.

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. Biophysical 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 Solomon Is.).

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**

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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. The SRIMP-PAC Workplan is to be undertaken over 5-years. 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 consultations during the formulation of SRIMP-PAC.

In recognition that it is likely that no one donor will fund the entire programme individual projects or group of projects will be developed into more detailed project proposals with their respective implementation programmes. The intent of the workplan and budget is to define indicative programme of activities and budget.

**Table Two: SRIMP-PAC Workplan**

Programme Area	Project Code & Title	Description	Priority	Funding source*	Models / Expertise sources	Time-line
<b>Institutional Arrangements (IA)</b>	IA1: Programme Coordination	Undertaken by SPREP Marine Pollution Adviser supported by Invasive Species Officer.	Very high	Funded separately as SPREP positions with broader responsibilities.		Ongoing
	IA2: Regional Coordination Meetings	Airfares and DSA for regional meetings 2.4.2	Very high	IMO ITCP?	IMO-GloBallast	Ongoing
	IA3: National Tasks Forces (NTFs)	Regular meetings of the NTF s in each PICT as outlined in section 2.4.2.	Very high	Internal PICT responsibility.	IMO-GloBallast	Ongoing
<b>Communication &amp; Awareness (CA)</b>	CA1: SRIMP-PAC web site.	Establish and maintain IMP page on SPREP web site linked to other relevant sites.	High	AusAID? NZAID?	IMO-GloBallast	Establish 2007. 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.	High.	APEC? Pacific-Rim countries?	IMO-GloBallast	1 <sup>st</sup> half 2007. Ongoing.
	CA3: In-region brochures/posters.	Develop and distribute awareness materials within the region.	High	AusAID? NZAID?	IMO-GloBallast	1 <sup>st</sup> half 2007. Ongoing.
	CA4: Awareness seminars / workshops	Hold 3 sub-regional awareness seminars / workshops (Micronesia,/Melanesia/Polynesia) based on standard GloBallast and GISP courses.	Very high	IMO ITCP?	IMO-GloBallast	June 2007 – Dec 2007

**Table Two: Workplan (continued)**

Project Area	Project Code & Title	Description	Priority	Potential Funding source*	Models / Expertise sources	Time-line
Risk Assessment (RA)	RA1: Overall regional risk assessment.	Carry out overall ballast water and 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.	Very High	AusAID? NZ AID? CIDA?	DAFF CSIRO Cawthron-NZ IMO-GloBallast	June 2007- June 2008
	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	Medium	AusAID? CIDA? APEC?	DAFF CSIRO Cawthron-NZ TransCanada	1st half 2008
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.	High	AusAID? NZ AID? IMO ITCP? IUCN?	CSIRO NIWA-NZ JCU IMO-GloBallast	July 2007 to Dec 2008
	SM2: Bishop Museum surveys.	Survey 4 medium priority reef sites using the Bishop Museum survey protocols. Include capacity building of experts from PICTs.	Medium	US sources?	Bishop Museum Univ. of Guam	July 2008 to July 2009
	SM3: SERC Settling Plates	Establish SERC-style passive settling plates at 4 low priority ports. Include capacity building of experts from PICTs.	Medium	US sources?	SERC	July 2009 to July 2010
	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.	Medium	Census of Marine Life? BioNET?	CSIRO NIWA-NZ JCU	Jan 2008
	SM5: Regional IMP taxonomy initiative.	Hold one marine taxonomy training workshop every 2 years	Medium	Census of Marine Life? BioNET?	CSIRO NIWA-NZ JCU Universities.	July 2008 and July 2010

**Table Two: Workplan (continued)**

<b>Project Area</b>	<b>Project Code &amp; Title</b>	<b>Description</b>	<b>Priority</b>	<b>Funding source*</b>	<b>Models / Expertise sources</b>	<b>Time-line</b>
<b>Legislation &amp; Regulations (LA)</b>	LA1: Regional model IMP legislation	Develop regional model IMP legislation consistent with the IMO BW Convention, UNCLOS and CBD and including the fouling vector.	Very high	IMO ITCP? IMO-GloBallast?	IMO-GloBallast SPC RMP	April 2007 to Sept 2007
	LA2: National legislative reforms	Assist each PICT to enact and implement national IMP legislation consistent with the regional model.	High	SPC RMP?	IMO-GloBallast SPC RMP	Ongoing
<b>Port State Control (PSC)</b>	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 inspectors.	Very high	AusAID? NZ AID? US sources?	DAFF AQIS MAF-NZ USCG	Jan 2007 Ongoing
<b>Ballast Sediments Management (BSM)</b>	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.	Medium	IMO ITCP?	Singapore? Rotterdam?	Jan 2008
<b>Training &amp; Capacity Building (TCB)</b>	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.	Very high	IMO-GloBallast? GISP? China? Singapore?	IMO-GloBallast GISP	July 2007 to Dec 2007
	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.	High	IMO ITCP?	IMO-GloBallast	July 2008 to July 2009
	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.	Medium	IMO ITCP? IMO-GloBallast?	IMO-GloBallast SPC RMP	Oct 2008



**Table Two: Workplan (continued)**

<b>Project Area</b>	<b>Project Code &amp; Title</b>	<b>Description</b>	<b>Priority</b>	<b>Funding source*</b>	<b>Models / Expertise sources</b>	<b>Time-line</b>
<b>Incursion Response, &amp; Control (IRC)</b>	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.	Very High	AusAID? NZAID? US sources?	CSIRO DEH NIWA-NZ MAF-NZ	July 2007 Ongoing
<b>Transit Shipping (TS)</b>	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.	High	Japan? China? AusAID? NZAID? US sources?	DAFF MAF-NZ USCG CSIRO NIWA-NZ IMO-GloBallast Japan Chile Canada	July 2007 to July 2008
<b>Information Management (IM)</b>	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.	Very high	APEC? AusAID? NZAID?	CSIRO SERC	Jan 2007 Ongoing

\*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: Indicative Budget**

<b>Project Code and Title</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>Total</b>
IA1: Programme Coordination	50,000	50,000	50,000	50,000	50,000	<b>250,000</b>
IA2: Regional Co-ordination Meetings	25,000	25,000	25,000	25,000	25,000	<b>125,000</b>
IA3: National Tasks Forces (NTFs)	30,000	30,000	30,000	30,000	30,000	<b>150,000</b>
CA1: SRIMP-PAC web site.	20,000	2,500	2,500	2,500	2,500	<b>30,000</b>
CA2: Pac-Rim Source Port brochures/posters	30,000	2,500	2,500	2,500	2,500	<b>40,000</b>
CA3: In-region brochures/posters.	20,000	2,500	2,500	2,500	2,500	<b>30,000</b>
CA4: Awareness seminars / workshops	150,000	-	-	-	-	<b>150,000</b>
RA1: Overall regional risk assessment.	75,000	75,000	-	-	-	<b>150,000</b>
RA2: Pac-wide DSS Scoping Study	-	50,000	-	-	-	<b>50,000</b>
SM1: CRIMP port surveys (4 Ports)	120,000	120,000	-	-	-	<b>240,000</b>
SM2: Bishop Museum surveys. (4 Ports)	-	80,000	80,000	-	-	<b>160,000</b>
SM3: SERC Settling Plates (4 Ports)	-	-	40,000	40,000	-	<b>80,000</b>
SM4: Regional voucher/reference collection	5,000	50,000	5,000	5,000	5,000	<b>70,000</b>
SM5: Regional IMP taxonomy initiative.	-	25,000	-	25,000	-	<b>50,000</b>

**Table 3: Indicative Budget (continued):**

<b>Project Code and Title</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>Total/Project</b>
LA1: Regional model IMP legislation	30,000	5,000	5,000	5,000	5,000	<b>50,000</b>
LA2: National legislative reforms	10,000	15,000	15,000	15,000	15,000	<b>70,000</b>
PSC1: At-border interdiction enhancement project	300,000	300,000	300,000	300,000	300,000	<b>1,500,000</b>
BSM1: Ballast sediments review.	-	20,000	20,000	10,000	-	<b>50,000</b>
TCB1: Develop regional model training course	30,000	-	-	-	-	<b>30,000</b>
TCB2: Deliver regional model training course	-	75,000	75,000	-	-	<b>150,000</b>
TCB3: Maritime curriculum IMP module	-	-	30,000	-	-	<b>30,000</b>
IRC1: Regional and national IMP response & control plans.	-	100,000	100,000	-	-	<b>200,000</b>
TS1: Transit Shipping Assessment	75,000	75,000	-	-	-	<b>150,000</b>
IM1: Regional IMP Information System (PAC-IMPIS)	50,000	30,000	10,000	5,000	5,000	<b>100,000</b>
<b>Total/Year</b>	<b>1,020,000</b>	<b>1,132,500</b>	<b>792,500</b>	<b>517,500</b>	<b>442,500</b>	<b><u>3,905,000</u></b>

## **14. Financing & Sustainability Plan**

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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\$3.9 million over five 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.

## REFERENCES

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Adams, T., Richards, A., Dalzell, P. & Bell, L. (1995). Research on Fisheries in the Pacific Islands Region. In South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries - Manuscript Collection of Country Statements and Background Papers Vol 2. Integrated Coastal Fisheries Management Project Technical Document No. 12. SPC Noumea.

AMOG Consulting (2002) Hull Fouling as a Vector for the Translocation of Marine Organisms – series of reports to Australian Department of Agriculture, Fisheries And Forestry.

Anderson, E., Judson, B., Tu'itupou, S. & Thaman, B. (2003) Marine Pollution Risk Assessment for the Pacific Islands Region (PACPOL Project Ra1). SPREP, Samoa.

Carlton, J. T. (2001). Introduced species in US coastal waters – environmental impacts and management priorities. Pew Oceans Commission, Arlington, Virginia.

Carlton, J.T. (1999a). The scale and ecological consequences of biological invasions in the world's oceans. In *Invasive Species and Biodiversity Management.* O.T. Sunderland, P.J. Schei and A. Viken, eds. Kluwer Academic Publishers, Dordrecht, Netherlands, 195-212.

Carlton, J. T. (1999). The scale and ecological consequences of biological invasions in the world's oceans, pp. 195-212. in: Odd Terje Sandlund, Peter Johan Schei, and Åuslaug Viken, editors, *Invasive Species and Biodiversity Management.* Kluwer Academic Publishers, Dordrecht, 431 pp.

CIA (2001). Central Intelligence Agency World Factbook.  
[www.cia.gov/cia/publications/factbook/](http://www.cia.gov/cia/publications/factbook/)

Clarke, C., Hilliard, R., Liuy, Y., Polglaze, J., Zhao, D., Xu, X. & Raaymakers, S. (2004). Ballast Water Risk Assessment, Port of Dalian, Peoples' Republic of China, November 2003: Final Report. GloBallast Monograph Series No. 12. IMO London.

Chisholm, J (in prep). The Global Economic Impacts of Invasive Aquatic Species – an Initial Scoping Study. Report to the GEF/UNDP/IMO Global Ballast Water Management Programme, IMO London.

Coles, S. L., Reath, P. R., Skelton, P.A., Bonito, V., deFelice, R.C. & Basch, L. (2003). Introduced Marine Species in Pago Pago Harbor, Fagatele Bay and the National Park Coast, American Samoa. Final report prepared for the U.S. Fish and Wildlife Service, Fagatele Bay Marine Sanctuary, National Park of American Samoa and American Samoa Department of Marine and Natural Resources. Technical Report No 26 Bishop Museum, Honolulu.

Coles, S. L., R. C. DeFelice, and L. G. Eldredge. (2002a). Nonindigenous marine species introductions in Kane'ohē Bay, O'ahu, Hawai'i. Tech. Rep. No. 24, Bishop Museum, Honolulu.

Coles, S. L., R. C. DeFelice, and L. G. Eldredge. (2002b). Nonindigenous marine species introductions at Waikiki and Hawai'i Kai, O'ahu, Hawai'i. Tech. Rep. No. 25, Bishop Museum, Honolulu.

Coles, S. L., R. C. DeFelice, and D. Minton. (2001). Marine species survey of Johnston Atoll June 2000. Bishop Museum Tech. Rep. 19, U. S. Fish and Wildlife Service, Pacific Islands Area Office, Honolulu.

Coles, S. L., R. C. DeFelice, L. G. Eldredge, and J. T. Carlton. (1999a). Historical and recent introductions to non-indigenous marine species into Pearl Harbor, O'ahu, Hawaiian Islands. Mar. Biol. 135:1247-1158.

Coles, S. L., R. C. DeFelice, and L. G. Eldredge. (1999b). Nonindigenous marine species introductions in the harbors of the south and west shores of O'ahu, Hawai'i. Tech. Rep. No. 15, Bishop Museum, Honolulu.

Coles, S. L., R. C. DeFelice, J. E. Smith, and L. G. Eldredge. (1998). Determination of baseline conditions for introduced marine species in nearshore waters of the island of Kaho'olawe, Hawai'i. Tech. Rep. No. 14, Bishop Museum, Honolulu.

Coles, S. L., Defelice, R. C., Eldredge, L. G. and Carlton, J. T. (1997). Biodiversity of marine communities in Pearl Harbor, Oahu, Hawaii with observations on introduced exotic species. Bishop Museum Tech. Rep. No. 10, Honolulu.

Coutts, A.D.M, Kirrily, A, Moore, M. and Hewitt, C.L (2003) Ships' Sea-Chests: An Overlooked Transfer Mechanism for Non-Indigenous Marine Species? Marine Pollution Bulletin 46 (2003) 1504–1515

Coutts, A.D.M & Taylor, M.D (2004) Preliminary Investigation of Biosecurity Risks A Preliminary Investigation of Biosecurity Risks Associated with Biofouling on Merchant Vessels in New Zealand. New Zealand Journal of Marine And Freshwater Research, 2004, Vol. 38: 215–229

Cranfield, H. J.; Gordon, D. J.; Willan, R. C.; Marshall, B. C.; Battershill, C. N.; Francis, M. P.; Nelson, W. A.; Glasby, C. J.; Read, G. B. (1998) Adventive marine species in New Zealand. NIWA Technical Report No. 34. 48 p.

DeFelice, R. C., Coles, S. L., Muir, D and Eldredge, L. G. (1998). Investigation of the marine communities of Midway Harbor and adjacent lagoon, Midway Atoll, Northwestern Hawaiian Islands. Final report to the U. S. Fish and Wildlife Service, Pacific Islands Area Office, Honolulu.

Eldridge, L.G. (1994). Perspectives in Aquatic Exotic Species Management in the Pacific Islands - Volume I: Introductions of Commercially Significant Aquatic Organisms to the Pacific Islands. Inshore Fisheries Research Project Technical Document No. 7. SPC Noumea.

Eldredge, L. G., & Carlton, J. T. (2002). Hawaiian Marine Bioinvasions: A Preliminary Assessment. Pacific Science 56:211-212.

Ferguson, R (2000). The Effectiveness Of Australia's Response To The Black Striped Mussel Incursion In Darwin, Australia. A Report of the Marine Pest Incursion Management Workshop, 27–28 August, 1999. Community Information Unit, Department of Environment and Heritage, Canberra, Australia.

Floerl, O., Inglis, G.J, and Hayden, B. J. (in prep). A Risk-Based Predictive Tool To Prevent Accidental Introductions of Non-Indigenous Marine Species.

Forsyth, D. and Sisto, N.P. (1999). Shipping in the Forum region. Report prepared for South Pacific Forum. 42p.

Heathcote, P. (1996). Shipping in the regime of oceans. Maritime Studies 1-9 (no. 89). [http://law.uniserve.edu.au/law/pub/icl/mStudies\\_89ms\\_shipping.html](http://law.uniserve.edu.au/law/pub/icl/mStudies_89ms_shipping.html).

Hewitt, C.L. & Martin, R. B. (2001). Revised Protocols for Baseline Port Surveys for Introduced Marine Species – Survey Design Sampling Protocols and Specimen Handling. Centre for Research on Introduced Marine Pests Technical Report No. 22. CSIRO Marine Research Hobart.

Hewitt, C.L. & Martin, R. B. (1996). Port Surveys for Introduced Marine Species - Background Considerations and Sampling Protocols. Centre for Research on Introduced Marine Pests Technical Report No. 4. CSIRO Marine Research Hobart.

International Maritime Organization, (1999). Alien invaders – putting a stop to the ballast water hitch-hikers. IMO News Number 4 1999.

Paulay, G., Kirkendale, L., Lambert, G. and Mayer, C. (2002). Antropogenic biotic interchange in a coral reef ecosystem: a case study from Guam. Pac. Sci. 56: 403-419.

Paulay, G., L. Kirkendale, G. Lambert, and J. Starmer. (Unpubl. Ms). The marine invertebrate biodiversity of Apra Harbor: significant areas and introduced species, with focus on sponges echinoderms and ascidians. Cooperative agreement N68711-97-LT-70001, Naval Activities Guam, Agana, Guam.

Taylor, A.H. & Rigby, G (2002). The Identification and Management of Vessel Biofouling Areas as Pathways for the Introduction of Unwanted Aquatic Organisms. Report to the Australian Department of Agriculture, Fisheries and Forestry.

Thresher, R. E.; Hewitt, C. L.; Campbell, M. L. (1999) Synthesis: introduced and cryptogenic species in Port Phillip Bay. In: Hewitt, C. L.; Campbell, M. L.; Thresher, R. E; Martin, R. B. *ed.* Marine biological invasions of Port Phillip Bay, Victoria. Centre for Research on Introduced Marine Pests. *Technical Report No. 20*. Pp. 283–295.

UNEP (1996). Maritime transport in small island developing states. United Nations Environment Programme, Commission on Sustainable Development Fourth Session, 18 April-3 May 1996. United Nations Document E/CN.17/1996/20/Add.4 of 29 February 1996. <<http://www.unep.ch/islands/d96-20a4.htm>>

Veron, J. (1998) Corals of Australia and Indo-Pacific. Australian Institute of Marine Science, Townsville.

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