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Phuket Island, Thailand
Photo: W.Y. Chiau

The Sixth APEC Roundtable Meeting on the Involvement of the Business/Private Sector in the Sustainability of the Marine Environment

Meeting Report and Summary Conclusions

October 7-8, 2005

Penghu, CHINESE TAIPEI

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The Sixth APEC Roundtable Meeting on the Involvement of the Business/Private Sector in the Sustainability of the Marine Environment was held from 7-8 October 2005, in Penghu, and was attended by representatives from: Australia; Canada; Hong Kong, China; Japan; Korea; Singapore; Chinese Taipei and the United States of America. Representatives from the business sector (petroleum, tourism, and risk response and management), academia, government and non-governmental organisations also attended.

Opening

Dr. Robert Hwang, President of the National Ocean University, Chinese Taipei, and opened the meeting and welcomed the participants. Dr. Hwang stressed the significance of the marine environment to member economies in the region, and thus the importance of ensuring the sustainability of marine resources. Dr. Hwang also outlined the recent and future initiatives undertaken by Chinese Taipei and particularly the National Taiwan Ocean University in pursuing the goal of marine sustainability.

Dr. Tsay T.K., Deputy Minister of the Environmental Protection Administration, Chinese Taipei, gave the opening address. Dr. Tsay outlined the history of the development of the APEC agenda on marine sustainability, and the recent emphasis on the participation by the private/business sector. He also reported the recent establishment of an inter-ministerial marine affairs bureau in the Chinese Taipei government to facilitate marine environmental management.

Election of Officers and Adoption of Agenda

The overall meeting was organized by Dr. Wen-Yan Chiau. Dr. Shing Yip Lee, Australia, was elected as rapporteur for the meeting. The meeting adopted the agenda (Annex 2) while noting changes of the titles of presentations by Mr. Battaglia (USA) Mr. Chan (Singapore), Professor Ni (Chinese Taipei) and Mr. Park (Korea).

Background Briefing

Dr. Wen-Yan Chiau, Chinese Taipei, provided the background leading to this meeting, which is organized to further the 1997 "APEC Action Plan on Sustainability of the Marine Environment", the 2000 "Action Strategies and Work Programmes" and the 2002 Seoul Declaration of APEC Ocean-related Ministerial Meeting. Another meeting was held in Bali in 2005. A Joint Ministerial Statement and the Bali plan of Action were adopted by the Bali meeting. The Seoul and Bali meetings provide forums for stakeholders from government agencies, academia, business sector, and NGOs to examine how best to promote public and private sector partnership and participation for the sustainable use of the marine environment.

Session I – Meeting background and recent initiatives of APEC.

(The meeting proceedings contain copies of the session presentations in full – this summary provides only a few key points from each presentation and the discussion following each presentation)

Co-Chairs: Dr. Robert Kay, Australia, and Dr. Robert Hwang, Chinese Taipei.

Following a round of introduction of all participants, Dr. Kay noted that participants came from government, non-government, business and academic institutions and looked



Delegate of Chinese Taipei at the 18th Meeting of MRC WG
Phuket Island, Thailand
Photo: W.Y Chiau

forward to significant discussions that will contribute to sustainable development of the marine environment.

1.1 Background and objectives – Dr. Wen-Yan Chiau, Chinese Taipei.

- Previous APEC meetings at various levels contributed to the present theme on marine sustainability, particularly the 2002 Seoul Ocean-related Ministerial Meeting and the 2005 Bali meeting.
- Roundtable meetings have been held to identify and develop project ideas (2001, 2002) and discuss the involvement of private/business sector in marine sustainability (2003, 2004, 2005).
- Various anthropogenic disturbances such as destructive fishing practices, aquaculture, ecotourism activities, shoreline modification and pollution significantly impact the marine environment, often exceeding the carrying capacity.
- The Sixth Roundtable meeting will address these issues, with themes in marine aquaculture, marine pollution, marine ecotourism.
- The Seventh Roundtable meeting will be held in Kinmeng in 2006.

1.2 Report of AOMM-2 and Bali Action Plan – Dr Michael Gau, Chinese Taipei.

- Private/business sector, the relevant APEC documents (the Seoul Ocean Declaration, Bali Action Plan), and the themes of the Roundtable meeting form the 3 pillars of this Roundtable meeting.
- Sections of the SOD stress the importance of an ecosystem-based approach and the involvement of the private/business sector.
- AOMM-II/BAP stresses the need to better understand the (market and non-market) value of the marine sector, minimize wastage and improve market access for small marine enterprises, increase community (particularly women) engagement through outreach

activities and partnerships, and to reduce the impact of ecotourism.

- The themes of this Roundtable meeting, namely, Market Values of the Marine Environment; Marine Pollution and Control; Marine Aquaculture Industry; and Marine Ecotourism bear direct correspondence to the BAP.
- Not all issues identified by the SOD are in the BAP, but some emerging issues, such as tsunamis, have been identified, while gaps are still present, e.g. marine underwater heritage.

1.3 Valuing the Marine Economy – Professor Alistair McIlgorm, Australia.

- The APEC Phase I project attempts to value the marine economy, enabling decision makers to assess the significance of various activities on the marine environment, rather than to compare different economies.
- Difficulty in defining and valuing marine economy – how far inland should marine economy go? In some economies, such as Chinese Taipei, some industries (e.g. engineering and ecotourism) are not distinguished into marine and land-based activities.
- Some values have not been addressed by the Phase I project, e.g. real estate, waste dumping, ecosystem services, but a framework has been established for further study of APEC economies in Phase II of the study.
- Value-added in national accounts (GVA) is preferable as a measure of contribution to the economy because this approach avoids double counting.
- Results of the Phase I study suggest that marine contribution vary from 1.2 to 4.9% GDP (UK, USA, Canada) or 3.6% GVA (Australia) plus employment.
- 3 more APEC economies will be focused on in Phase II, and will reflect the priorities defined by the BAP and invitations are extended to member economies are invited to participate.

Session II – Oil Spill Response.

Co-Chairs: Professor Nobutiro Swano, Japan; Dr. Ni I-Hsun, Chinese Taipei.

2.1 Fundamentals of an Effective Oil Spill Response – Mr. Daniel Chan, Singapore.

- A global response network has been set up to enable rapid response to all incidents.
- Five major response strategies are possible: (1) Monitor and evaluate, (2) use of dispersants, (3) contain and recover, (4) protection and (5) shoreline cleanup; each with their suitability/advantages for different situations and issues/limitations.
- Some strategies require prior approval from authorities, e.g. use of dispersants; project planning and coordination including public relations are also important areas for attention.
- Strategy to be adopted should have reference to the local situation, e.g. different levels of biodiversity and other values. Tools such as net environmental benefit analysis (NEBA) may provide insight into the suitable strategy.

2.2 Policy on Marine Environmental Protection for Fishing Ground in Korea – Mr. Jae-Young Park, Korea.

- Marine fisheries in Korea has suffered significant decline in work force since 1975, but the size of the powered fishing fleet has increased significantly. There is a sharp decline in self-sufficiency in fishery produce with time.
- Pollution is one of the main reasons for the decline in fishery production. Red tides occurrence and oil spills have inflicted heavy economic loss to the fishing industry in recent years. Marine debris and sand dredging are also emerging concerns.
- Coherent policies have been proposed in Korea to remedy the situation. A comprehensive marine environment protection plan has been

proposed, with well defined objectives set for the 2001-5 five-year period.

- A 10-year comprehensive treatment system for marine debris is in force between 1999 and 2008. International cooperation through the NOWPAP and PEMSEA will also contribute towards marine environmental protection in Korea.
- Future measures for marine environmental protection in Korea include: enactment of marine environmental legislation, increased funding, improvement of marine debris treatment, increased marine environmental R&D, strengthening human resources and regional cooperation network.

2.3 Components of a Successful Oiled Wildlife Response Effort – Mr. Chris Battaglia, Canada.

- Arguments have been put forward for or against response effort towards oiled wildlife. Considerations include costs and cost-effectiveness, training opportunities for species at risks, among other factors.
- Many incidents involve multiple parties in different countries and geographical locations, response effort is therefore a responsibility for all.
- Response should be culturally

sensitive and responsive.

- Response action provides a good platform for public education and awareness.

Session III – Ocean Development and Environmental Management.

Co-Chairs: Mr. Kenji Nashigaki, Japan, Dr Lei Yang, Chinese Taipei.

3.1 Long-term Shoreline Monitoring After Nakhodka Oil Spill and Efforts for Involving Local Stakeholders – Professor Nobutiro Sawano, Japan.

- The ESI ranking system (NOAA) seems to provide a good framework for predicting the effects of oil spills on shore ecosystems, based on studies conducted after the Nakhodka spill event.
- 7 criteria were used to classify shores, including various structural attributes of the shore, presence of wave cutters, and amount of marine debris. The time of residue was then predicted from these parameters using quantification analysis. Good agreement was obtained between predicted and observed residue amounts on the shores. This approach is more appropriate to Japanese shores than the Predicted Wave Exposure Index (PWEI) of Hayes (1996).
- Based on this system, 3 classes of

shores (ESI Shoreline ranking <4; 4<SR<7; SR>7) have been identified, with different oil residue times.

- The Abashiri Citizens' Council for Oil Spills, a local stakeholders council with 10 members involving government and NGOs was set up in July 2005 to facilitate the application of the above research outcome.

3.2 Conservation Aspects of Marine Fisheries – Dr I-Hsun Ni, Chinese Taipei.

- Various commercial fishing methods impact the marine environment in various ways: mortality of non-target species, habitat destruction, indiscriminant capture of size classes, and some effects (e.g. ghost nets) may persist for a long time after fishing activities have stopped.
- Recreational fishing also has strong environmental impact ranging from coastal pollution and often unrecognized large fishing effort.
- The present food production and consumption pattern is creating many grave problems for the future.
- Designs are now available to make fishing gears more environmentally friendly through reduction of by catch mortality; better fishery management practices like closures contribute to conserve stock; but changes must occur quickly to ensure long-term



Pratas Island, Taiwan
Photo: W.Y. Chiau

sustainability.

3.3 Sharing Environmental Awareness: Outreaching Through Software – Government – Academic Partnership – Mr. Robert Beltran, USA.

- Traditionally the 'stick and carrot' approach was used to promote environmental changes but various issues make them ineffective, e.g. incentives can be expensive.
- Most people are willing to adopt environmental best practice, but hampered by a disconnection between environmental science and environmental opportunity.
- Partnership between EPA (public) and Purdue University (private) has produced 50 free environmental, including interactive executable and modelling, software for various applications and clients (business/industry, agriculture, governments, educational institutions, general public) since 1987.
- Functional partnerships grow in time, attracting more partners.

Session IV – Marine Aquaculture and Marine Contaminants.

Co-Chairs: Dr Alistair McIlgorm, Australia;
Mr. Yung-The Lin, Chinese Taipei

4.1 Mercury Accumulation and Improvement of Dietary Feeds in Net

Cage Salmon – Dr. Chiu Chou, Canada.

- Persistent organics (e.g. PAHs), metals (mercury, arsenic and cadmium) and medicinal (e.g. antibiotics) are concerns in salmon culture, but worldwide there is no guideline for the management of pollutants in aquaculture.
- Mercury from the environment (diet and the water, particularly the former) is stored in the liver, muscle and kidney in salmon. After smolting, the mercury body burden increases with rapid growth, particularly in the muscle, but tissue concentration decreases because of the fast tissue increase.
- Good design of fish feed for various phases of the culture period, i.e. low Hg content during the fast grow-out period, will reduce the final Hg content to below USEPA standard.
- Much is yet to be done on the environmental impact of marine aquaculture. This is particularly relevant to emerging regional economies such as Penghu.

4.2 Dioxins, Dibenzofurans and Co-planar PCBs Contamination in Korean Seafood – Dr. Narayanan Kannan, Korea.

- Fish is often consumed for their potential health benefits from a high omega-3 fatty acid content, but they

may also contain high concentrations of pollutants, especially lipophilic compounds like PCBs, dioxins, PBDEs and dibenzofurans. Consumption of fish products would therefore have to be balanced between the potential health benefits and risks.

- A survey of fresh and processed fish and invertebrate products in Korea found that persistent organic pollutants are prevalent but the concentrations of PCDDs and PCDFs are low compared with those reported from the USA and Europe.
- PCBs contribute most significantly to the Toxic Equivalent Quotients (TEQ). Based on the TEQ and consumption data, the common dietary fish, dried anchovy, contributed the largest source of TEQ to Koreans.
- The daily intake of persistent organics by Koreans is lower than those of many other developed countries such as Japan. Currently the benefits of fish consumption still outweigh the risks from these chemicals.

4.3 Behaviour and Effects of Contaminants in the Australian Marine Environment: An Overview – Dr. Des Connell, Australia.

- Many toxic chemicals are generated from many anthropogenic sources.



Welcome Banquet of the 5th Joint Session.
Phuket Island, Thailand
Photo: W.Y. Chiau



Matzuu, Taiwan
Photo: W.Y. Chiau

Often one toxic compound (e.g. DDT) is replaced only by another less persistent, but even more toxic one.

- In risk assessment of toxic pollutants, both exposure and toxic effects must be considered before the biological effect can be assessed. Attention should be paid to internal concentration rather than just the ambient concentration for assessing biological impact.
- Lipophilic compounds are mostly associated with the sediment, but concentration can be high in the biota, causing endocrine disruption.
- A survey of the level of organic pollutants in the Australian marine environment suggests that levels are generally low except in major urban centres or locations with high human activities, e.g. port in the Great Barrier Reef, but records exceeding the MRL for POPs were found in the 1990s and some metals (Hg, Cd) are still of concern.
- Contrary to most marine systems, corals are particularly sensitive to P enrichment, showing increased productivity for 2-3 fold increases in [P] compared to normal values, but tend to suffer when increase is >3x. The negative impact is mainly due to increased algal growth causing shading and deoxygenation of the sediment.

Discussion

- Dr. McIlgorm asked the speakers to comment on the possibility of joint efforts to combat the problems posed by the pollutants mentioned in the presentations.
- Dr. Kannan: The chemical industry should provide more information on the compounds they produce, and

more research effort should be put towards the impacts on ecosystems.

- Dr. Chou: pollution hotspots should be identified. Areas that are seemingly remote from pollution sources could be contaminated, and should be monitored. This requires a shift in resource allocation.
- Dr. Connell: Tropical areas deserve more attention. Coral reefs and marine mammals are under threat, for example. Research traditionally is biased towards studying temperate systems. There should be concerted research effort to focus on tropical marine areas.
- Dr. Chou: Some training occasions can be organized to share the knowledge and skills in pollutant monitoring among the APEC member economies.
- Professor McIlgorm: the external costs of marine pollution are not adequately recognized, particularly in the tropics as the victims of pollution may be present themselves.

Section V. Marine Conservation and Ecotourism.

Co-Chairs: Mr. Robert Beltran, USA; Dr Yu Shyi-liang, Chinese Taipei

5.1 Hermit crabs of plastic house: A Movie on Marine Resource Conservation Presented by Taiwan Public Television – Director Yu Li-Ping, Chinese Taipei.

- The movie was presented during the lunch break.

5.2 The Challenge of Sustainability of Whale Watching in Taiwan, Chinese Taipei – Dr. Chou Lien-Siang, Chinese Taipei.

- Commercial whaling stopped in 1982 in Chinese Taipei and all cetaceans

were added to the Protected Species List in 1990. There is still much conflict between fishery and cetacean conservation.

- The first whale watching boat was launched in 1997 and the number has risen to >32 in 2003 on the east coast of Taiwan, with the number of tourists approaching 250 thousand per year. Species seen include spinner, spotted, Fraser's and bottlenose dolphins and killer, sperm and recently humpback whales.
- Tourists are spending more on non-ticket expenses while tickets have become cheaper. Total revenue from whale watching ecotourism has increased steadily between 1997-2003, accompanied by improvement in touristic and port facilities.
- Different species of dolphins respond differently to human presence, depending on the location, species, and encounter circumstances.
- Recent roundtable meeting on whale watching in 2004 concluded that ecology, economy and education are the highest priority areas for future action. The National Science Council is also supporting a group project on whale watching, with 5 sub-projects covering the priority areas.

5.3 Conservation of Indo-Pacific Humpback Dolphins (*Sousa chinensis*) in the Coastal Waters of western Taiwan: Problems, Threats and Policy – Dr John Y. Wang, Canada.

- There were no records of *S. chinensis* before 2000 in Taiwan. The local animals have different pigmentation from the mainland Chinese populations and could be an endemic sub-species. The local population is small (~100-200) and occurs very close to shore, mainly on

the central west coast of Taiwan.

- Urgent action is required for the IPHD, which is most likely critically endangered. Many anthropogenic threats endanger this dolphin: land reclamation, pollution (including noise), fishing gear and boating damage, and depletion of food resources.
- Major new development projects on the coast will also impact the dolphin populations. Naval sonar and noise pollution are also emerging threats.
- Limited resources are available for research on this species of highest conservation priority. While wildlife conservation laws can prevent direct hunting, they are ineffective in stopping indirect harm to the dolphins.
- Due consideration should be given to the IPHD in future EIAs, and public awareness should be increased. A multidisciplinary approach supported by global multi-stakeholder participation is necessary. Much monitoring and research work can be done with relatively small funding.

5.4 Functional morphology of the Feeding Appendages and Architecture of the Mud Shrimp *Austinopecten edulis* (Crustacea: Decapoda: Thalassinidea) – Dr. Benny Chan, Hong Kong, China.

- *Austinopecten edulis* is commonly distributed on the west coast of Taiwan and is harvested for human

consumption.

- Analysis of the setation pattern of the feeding appendages using scanning electron microscopy suggests that this animal is a mixed filter- and deposit-feeder, which is confirmed by gut content analysis.
- Y-shaped burrows are maintained to facilitate feeding and removal of wastes. Burrows seem to be connected during the breeding season to allow mating. The ability to dig a new burrow is lost in the adult, unsuccessful fishing effort may impact the population because of disturbance.

Section VI. Coastal Planning and Partnership.

Co-Chairs: Dr. Chiu L. Chou, Canada; Dr. Wen-Yan Chiau, Chinese Taipei

6.1 Community Participated Conservation Actions on Taiwan's Coastal Protected Corridor – Professor Monica Kuo, Chinese Taipei.

- Only 40% of Taiwan's coastline remains natural, the west coast is particularly impacted by extensive industrial development. There are now 12 coastal protected areas in Taiwan but their effectiveness is hampered by lack of resources.
- Over development, oil pollution, fishing port development, landfill site construction, land reclamation, highway construction and sand dune obstruction and coast fragmentation are important issues affecting the condition of the coastal ecosystems.

- Action plans have been proposed for facilitate conservation of the coastal and marine environment throughout Taiwan, participated by close to 100 community groups to help with education, training courses, and ecosystem restoration.
- A "Marine Protected Corridor" could be established through effective partnership of relevant bodies in the region.

6.2 Public/Private Partnership and Effective Oil Spill Response – Mr. Kenji Nashigaki, Japan.

- Responsible parties should shoulder the cleanup task, government and coastguard should be central to coordinating the cleanup task.
- Private and public bodies should cooperate to ensure that suitable equipment and material for response are available promptly (a demonstration was shown on equipment deployment).

6.3 Private Sector Engagement in Coastal Zone Management: Models and Practical Examples from Australia – Dr Robert Kay, Australia.

- Governments usually compel, induce and facilitate in order to encourage private sector involvement; private sector looks for branding and marketing opportunities and incentives. These issues form the basis of engagement models.
- Five engagement models were proposed in the 5th APEC Roundtable meeting: traditional consultation on plans and strategies, involvement and



Fruit Cutting Art in Phuket, Thailand
Photo: W.Y. Chiau

consultation on major infrastructural projects, coordinating committees for ongoing projects, single issue based partnership and geographic (multi issue) based partnership.

- It is proposed that further research steps before these models are adopted by APEC economies include: Analyse from government and private perspectives; best-practice case studies; national-level profiling and model testing.
- Given support from member economies and feedback on the approach, the proposed research can be conducted to benefit the APEC region.

General Discussion and Recommendations

Co-Chairs: Dr. Robert Kay, Australia; Dr. Y.F. Liang, Chinese Taipei

Summary of Discussion

- A series of case studies in public/private partnership from the region could be beneficial to all member economies. Sharing of experiences and expertise in more specific issues of interests, for example, oil spill response, would be highly desirable.
- The internet can act as a good platform to share standards and promote future networking amongst organizations and individuals in research and education in marine pollution prevention and control.

- Given the highly diverse nature of the APEC region, care is needed to ensure effective dissemination of information. Member economies that are not actively involved in the network should be included through better information dissemination in the future.
- Chinese Taipei is keen to sponsor similar activities in the future, and would like to see more emphasis on economics and ecology.
- Commercial considerations seem to be the driving force behind most changes, how to leverage this force is important to achieving outcomes in environmental projects.
- Action may actually start with action, e.g. web resources, then gradually develop a framework.
- A set of core values for marine environmental conservation and pollution prevention and control have been identified by the meeting and these will drive the process of change.

Recommendations

The meeting supported the following recommendations for consideration by the MRC WG:

Priorities:

- **Investigate** ways to improve oil spill response capability in the region

through better coordination among existing centres and new partners.

- **Extend** the Marine Value Project to Phase II. Cost-benefit analysis can be conducted for a study linking the Marine Value and the Oil Spill Response projects.
- **Sustain** support for projects on marine aquaculture, particularly in the areas of conservation and pollution prevention.
- **Provide** long-term support for research in priority species, such as cetaceans, in the region. Partnership between government and private sectors to ensure long term sustainable management should be investigated, drawing on the experience of regional best practice models.
- **Organise** private senior executive leadership summits that are targeted to ensure business benefit and encourage involvement.
- Marine pollution including marine debris should be treated as an urgent issue in coastal management for funding and cooperative action among member economies.

Closing

- The delegates recorded a note of appreciation for the organizer of the meeting.



Taipei County, Taiwan
Photo: W.Y. Chiau

2005 Asia-Pacific Conference on Marine Pollution Prevention and Control

Call for Action for the Prevention and Control of Marine Pollution in the Asia-Pacific Region

*Kaoshiung and Penghu, CHINESE TAIPEI
October 4-6, 2005*



The Scientific Tour to Penghu National Scenic Area Administration in Penghu, Taiwan
Photo: W.Y. Chiau

The marine environment is an integral part of the Earth's life support systems and has provided one of the most important sources of natural resources for human development. The Pacific Ocean, the world largest ocean, is critical to support the economy and long-term welfare for countries and peoples around its rim. However, marine pollution has become a major regional concern. A significant volume of municipal wastewater and various land-based pollutants have been continuously discharged into the marine environment without proper treatment. Incidents, such as oil spills, have aggravated the situation. Introduced exotic species and some ecologic concerns (e.g., antifouling materials) have also been the focus of marine environmental management and regional cooperation. Illegal or un-managed fisheries and aquaculture are major sources of marine pollution. There is a necessity to provide a forum for exploring the current status, identifying the major issues, exchanging information and ideas as well as adequate strategies to overcome the problems of marine pollution in the Asia-Pacific region.

The 2005 Asia-Pacific Conference on Marine Pollution Prevention and Control

(ACMPC) was held between October 4-6, 2005 in Kaoshiung and Penghu, Taiwan. The conference was organized by academia, NGOs and business sector of the APEC region and was coordinated by the Taiwan Association of Marine Pollution Control.

The conference provided an excellent forum for views to be exchanged on the issues and priorities facing the management of marine pollution in the Asia-Pacific region. Issues addressed by the conference included: oil spills, non-point sources of marine pollution, marine debris, chemical pollution, coastal engineering, biodiversity, habitat/ecological analysis and port management. Management responses discussed included reducing pollutant inputs into the marine environment, the restoration of habitats degraded through pollution, and rapid response mechanisms to manage pollution incidents such as oil spills.

All delegates of the conference shared their common vision for ensuring that the momentum built at the event continues into the future.

This Call for Action aims to summarize key scientific, management and policy-related information presented

at the conference. In doing so, those with the ability to improve the condition of ocean waters in the Asia-Pacific region are targeted. These include policy-makers, managers, private sector organizations, NGOs, inter-governmental organizations (IGOs) educators and the general public.

The common theme in this MRC round table was the management of costs externalised by the private sector onto the marine environment. Examples are pollution of the marine environment by the oil industry, chemical and waste industries (sewage and marine debris) and the aquaculture sector.

Traditionally the role of government has been to consider intervening to protect the public good nature of the marine environment, usually through legislation to protect the marine environment.

In the area of marine oil spills, the private sector is aware of its responsibilities and can act collectively within industry to provide remediation when accidents occur. This is an improvement on the situation with chemicals, waste and aquaculture, where private sector collective solutions to remediate environmental impacts have

not yet been developed.

The challenge for the APEC is to progress both private sector and government action in protecting the marine environment.

The incentive for:

- Government is cost saving from addressing these issues today, as opposed to the increased cost and risks from inaction.
- The private sector comes in conforming with environmental legislation and examining any market advantages from improved environmental practices and an improved public perception.

A problematic area, is the case of species which are endangered by the general degradation of the marine environment, as may be the case of some marine mammals. It is envisaged that precautionary plans and actions by government and the private sector may be required to address the immediacy of a threatened species issue.

The challenge for the MRC is getting industry to the table if they believe that all outcomes involve increased costs for the private sector.

The delegates would like to thank the Taiwan Association of Marine Pollution Control, and in particular Dr. Wen-Yan Chiau and Mr. Eilif Wang for hosting such a stimulating conference. We would also like to stress the commitment for concerted, long-term effort for the improvement in the condition of the marine environment build through our shared friendship, spirit and dedication.

The conference delegates reported a number of key findings:

- Marine pollution continues to be a major concern in the Asia-Pacific region.
- The rapid economic development and population growth of the region will accelerate present concerns unless concerted and coordinated management action is not taken.
- Pollution from chemical compounds used in information technology manufacturing (electronic waste) in

the region appear to be increasing. The impacts of these compounds to the marine environment is poorly known and warrants urgent research.

- The ecological impacts of marine pollution are becoming critical in the region – extending from the polluted areas adjacent to many major coastal cities.
- The rapid growth in marine aquaculture has the potential for significant pollution of Asia-Pacific marine waters.
- Examples of approaches used in the region to manage marine pollution have the potential to become widespread – using the internal capacity of regional economies supported by regional leaders.
- Regional countries can profit from the lessons learned from experiences from other parts of the world.
- True partnerships between government, IGOs, NGOs, the private sector and educators are vital to ensure long-term, concerted marine pollution reduction.
- Marine pollution in the region is a long-term problem – and so needs long-term solutions and programs to be effective.
- The emerging coordinated regional approach to oil-spill prevention, preparedness and response management has the potential to be broadened to addressing other marine pollution issues.
- Marine debris is a major concern and appears to be growing as a problem for water quality, biodiversity and human use of the marine and coastal environment.
- Many, if not most, marine pollution issues does not recognize political boundaries – we all share the same ocean – and so management responses must be appropriate to this scale while recognizing the need for concerted local-level action.
- While it is clear that widespread pollution and marine environmental degradation is taking place – region-wide ocean monitoring 'health

checks' are not taking place. As a result, long-term trends in ocean conditions are difficult to assess.

- There are presently no widely accepted standards for marine monitoring in the region. As a result, this makes inter and intra-regional comparisons and benchmarking difficult.
- The ocean is used for a multitude of purposes – and by many sectors of society and the economy. So management responses must be multi-sectoral, multi-disciplinary and multi-jurisdictional in nature.
- The economic, social and environmental values of the marine environment are not well known. This is a key constraint for policy making in the future.
- The various international conventions and protocols affecting the management of the marine environment were determined to be un-coordinated in their implementation. There is scope for increased collaboration and communication to increase implementation effectiveness.

While it is recognized that focused action must be made by all stakeholders on all issues impacting regional marine pollution, the following targeted recommendations from the ACMPC are made:

For Policymakers

- Reduce the input of pollutants into the marine environment from land-based sources through concerted and integrated management responses.
- Encourage the continued growth and networking of regional oil-spill response centers.
- Develop regional strategies to address marine debris.
- Support researchers in their important work through long-term, ongoing funded research programs.
- Actively participate in the development of regional policies, guidelines, educational material to reduce marine pollution.

- Recognize the increased interconnected nature of regional economies and inter-dependency of marine policy issues.

For researchers

- Conduct further research on sources, pathways and sinks of marine pollution and consequent effects on ecosystems and human health.
- Enhance regional scientific cooperation through sharing of knowledge, project proposals and the development of research networks.
- Increase monitoring and assessment studies to better inform marine pollution management and determine long-term trends.
- Develop regionally consistent approaches to marine monitoring.
- Identify critical gaps in research and assist in prioritizing future regional research priorities.
- Ensure that important research findings are included into policy and management responses through active communication programs.
- Coordinate the development of international protocols and approaches for standardized marine monitoring and assessments (including minimum standards).

For Managers

- Increase management action for marine and coastal pollution prevention, preparedness and response.
- Develop integrated management strategies that address marine pollution issues at the appropriate scale – from local to regional.
- Continue to support the prohibition of destructive management practices, such as un-controlled marine aquaculture, unmanaged dredging and trawling and illegal dumping.
- Promote the ongoing participation of the private sector, IGOs, NGOs and the general public in management at all levels of management action from international to local.

For Educators

- Develop educational materials of all media to target different ages and educational level to both educate and influence school children and members of the general public.
- Share examples of 'good practice', marine pollution management models, guidelines and information products.
- Encourage regional educational leaders through environmental education programs.
- Methods of disseminating knowledge of regional issues – public education, mentoring

In addition, a number of recommendations are made to ensure on-going regional collaboration:

- Consider establishing a body to coordinate on-going regional collaboration to complement existing bodies. Taiwan is encouraged by delegates to take leadership in this regard.
- Build on the existing initiatives of the Taiwan Association of Marine Pollution Control for inter-networking using the Association's website through the development of interactive features, such as specific communities of practice and on-line topic groups.
- Organize a series of inter-organization programs focusing on priority issues, such as marine debris, oil-spill management and development of oil-spill response centers.
- Stage a series of on-going workshops, conferences and seminars to enhance regional cooperation and knowledge sharing including annual conferences of the ACMP.
- Form of a network of marine pollution control organizations, such as oil spill response centers and foundations.
- Develop an online register of projects, potential project partners and donors for regional marine pollution prevention and control initiatives.



The 26 December 2004 Indian Ocean Tsunami: Coastal Management and Planning Considerations

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Abstract

The tragedy of the 26 December 2004 Indian Ocean tsunami triggered a multitude of responses to the disaster – from large multi-million dollar projects managed by international organisations through to small on-the-ground micro projects.

Ten months after the disaster and the long-term implications for coastal planning and management in the region are becoming clearer. To-date, the sheer scale of the disaster (followed by the scale of the response) has made analysis of the overall status of response efforts difficult. This is one of the key reasons why in the Joint Ministerial Statement of the 2nd APEC Ocean-Related Ministerial Meeting (AOMM2) held in Bali from 16-17 September 2005 (the 'Bali Plan of Action') stressed the importance of information sharing and using proactive coastal management tools, in particular that:

APEC investigate the use of an on-line database to allow APEC economies to update and view details of all tsunami-related projects, programs and activities (section xi)

Develop integrated coastal zone management plans that anticipate and plan to mitigate the impact of hazards and climate extremes, allowing coastal communities to adapt and mitigate the affects (section xii)

The APEC 'Bali Plan of Action' initiatives are analysed within the context of broader coastal environmental management and planning considerations. A specific proposal to take the initial step in the development of the online tsunami projects database, through a 'requirements analysis' is put forward for discussion.

The tsunami tragedy also provides an opportunity to improve coastal planning and management in the region due to the renewed focus on coastal zones. The implications of this opportunity are discussed

Introduction and Background

An estimated 290,000 people were killed and 1.2 million were displaced or directly affected by the Indian Ocean tsunami of 26 December 2004. The APEC economies of Indonesia, Thailand and Malaysia were impacted by the tsunami. The most affected by the combined effect of the earthquake (magnitude 9.0 on the Richter scale) and the tsunami (at its greatest height of its run-up was 35-45m), was the Aceh province of Indonesia with 98,000 confirmed dead and 132,000 people missing. The full extent of tsunami and earthquake affected areas is shown in Figure 1.

There have been a multitude of responses to the disaster – from large multi-million dollar projects managed by international organizations through to small on-the-ground micro projects. For example, a recent World Bank review of Aceh, Indonesia, revealed over 700

tsunami-response projects (www.e-aceh.org).

Importantly, the tsunami appears to have changed the rules of engagement on marine and coastal management issues in the affected countries. The direct investment at all levels – from national governments all the way through to local communities – by a plethora of donors has resulted in an impossibly complex landscape. Traditional donors are mixed in with NGOs, local and provincial governments, charitable clubs and wealthy individuals. There are also various multi-lateral and bi-lateral arrangements.

The APEC Bali Plan of Action

The author was supported by the Australian National Oceans Office to provide specialist advice on the potential role of the APEC Fisheries Working Group (FWG) and Marine Resources Working Group (MRWG) in long-term tsunami response. The focus of the advice was to ensure that the APEC 2nd Oceans Ministerial Meeting (AOMM II) incorporated targeted and meaningful proposals for APEC economies to support those nations affected by the tsunami. In particular, the focus was on how tsunami response will be integrated into the key outcome of the 2nd AOMM the "Bali Plan of Action (BPA)". The BPA is the blueprint for the implementation of key strategic considerations of the APEC Seoul Oceans Declaration the key outcome of the 1st AOMM.

It is clear that the tsunami has brought renewed focus to oceans. As a

result, APEC economies that attended the Ocean-related meeting wanted to ensure that a well-thought out and coordinated response was proposed. In addition, the FWG and MRWG stressed that this should reiterate APEC over-arching principles of transparency, integration and cooperation. Consequently, the FWG and MRWG stressed that AOMM II should support existing projects and initiatives – with a focus on supporting existing coordinating mechanisms, such as those outlined in the World Conference on Disaster Reduction and Regional Workshop on the Rehabilitation of Fisheries and Aquaculture in Coastal Communities of Tsunami Affected Countries in Asia.

Importantly, the FWG and MRWG suggested that APEC play a role in the transition from short-term (6 months-1 year) projects to those over long timeframes (1-10 years). This is to ensure that more sustainable practices are

introduced into the region – recognising the risk of tsunami-response projects actually contributing to un-sustainable practices if poorly coordinated.

Consequently, it was recommended that AOMM II concentrate on developing an online database as a tracking mechanism which should focus on the transition from medium-term recovery to long-term sustainable livelihoods. Further, it was suggested that the tracking mechanism could 'hook into' existing project registers.

The Joint Ministerial Statement of the 2nd APEC Ocean-Related Ministerial Meeting (AOMMII) held in Bali from 16-17 September 2005 (the 'Bali Plan of Action') heeded the suggestions put forward by the FWG and MRWG. The Statement stressed the importance of information sharing and using proactive coastal management tools, in particular that:

APEC investigate the use of an on-line database to allow APEC economies to update and view details of all tsunami-related projects, programs and activities (section xi)

Develop integrated coastal zone management plans that anticipate and plan to mitigate the impact of hazards and climate extremes, allowing coastal communities to adapt and mitigate the affects (section xii)

Proposed On-line Tsunami Tracking Database Development Process

The first step in the investigation of the on-line database is to undertake a thorough 'user requirements analysis' (see Figure 2). This essential first step is to ensure that all system users are clearly identified and what information these users would require in support of various governance, compliance and accountability processes.

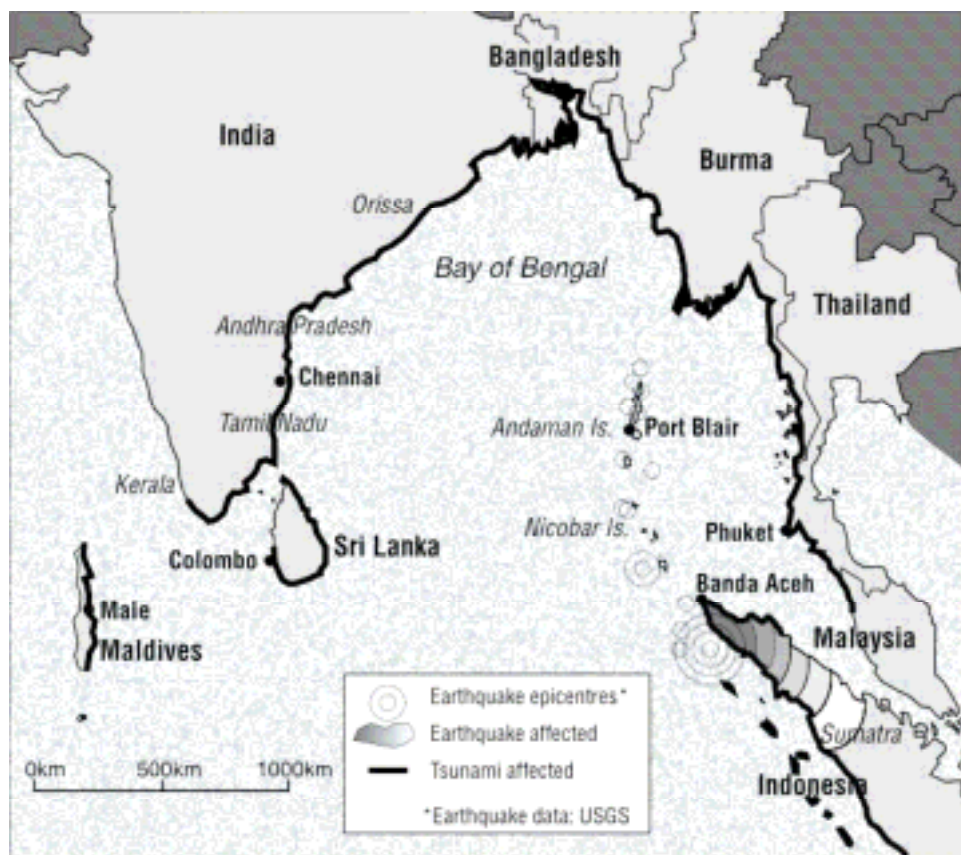


Figure 1 Extent of Areas Affected by the 26 December 2004 tsunami (Kay and Alder 2005) adapted from (AusAid 2005)

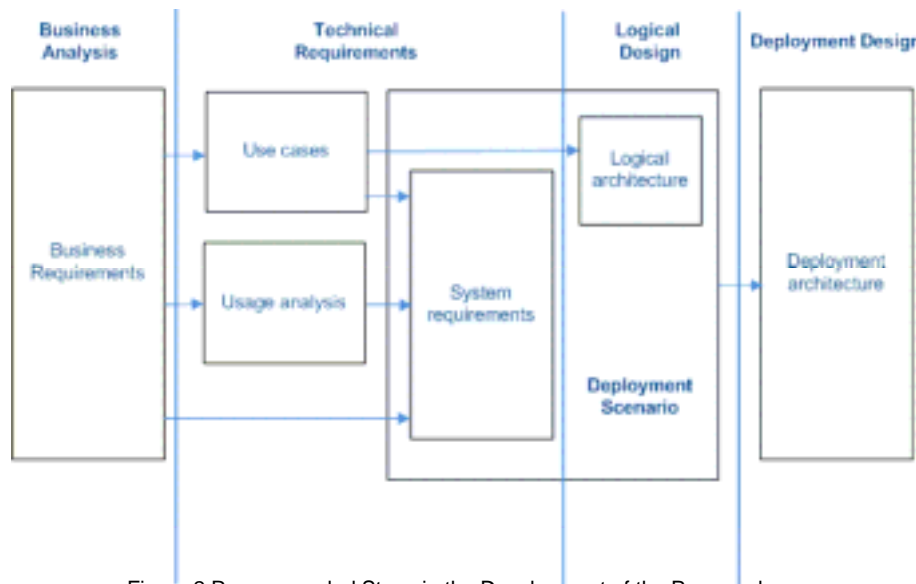


Figure 2 Recommended Steps in the Development of the Proposed APEC Tsunami Tracking System (Wild, 2005)

Clearly identifying user requirements involves intense interaction between the communities of interest. From this process, it will be possible to determine the features necessary to enable any future product to function fully and efficiently. At the end of the assessment process, this stage of the project will deliver a document specifying systems requirements to enable product development including sequencing strategies and an assessment of implementation mechanisms to support users within the region. This document can then be presented to relevant APEC Working Groups and Task Forces for final review prior to engaging in product development and implementation.

The process has a number of advantages in ensuring that the BPA objectives are met:

- Misunderstandings between all stakeholders over the design requirements are eliminated.
- Conflicting design constraints can be identified.
- The cost of the design is reduced, since unnecessary features can be omitted from the requirements list or structured into staged feature releases.
- Linkages to other systems and databases can be clearly defined. This reduces duplication and builds on the efforts of linked initiatives within APEC economies.

It is recommended that a project proposal be prepared to develop the APEC online tsunami project tracking database base through either or both the FWG and MRWGs during 2006. Feedback from conference delegates is

requested on the merits of this proposal.

Conclusions

The 26 December 2004 Indian Ocean Tsunami was a horrific tragedy for people living on affected coastlines. The impacts have provided new focus on the terrible damage these events can cause to coastal areas. Perhaps the critical issue for policy making more broadly in the Asia-Pacific region is that the community and political consciousness of natural disasters has been raised. This may present a 'window of opportunity' for coastal planners to increase the profile of natural hazard management within integrated planning approaches. Potential opportunities are in supporting the implementation of (Kay, 2005):

- Pro-active mitigation planning – such as development setbacks, minimum building floor levels and foreshore reserves/building exclusions.
- Disaster preparedness – ensuring that coastal communities are well prepared to react to warnings and that government agencies are well coordinated.
- Post-disaster recovery planning – immediately after natural disasters is not the best time to attempt to develop integrated coastal re-development plans. Planning measures should be established before a disaster to ensure well-coordinated, long-term, sustainable recovery.

There are numerous lessons to be learned from the tsunami disaster. These lessons are now for us to analyse and implement through the regions coastal planning and management systems to mitigate the impacts of our next coastal disasters. An important component of this

'lessons learned analysis' will be the transparent tracking of tsunami-response projects over the long term. The proposed online tracking database will be an important tool in this regard.

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Sakhalin Islands Oil Drill Rig Development: Current Status of Sakhalin Oil & Gas Developing Project and Japanese Local Stakeholder Involvement

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Introduction:

Exploration and production for multibillion-dollar offshore oil and gas developing projects have started on the Sakhalin shelf and the sea of Sea of Okhotsk. Price tag of these projects are said to be \$100 billion over the next forty years, doubtlessly one of the world biggest developing projects. Some observers believe that these projects will have positive economical effect on Sakhalin and far eastern area of Russia; others pointed out the concern about the environmental impacts, threat to the fisheries industry as well as the risk of oil spill. This paper discusses current issues relating to Sakhalin II, which is most advanced project among nine energy developing projects.

Background

The area of Russian Far East (RFE) and eastern Siberia have a wealth of oil and natural gas. Most promising area is situated offshore of eastern part of Sakhalin Island. There are total nine developing projects called Sakhalin I to IX (see Figure 1). Among these projects, Sakhalin I and II have almost completed their "Phase I" stage and partly started exporting their products to neighbor countries of Korea and Japan. At the time of writing this paper, projects between Sakhalin III and VI are at the stage of their contract, agreement or facility design. Projects more than Sakhalin VII are blurred.

According to the huge amount of

promising reserves, total scale of developing projects is said to be the world biggest. Only of the Sakhalin II, estimated reserves are 140 million tons of oil and 494 billion m³ of natural gas (Newell, 2004), thereby holding great promise for a stable supply to Japan and other neighboring countries.

Owing to Japan and other most South East Asian nations' high dependency of their energy supply to the Middle East countries and recent regional conflictions, Sakhalin's oil collects world attention as one of the alternative energy sources. Furthermore, Japan has the biggest geological merits, as of February and March 2003, Tokyo Gas, Osaka Gas, Nippon Oil Corporation and other Japanese energy companies announced that they would purchase oil and natural gas produced in Sakhalin' offshore area (Japan Environmental Council, 2003).

Details of Sakhalin II project

Sakhalin II is the first project to start producing oil among all Sakhalin projects; it has started exporting oil since July in 1999. This project is operated by Sakhalin Energy Investment Company Ltd. (SEIC), which was established in April 1994 under the investment of Royal Dutch Shell 55%), Mitsui Sakhalin Holdings B.V. (25%) and Diamond Gas Sakhalin B.V. (Mitsubishi, 20%). Project area and estimated reserves are as follows.

- Area: Two fields – Piltun-Astorkhskoe and Lunsokoe.
- Estimated reserves: 140 million tons of oil, 494 billion m³ of natural gas.
 - Expected project cost: \$10 billion

Russian Federal Government and SEIC signed PS (Production Sharing) agreement in June 1994, and they declared "Commencement Date" (starting day of the project) on June 15 in 1996. Oil production from offshore plant has been started in July 1999 with 20,000 barrels a day. In 2001, after the third season of oil production, amount of production has reached to 2.1 million tons for a year. In December 2000, Shell acquired Marathon's 37.5% share of SEIC in exchange for other assets, and Mitsubishi bought 7.5% additional share from Shell.

In September 1999, during off-loading from the Molikpaq platform (see figure 2) in heavy winds, about half a ton of crude oil was released. This accident raised both local and world-wide strong attention and criticism. Sakhalin II introduces the system of offshore production and temporal storage by Floating Storage and Offloading (FSO), which requires two times of loading and reloading of oil. Lawn et. al (1999) and others pointed out insufficient regulation while reloading oil from FSO to shuttle tankers under heavy wind conditions.

Pipeline construction

Sakhalin II project is divided into two stages, the former is named Phase I mainly for crude oil exploitation and the latter Phase II is for total development including pipeline construction from Piltun-Astorkhskoe and Lunsokoe to Prigorodnoe where faces Aniva Bay at southern end of Sakhalin Island.

In 2003, construction of offshore platform named PA-B and onshore processing facility have started in Piltun miming site, and offshore pipeline was planned to connect these two facilities in



Figure 1. Project areas of Sakhalin Offshore Area

2005. As of 2003, Murakami (2003) stated that main pipeline traveling through the island conveying natural gas and crude oil would be finished in the end of 2005, and year-round oil production would start in 2006.

Environmental Concerns

This area, especially offshore of Sakhalin, is well known as wildlife habitat for 25 marine mammal species, including 11 endangered ones (Zarsky, 2002). The eastern coast of the island, where the first oil well was drilled, provides the grounds for the world's most critically endangered populations of whales of western grey whale (*Eschrichtius robustus*) (see figure. 4).

Sakhalin's seashore marshes and wetlands provide critical breeding grounds for large numbers of migratory waterfowl and are a stopover point along the migratory route followed by many of the endangered birds of Asia, including cranes, osprey and Steller's sea eagle (*Haliaeetus pelagicus*).

The Sea of Okhotsk off the coast of Sakhalin is one of the most productive fisheries in the world, providing over 60% of total regional fish catch of Sakhalin Oblast. The fishing industry dominates the island's economy, employing over 50,000 of the island's 700,000 residents. In the shelf waters alone, there are 70 different species of fish; in the Sea of Kiosk, more than 300 (Zarsky, 2002). The situations of Sakhalin Island fisheries hold true to that of Japan. According to Hokkaido Educational Fishery Union, total fish catch along the coastline of the Sea of Okhotsk, from Wakkanai to Shiretoko, is more than 4 times of whole coastline of the Sea of Japan. The annual total sum is close to 300 billion JPY (about \$2.5 billion) and this only represents the economic benefit of primary fish production. The direct income from the fishery also sustains numerous seafood fabricating companies and thus the total income including

companion industries should be twice or more that of the fishery itself. Just like Sakhalin Island, the Hokkaido local economy is strongly underpinned by the fishery of the Sea of Okhotsk.

Another scientific aspect should also be reviewed. As the Sea of Okhotsk is an 'Affluent Ocean' producing hundreds and thousands tons of seafood and this affluence is fueled by the fresh water supplied by the River Amur. This river also conveys tremendous amount of nutrient salts, these substance promotes to burst phytoplankton in the water column in spring.

The salinity of the Sea of Okhotsk is slightly lower than that of the other open ocean in general because the River Amur supplies vast amount of fresh water. This area is well known for ice-cover-ocean or sea ice (Ryuhyo in Japanese) in winter, and this area is world southern limit of ice-cover-ocean (see figure 5). Recently, scientists in Hokkaido University advocate the role of the surface ice of this area; they think ice 'absorbs' solar energy in winter thus global temperature keeps cool. It must be noted that the environment of the Sea of Okhotsk, particularly mass balance between fresh water, saline water and nutrient salts, dictates an energy balance between absorption and reflection of solar radiation. Once this stable relationship is disrupted, the influence will be felt at a global scale.

Current Situation of Sakhalin II Phase II project

In June 2005, European Bank for Reconstruction and Development (EBRD) announce to freeze their \$4,000 million loan to this project for the environmental concerns arisen by SEIC pipeline construction. The latest trends of this project are as follows:

- March 30: The Financial Times and other world major news paper

reported that SEIC has been forced to re-route a pipeline because it threatened the survival of the western grey whale.

- April 5: Sakhalin Local environmental NGO's demonstrated against the dumping of the drill cuttings into the Aniva bay where is one of the best scallop fishery around this area. Sakhalin local newspaper reported SEIC plans to dump about 1.45 million cuttings into the bay.
- April 8: Hokkaido(Northern part of Japan, near Sakhalin) local news paper reported scallop shellfish poisoning has occurred because poisonous plankton is coming from Aniva bay of Sakhalin Is land.
- May 19: SEIC has a meeting environmental NGO groups in Moscow. Main focuses were 1) on-shore pipeline, 2) dumping of drill cuttings, 3) oil spill, 4) wild lives, 5) social problems concerning with ethnic minority.
- May 20-24: EBRD assembly was held in London. Every administration officer except Netherlands clearly expressed their misgivings to the investment for Sakhalin II phase II project. Representatives of the Netherlands said trans-boundary issues for oil spill is a Japanese own problem. Japanese vise Minister of Finance stated "As to the Sakhalin energy development project, we hear that there are great concerns over the environmental issues. I hope the EBRD will continue to encourage project sponsors to listen to external stakeholders and to make every effort to promote a broad-based understanding of the project
- June 13-15: SEIC held meetings for local stakeholders in Rumoi and



Figure 2. Molikpaq offshore platform (<http://www.offshore-technology.com>)

Wakkanai, in Hokkaido.

- June 19: EBRD announced that they froze the loan for Sakhalin-2 phase-2 mainly because the lack of environment-conscious to the 600km pipeline construction.
- July 14: one of Japanese major newspaper "Yomiuri Shinbun" reported Sakhalin-1 also had to change their pipeline route for protecting gray whales, then production of natural gas will be delayed for about a year.
- July 21: Sakhalin-1's work barge spilled about 5.5 tons of fuel oil in Chaibo.
- August 3: Japanese major news paper on economics "Nikkei" reported Sakhalin-2 full year oil production will be delayed until 2008.

Discussion

Both Japanese regional and general

opinion never have been against the Sakhalin projects, even Hokkaido fishery unions are welcome these project in themselves. In addition, Japanese Bank for International Cooperation (JBIC), the biggest investor to the Sakhalin II, has started public consultations to involve various stakeholders in Tokyo and Sapporo (capital city of Hokkaido) since October 2004. But the time of this writing, concrete outcomes are still ambiguous, and then following items have to be key issues for the progress of Sakhalin projects.

- Preparedness for "transboundry" oil spill
- Introducing world best standard and criteria for environmental protection
- Enhancing information disclosure
- Encourage local stakeholders' involvement

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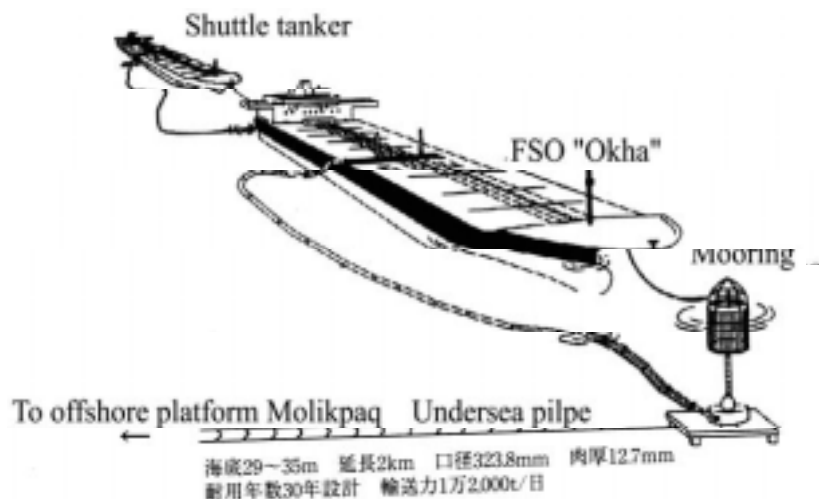


Figure 3. Sketch of Sakhalin II offshore oil loading unit (Murakami, 2003)



Figure 4. Gray whale in Sakhalin (<http://www.pacificenvironment.com>)

Figure 5. Ryuhyo (Drifting Ice floating on sea)
 The Okhotsk sea is covered with ice in winter, world southern limit of iced covered sea.
 (<http://www.do-inaka.net>)



Figure 6 Pipeline construction site near Drinsk. Sakhalin Local NGO Sakhalin Environmental Watch (SEW) says salmon spawning rivers have been destroyed by SEIC' environmental reckless construction by using many heavy machinery

Conservation News

HEALTHY CORALS FARED BEST AGAINST TSUNAMI

December 15, 2005

Indian Ocean coastlines increasingly vulnerable, warn the World Conservation Union (IUCN) and CORDIO.

Gland, Switzerland, 15 December 2005 (IUCN) –Throughout the Indian Ocean, healthy coral reefs were better able to withstand the force of the December 2004 tsunami, and may have offered increased protection to adjacent coastal areas, reveals the 2005 Coral Reef Degradation in the Indian Ocean (CORDIO) Status Report, released by the World Conservation Union (IUCN) and the CORDIO programme.

On the other side of the coin, reefs weakened by overexploitation or bleaching suffered disproportionately during the tsunami and their recovery has been much slower since, the publication says.

"Reefs continually degraded by over-fishing, coral mining, dynamite fishing and land-based pollution are more susceptible to future natural disasters exacerbated by climate change, creating a vicious circle of reef destruction and human suffering," says Jerker Tame Lander, IUCN-CORDIO Marine Coordinator for South Asia and one of the report's authors.

"Yet the tsunami aftermath has been less severe, both for the corals and the people, where reefs had been soundly managed," he says. The marine protected area of Hikkaduwa in Sri Lanka for example saw less reef damage from the event, whilst at Bar Reef in Sri Lanka recovery from past stresses, such as the El Niño bleaching episode of 1998 which caused up to 90% of Indian Ocean corals to die, has been swifter than elsewhere.

IUCN has valued coastline protection and other services provided by coral reefs in the Indian Ocean at over US \$1.5 billion a year. Moreover, annually, coral reefs provide nearly US \$30 billion in net benefits in goods and services to world economies, including tourism, fisheries and coastal protection.

"These findings outline the importance of well-managed marine protected areas and healthy reefs," says Carl Gustaf Lundin, Head of IUCN Global Marine Programme, "such areas act like a buffer against damage and disease."

Corals do bounce back if given a chance and a favourable environment. The report finds coral reproduction and regeneration in most areas. "There is a ray of hope that corals will make it through, even in the most degraded areas, and keep on providing the poorest with the means to survive," notes Tamelander.

Globally, almost 2.2 billion people (over one third of the world's population) live within 100 kilometres of a coral reef. In Southeast Asia – which contains onequarter of the world's reefs and extraordinarily high levels of diversity, primarily within Indonesia and the Philippines – more than 70% of the population lives within the coastal zone.

"The 1998 mass-bleaching event demonstrated that an increase in the temperature of the oceans brought about by global warming is the biggest single threat to coral reefs worldwide," says Carl Gustaf Lundin, Head of IUCN Global Marine Programme. "However, human-induced impacts such as overexploitation of marine resources, destructive fishing practices and sedimentation can be just as devastating on a local scale and also hinder recovery efforts from previous bleaching events."

The report identifies low awareness of the value of coastal ecosystems, inadequate laws, poor enforcement and insufficient political will as the main stumbling blocks in the efforts to maintain the ocean's productivity.

The impacts of the tsunami on Indian Ocean coral reefs ranged from negligible in parts of East Africa, India and the Maldives to extreme in parts of Sri Lanka and Nicobar Islands.

The 2005 CORDIO Status Report is a result of a two-year scientific monitoring of coral reefs, related coastal ecosystems and dependent communities in nine countries of the Indian Ocean rim, and has been compiled by over 50 scientists from Africa, Asia, Europe and the Middle East. It charts the status of reefs and their recovery from previous damage and reports on regional programmes to improve reef management. These programmes focus on activities such as monitoring, raising awareness, boosting reef resilience, promoting alternative livelihoods and exploring restoration techniques.

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