

From the Editor

Welcome again to Ballast Water News (BWN), it seems like only yesterday that we were putting together the first issue back in June. It has been an extremely busy three months for us here at the Programme Coordination Unit (PCU) and significant progress has been made with the programme.

In the first newsletter, we provided an introductory overview of the ballast water issue and the GloBallast programme. While we maintain a summary of the programme's progress on pages two and eight, we are now including broader articles. This issue focuses on ballast water treatment technology, with updates on a few of the many R&D projects being conducted around the world.

I am pleased to report that the response to the first issue of BWN was extremely positive. Several articles have been contributed by external parties. Many thanks to those who have taken the time to write for us. Regrettably, not all articles received are able to be included at this time. Our apologies to the authors, your articles will appear in future issues. The invitation to make contributions remains open, on any aspect of the problem.

A new column in BWN is the 'Guest Speaker'. We hope this will become a permanent feature, through which leading figures in industry, government, academia and the environmental community will be invited to present their views on the problem. In this issue, I am most pleased to introduce Mr Alec Bilney of the International Chamber of Shipping, as our first 'Guest Speaker'.

I trust that the newsletter will continue to assist the dissemination and exchange of information and views about the major ecological, economic and human health threats posed by invasive marine species. Improved communication between all parties involved in this challenge is vital. Every effort should be made to avoid duplication of effort and 'reinvention of the wheel'.



Steve Raaymakers
Contributing Editor

From the Programme

The most significant event for the programme in the last three months was the 1st meeting of the Global Programme Task Force (GPTF) held at IMO in London from 5 to 7 July.

The GPTF is the highest advisory body for the programme. It comprises senior representatives of IMO, UNDP/GEF, UNDP, the Country Focal Point (CFP) and Assistant CFP from each of the programme's six pilot countries plus observers/advisors from the shipping and port industries and international non-government environmental groups.

As this was the first meeting of the GPTF, it provided the forum to officially launch the programme, to review and endorse the Project Implementation Plan that had been prepared by the PCU and to confirm coordination and administrative procedures. The meeting also provided an opportunity to establish the current status of ballast water activities in each of the pilot countries and hear the views and positions of the industry/NGO groups

The Secretary General of IMO, Mr William O'Neil, addressed the GPTF, stressing the need for a standardised, international response to the ballast water problem and re-affirming IMO's commitment to actively support the programme, by offering essential access to the resources of the Organization.

The message from the shipping industry was that the problem is recognised and has to be addressed, but that measures to be taken must be safe, cost effective and practical.

The meeting was considered a major success. All objectives set under the agenda were achieved, and most notably the PCU was given the green light to proceed with the Project Implementation Plan.

Since the GPTF, the PCU has given priority to working with the six pilot countries to finalise financial arrangements, and assisting them to develop their National workplans.



Dandu Pughiuc
Chief Technical Adviser

Ballast Water News is the quarterly newsletter of the Global Ballast Water Management Programme (GloBallast). GloBallast is a cooperative initiative of GEF, UNDP and IMO to assist developing countries to reduce the transfer of harmful organisms in ships' ballast water, through the implementation of IMO ballast water management guidelines.

For further information please contact:

Programme Coordination Unit, Global Ballast Water Management Programme
International Maritime Organization, 4 Albert Embankment, London SE1 7SR, UK
Tel +44 (0)20 7587 3247 or 3251. Fax +44 (0)20 7587 3261
Email dpughiuc@imo.org or sraaymak@imo.org Web <http://globallast.imo.org>



Programme Highlights

First GPTF Meeting a Success The first meeting of the Global Programme Task Force (GPTF) was held at IMO in London from 5 – 7 July. Activities and major outcomes are described by Captain Pughiuc on page one.

UNDP/GEF stated that they were extremely pleased with the progress that had been made since the programme's inception, and that new standards were being set for GEF International Waters projects. The next GPTF meeting will be held in December 2000.



First meeting of the GPTF

National Workplans Developed During July – September the six pilot countries made substantial progress on developing their National Workplans. These detail the activities, budgets and timelines for the in-country implementation of the various components of the GloBallast programme.

Planning workshops were held in South Africa, India, China and Brazil. Draft National Workplans are submitted to the PCU for review prior to approval and commencement of in-country activities.

First MoA Agreed The first Memorandum of Agreement between IMO and one of the pilot countries, which provides a strengthened framework for project sustainability, was agreed with the Ukraine Ministry of Transport. Discussions are continuing with the other countries.

Web Site Development Underway The PCU awarded a contract to the International Oceans Institute – Southern Africa Centre (IOI-SA) based at the University of Western Cape in Cape Town, to develop the programme's web-site. Consideration was given to using a supplier based in London, but it was decided to use the expertise available in one of the pilot countries instead. This approach has the following advantages:

- Programme funds will be spent within one of the pilot countries where they will be of greater development benefit than if spent in London.
- Capacity will be built within the pilot country, consistent with the development objectives and underlying principles of the programme.
- IOI has a network of centres around the world, including in most of the programme's six pilot countries. These can be utilised when country-specific web-sites are developed later.

The new web site will be <http://globallast.imo.org>

Data Collection Commences Since the commencement of the programme Brazil, China, India and South Africa have instructed all or most of their ports to begin collecting detailed data on ballast water discharges, by requesting visiting ships to complete and submit the standard IMO Ballast Water Reporting Form, as contained in the IMO guidelines (A.868(20)). This is a most positive development and will provide extremely valuable data for use in the risk assessments to be conducted for each demonstration site in early 2001.

Consultants to Conduct Case Studies The PCU awarded a contract to Dr Stephan Gollasch, a leading marine bio-invasions specialist from Germany, to commence the case studies component of the programme. Dr Gollasch will work closely with the experts in Brazil, South Africa and Ukraine to identify case studies of invasive marine species that are relevant to these pilot countries. The ecological, economic and/or human health impacts of these species will be described and quantified as far as possible. The outcomes will be used to raise awareness about the issue in each country, particularly among key decision-makers and policy planners. A separate consultancy will be awarded to undertake similar case studies for the other three pilot countries of China, India and Iran.

GISP Links Established During September the Global Invasive Species Programme (GISP) held a major conference in Cape Town. GISP is an international initiative combining the resources and expertise of a large number of organisations working to address invasive marine species of all kinds, both terrestrial and marine. The GloBallast programme was represented by Mr Adnan Awad, our Assistant Country Focal Point in South Africa. The opportunity was taken to establish better links between GloBallast and GISP and to explore opportunities for collaborative activities.

Guest Speaker

Mr Alec Bilney

International Chamber of Shipping

The International Chamber of Shipping (ICS) has been involved from the start in IMO's work to control the discharge of ballast water by ships. Industry participation has helped to ensure that achievable targets are set. Protection of the marine environment is a common concern, but ship owners and seafarers need to know what is expected of them. With respect to harmful marine organisms they need guidance on what they can do now, and they need tools to be developed for the future. Rushed and impractical legislation will not help.



ICS understands that the intent of IMO is to eventually produce a single, global ballast water control system that will apply internationally. But at present ships must meet local or national requirements, some voluntary and some mandatory, which all differ in small ways. ICS therefore urged IMO first to produce some voluntary guidelines, which all nations could use to harmonise requirements. The result, IMO Assembly Resolution A.868(20), has been universally accepted by all nations wishing to pursue the matter. To complement those guidelines, ICS has published a model ship's ballast water management plan.

IMO is now progressing towards a mandatory legal instrument. ICS believes that three steps must be taken first:

1. The level and type of ballast water treatment required must be established. Experts must agree and promulgate a standard that all treatment systems must meet. At present mid-ocean exchange is used as the reference level, but exchange is unquantified and wildly variable in its effectiveness. Something much more objective must be established.
2. A measure for the standard must be set, so that equipment can be seen to achieve that standard, allowing the use of a type-approval procedure.

3. It must be agreed what authority will do the measuring. IMO may be the best body to give international approval to ballast water treatment systems. A ship fitted with properly working, approved equipment, certified if necessary, should be allowed to discharge its ballast in any port in the world.

It is important that these matters are progressed urgently, but also that adequate time is allowed. More authorities are creating mandatory legislation. International shipping recognises that ballast water management is here to stay, and is preparing for it.

The shipping industry has successfully handled crew inoculation, de-ratting of ships and fumigation of cargoes. Marine organisms will not defeat it, but it needs the tools to do the job; tools which do not presently exist.

Further information:
International Chamber of Shipping
ics@marisec.org

Editor's note:

Under the GloBallast programme an international symposium on ballast water treatment research and development (R&D) is being planned for early 2001. We will be inviting all of the key players currently conducting treatment R&D around the world, plus scientific experts, ship designers, builders, owners and operators and government representatives.

The objectives of the symposium will be to update the latest situation with regard to treatment options, encourage communication between the R&D community, governments and industry, and most importantly; convene a workshop to propose possible standards and criteria for the evaluation and approval of ballast water treatment methods.

The outcomes of the workshop will be submitted to the Marine Environment Protection Committee (MEPC) of IMO for consideration.

For further information about the symposium please contact me at sraaymak@imo.org.

SR

Have your say!

Please feel free to submit articles or letters to the editor for consideration for publication in **Ballast Water News**
sraaymak@imo.org

Are you on our mailing list?

To receive
Ballast Water News

Please fax or e-mail your name and postal address to the Programme Coordination Unit

Fax +44 20 7587 3261 ■ E-mail mbaker@imo.org

Ballast Water News will also be posted on

<http://globallast.imo.org>

Developments Down Under

It is generally well known among the maritime and 'ballast water' community that Australia is a world leader in the response to the ballast water problem, and was largely responsible for initiating action on the issue at IMO. Not so well known is the fact that Australia's close neighbour, New Zealand, is also extremely active in this area. In fact given its relatively small population (about 3.8 million), per capita New Zealand is perhaps investing more in ballast water management initiatives than any other country.

New Zealand is no stranger to the problem of invasive species. Its terrestrial environment and biodiversity have been substantially altered through two waves of human settlement; firstly the Polynesians and then the Europeans. The latter in particular brought all manner of foreign plants and animals, and invasive species are recognised today as one of the most serious environmental problems in the country. This high exposure to the issue of invasive species, combined with New Zealanders' close affinity to the coast and ocean, meant that there was ready recognition of the problem when marine invasives first emerged as an issue.

Unlike most countries, New Zealand treats ballast water introductions as a 'biosecurity' rather than a maritime matter. New Zealand is one of the few countries in the world to have legislation in place (*Biosecurity Act 1993*) making it mandatory for ships visiting the country to reballast at sea, subject to safety considerations and in accordance with IMO guidelines (IMO Assembly Resolution A.868(20)).

The country is also very active in scientific research and development. The Cawthron Institute, located in Nelson in the South Island, has been carrying out research on ballast water and marine biosecurity since 1995. Our marine biosecurity programme aims to provide the shipping industry and coastal managers with ways to reduce invasion rates, and improve management of species already established.

A semi-quantitative risk assessment model is under development for the transport of high impact marine invaders to international shipping ports in New Zealand. The relationship between species transport and establishment is being determined using field studies at Shakespeare Bay, a recently completed international shipping port in the Marlborough Sounds in the north east of the South Island.

Working with a local consultant under a contract from the New Zealand Ministry of Fisheries, we have recently completed a proposed management strategy for the introduced Asian kelp, *Undaria pinnatifida*, which was first discovered in New Zealand in 1987. This may result in the first national pest management strategy for a marine organism.

We have developed a novel ballast sampling method utilising ships' sounding pipes and have reviewed methods available for metering the flow of water through ballast tanks, and possible methods of measuring exchange efficiency, including utilising the optical characteristics of sea water and plankton assemblages. This review, carried out in collaboration with Battelle, Massachusetts, demonstrated the need for further research into methods for verifying ballast water exchange, and established that the optical characteristics of seawater show great potential as a tool for verifying compliance.

The use of waste heat from ships' engines may be a cost-effective way of killing unwanted organisms in ships' ballast water. Cawthron has developed a shipboard system on the RoRo vessel *M.V. Rotoma* for the heat treatment of ballast. Water from ballast tanks is pumped through a heat exchanger, which is heated by the vessel's engine exhaust. Studies have shown that a complete kill of test organisms can be achieved in 6-10 hours by heating to 36-38°C. Further tests are planned for early 2001.

Recently we have embarked on a new study, where we are examining the contents of sea chests (sea water intakes) in ocean going fishing vessels that are slipped for repairs in Nelson. We have found a variety of interesting organisms in the sea chests of a number of vessels, including live shellfish, crabs, worms and amphipods. This strengthens our conviction that sea chests may well be an under recognised source of potential marine invaders, and one that should be considered during the development of management measures aimed at preventing the introduction of foreign marine organisms.

A list of contacts and further information about our research can be found on www.cawthron.org.nz

Information on NZ's regulatory regime for ballast water can be found on www.fish.govt.nz

Tim Dodgshun
Marine Biosecurity Research Group
Cawthron Institute
Nelson, New Zealand



US Launches Two New Projects

Miami Makes its Move

The US Coast Guard Research and Development Center in Groton, Connecticut has awarded a contract *Field Tests on Alternatives to Ballast Exchange* to Dr Thomas Waite of the College of Engineering at the University of Miami. The focus of the project is to evaluate the treatment efficiency of self-cleaning screens (50 micron), hydrocyclone, and UV radiation at large scale (300 cubic meters/hour flow).

The dockside system is currently under construction at the University of Miami Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), located on Virginia Key (Biscayne Bay), Miami. Researchers from RSMAS will monitor zooplankton and phytoplankton removal and inactivation as a function of operational variables. Researchers from the College of Engineering will monitor equipment behaviour and operational constraints.

It is anticipated that testing will begin sometime in September and the first phase of work should be completed by December 2000.

Further information
Dr Thomas Waite
Twaite@miami.edu

Private/Public Partnership

Maritime Solutions Inc., a private US company, has received major grants from the State of Maryland Port Administration and the US National Oceanic and Atmospheric Administration (NOAA) to support the rigorous testing of the its patent pending ballast water treatment system.

The funding exceeds US\$650,000 and will support a larger public/private initiative to test the Maritime Solutions' treatment system. The programme seeks to demonstrate whether the system is a safe, effective, economical, energy efficient and crew friendly shipboard treatment system as an effective alternative to the troubled practice of ballast exchange.

Maritime Solutions, working in cooperation with the University of Maryland, has additionally won the support of the US Maritime Administration to allow the testing programme to take place aboard the 39,000 dead weight tonne *Cape May*, a ship of the US Ready Reserve fleet. Berthed in the Port of Baltimore, it will provide for realistic shipboard testing taking water from Chesapeake Bay.

The Maritime Solutions' ballast water treatment system consists of two stages; a first stage patented *voraxial* separator and a second stage treatment of ultraviolet (UV) irradiation or, alternatively, the chemical biocide *Seakleen*.

Maritime Solutions believes that UV irradiation is the secondary treatment of choice for vessels with ballast flow rate requirements up to 2,000 tonnes per hour. For larger vessels including tankers and bulk carriers with ballast flow rate requirements between 2,000 and 20,000 tonnes per hour, they believe that the biocide *Seakleen* could offer a more economical and effective treatment.



The Cape May

The inclusion of the *voraxial* separator as the first stage aims to remove more than 95% of the silt, sediment and larger marine organisms and return these to the source water. The relatively solids-free water is then treated to kill remaining organisms in the secondary stage with UV or *Seakleen*.

Maritime Solutions, working with the University of Maryland and Aquionics Inc, has specified a UV system specifically designed for ballast water treatment. Combining the *voraxial* separator and the specified UV system, a 'kill' rate approaching 99% is hoped for.

The biocide *Seakleen*, patent pending, is a proprietary, natural product specifically formulated for ballast water use and has a half-life of 14 - 17 hours. As a result of the pre-cleaning provided by the *voraxial* separator, Maritime Solutions believes that a dosage approaching 1 part per million will be sufficient to produce an effective overall 'kill' rate in excess of 97%. This remains to be tested.

If approved by the US Coast Guard as an alternative to ballast water exchange, Maritime Solutions will begin offering its system to ships calling at US ports.

Further information:
Maritime Solutions Inc.
info@maritimesolutionsinc.com

Princess Selects 'OptiMar'

Hyde Marine Inc and OptiMarin A/S are pleased to announce delivery of the first ballast water treatment system aboard an operating vessel. The system, installed aboard the Princess Cruises' *Regal Princess*, is designed to remove and destroy/inactivate organisms including zooplankton, algae, and bacteria from ballast water without affecting the normal operation of the ship.



The Regal Princess

Open ocean exchange of ballast water is not a practical alternative for cruise ships in regular coastwise operations. Princess Cruises chose the OptiMar ballast water treatment system to address the problem of non-indigenous species in ballast water at a realistic total installed cost.

The *Regal Princess* takes on and discharges ballast water at a rate of 200 tonnes per hour as fuel and other consumables are used. Ballast water is pumped through the OptiMar system, which separates solids and irradiates the water with UV light in two stages. The patented *MicroKill* cyclonic separator removes heavier particles larger than approximately 40 microns and the *MicroKill* ultraviolet light treatment system kills or inactivates biological organisms with UV radiation. The UV system can also be used during deballasting to ensure that all organisms have been killed or inactivated when they are discharged from the ship. All system components are proven reliable, safe and easy to maintain.

The OptiMar system was installed aboard the *Regal Princess* during a regular scheduled two-week cruise along the Mexican West Coast in late March 2000. There were no interruptions to the ship's normal operations. The system is compact enough to be located in the ship's pump room. The ship's existing ballast system is used to minimise installation costs.

Testing of a scaled version of the OptiMar system was conducted during 1998 and 1999 at the Norwegian Institute of Marine Research, which confirmed its suitability for ballast water treatment. Efficacy testing on the *Regal Princess* began when the ship first visited Vancouver on May 17th during a short four-day cruise to Alaska. It continued during the summer Alaska cruise season and included third party testing in late August. Initial sample results have confirmed that the system's performance is at least equivalent to mid-ocean exchange.

OptiMarin and Hyde Marine provided an identical but scaled up 350 t/hr (1500 USGPM) capacity system for testing aboard the Great Lakes Ballast Technology Demonstration Project's test barge in Duluth Harbor, Minnesota in September 2000. Additional system testing is also planned and Hyde Marine will participate in a full-scale design study to determine the cost and economic impact of installing OptiMar systems aboard a large containership and a tanker for the Alaska trade.



The compact OptiMar system installed on the Regal Princess

Further information:
Mr Tom Mackey
Hyde Marine Inc.
Tmackey@hydeweb.com

Editor's note:

It is interesting to note the similarities between the OptiMar and Maritime Solutions systems (see article on page 5). Both involve an initial physical separation of solids and larger organisms from the ballast water followed by a secondary sterilisation using UV, or in the case of Maritime Solutions, a proprietary biocide for larger quantities of ballast.

Both systems appear to require significant further work to assess the feasibility of scaling them up to deal effectively and economically with the large volumes of ballast water carried by large bulk carriers and tankers.

It is also interesting to note that Hyde Marine compares the effectiveness of their system with the IMO recommended technique of mid-ocean exchange. The limitations of using this as an evaluation benchmark are clearly pointed out by the International Chamber of Shipping in Mr Bilney's article on page 3.

R&D groups and companies should be applauded for taking the initiative in pursuing the as yet elusive solution to the ballast water problem.

To make their task easier, the international community must come up with clear, internationally accepted criteria for the evaluation and approval of such systems.

SR

Singapore Seeks Solution

The Environmental Technology Institute (ETI) of Singapore believes that a near-term technological solution to treat ballast water is feasible. A major study (Phase 1) undertaken by ETI in collaboration with the Maritime and Port Authority (MPA) and the National University of Singapore (NUS) in 1998/99, evaluated treatment technologies using a pilot scale facility with a flow through of 1,200 tonnes/ day.

This flow rate was chosen as it would allow a number of system modifications and optimisation experiments in a relatively short period of time, without having to face serious scalability issues.

The sixteen months study included hydraulic as well as biological performance evaluation of mechanical, physical and chemical treatments.

The study gave promising results for filtration systems, but 'off-the-shelf' filtration technologies may require significant modifications. Phase II efforts are now underway to develop a hybrid treatment system, including mechanical, physical and chemical combinations and to evaluate them onboard a ship.

ETI has secured S\$2.5 million in funding for this research from internal sources and from the Singapore National Science and Technology Board, MPA and a local ship builder. Phase II will be undertaken during 2000 – 2001.

Further information:

Dr Jose Matheikal
Environmental Technology Institute,
jtmath@eti.org.sg

Aussies Assemble Consortium

The Australian's are increasing their research and development efforts in the pursuit of a technological fix for harmful organisms in ballast water.

The Ports Corporation of Queensland (PCQ), a government-owned corporation that administers 14 ports in the State of Queensland, including large bulk ports in the environmentally sensitive Great Barrier Reef region, is leading the charge.

PCQ has had a comprehensive environmental programme in place since 1993, called 'EcoPorts', and has carried out a number of ballast water initiatives.

From 1995 to 1998 PCQ funded engineering PhD student Darren Oemcke to investigate potential ballast water treatment options. The results of Dr Oemcke's work are published in a number of reports. His findings were as follows:

- Filtration or clarification to less than 20um should remove zooplankton and toxic dinoflagellate algae, as well as larger organisms.
- Secondary sterilisation will destroy any remaining organisms, and UV appears to hold the most promise.
- A pilot plant design for follow-up research was proposed.

PCQ is now moving ahead with plans to build the pilot plant and proceed with the follow-up R&D, through the establishment of a private/public sector consortium. It is hoped that the pilot plant will be containerised to allow it to be moved to various locations for testing under different conditions.

It is estimated that a budget of AU\$600,000 is required over two years. AU\$300,00 has been secured from consortium members. These include four Queensland port authorities, Amiad (an international filtration company), Pasmenco Century Mine (a bulk exporter of minerals and therefore a bulk importer of ballast water), North Forest Products (another importer of ballast water) and the Great Barrier Reef Cooperative Research Centre.

Non-financial support has also been offered from the Australian Quarantine and Inspection Service, the Great Barrier Reef Marine Park Authority, the Western Australian Department of Environmental Protection, United Water (a major water treatment company) and the Queensland Sugar Corporation (an importer of ballast water). Interest has also been shown by parties in Norway and the Netherlands

Further information:

Mr Bob Brunner
Ports Corporation of Queensland
Bbrunner@pcq.com.au

EU Allocates Euros

News has been received that the European Union is also forging ahead with R&D of ballast water treatment technology, and has awarded a major grant to the University of Newcastle (UK), with support from the International Association of Independent Tanker Owners (INTERTANKO). Further details will be reported in the next issue.

Editor's Note:

It should be noted that the range of ballast water treatment R&D projects presented in this issue of BWN is not exhaustive. Articles on projects being conducted by other groups will be presented in future.

It has been estimated that the market for an effective, internationally accepted ballast water treatment system is worth in the order of US\$2 billion!

SR



Progress Report



Activities Undertaken July – September 2000:

- ✓ 1st GPTF meeting held 5-7 July, PIP approved.
- ✓ 1st media release – significant global coverage.
- ✓ Development of web-site commenced.
- ✓ Development of National Workplans commenced.
- ✓ National workshops held in China, Brazil, India and South Africa.
- ✓ MoA between IMO and Ukraine agreed.
- ✓ Consultants' register established.
- ✓ GISP Cape Town conference attended.
- ✓ BW Treatment R&D directory established.
- ✓ Case studies commenced.
- ✓ 1st generic education/awareness materials produced.
- ✓ PCU/country financial arrangements in place.
- ✓ 2nd issue of Ballast Water News produced.
- ✓ Train X course developers' workshop attended.
- ✓ Arrangements commenced for 2nd GPTF meeting.

Activities Planned October – December 2000:

- Attend/assist IMO MEPC 45 (London 2-6 Oct).
- Approve National Workplans.
- PCU missions to Iran and Ukraine.
- Commence implementation of in-country activities.
- Finalise web site.
- Distribute 1st generic awareness raising materials.
- Complete 1st case studies.
- Start detailed planning for risk assessments.
- Start detailed planning for port baseline surveys.
- Start detailed planning for R&D symposium.
- Attend GEF International Waters meeting (Budapest, Oct).
- Assist ICHCA ballast water conference (London, Nov).
- Hold 2nd GPTF meeting (Dec).
- Produce 3rd issue of Ballast Water News.



More Information?

Check out these web-sites:

(these are additional sites not listed in BWN Issue 1):

- www.aqis.gov.au/shipping/ – Australian Quarantine & Inspection Service
- www.uscg.mil/hq/g-m/mso/mso4/bwm.html – US Coast Guard Ballast Water Management
- www.cawthron.org.nz – Cawthron Institute, New Zealand
- www.fish.govt.nz – New Zealand Ministry of Fisheries
- www.issg.org – IUCN Invasive Species Specialist Group
- <http://jasper.stanford.edu/GISP/> – Global Invasive Species Programme
- www.wkap.nl/journals/biological_invasions – Biological Invasions (new international journal)

More web-sites next issue. To contact the PCU – see details on front page.



Photo credits (in order images appear): Mathew Baker, ICS, Tim Dodgshun, Maritime Solutions, Hyde Marine, Hyde Marine, IPIECA, Roger Steene.