Ballast Water News

Global **Ballast Water** Management Programme

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From the Editor

As we look back on the 3rd quarter of 2003, there are many major achievements for IMO and the GloBallast Programme to reflect on. The IMO Marine Environment Protection Committee (MEPC), at its 49th meeting in July, agreed to proceed with a Diplomatic Conference in February 2004, to adopt the International Convention for the Control and Management of Ships' Ballast Water and Sediments. With achievement of this major breakthrough, we are most pleased to welcome as our Guest Speaker Mr Koji Sekimizu, Director of the IMO Marine Environment Division, who as Secretary to MEPC successfully steered and supported the extremely complex negotiations in recent years. Immediately following MEPC, the 2nd International Ballast Water Treatment R&D Symposium was successfully convened. The main outcomes of the symposium, including prospects for more effective ballast water treatment technologies, are summarized on page 3.

A major technical activity was completed last quarter, this being the ballast water risk assessments for each demonstration site. This has resulted in the development of an innovative, modular risk assessment methodology that can be adopted and applied by any port in the world; the generation of comprehensive ballast water risk profiles for the six demonstration sites; and the establishment of fully operational risk assessment systems and trained teams in each Pilot Country. The results for Khark Island are presented on pages 4 and 5. In the first week of September, an international workshop was held in Melbourne, with generous sponsorship from New Zealand and Australia, to review the GloBallast risk assessments, compare with other approaches, and generate recommendations for risk assessment guidelines under the new Convention.

One issue that has received some discussion recently, is the total volume of ballast water estimated to be transported by ships. On pages 6 and 7 we present an analysis by staff at Det Norske Veritas (DNV), which estimates that based simply on world cargo figures, global volumes of ballast water transported are probably in the order of 3 to 4 billion tonnes per year, compared to 10 to 12 billion tonnes put forward by previous estimates. Never-the-less, when considering the risk of ballast-mediated bio-invasions, case histories indicate that port environmental matching and risk species profiles appear to have a more significant influence on the risk of introductions, irrespective of volumes of ballast.

In this issue we also take a look at the hull-fouling vector, with an article from New Zealand on a remote method of hull-fouling assessment. The World Conservation Union (IUCN), as a partner in the production of Ballast Water News, makes it contribution with an article summarising the main outcomes from the 5th World Parks Congress, and an update on aquatic invasive species in the Mediterranean.

Finally, we wrap up this issue with a report on ongoing regional initiatives, in this case for the countries along the west coast of South America, through the Permanent Commission for the South Pacific (CPPS), and a brief announcement of some recent publications. As we enter the final stages of the GloBallast pilot phase, we look forward to bringing you, in the next issues of Ballast Water News, further results and outcomes of many of the activities that are now being completed by the Pilot Countries.

Steve Raaymakers
Contributing Editor

From the Programme

The 49th session of MEPC, held from 14 to 18 July 2003, marked an important moment of reference for the programme and the decisions taken by IMO member States during the meeting established clear directions for the continuation of GloBallast. After extensive discussions the various delegations involved in the drafting of the new Convention, harmonized their views on most of the provisions and decided in favour of a Diplomatic Conference for the adoption of the Convention, to be held from 9 to 13 February 2004. Although a number of aspects related to inspections, concerted areas, grandfathering conditions for existing ships and standards for ballast water management are still being debated, the decision to move towards adoption of the Convention, is an incentive for GloBallast to start planning the transition from the pilot stage to a more complex phase, which will focus on assisting countries to implement the Convention.

The member States received with interest a paper submitted by the IMO Secretariat in this respect. The Committee acknowledged the substantial contribution of GloBallast in assisting developing countries to prepare for the implementation of the Convention and requested the IMO Secretariat to approach GEF and other donors, to explore the possibility of continuing the activities initiated during the pilot phase and replicating best practices in additional countries in various regions.

In response, the PCU in consultation with the six Pilot Countries and other partners such as IUCN and the Global Invasive Species Programme (GISP), has prepared a concept paper for a new phase named "GloBallast Partnerships". The overall objective is to promote the development and implementation of long-term, national-level, regionally coordinated measures to minimize the adverse impacts of invasive aquatic species transferred through ships' ballast water. GloBallast Partnerships will provide a programmatic framework for the sustainable replication of pilot phase successes and best -practices, ensuring that maximum benefits accrue from the six centres-of-excellence established in the pilot phase.

Another milestone last quarter was the 1st International Workshop on Ballast Water Risk Assessment held in Melbourne, Australia from 22 to 26 September. The Workshop offered a unique opportunity for the Pilot Countries to share experiences and lessons learnt during the development of their national risk assessment systems and to review approaches used by other countries. The Workshop was organized by our risk assessment consultants and generously sponsored by a consortium of Australian and New Zealand institutions. A sincere and wholehearted thanks goes from the Programme to the sponsors!

Last but not least GloBallast is proud to announce being awarded the Queen's Golden Jubilee Medal for significant contribution to the advancement of protection of the marine environment. The prestigious distinction offered by the Institute of Marine Engineering, Science and Technology is a confirmation of the success of GloBallast and a much-deserved recognition of the efforts made by the six participating countries.

Dandu Pughiuc
Chief Technical Adviser

Ballast Water News is the quarterly newsletter of the Global Ballast Water Management Programme (GloBallast), and is produced with the support of the World Conservation Union (IUCN). GloBallast is a cooperative initiative of GEF, UNDP, IMO and other partners to assist developing countries to reduce the transfer of harmful organisms in ships' ballast water, through the implementation of IMO guidelines.

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Guest Speaker

Mr Koji Sekimizu
Director, Marine Environment Division
International Maritime Organization

Mr. Koji Sekimizu was appointed Director of the Marine Environment Division (MED) of IMO in August 2000, having served in various capacities at IMO since 1989, including Head of the Technology Section and Senior Deputy Director of MED. He graduated from Osaka University (Master of Engineering) in 1977 and joined the Ministry of Transport of Japan as a Ship Inspector. He worked with the Ministry of Transport for twelve years in various capacities, including working with the Ministry of Foreign Affairs, dealing with the Maritime Transport Committee of the Organization for Economic Cooperation and Development (OECD). During his last two years with the Ministry of Transport he held the position of Deputy Director of the Safety Standards Division. As Director of MED at IMO, Mr. Sekimizu is the Secretary of the IMO Marine Environment Protection Committee (MEPC) and the Administrative Secretary of the UN Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP).

In July this year, the 49th meeting of MEPC finalised the draft text of the International Convention on the Control and Management of Ships' Ballast Water and Sediments and agreed to hold a Diplomatic Conference to consider adoption of the Convention in February 2004.

This is one of the major achievements of MEPC since the beginning of the 1990's, based on ten years of highly complex and challenging discussions, which has produced two sets of ballast water management guidelines and finally developed a new legal instrument as a stand-alone international Convention.

The draft Convention sets out a legal framework of regulatory measures and further international work to be carried out over the next two decades to address the global problem of the transfer of harmful aquatic organisms and pathogens through ships' ballast water. Significantly, the draft Convention sets a performance standard for ballast water treatment, taking into account:

- the need for further developments aiming at better treatment technologies;
- the limited effectiveness and associated operational problems of ballast water exchange at sea;
- the operation of international shipping in coastal waters;
- standards to be applied to new ships to be constructed in the future.

The right of coastal States to establish more stringent standards will be further debated at the Diplomatic Conference, taking into account the principles established under the United Nations Convention on the Law of the Sea (UNCLOS).

Although it will take some years for the Convention to come into effect, the establishment of this new legal framework is a significant development in the history of IMO and must be interpreted as being the result of the seriousness of IMO in dealing with this issue, along with the shipping industry, and also in response to the request made of IMO at the World Summit on Sustainable Development in 2002.

In addition to the Convention, the development of associated technical cooperation efforts, including the GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast), further indicates the determination of IMO to address this issue beyond the adoption of the Convention next year. These efforts aim to expedite the Convention's entry into force and establish frameworks for regional cooperation and catalyse national actions for the effective implementation of the Convention, particularly in developing countries. In this regard, IMO is currently preparing new project proposals, based on the highly successful GloBallast Programme, with GEF, UNDP and other partners.

These achievements are the result of the intensive efforts of the dedicated individuals involved in the work of the MEPC Ballast Water Working Group, including Messes Denis Paterson, Mike Julian and Alan Taylor from Australia, Mike Hunter (UK), Fred Kenney (USA) and Manfred Nauke and Rene Coenen of IMO, and other numerous people I cannot name here. Additionally, the efforts of Dandu Pughiuc, Steve Raaymakers and their staff and Country Counterparts of the GloBallast Programme, have played a major role in supporting development of the Convention and greatly increasing the active participation of developing countries.

The outstanding achievements of GloBallast received recognition this year, in part through the Queen's Golden Jubilee Medal, awarded by the Institute of Marine Engineering, Science and Technology.

I praise the tremendous contribution and dedication of all involved in IMO's response to the ballast water issue, which has resulted in a final draft of the Convention at last, and I look forward to these efforts being rewarded through its adoption in February 2004.

Koji Sekimizu

2nd R&D Symposium

From 21 to 23 July this year, GloBallast, with organizational support from the Institute of Marine Engineering, Science and Technology and sponsorship from the US National Science Foundation, UK Maritime and Coast Guard Agency and University of Newcastle Upon Tyne, convened the 2nd International Ballast Water Treatment R&D Symposium, at IMO Headquarters in London.

Keynote Speaker Dr Tom Waite

The 1st Symposium was held in March 2001, and was hailed as a success in bringing stakeholders up-to-date with latest developments in ballast water treatment technologies and catalysing a more coordinated global R&D effort. Since 2001 significant progress has been made in the field of ballast water treatment R&D and with the new IMO ballast water Convention. The 2nd Symposium therefore provided a timely opportunity for another major update and refocus of the global R&D effort.

In opening the 2nd Symposium, the Director of the IMO Marine Environment Division, Mr Koji Sekimizu, speaking on behalf of the Secretary-General, Mr William O'Neil, stated that during the development of the ballast water Convention, it has been widely recognized that the practice of ballast exchange at sea has many limitations, including serious safety concerns and highly variable biological effectiveness. As an example, approximately 15 new species have invaded the North American Great Lakes since 1993, despite mid-ocean exchange becoming mandatory that year for ships entering the Lakes region. This is the same number of invasions that occurred during the 1970s and 80s, indicating that current management efforts are not completely effective. Overall, the current rate of invasions is >60% higher than 100 years ago.

Mr Sekimizu stated that it is therefore extremely important that alternative, more effective ballast water treatment methods are developed as soon as possible, and the new Convention will provide a powerful, regulatory driven incentive for this effort. Significant R&D is already underway, as presented at the IMO symposiums and in the global R&D Directory (http://globallast.imo.org/research).

In delivering the keynote address at the Symposium, Dr Tom Waite, Programme Director of Environmental Engineering at the US National Science Foundation, Associate Dean of Research at the University of Miami and veteran of the war against biological invasions, quoted a 2002 report by the US General Accounting Office which states 'Overall, scientists, academicians and industry leaders are recognizing invasive species as one of the most serious environmental threats of the 21st century . . .'.

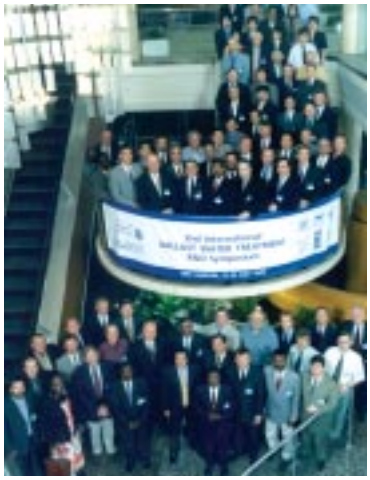
Dr Waite also stated, inter alia, that the search for solutions requires far more input from naval architects and marine engineers, that the initial focus should be on adapting existing water treatment techniques, that the R&D effort should look for synergies between treatment processes, and that non-chemical, reversible treatments such as heat, de-oxygenation and pH extremes should be seriously pursued, along with new techniques such as light-sensitive biocides.

A total of 35 technical papers were presented over the three days (and 20 more papers were unable to be accepted due to time constraints). Papers covered mechanical and gas-based treatment systems, heat and electro-based systems, chemical-based approaches, multiple technologies and combined systems, with a special session on test protocols and verification procedures.

Several papers provided updates on work that had been presented in 2001, while others reported on new initiatives. Overall, there has been a significant increase in R&D (the 1st Symposium received 26 papers). However, although good progress has been made in moving closer to viable, practical, effective solutions, all groups remain at the basic research stage. The lack of finalised treatment standards in the IMO Convention was identified as still being the major obstacle to the R&D community. Two other major points that emerged from the symposium were as follows:

- It is unlikely that a single treatment technology will suit all vessel types and voyage characteristics. The R&D community should seek to develop different treatment options for different scenarios, as long as they meet the international performance standard. For example, heat appears to hold significant promise for cruise ships and some tankers that generate significant waste heat, but is unlikely to be an option for bulk carriers with large volumes of ballast but little waste heat.
- It appears that treatment systems will need to involve combined technologies, and that primary filtration or physical separation will almost certainly be necessary, followed by secondary biocidal treatment(s). If primary filtration alone was implemented now, a significant reduction in bio-invasions would be achieved.

While the quality of papers was better than in 2001, some were still (regrettably) oriented towards 'sales pitches', rather than presenting scientifically defensible data, and many papers provided limited information on their experimental designs and test protocols. The lack of internationally agreed testing methods was also identified as a major problem, making it difficult to compare different projects.



Some of the symposium delegates, over 230 attended

The development of internationally standardised test protocols and verification procedures was identified as the most urgent remaining priority that must be addressed by IMO, and the final session of the symposium provided some useful papers on this matter.

The Symposium Abstracts are available at http://globallast.imo.org/treatment and the full proceedings will be available at http://globallast.imo.org/publications in December 2003.

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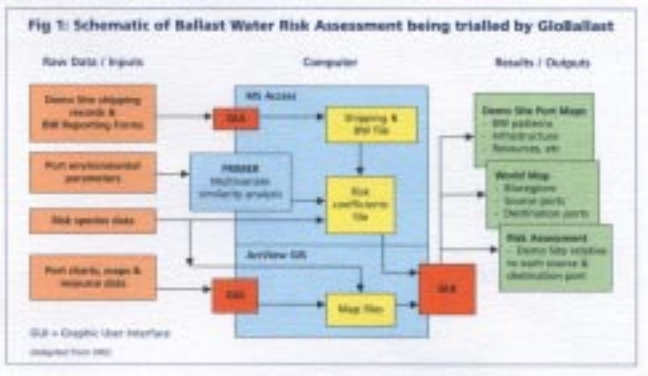
Risk Assessment Released for I.R. Iran

The first report of the Ballast Water Risk Assessments to be conducted by the GloBallast Programme has been released, for the Port of Khark Island, Islamic Republic of Iran.

In Ballast Water News No. 8 (Jan – March 2002) we announced commencement of the Ballast Water Risk Assessments at each of the six GloBallast Demonstration Sites (Sepetiba - Brazil, Dalian - China, Mumbai - India, Khark Island - Iran, Saldanha - South Africa and Odessa - Ukraine). The risk assessments for all six sites have now been completed, and operational risk assessment systems (data collection procedures plus computer hardware and software - Figure One), along with trained risk assessment teams, have been established in each Pilot Country.



Final reports are now being prepared for each site and the first report, for the major Iranian oil port of Khark Island, located in the ROPME Sea Area, has now been published (http://globallast.imo.org/publications) (ROPME = Regional Organization for the Protection of the Marine Environment, comprising the Kingdom of Bahrain, Kingdom of Saudi Arabia, Islamic Republic of Iran, State of Kuwait, State of Qatar, Sultanate of Oman and the United Arab Emirates. Iraq is also a member, although currently inactive).

The risk assessment for Khark Island was undertaken by Australian consultants Meridian Pty Ltd, working with and training a team of Iranian counterparts led by Mr Hassan Taymourtash, Dr Vahid Yavari, Mr Nasser Kayvanrad and Mr Ahmed Parhizi of the Iranian Ports and Shipping Organization, and supported by the Programme Coordination Unit at IMO.

Risk assessment is a basic first-step for any country contemplating a formal system to manage the transfer and introduction of harmful organisms in ships' ballast water. In order to assess the risk of ballast mediated invasions 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, and the locations where ballast water is received from (source ports) and exported to (destination ports).

In determining the nature and extent of their ballast water 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 developing countries that may not have sufficient resources to target every single vessel calling at its ports, and which therefore need to prioritise their regulatory efforts.

The first step for the GloBallast risk assessments was to collate data from IMO Ballast Water Reporting Forms, which had been requested from arriving ships at each Demonstration Site since early in the programme. The activity included the establishment of a customised Access database at each Demonstration Site, for the ongoing entry and management of the reporting form data. For periods or vessel arrivals where reporting forms were not collected or were incomplete, gap-filling data were extracted from the shipping records held by port authorities, customs, shipping agents and other sources.

The Access databases, when linked to the ArcView Geographic Information System (GIS) also established for each site, allow ballast water characteristics to be displayed for each berth in the port. The utility of this database of-course depends on the port State continuing to collect reporting forms from arriving ships, and maintaining the system over the longer term.

A multivariate procedure was then used to identify the environmental similarity between the Demonstration Site and each of its ballast water source and destination ports, based on 34 different environmental parameters, collected from existing sources for a set of 357 ports around the world. Environmental similarity was assessed using PRIMER software, which was also established permanently at each site as part of the overall risk assessment system (Figure One).

Port-to-port environmental matching provides a relative measure of the risk of organism survival, establishment and potential spread. Other factors relating to the risk of introduction, include the frequency of ship visits/ballast water discharges, the volume of ballast water discharged, voyage times and ballast tank size, any management measures applied, the presence/absence of known 'pest' species at the source ports and the characteristics of these species. While environmental matching alone does not provide a complete measure of risk, invasion case histories may indicate that if any one factor is to be used alone, environmental similarity is probably the best single indicator of risk.

Figure Two shows the GIS output of the environmental matching co-efficient for Khark Island source ports. Understandably, the ports that pose the 'highest risk' to Khark in terms of environmental similarity, were assessed to be those within the enclosed gulf of the ROPME Sea Area. While native species within this region are likely to be shared by most regional ports through natural circulation, the potential for translocation of a foreign species from one 'point-of-entry' to other ports in the region is highlighted by this result. This in turn serves to highlight the vital need for a cooperative, multi-lateral, regional approach. No one port or even one country can address this problem alone.

The 'highest risk' source ports to Khark Island beyond the ROPME Sea Area, in terms of environmental matching, were assessed to be Hodeidah in Yemen, Suez and Ain Sukhana in Egypt, Okinawa in the Pacific, Sabine in Texas and Piraeus in the Mediterranean. Unsurprisingly, the most dissimilar ports were in places like Sweden and Canada.

Another objective of the activity was to identify 'high-risk' species that may be transferred to and/or from the Demonstration Site, and the customised Access database includes information on risk species.

Altogether, the GloBallast risk assessment calculates 4 risk co-efficients for each source and destination port, relating to frequency of ballast water discharges (C1), volume of discharges (C2), environmental similarity (C3) and risk species (C4). These are combined in an overall equation, to give a measure of 'Relative Overall Risk' (ROR). The results for each co-efficient are graphically presented on GIS – Figure Two shows an example for C3. Details of the basis of each co-efficient and the risk equations, are contained in the published reports.

Figure Three shows the GIS output of the ROR for each Khark Island source port. The 'highest risk' source ports (outside the ROPME Sea Area), considering all factors included in the ROR calculation, were assessed to be Kaohsiun (Taiwan), Ain Sukhana (Egypt), Okinawa, Chiba and Sendai Kagoshima (Japan) and Ulsan (Republic of Korea). In considering these results, the assumptions and limitations underlying the risk assessment must be taken into account, as outlined in the full report.

Having identified the source ports/voyage routes that present the highest risk, Iranian authorities are now in a more enlightened position from which to develop management measures. One option might include, seeking to enter into 'twin-port' arrangements with authorities at the 'high priority source ports, so as to develop cooperative management measures and mutually reduce the bio-invasion threat.

As a result of the GloBallast risk assessment exercise, each Pilot Country now has:

- a fully operational database for the management and analysis of IMO Ballast Water Reporting Forms and other relevant data in all of their ports,
- an extremely comprehensive understanding of the nature and patterns of ballast water operations at their Demonstration Site,
- a Geographic Information System for the storage, management, analysis and presentation of information, including port resource maps and other layers,
- a sound indication of relative risks posed by the discharge of ballast water from each port their Demonstration Site trades with, providing an informed basis for management (including 'port twinning'),
- a fully operational risk assessment programme combining the various elements of the system,
- a trained risk assessment team capable of continuing to run the system and replicate assessments at additional ports, both within the country and the region.

The exercise has proven extremely useful in giving relevant personnel from each country an in-depth involvement in the issue, creating increased awareness and building technical capacity and institutional structures to begin to address the ballast water problem in an organized, structured way.

The wealth of data collected for this exercise, including environmental and risk species data for a huge set of ports around the world, helps to fill a very large data gap in the existing global knowledge base. All of this information is available in the final reports, which will be published for the other five sites as they are completed.

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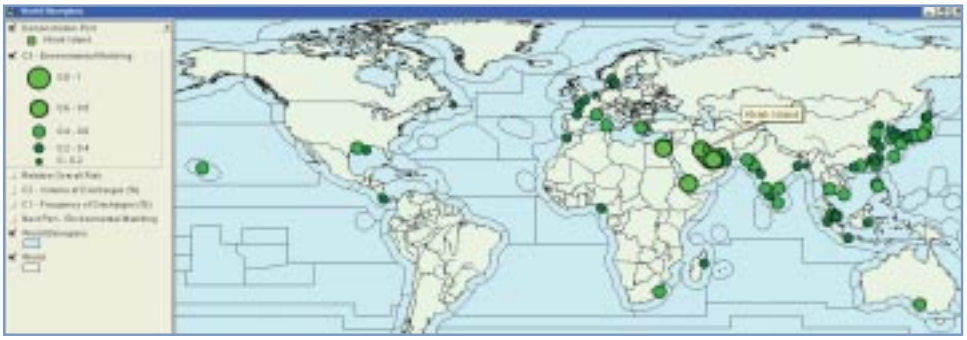

Figure Two: Graphic representation of Environmental Matching (C3) coefficients for Khark Island ballast water source ports, as displayed on the GloBallast risk assessment GIS for I.R. Iran. Similar outputs are available relating to frequency and volumes of ballast discharge (C1 & C2)

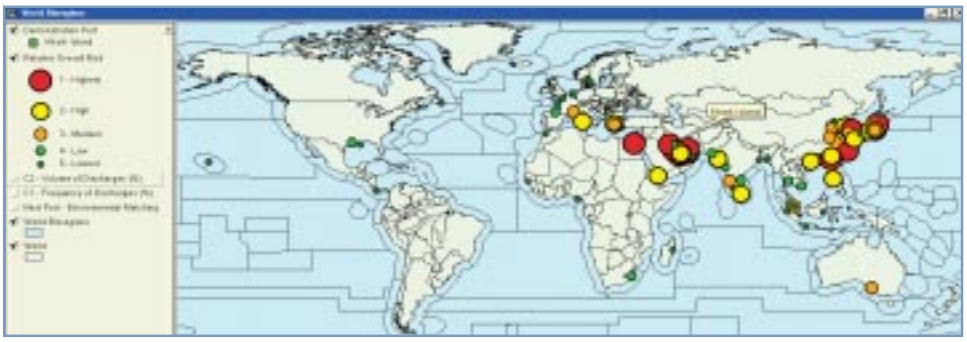

Figure Three: Graphic representation of Relative Overall Risk (ROR) coefficients for Khark Island ballast water source ports, as displayed on the GloBallast risk assessment GIS for I.R. Iran

How much ballast?

Despite worldwide concerns about the transfer of harmful aquatic organisms and pathogens in ships' ballast water, no studies to date have presented detailed models for calculating the total volumes of ballast water carried by ships globally. Previously reported figures range from 10 to 12 billion tonnes per year, yet these figures do not appear to have been supported by transparent calculations, and global seaborne trade statistics indicate that total annual tonnage of cargo carried is substantially lower than these figures, raising doubts about their accuracy.*

Clearly, to support the development of sound ballast water management measures, a more accurate calculation of ballast water volumes carried is required. This article presents some such calculations, and arrives at an overall figure of between 3 and 4 billion tonnes of ballast water transported globally each year.

The world fleet of ocean going merchant ships above or equal to 100 gross tons (GT) in the year 2000 was 87,546 vessels (Lloyd's 2000). The fleet can be broadly categorized into 46,205 cargo carrying vessels (general cargo, tankers, bulk carriers, container ships etc.) and 41,341 non-cargo vessels (research and fishing vessels etc). Ocean going cargo ships altogether represent 792.4 million DWT (dead weight tonnes). The total number of crude oil tanker vessels was 1,789 with a total of 241.3 million DWT. Bulk dry vessels count some 4,886 vessels, representing a total of 255 million DWT. Thus, these large cargo vessels account for about 63% of the world tonnage.

The world's international seaborne trade in year 2000 was 5.4 billion tonnes (Fearnleys 2002). By commodity, crude oil represents the biggest share (30%), followed by coal (9.6%), iron ore (8.4%), oil products (7.7%) and grains (4.2%). These principal cargoes combined accounted for 60% of the total measured by weight, and are mainly transported in large oil tankers and bulk carriers within a fairly well defined system of international sea routes. Figure 1 shows the system of sea routes as appearing from vessel observation by AMVER (Automated Mutual-Assistance Vessel Rescue system) (AMVER 2001). AMVER holds information on more than 7,100 cargo and passenger ships, mainly greater than 2,000 DWT, that report to AMVER daily during their voyage (AMVER 2002). This represents about 27% by number of the world cargo and passenger fleet greater than 2,000 DWT (Lloyd's 2000).

The domestic transport of cargo by ships amounted to about 3.3 billion tons world wide in year 2000 (Fearnleys February 2002). A large fraction of this cargo is comprised by basic materials, such as petroleum products, non-metallic minerals, metals, cement and coal. The domestic transport is then about 60% of the international transport measured in weight.

For commercial reasons, vessels will strive to operate with maximum cargo and minimum ballast at any time. The optimal ballast condition is however also affected by requirements associated to safety as well as performance. Ballast water may be carried in either dedicated ballast tanks or in cargo-tanks if appropriate. Ballast water capacity varies as a function of cargo carrying capacity and ship type, with typical values ranging from 25 - 40% of the dead weight tonnage (DWT) (Carlton et al 1995, EPA 1995, Greenman et al 1997). However, the ballast capacity is commonly only partially utilised. Carlton et al. (1995) reported 86% exploitation of the ballast capacity based on two separate US-studies covering more than 1,100 vessels calling at US ports (only bulk carriers, tankers and container ships).

In this study statistical analysis has been undertaken for 100 cargo vessels selected from the DNV classed vessels (Det Norske Veritas 2002) with dedicated ballast tanks, built after 1990. The ballast water capacity was found to be 36% of the DWT. For bulk carriers, tankers and container vessels, these results correspond with the statistical relationships reported by Carlton et al. (1995) and Smith et al. (1996). The correlation coefficient varied from 0.9 to 0.97 for the different ship types as documented in Behrens et al (2003).

The ballast water amounts for each ship type and size categories for the world fleet may then be estimated by using the fleet statistics, the relationships between ship size and ballast water capacity, the exploitation degree of the ballast capacity, and the number of ballast voyages. This modelling approach was recently applied to estimate ballast amounts for the ships in foreign trade, registered in Norwegian registries (Behrens et al 2003).

Alternatively, the annual ballast water amounts could be estimated as a function of the total cargo amounts transported annually. The cargo amounts transported are less than capacity, which may be measured by DWT. For large tankers, a rule of thumb is that at least 2.5 % of the total carrying capacity is reserved for stores, provisions and bunkers. The maximum cargo load factor is therefore 0.975, but can also be lower (0.65) due to part loading and multi-porting (Wijnolst & Wergeland, 1997). The conversion factor from DWT to tonnes of cargo carried is typically 0.87 for tankers and 0.91 for dry bulk (Fearnleys September 2002), and 0.89 is assumed representative in our calculations.

From the above analysis, we may roughly assume a ballast capacity of about 40% of cargo transported (36% ballast capacity per DWT divided by 0.89 tonnage cargo per DWT) with an exploitation factor of 86%. If the total annual tonnage of cargo carried is 8.7 billion tonnes (comprising 5.4 billion tonnes of international trade and 3.3 billion tons of domestic trade), as obtained from Fearnleys (2002), the total annual global ballast water loaded in port can be estimated to be approximately 3.1 billion tonnes. This is shared between international trade (1.9 billion tonnes) and domestic trade (1.2 billion tonnes).

The uncertainties in these estimates relate to input data (e.g the completeness of world trade statistics), assumptions made (need for ballast etc), and relationships between ballast amounts and cargo transported. We have not made error analyses, but we judge an order of ±20% uncertainty for the loaded ballast inventory.

Even with addition of an error factor of +20%, giving an estimated total of 3.72 billion tonnes of ballast water transported globally each year, this is significantly less than the 10 to 12 billion tonnes quoted in various sources previously (Gollash & Leppäkoski 1999, MARTOB 2003). It should be noted that the original source of these earlier figures has not been possible to identify despite extensive research and hence should be considered as undocumented.

We hope that this analysis provides a more concrete basis for global efforts to address the ballast water issue.

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(*note in this article 1 billion = 1 thousand million or 10^9).

Comments and observations on this or any article are welcome, write to:

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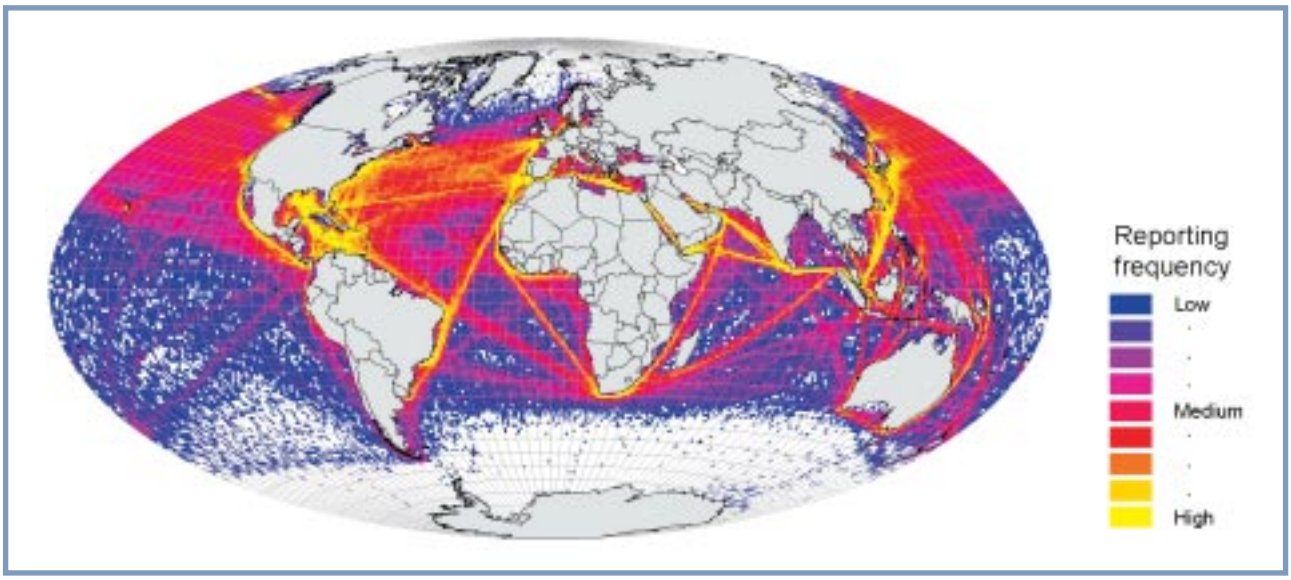

Main sea routes based on traffic density as indicated by AMVER (2001) (NB: Only about 27% of the world fleet >2,000 DWT use AMVER, making this figure an incomplete, under-representation)

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Biosecurity 'HullCam'

While ballast water carried by large ships is a major vector for the transfer of invasive aquatic species, and one that has received significant attention by the international community, concerns are also beginning to focus on the transfer of species by fouling on vessel hulls and other surfaces.

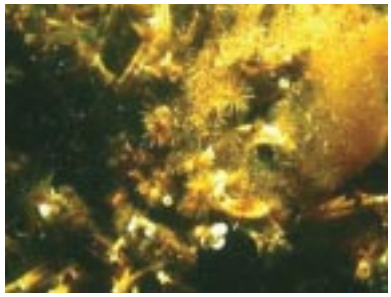
Over the past 50 years there have been major advances in the development of antifouling paints and other systems to prevent the growth of marine species on hulls, driven primarily by the need to improve the operational efficiency of vessels. Until recently, many anti-fouling paints were based on highly toxic (and highly effective) tri-butyl-tin (TBT). With the adoption of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS) by IMO member States in 2001, the use of TBT is now being phased-out globally. Ironically, while the AFS Convention helps to address one serious marine environmental issue (chemical pollution), the banning of TBT may compound another major problem, causing a significant increase in the rate of harmful marine bio-invasions through hull fouling.

The HullCam is easy to operate in the field, and has been used to sample yachts ranging from 10 to 25m in length

One group of vessels that has not received much attention is ocean-going yachts. These yachts can pose a biosecurity risk if they carry problem species on their hulls, especially because they travel more slowly than merchant vessels, and spend more time in more ports. In New Zealand, the National Institute of Water and Atmospheric Research's (NIWA) is researching the development of better predictive tools to identify and manage the marine biosecurity risks posed by ocean-going yachts. Between 400 and 500 international yachts visit New Zealand each year – and even more during major racing events such as the America's Cup held in Auckland this year.NIWA and the New Zealand Ministry of Agriculture and Forestry (MAF) Quarantine Service have been working together to assess the recent travel and maintenance history of yachts entering New Zealand from overseas, and the amount and diversity of fouling organisms they carry. Fouling can be estimated by using 'HullCam', a purpose-built sampling device with a remote underwater video lens mounted on a wheeled frame, that rolls along or across a yacht hull while being steered from the surface by a telescopic arm. The remote lens, aided by twin underwater lights, transmits to a digital video camera at the surface. Still images can then be captured to determine the composition and abundance of fouling assemblages.

So far NIWA has used the HullCam to sample nearly 100 yachts. Cross-comparisons have been made between SCUBA divers and HullCam, and both methods recorded similar estimates of fouling cover and composition. However, the HullCam is more efficient; only two or even one person is required to operate it, while at least three staff are required for diving. HullCam only takes half the time of divers to sample a single yacht, and divers can make only a limited number of dives in a day.

'HullCamaniacs' at work in an Auckland marina



A look at a hull through the HullCam's 'eye' – no shortage of fouling species!

Statistically robust and predictive models require many samples for calibration. With HullCam, information can be easily and quickly obtained on the degree of fouling on vessel hulls. NIWA intends to sample another 100 international yachts during the coming boating season in New Zealand (November 2003 – February 2004), and develop a model from the data that identifies the risk factors associated with hull fouling.

NIWA
Taihoro Nukurangi

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The Mare Nostrum: a Melting Pot

The Mediterranean Sea covers less than 1% of the world's oceans but hosts 7.5% of the world's known marine animal taxa and 18% of the world's known marine flora. It is one of the richest seas for biodiversity in the world. Its fauna and flora have evolved over millions of years in a unique mixture of temperate and subtropical elements; and as a result a very high number of the marine species (around 20%), including some emblematic species of global conservation concern, are endemic and only found in this sea.

Although the Mediterranean has experienced major changes in its biodiversity composition throughout its history, an increase in alien species in recent decades is beginning to give cause for alarm. Alien and invasive species have been highlighted by most Mediterranean countries as a major threat to marine biodiversity and the UNEP Mediterranean Action Plan (MAP) has acknowledged that this is a major issue. Extrapolating from initial surveys of some taxonomic groups, an overall estimation of alien species present in Mediterranean waters would be around 1000, entering by various vectors.

Although at the global level shipping is one of the most important vectors, this may not be the case for the Mediterranean Sea. Examination of recent publications shows that more than 70% of the non-indigenous decapods (crustaceans such as shrimps and crabs) and about 63% of the exotic fishes documented in the Mediterranean so far (mainly in its Eastern basin) are of Indo-Pacific origin, and are likely to have entered via the Suez Canal ('Lessepsian' species). This indicates that the canal may be the principal pathway by which alien decapods and fishes have entered the Mediterranean to date. Other artificial waterways have also been used by species to invade the Mediterranean . For example, the Chinese mitten crab *Eriocheir sinensis* has spread from the Atlantic via the Canal du Midi

Shipping, either through ballast water or hull fouling, is still an important vector for species introductions into the Mediterranean. About 30% of international maritime traffic transits Mediterranean waters and the prospect of a Euro-Mediterranean free trade area by 2012 brings with it the promise of additional transport links, the development of ports in natural coastal areas and increased maritime traffic, associated pollution and perturbation of marine biodiversity. This will provide more opportunities for species to be spread accidentally. Many species are thought to have entered the Mediterranean via shipping, but species can also be exported. The fan worm *Sabella spallazanii* is an example of a Mediterranean species that has invaded other parts of the world via shipping.

While shipping is very important in the Mediterranean, very few ballast water or hull fouling studies have been undertaken. To date, Mediterranean studies have focussed mainly on Lessepsian species or on particular species that have caused major damage to ecosystems, such as the marine alga *Caulerpa taxifolia*, which competes with native seagrass meadows. More intensive port surveys will undoubtedly detect more shipping-related examples.

Caulerpa taxifolia. (Image: J A Moya)

In November 2002 the International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM), convened an expert workshop on shipping as a vector in the Mediterranean (see BW News No. 11). Other recent shipping-vector initiatives in the region include the commencement of a study by Slovenia (see BW News No. 12), and the inclusion of a Strategic Environmental Assessment on ballast water introductions in the work programme of the Adriatic – Ionian Initiative, involving Italy, Slovenia, Croatia, Bosnia & Herzegovina, Serbia & Montenegro, Albania and Greece. The GloBallast Programme is supporting all of these initiatives.

Aquaculture is another important introduction vector into the Mediterranean. Oyster and clam cultures are sustained by two intentionally introduced species (*Crassostrea gigas and Ruditapes philippinarum*), and many fish species have been introduced to enhance inland aquaculture - several carp species, European catfish (*Silurus glanis*), pike (*Esox lucius*) and pike-perch (*Stizostedion lucioperca*). Some of these have proved to be invasive and have caused considerable damage to native ecosystems. Other species (including their parasites) have "piggy-backed" with the aquaculture species.

It is in this complex situation, coupled with strong political and socio-economic pressures, that the Mediterranean countries have to deal with the issue. Conscious of the threat and aware of the importance of economic activities, the countries decided to join forces to develop a regional "Action plan concerning species introductions and invasive species in the Mediterranean Sea", under the auspices of MAP and the Barcelona Convention (see BW News No. 11). The regional Action Plan aims to promote the development of coordinated measures and efforts in order to prevent, control and monitor the effects of aquatic species introductions and invasions, considering all vectors and pathways. In relation to shipping and ballast water, the Action Plan provides for close cooperation with GloBallast and the uniform implementation of IMO measures in the region.

IUCN has always stressed the need for cooperation at all levels to secure the conditions necessary to prevent and minimise the risks posed by alien invasive species. As a participant in activities under the Barcelona Convention and a regional partner particularly involved in this issue, we are pleased to see the Mediterranean countries moving in this direction. The shipping industry also has a key role to play in the Mediterranean and IUCN looks forward to contributing to this process through IMO and the Barcelona Convention processes.

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Durban Accord Directs Action

In the last issue of Ballast Water News we announced the 5th IUCN World Congress on Protected Areas (or World Parks Congress – WPC), and outlined some of the challenges that invasive alien species pose to protected areas, including marine protected areas.

The 5th WPC closed on the 17th of September in Durban, South Africa with participants agreeing on new commitments and policy guidance for protected areas worldwide.

Durban offered participants a unique opportunity to exchange experiences, learn from each other, and establish a common agenda. Discussions in more than 200 sessions covered several questions related to protected areas. Invasive species were repeatedly recognised as one of the main threats to biodiversity and one of the major challenges to protected area managers.

In the Opening Ceremony alone, the threats posed by invasive species were highlighted several times. In addressing the 2,500 congress delegates, Mr Nelson Mandela, co-sponsor of the event stressed the need for approaches that combine environmental protection with economic relief for the poor. In this regard, Mr Mandela praised the efforts of the Working for Water Programme, which has employed thousands of poor South Africans in recent years in its efforts to eradicate invasive species.

The host of the Congress, South African President Mr Thabo Mbeki, told delegates that natural resources and biological diversity are a priceless heritage the world can ill afford to lose. He also stressed the enormous constraints that conservation efforts faced. "These include threats to biological diversity from land degradation, climate change, human settlement and invasive alien species" he said.

Invasive alien species were specifically discussed during a workshop in Stream V of the Congress - Maintaining Protected Areas Now and in the Future. This session, organized by the IUCN Invasive Species Specialist Group, included a presentation by the GloBallast Programme on the impacts of aquatic invasive species on marine protected areas and discussion of marine management options.

The participants in the invasives session at WPC put invasive species forward as an emerging issue, which was added to the overall Congress outputs. They unequivocally agreed that management of invasive alien species is a priority and must be mainstreamed into all aspects of protected area management.

Order from cgregory@imo.org

GloBallast, in conjunction with the Global Invasive Species Programme (GISP) and with support from the United Nations Environment Programme (UNEP), also distributed a poster and flyer entitled 'Preventing Pests in Paradise', developed specifically for WPC. These awareness materials explore the relationship between aquatic invasive species and marine protected areas, highlighting the fact that not only do marine protected areas generate benefits beyond their boundaries, but are also vulnerable to impacts from beyond boundaries and require a cross-boundary management approach.

Recommendations from the WPC invasive species session included:

- The wider audience of protected area managers, stakeholders and governments need to be urgently made aware of the serious implications for biodiversity, protected areas and livelihoods that result from lack of recognition of the invasive species problem and failure to address it.
- Promoting awareness of solutions to the invasive species problem and ensuring capacity to implement effective, ecosystem-based methods must be integrated into protected area management programs.
- Recognising the 'borderless' character of the natural world, particularly the marine environment, and the need to take a cross-boundary approach to managing protected areas, especially for invasive alien species.

The Closing Plenary of the Congress delivered the Durban Accord – a succinct statement for the future of protected areas, an Action Plan; a set of 32 specific Recommendations; and a message to next year's meeting of the Convention on Biological Diversity. All of these outputs state alien invasive species as one of the most significant threats to protected areas and biodiversity and recommendd various management actions.

Addressing alien invasive species in protected areas is challenging, and it is even more challenging to address them outside these areas, particularly in the borderless marine environment. Efforts should be made to equip managers with a better understanding of the impacts of alien species on complex and highly diverse ecosystems.

The outputs of the Congress empower protected area managers and policy makers around the world. With the Durban Accord and the Recommendations in hand, they can start a process with their governments, institutions and organisations to make the vision set in Durban – of protected areas as a common tool for biodiversity protection and poverty alleviation – a reality.

Maj de Poorter
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Experts Convene in Panama

While the transfer fo exoctic species through ships' ballast water is a matter of concern worldwide, the members of the Permanent Commission for the South Pacific (CPPS) – comprising Colombia, Chile, Ecuador, Panama and Peru, have recently manifested their specific concerns and taken action to commence a regional response to aquatic invasive species, through the Plan of Action for the Protection of the Marine Environment and Coastal Areas of the South East Pacific.

Concerns in this region are highlighted by the fact that, during the past decade, the region was affected by a major outbreak of cholera possibly linked to ballast water introductions, commencing in Peru in 1991, and causing thousands of deaths and major social and economic impacts. There are also concerns that the 'white spot' virus epidemic that has devastated shrimp aquaculture industries in Ecuador, Peru, Colombia and Central America, may have been introduced through ships' ballast water from Asian countries.

From 9 to 11 July 2003 CPPS, which is the Executive Secretariat for the regional Plan of Action, with the cooperation of the Secretariat for the Convention on Biological Diversity (CBD) and the GloBallast Programme, among others, convened a "Meeting of Experts on the Impact of the Introduction of Alien Species in the South East Pacific, Ballast Water Problem", in Panama City. The main objectives of this meeting were:

- To obtain current knowledge of the effects produced by the introduction of alien species in marine ecosystems;
- Support regional implementation of international agreements and initiatives; and
- Commence development of a regional programme for control and management of the aquatic invasive species.

The meeting in Panama (Photo: Néstor Ardila).

More than twenty specialists from the region attended the meeting, which also included the participation of Mr Alexandre de Carvalho Leal Neto, representative of the GloBallast Programme for South America, based in Brazil.

The main recommendations issued from the meeting included the creation of a regional group of experts to investigate the effects of alien species in coastal/marine habitats; prepare a proposal for an inventory of the coastal-marine biota of the region; establish a monitoring program on the effects of exotic species; regulation and contingency plans to minimize accidental loses from aquaculture and ornamental species.

Regarding ships' ballast water, the meeting encouraged the member states of CPPS to adopt the IMO resolution A.868(20) and carry out biological research in their ports, identify critical zones to avoid uptake of ballast water; participate in the GloBallast Programme; initiate studies and control measures on hull fouling, form a regional marine taxonomists network; and to increase the exchange of information and expertise about the issue with the aim to strengthen institutions in charge of its control and management.

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New Monographs

The two latest GloBallast Monographs are No. 8 – the report on the Ballast Water Risk Assessment for the Port of Khark Island, Iran and
No. 9 - the report on the 1st International Workshop on Ballast Water Sampling held in Rio de Janeiro, Brazil in April 2003.

http://globallast.imo.org/publications

Kiwis Release Strategy

The Government of New Zealand has recently released one of the first comprehensive biosecurity strategies ever to be developed at the national level by any country, taking an integrated, holistic and strategic approach to addressing all pathways and vectors for both aquatic and terrestrial invasive species and pests, under a single regime.

Despite its comprehensiveness, and the intention that ballast-mediated bio-invasions are included in this integrated approach, the Strategy does not appear to include explicit provision for New Zealand to implement the forthcoming IMO ballast water Convention, and there is a distinct lack of mention of this major marine vector and the responses necessary to effectively address it.

www.maf.govt.nz/biosecurity-strategy

Progress Report

Activities Undertaken July - September 2003

- ✓ PCU staff annual leave.
- ✓ Attended Guinea Current LME Project Meeting, Lagos, 11-20 June (S. Africa Rep).
- ✓ Attended / supported CPPS regional ballast water meeting Panama 9-11 July (Brazil Rep).
- ✓ Attended / supported MEPC 49 14-18 July.
- ✓ Convened 2nd International Ballast Water Treatment R&D Symposium, IMO London 21-23 July.
- ✓ Produced new awareness poster 'Preventing Pests'.
- ✓ Attended and presented at 5th World Parks Congress, Durban 8 to 17 September.
- ✓ Held 1st International Ballast Water Risk Assessment Workshop, Melbourne 22- 26 September.
- ✓ Commenced publication of final reports on Risk Assessments for each Demonstration Site.
- ✓ Published report on 1st International Workshop on Ballast Water Sampling.
- ✓ Progressed drafting of international guidelines and standards for ballast water sampling.
- ✓ Progressed validation of modular ballast water management training course.
- ✓ Developed joint ballast water project proposal with UNEP.
- ✓ Submitted Concept Paper to UNDP and GEF for follow-up activities to the GloBallast pilot phase.
- ✓ Progressed BWEEMS (Ukraine), ballast water treatment R&D (Ukraine & P.R China), Golden Mussel study (Brazil) and National BW policy (S Africa).
- ✓ Produced 14th issue of Ballast Water News.

Image credit: J Halas

Activities Planned Oct - December 2003

- Publish proceedings of 2nd International Ballast Water Treatment R&D Symposium.
- Update / republish Global Ballast Water Treatment R&D Directory.
- Complete publication of final reports on Risk Assessments for each Demonstration Site and progress same for Port Biological Baseline Surveys and other activities.
- Attend and present at Adriatic-Ionian Initiative Round Table, Slovenia 27-28 Oct.
- Convene 2nd Regional Meetings for ROPME Sea Area (Tehran, I.R. Iran) and East Asia (Dalian, P.R. China) to adopt Regional Strategic Action Plans.
- Hold planning meeting for 1st regional replication of port surveys in Mombasa, Kenya (South Africa lead).
- Progress regional replication and cooperation activities for South Asia (India lead) and South America (Brazil lead).
- Attend / support ballast water treatment system type-testing workshop, IMO London 10-12 Nov.
- Attend and present at Global Conference on Oceans, Coasts & Islands, Paris 12-14 Nov.
- Validate modular ballast water management capacity building course in I. R. Iran.
- Progress drafting of international guidelines and standards for both ballast water sampling and IAS surveys and monitoring in port areas.
- Plan and organize 5th Global Task Force meeting for Feb 2004, including review of proposed amendments to Pilot Country workplans and 6 month extension of project to Sept 2004.
- Attend and present at East Asian Seas Congress, Malaysia 8-12 Dec (P.R. China Rep).
- PCU staff annual leave.
- Produce 15th issue of Ballast Water News.

More Information?

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