

**POLLUTION PROBE**

**MANAGING SHARED WATERS**

**Day 3 - Measuring and Understanding Coastal Ecosystems**

June 26, 2002

**Michael Goffin – Director, Great Lakes Corporate Affairs, Environment Canada**

Thank-you, Rick. Good morning.

I want to let you know that I've bribed the translators. You can pick up the soccer game on the little box, here, if you want.

Good morning. Welcome to Day 3 of Managing Shared Waters. Today the focus of our discussion will be the capacity for measuring and understanding ecosystems.

All good policy relies on sound science. Delivery of adequate, accurate and reliable scientific advice and information relies, in turn, on the capacity to research, measure and monitor the health of our ecosystems.

In shared waters, the ability to measure and understand the ecosystem is critical to being able to establish a common agenda to focus the efforts of all countries on the most pressing problems, and not on the political interests of one country or the other.

The increase in complexity of the environmental threats we face is putting our science capacity to the test. In shared waters, the challenge is further complicated when nations have different information management, data collection and equipment regimes, making it difficult to share information even when the nations agree to do so.

Capacity to communicate science is also a very important issue. Complex scientific data needs to be transferred in a way that policy makers, stakeholders, and the general public can understand and use in their decision making.

To chair this morning's panel discussion on measuring and understanding ecosystems I'm very pleased to introduce Dr. Art Hanson. An internationally recognised ocean expert, Dr. Hanson has dedicated his career to marine management issues.

Two years ago Dr. Hanson was appointed by the Minister of Canada's Department of Fisheries and Oceans as our official Oceans Ambassador. In his role as Ambassador, Dr. Hanson has led the Minister's Advisory Council on Oceans, a nine-member council which provides the Minister with expert advice on strategic issues relating to oceans and coastal issues.

A graduate of both the University of British Columbia and the University of Michigan in fields of fisheries, ecology and natural resources, Dr. Hanson has also been awarded the title of Distinguished Fellow and Senior Scientist of the International Institute for Sustainable Development.

It's my pleasure and privilege to welcome Dr. Hanson.

**Art Hanson - Oceans Ambassador, Canada**

Thank-you very much, Mike.

I'm going to chair this session this morning, and that means I won't say as much as I would like to, but I'll give you an advertisement. This afternoon I will get a chance to actually make a presentation, so I look forward to seeing you all there.

I haven't checked the soccer schedule to see whether that will interfere in the afternoon.

I'd like to make a few comments about the morning's session. This whole business of measurement, of course, is a very difficult one. We're never quite sure what to measure. It's got much more difficult in recent years because we now talk about sustainable development and sustainable use of the oceans, which means that we have to have a much broader information base to consider in our measurement. What we start with, ideally, the ecosystem, we also have to think about the social and the economic measures, and particularly the kinds of indicators and measurements that will allow us to take an integrated view.

There's kind of a holy grail out there, that is; we could have a select number of indicators that we could use to determine the health of the oceans, the health of our coastal zones, and the health of our fresh waters.

The reality is that's proven very difficult. The National Roundtable on the Environment and the Economy, at the present time, has a program which many of you would be familiar with that is actually trying to look at indicators of sustainability. And it's, I'd say, right at that crucial point, right now, and people are discovering just how difficult it is once you get by the fact that, 'Gosh, we're going to do it,' it really does prove to be a chore, and one that as much as anything sometimes depends upon just getting agreement, as opposed to getting something that is perfect.

So that's at one end of the spectrum. The other end of the spectrum - and I think that relates back particularly to this theme of shared waters - is that we have certainly what I call the

gold standard for looking at ecosystems. And for those of you who are not from this area, you would probably still recognise, by now, halfway through the week, that one of the gold standards is the Great Lakes.

Whenever I'm looking for trying to understand ecosystem management of bodies of water - marine or fresh water - I always go to the work that's been done on the Great Lakes, because I think it best reflects the ideas of ecosystem-based management, and we've got a lot of experience.

I was introduced as doing my Ph.D. at the University of Michigan, and that was just at the time - back in the late 60s, early 70s - when the whole coastal zone management program began in the Great Lakes and elsewhere in the United States. And even back in those days people were trying to grapple with these problems.

But let me give you a few examples that I've found over my career that reflect some of the difficulties of measurement. Most of these, remembering that ecosystems are not divorced from political systems, and one of the big challenges in the past - and I think it still is in some parts of the world, including in our own, at times - is just getting past the political barriers. Our speaker this morning, whom I'll introduce in a moment, has certainly had lots of experience with this, but let me just give a couple of examples.

One is the Gulf of Maine, which happens to be one of the areas that I truly enjoy and try and learn from, just as I do from the Great Lakes. In the Gulf of Maine, in the early 1980s and mid-1980s, we were trying to develop the first ever atlas of the ecosystems and the management needs for that region. We called it the FMG - Bay of Fundy, Gulf of Maine, Georgia's Banks.

Well, when we started looking at things like contaminants, we found that - there was no border line at that point in time because they hadn't agreed on a boundary - the Americans were measuring PCBs and stuff like that on one side, Canadians on the other. They never even communicated with each other, it seemed, and they certainly didn't let those boats do transits right across the ecosystem. So it was impossible. The data were all scrambled up.

Another one - and this goes back to South-east Asia - was in Indonesia. I spent a lot of my earlier working career, and where I first got to know Dr. Chua, in fact, was in Indonesia and Malaysia, the ASEAN region.

In this particular instance, there are nice little spots for submarines to go through some of the straits, so having basic information - temperature, salinity profiles, and so forth - was very valuable data. The Russians wanted it, the Americans wanted it - and probably had it - but in any case it was kind of almost a capital offence to be going around giving away what we would consider is the most fundamental, basic information that you needed to understand the marine ecosystems of that area, if you were an Indonesian scientist.

And in fact, one of the Indonesian oceanographers did end up in jail - or at least was changed with, I don't know if he did end up in jail - with giving away state secrets by giving away temperature and salinity profiles.

And the head of Aeroflot, the local head of Aeroflot, was picked up for spying because he was going after this oceanographic information, and apparently, according to Maclean's magazine, he actually had an implanted microphone in his chest so he could go to various meetings and then have somebody else with a transmitter, or at least picking up the signals from his transmitter.

So this is measurement at its very worst. But let me just point out that for a lot of parts of the world it still isn't that much easier. Probably parts of the Indian Ocean, certainly parts of the waters off Russia, would still qualify as having some of those problems, and when you start adding in some of the coastal issues in an area like Kamchatka, which has a very heavy-duty kind of Russian mafia running the resource base there, now, you might not find a very welcome audience for some of the things that we would consider basic data gathering.

So we're not out of the woods yet in terms of just doing the basic logistics of measuring, and I think we're far from being out of the woods in terms of having a good conceptual base. If you come to the session this afternoon - DFO is involved in oceans - you'll hear about some of the things in relation to what we hope will be Canada's ocean strategy.

And here, the whole issue of measurement and the shift that's called for under the *Oceans Act* for moving from a single species approach to an ecosystem approach is still at a relatively early stage. So, the basic message I have is that there's lots of work to be done.

Some people work under more difficult conditions than we do here in Canada. Now, one of those people is Dr. Chua Thia-Eng, whom I've known since the early 1970s. He says he spent

34 years of his active life in East Asia serving in various capacities. I think I've known him for 30 of those 34 years.

He has a very distinguished career looking at integrated coastal zone and ocean management. Now, this has taken him through a number of different organisations, the International Maritime Organisation, particularly through the International Centre for Living Aquatic Resource Management and its Coastal Area Programme. He worked out of the Philippines for a long time on this.

And I'm not going to go into all the details of what he is doing now under PEMSEA, because I'll let him introduce it, but I wanted to say just one thing about it. This is his latest and greatest effort, in my view, which is funded through the Global Environmental Facility and other organisations, and it's really looking at the whole of East Asia, right from the tropics into the more northern seas. And it's truly a remarkable effort, in my view, because it's tying together the sub-regional right down, in some cases, to the very local kinds of problems of integrated ocean and ecosystem management, right up to large regional seas, in an area that has been filled with conflict, and to some extent still very much is, and he's managed to bring together the most unlikely range of countries and interests to really try and address integrated ocean and coastal management issues.

He's going to provide us, as our keynote speaker, today, what I would call a comprehensive overall look at the issues of measuring and understanding coastal and marine ecosystems. And I'm going to ensure that he gets as much time as possible to do that, and then we will move, later in the morning, to our panel. And I'm going to hold on the introduction of our panel members until we get to that point, if that's okay with you.

So, I'd like to turn things over to Dr. Chua, and I'll try and keep track of time. And if there's any soccer scores come in over the headsets, we'll hear about them.

Thank-you.

**Chua Thia-Eng - Regional Program Director, Partnership in Environmental Management for the Seas of East Asia (PEMSEA)**

Well, good morning. I'm pleased despite the soccer game this morning that we have quite a large number of people coming to these sessions.

I would like to first and foremost thank the organisers for giving me this opportunity to speak with you. I am used to giving my lectures walking around, so I prefer to have this mike, walking mike, and I go around and say what I like to say.

Again thanks, Art, for the very nice words. I spent close to 30 or more years in Asia. I refuse to leave the region so I can concentrate in looking at some of the issues. I was first trained as a fisheries biologist, and I didn't make much headway. Fisheries kept on getting down. Then I was working for FAO and we haven't solved any problems. So I got out of it knowing that fisheries solutions do not lie within the fisheries sector. It has to be something broader than that. That's what made me look at much bigger areas, looking at issues outside of the fisheries arena.

Now, the topic given to me is measuring and understanding coastal ecosystems, and I think it's a very difficult subject. Dealing with the science, we may not be able to come out with certain solutions, so I would prefer to go through just from the standpoint of management, and then use a management framework to explain how through science we can start to understand more about the ecosystems, how we can develop ways of measuring at least part of it, taking into consideration the sensitivity issues that Dr. Hanson just mentioned.

Managing the coastal areas, as you know, is a very complex undertaking. You need to look into inter-agency, multi-sectoral coordination. You need also to look into the policy and functional integration, and understanding the interplay between the various sectors and the social, economic, political, cultural, and ecological elements. These are very important to understand - the interplay between these various elements.

Also, we have to have the ability to analyse the social and ecological fabrics, delineate their linkages, identify causal changes, and distil past experience and lessons.

There needs also to be a common vision among the stakeholders, and also a mechanism that can involve the participation of the stakeholders. Last but not least we also need the capacity to implement some things on the ground.

And I would like to say that despite over 30 years of efforts in coastal zone management we are still staying on a very superficial level.

Now, first and foremost let us look at this diagram, which .. I think I picked it up in the 70s. It depicts mangrove ecosystems, and you can see here the scientific sites are the ones that explain the food chain; the eutrophic level over here. And what is more important, also, you may

like to look at the human activities that are exploiting the resources. But mangrove has been considered to be a very important ecosystem that a lot of world effort has been put into, and it has been known to provide coastal protections, human livelihoods, and habitats, and also is a source of food.

But what happened after 30 years of effort in this region? We have lost close to 70% of the original mangrove in the South China Sea area. The mangrove declined from 6,000 square km to 2,000 square km. And if there is no effective management, by the year 2030 we probably will have lost all of them.

So this is one example that we cannot keep on waiting for science to solve the problem. We need actions, but at the same time we've got to bring science in to provide the necessary scientific advice to the policy makers.

Now, integrated coastal management has been introduced about 35 years ago. As you can see, the efforts initiated in the region have actually increased. In the last ten years we find in East Asia there are a lot of ICMs initiated; they have been mushrooming in this region.

But most of these ICM programs end up in a plan that is staying on the book shelf. Very few of these plans ever got into implementation. So we have a situation where there is a lot of initiative, and they were very much driven by scientists. It's not a bad thing to be driven by scientists, but if scientists are not able to interact with the managers we will always have our very nicely-developed plans lying up on the book shelf.

So, here we have to look at two issues. It is driven by scientists, it is also driven by donors. And there is not enough effort at the local level, at the national level, to do ICM on their own.

Now, despite these efforts on coastal zone managements, you now have various types of coastal management schemes - you have river basin management, you have river basin coastal zone management, all sorts of integrated management programs - but if you look at all these programs, they have a lot of similarity in terms of the elements, basic essential elements, such as institutional arrangements, development and implementation of management strategies and programs of actions, capacity building, stakeholders' involvement and participation, scientific advice, sustainable financing, monitoring of changes.

These are some of the basic elements that we always see in many of these activities, but the challenge is how to put all these things into action, how to operationalise an ICM program that can really benefit the people on the ground.

So I'm going to address these issues by looking at a broader perspective, by using some of the efforts that have been developed by my team in East Asia. And first, I would just like to give you a very quick explanation of how important this area is.

As you know, the East Asian Sea, particularly the South China Sea - which is one of the large marine ecosystems - is the centre of marine biodiversity. I don't want to go into the ocean's physical structure, which I think you are very familiar, but my program covers from the north - that is Japan, and very difficult countries, DPR Korea - and down to Korea, Vietnam, and all the south-east Asian countries. And the whole area, known as East Asian Sea Region, covers five large marine ecosystems. And you will notice that it is a very important area because it covers 30% of the world's coral reef, 30% of the world's mangrove, 51% of the world's 70 mangrove species, and also 40% of the world's fish production, 23% of the world's species of sea grass. And most important, is a centre for world aquaculture production. So it is a very important area.

Now, on top of that, it also a major area where you have very active maritime traffic.

Now, the problem we are facing in these regions, is high coastal populations. You have 1.9 billion people living around the area, of which 1 billion people are living in coastal areas. It is an area with a diversity of political, social, cultural, religious and economic characteristics. It is an area with heavily degraded environmental habitats, watersheds. We have increased pressure from the maritime freight, overdrawing of fresh water, trade globalisation, and regionalisation of economies. And as the region is moving from single- to multi-sector integrated management we also have problems of being able to catch up with the capacity to manage the region.

And finally, I'd like to mention also that the implementation of various international instruments in this region is also inefficient, and it also one of the problems that we are facing.

Now, you may be aware that this region is a major maritime route where oil has to go through the Straits of Malacca and the Madagar(?) Straits. I think Art mentioned about the sensitive information. I'm trying to trace how the movements of radioactive material that has been in Europe - how did it get into Japan? - through the Straits of Malacca. So this is a very

sensitive issue. Luckily I didn't end up in jail. But it is an area where you see very heavy shipping traffic, and where you superimpose a lot of sensitive areas around this area.

And how do you now resolve all these maritime activities, the pressure of economic growth, the pressure of population, and at the same time try to save the environment, try to save the habitats, protect the water quality?

We have developed what we call the Partnership for Environmental Management for the Seas of East-Asia (PEMSEA), which is a GEF program, and implemented through the International Maritime Organisation.

Now, we focus on several aspects. One is to build an inter-governmental, inter-agency and inter-sectoral partnership and collaboration. Now, it's easier to say than to do. How long to get the various countries to work together? I have to involve 12 countries, but it took me 7 years to convince Japan to join, and Japan just joined last March, after 7 years of persuasion.

Now, with Japan's participation we have been able to bring a metric of these governments together to look at the regions more seriously. And knowing how difficult it is to bring DPR Korea into the picture, the moment we get DPR Korea into the picture we get objection from some quarters. So it is a lot of human interaction to get one country to balance the other.

So, here we have 11 countries, and we have the South-East Asian countries. We have to balance these two, in order to get the 12 countries working together in harmony, and that is even more difficult knowing the conflict in the South China Sea. Very complicated situation.

So, we have achieved that. By March we completed the 12 country inter-government cooperation, and Japan came in and said, 'Well, we are late. We are now trying to catch up.' That is very good news.

Now, to get inter-agency cooperation is another effort that we all have to do, but as you know, in all countries in the world there are fundamental issues that have to be faced by the resource managers, and that is the inter-agency conflicts. And this is even worse in developing countries, but clearly in south-east Asia. It's very difficult to get one agency to cooperate with the other because there is a question of competition for financial resources, competition for power. And it is not an easy task.

But our experience shows as we go down the line to the local government, inter-agency cooperation becomes much more possible, and it is more effective.

Now, we have carried out quite a lot of coastal management activities at the local level, and it has proven to be very effective, but to bring it up at the national level you still need a lot of effort.

Now, inter-sectoral cooperation, as I mentioned earlier, if you are fisheries people trying to solve fisheries problems, you will not be able to solve within the fisheries sector. You've got to go beyond that. So, how do you bring the various agencies together, how do you bring the various sectors to cooperate, to understand each other, particularly in bringing the industry, in bringing the private sector into the picture? And that is also a focus that we have been taking.

I'm very happy to say that with our effort, today, we have Intertanco(?) joining us, we have even the Japanese Foundation joining us, we have the shipping as well as the maritime sectors participating in collaborations with this program.

So, to build an inter-agency, inter-governmental, and inter-sectoral structure at a regional level, a national level, and also at a local level, it is a very important approach that we have found, over the last several years, and that it is the right direction.

Now, the second thing is that when we talk about management, we have to convince the politicians, we have to convince the policy makers, that integrated management really works, and therefore there is a need to demonstrate how it works.

So we have, over the last seven years, built a number of Integrated Coastal Management projects at the local level. In fact we have planned demonstration projects ranging from the far north in Nam Po in DPR Korea, right down to Bali in Indonesia.

And over the years, after those activities, for example after the project has phased out, after you don't provide them any form of funding, will they be able to sustain themselves? Now, we have very good responses. Two of our earlier demonstration projects in Siamun(?) as well as Botlandas(?) have already been operating on their own, with no more funding from us.

But more interestingly, a lesson I have learned is to not give them too much money. Money is a problem. Do not give them much money. And are they willing to go into coastal zone management? I have two demonstration projects which are totally funded by the local government, and funded by the private sector, and these are the projects that actually do better than the ones that receive funding from international agencies.

So here, again, promoting the ownership, promoting the participation, promoting the valuation of the methodology that can be useful to them, I think is something that is worth, then, just all the money that you want to give to them.

Now, we have also established demonstrations on bigger bodies of water, referring to the Straits of Malacca, the Gulf of Thailand, the Bo Hai (?) Seas, all these are big bodies of water where they share waters, they share boundaries. The management jurisdiction is across various provincial or even national boundaries.

So this was the second part of our major activities. The third part is how to bring science - scientific advice - to the policy makers, to the managers, and to translate scientific findings into policy support so that the policy makers can use this information for them to make decisions.

And fourth is that in dealing with environmental management, the question that we come up with, we really need funding to really support the proper infrastructure that would be required. For example, solid waste management, receptions, facilities for ports, all these require funding. And we are putting a lot of our effort in developing environmental investment opportunities, so that this becomes an attraction, an incentive to the local governments to get involved in coastal zone management, to do management. Because by doing management they know that they can create investment opportunities.

So, how to do that? You have a system known as a public / private sector partnership trying to create a policy environment to enable the private sector to take advantage of the policy environment, so then they can go in to share a partnership in undertaking the enterprise.

Now, here I'd like to mention partnership is not just bringing people together. It is not just a networking. Partnership is bringing people together that share the same common objective, that share common visions - that is; sharing risk but at the same time sharing the benefits.

So, unless that type of partnership is developed, you will never be able to sustain the partnership, and we have been trying very much, in all the fields of activities, and this concept of partnership was instilled into the minds of all the participants.

So I have a partner, a private sector partner that joined me, and they would have to make sure that they are willing to contribute something apart from benefiting from the enterprise or the investment that they are coming in with.

So, the same thing is true with local government or the central government.

Now, since this is basically a scientific topic, I will not talk about the private sector's investment. I'm leaving, here, some of the brochures on a public / private sector roundtable that will be held in Siamun (?) this coming September, so if there are any private sector partners who are interested in investment they can get a copy of this. We are creating \$600 million worth of investment in our coastal management program, and we hope that some in the private sector may be interested to look into it, particularly the Canadian industry people.

Now, another aspect is an environmental and natural resource governance framework. Now, this is a very important part where we thought that unless you provide a framework at the regional level, national level, or at the local level, then you will not be able to bring the various stakeholders to work with a clear focus of a shared vision.

So we are developing something on the environmental resource governance framework, which I will introduce later, and we also will put in a lot of effort to beef up the capacity, and also develop an information management system at the local level.

I'm not talking about information just for dissemination, but information that can be used by the managers, and the place where the managers can use it is at the local level. So, an information system that they can use for EIA, they can use it for planning, they can use it for the future management intervention.

And finally, the idea is to develop a communications system so we can talk to the stakeholders. I think the major issue that we all failed in the past at is that we are not able to communicate with each other. Although we say we can, actually we didn't.

So, how can we communicate? Can the scientist communicate to the policy makers? Will the policy makers be able to communicate to the other groups?

So, here is the question of how to improve a communications system between the various stakeholders. And here I will talk about the need to develop a communications plan to address different sectors of the people when you're dealing with the management regime.

Now, I would like to start off with a regional framework. Now, this is a document that is still in the process of going through the endorsement process, consultation process. It was first started as an environmental strategy for the seas of East Asia, but after a few rounds of meeting with the government they suggested we have a sustainable development strategy for the seas of East Asia, which actually consists of six strategies - not five - six strategies, 20 action objectives

and 212 programs of actions. I'd like to mention here the shared vision, and address the issues of threats that have been listed up here, and also how the threats have been affecting the value that they are getting.

And so, we are trying to promote a common vision between the countries; what do they want to use the East Asian sea for? And based on that vision, what are the strategies that will be able to be agreed upon by them, and what are the action programs that can be developed to implement the strategies that will lead to achieving the shared vision?

Now, fundamentally, the strategy is a regional framework for natural resource and environmental governance by strengthening collaboration and cooperation of participating governments, through promoting inter-governmental collaborations, strengthening the linkage and synergies among the UN agencies, international agencies, regional and international NGOs, in implementing regional programs.

Now, this is very important. We have a lot of UN programs, but the UN programs do not talk to each other. UN agencies, they get together but I don't think they talk. So here you require a framework to bring them together.

Encouraging active participation of the private sector... the private sector is always left out...I think we can bring them in. They are people's organisations, and members of the civil society.

Another aspect which is also important is how to develop a framework where the various international instruments can be implemented in an integrated format. So, the integrated implementation of international conventions is something that will enable countries that already rectified several environmental instruments, to implement it together.

So what do you have today? Climate change people have their own secretary, they do it somewhere. The Basil convention people have another one. The GPA has another one. But if you can put them together and implement them at the regional level, you can see the power and effectiveness, and we have demonstrated a few of these. Unless we are able to get these international instruments implemented, there's no use to have more international instruments.

Finally, there is a need to document and assess the changes arising from management interventions. This is something that is the major idea that we're supposed to talk about, how to

measure them, but I think how to measure them will have to be based on what is the framework that we have created for them so that we can measure.

Now, at the regional level we have now got a lot of interest. The World Bank is joining us, now, and we're trying to invite as many UN agencies, international agencies, private sectors, to join in to endorse this document. And the next step is that we are encouraging the governments to move forward to implement the international... the regional strategy.

A way for them to do it is for them to develop what we call a national strategy for sustainable coastal and ocean development. Now, this strategy, at a national level, is important, but they can use the regional strategy as a framework to develop the national strategy.

And there are many, many recent developments that are favouring this concept; first and foremost the national oceans and coastal policy has been developed already in R.O. Korea and China, Indonesia and Philippines, national ICM R.O. Korea has developed that. China and R.O. Korea have Ocean Agenda 21. R.O. Korea and Indonesia have already developed national Ministry of Fisheries and Marine Affairs. China has recently passed a law on sea use, and also a white paper on ocean development and many countries have environmental policy and also environmental ministries.

Also, Thailand and the Philippines have been developing their own biodiversity strategy, and most countries have strategies in dealing with the mangrove or coral reef management programs.

So, there are already various activities being undertaken by the national government, and they are moving forward. If you can put them together, they will work.

So, after we have got this regional strategy, we are now working with the Philippine government to show how a national government can establish a national strategy, and this project is continuing.

So I am positive that without forcing the governments to do anything, by giving them a guide, they will take it on themselves. I think that is a better way than forcing them to come to an agreement.

Now, as a result of the regional and national efforts, we move into looking at bigger bays. Now, (San Miguel?) Bay is a good example. San Miguel Bay covers four provinces, and the sharing of the bay resources will be something to bring the various local governments to work

together. And we have been using the regional strategy; we have already developed sub-regional strategies, like for Manila Bay, like in the case of Vietnam we have a Danan(?) strategy, we have a Bali strategy, we have the Bothaon(?) strategy.

And all of these strategies, a copy of this is available here - you can have a look- I would like to highlight the importance of having a strategy that is not going to end up on the bookshelves. This strategy has been endorsed by the president herself in the Philippines. But more importantly, it has to go into the national economic authority where a budget can be allocated, where the governments can use this document as an excuse or as a framework to obtain government budgets. It is also a document that can be used for donors to provide support.

So, here is a framework that provides a complete structure for the various different stakeholders, donor communities, to work together in achieving a common goal.

Now, the strategy varies from country to country. In the case of Bali's strategies, the focus is very much built upon the Hindu philosophy, because Bali - as you probably know - is one of the world's famous tourist sites, and what has kept the host program, the Bali management going, is its ability to stick onto religious thinking. So we are using that to develop a strategy, and then get the support of the people.

Now, all these strategies are only useful if they're implemented and accepted by the government as well as by the people, and we have all these things now in place.

So what I'm trying to show you, here, is we have the local strategy, a framework that will be used by the local government for 10, 20 years. We have the regional strategy, we have a regional strategy as it develops, and this will provide the framework at which international and national cooperation can take place.

Now, with bigger bodies of water, an activity that can bring the various stakeholders together, and something that unites the various disciplines together, is based on a recent mechanism that we're trying to develop in the sub-regional and management level to share waters. And here we have a risk assessment. We have developed a response mechanism, and we go into the compensations and restorations.

So, you will find that the amount of monitoring, capacity-building and institution arrangements are all linked together. I'll give you an example. If there is a risk assessment that shows that oil is the major issue, how do you respond to oil spills, and how do you now develop

damage assessment that you can then claim under the international conventions of FAN(?) or CLC (?). And that is the way that you can make environmental monitoring become useful; the needed capacity can be developed through this format.

And here is an example of risk assessment, response, compensation and restoration mechanisms, and how you can develop the various types of institutional mechanisms to strengthen regional cooperation.

So, this is one example of providing a framework to allow the various stakeholders together to come together.

Now, the Gulf of Thailand - I will skip this – it is along the same lines - and in the Straits of Malacca, we have also various activities that contribute to this. Since time is running out this is some of the output that we have achieved in the Straits of Malacca. And also, an important thing is to put a value to the coastal resources in the Straits of Malacca. And this is the first time where information was put together, and also the costed, predicted value of the resources in the Straits of Malacca have been estimated, which comes close to about over \$7 billion per year. And you will also see how to put a value to the habitats.

I would also like to highlight even the sea lanes. As a result of the assessment, the Malacca Strait sea lanes are only worth \$340 million, but the total cost of the Malacca Strait is \$7.4 billion. So, if you close the straits, you will find that the loss to the government is only that part, \$340 million. This becomes a strong leverage to tell the ship owners that to use the straits you'd better share the costs of managing it.

Now, that's how this has led to what is called the Marine Electronic Highway Project that is now being developed in the Straits of Malacca, following the St. Lawrence shipping safety mechanism they have developed.

Now, the same thing is true with Manila Bay; there are several types of activities.

What I want to mention about the cross-sectoral importance, as you can see here, is a model that looks into the sewage outflow from one of the important rivers, and you will find this polluted area where the Tourism Department of the Philippines is trying to develop their tourism complex. Now, it shows that with a lack of collaboration, you always end up with very stupid actions.

Now, here we have the President of the Philippines receiving the Manila Bay strategy. Bo Hai Sea is another big area which also brings the various stakeholders together. One achievement we've made is to be able to bring the various local governments together to come to a Bo Hai Declaration which they signed in July of last year... in the year 2000, and that became the basis, and with that it catalysed the Chinese government's contributions of \$600 million for the next ten years. So this shows some of the usefulness.

Badangas(?) Bay, one of our demonstration projects, has been going on for a long time, and these are some of the outputs that you'll probably be interested in; the institutional mechanisms.

I would like to very quickly mention the scientific support that is needed. Ecological capacity. The managers want to know how much can you develop in a certain area. That information is difficult to get. I recently organised a workshop, bringing some of the key model experts together, and we can't even agree on one single model. So it's very difficult, and it has to take a lot of effort to build this risk assessment, and the impact assessment in the developing countries was misused. How can they can be strengthened, how can they value the resource, how can they know more about the coastal and the ocean dynamic, and develop a sustainable economy and development.

The use of geographical information is known quite well, but it is very poorly-utilised.

One final thing I want to mention is sea zoning. Sea zoning is a very important tool to create cooperation, but very often we fail in this. It's not easy to do because of conflicts. And we have a successful story in Siamun where coastal zoning has worked, and a permanent system has developed. And here you'll find that even the dolphins, in an area where the dolphins are found, the ships that enter the area had to lower down their noise level, and dolphins can now be sighted there.

Monitoring those changes where you need to bring various agencies together into one common monitoring exercise, rather than split into the various agencies.

And finally, you need a specialised training course.

And capacity is a very important component. Because of our experience in the Siamun we're able, now, to develop a Siamun training centre for coastal zone management using Siamun as a demonstration laboratory. And Siamun, one of the islands that you see over here has been

preserved, and that island has just got ISO 14001 certification. So it is not an ICM that's based on talk, an ICM that's based on action and certification.

Thank-you very much.

### **Art Hanson**

Well, that was a real tour de force, and it was - for any of you who have travelled through - and I know some of you have - travelled through that part of the world, there's a thousand things that could be said about any one of those cases, and I think just the fact that one can get all of those diverse countries cooperating is a tremendous... actually, I think it's tremendous not only for the countries themselves and for the region, but it's also a tribute to you, Dr. Chua, that you have been able to do this. And I think it shows, as much as anything, the force of personality as well as force of science and rationality playing a big role in dealing with these kinds of programs.

Now, we have our full panel at the front, here. I'm just going to very briefly introduce the three panel members, and I'm going to change the speaking order slightly as well. I think it makes a lot of sense for Dr. Monthip to speak first, if that's okay, because we could follow right up from what Dr. Chua has been describing with a specific case again in Asia.

So I'm going to introduce Dr. Monthip first, and I'm going to get my glasses so I can actually read. It's one thing to have been around for 30 years in this business, it's another thing to have to wear reading glasses.

Dr. Monthip Tabucanon... is that close enough? I'm sorry my Thai is not very good. But anyways, Dr. Monthip is the Deputy Director General of the Department of Environmental Quality Promotion in the Ministry of Science, Technology and Environment in Thailand.

And she has a series of degrees, a Bachelor in Chemistry from Mahadan(?) University, an M.Sc. in Environmental Engineering at the Asian Institute of Technology - both of those are major institutions in Thailand - and then she did a Ph.D. in Urban Engineering at the University of Tokyo in Japan.

She has been involved with a whole host of activities, and I won't go through them all. Needless to say that, as anyone in her position would do, she has been very deeply involved in regional activities through ASEAN and other organisations in addition to her work in Thailand.

She's also been involved with the UN system and has a number of different activities, one of which is one that I particularly follow here in Canada, is in dealing with a green tax system, which she has been looking at in Thailand.

Now, I'm just going to introduce the other speakers as well so you know who you have in front of you. The second speaker will be Dr. Harvey Shear, who is Regional Science Advisor with Environment Canada. He did a Ph.D. at the University of London in Freshwater Ecology of Blue-Green Algae, and a Bachelor's degree before that at the University of Toronto in Aquatic Ecology.

He has been involved with the Great Lakes in many ways for many years, and is more qualified with blue-green algae as part of his background. But his present position as Regional Science Advisor involves provision of scientific advice in Ontario on all environmental issues from Point Pelée in Lake Erie to Hudson Bay, which includes quite a large area, not just the Great Lakes.

He is the Canadian Chair of the Biennial State of the Lakes Ecosystem Conference, with the United States EPA involved as well on that, and is Canadian Chair of the International Joint Commission's Council of Great Lakes Research Managers.

He's also an adjunct professor at the University of Toronto where he teaches an undergraduate course in ecology and economy, and has taught various courses on the Great Lakes and general science.

The third speaker in our panel this morning will be Dr. Gail Krantzberg who is the Director of the Great Lakes Regional Office of the International Joint Commission.

Gail completed her Masters and Ph.D. degrees on the topic of Contaminant Cycling and Ecological Effects at the University of Toronto. She has worked for the Ontario Ministry of the Environment, from the period of 1988 to 2001 as Coordinator of Great Lakes programs and Senior Policy Advisor on the Great Lakes.

In her role with the IJC, in the Regional Office of the Great Lakes, her scientific team plays an important role of overseeing bi-national progress made under the auspices of the 1972 Great Lakes Water Quality Agreement.

And as most of you in the room will know, that document, an agreement, was a landmark in environmental matters really for the whole world, actually. It was negotiated at a time when

the Great Lakes were viewed as being truly endangered, and as I recall living in the United States at that point in time, we felt that Canada had got the best deal out of it. In fact, everyone in the States was amazed that the president there had signed it.

What has really happened, I think, as a consequence of that, is that the world has got a reasonably good deal - not a perfect deal - but it's to the credit of both Canada and the United States that a great deal of activity has happened under that.

So, we will have a very interesting panel discussion, now, that will follow up on some of the kinds of issues that Dr. Chua has brought forward, and we will take a look at Thailand first of all, and then we will come back right into our own back yard, here, on the Great Lakes.

So if I could ask Dr. Monthip to take the podium, here? Thank-you.

**Dr. Monthip Tabucanon - Deputy Director General, Department of Environmental Quality, Thailand**

Good morning, ladies and gentlemen. It is really my great pleasure and honour to present here today on measuring and understanding coastal ecosystems.

Well, as you may know, good decision making relies on the availability of adequate, accurate and reliable information gathered from monitoring and research, and in the monitoring and research of waters and coastal regions, the management of data and information is a major challenge. However the information... the benefits of sharing this information between stakeholders are significant.

Gathering the data needed to support sustainable management frameworks for shared water is beyond the capacity of only one organisation, so partnerships that allow agencies to tap knowledge and technical capacities is really important.

I would like to touch on the key policy questions - why do we need to measure and understand coastal ecosystems? The eleven questions, is what are the major regional and global environmental problems, changes, both current and emerging, especially on the coastal ecosystems. Why are these changes significant? What are the major demographic, social and economic driving forces behind the observed problems, and where are we heading if we do business as usual? Where do we want to be heading?

I think these are some things which scientists should communicate to policy makers.

And what is being done to address environmental concerns, and what can be done in future to move forward on the path of sustainable development?

I would like to touch on the State of Environment - or, SOE - guiding principles. In compiling information, what we need to look at is based on accurate and scientific information - for policy makers I think these are very important elements - presented without bias and modification, because otherwise if the information is compiled without good consensus, or good communication, then there will lack of trust in the information.

Done through partnerships and collaboration with the non-government, government, private sectors, and all stakeholders, addressing global and regional issues. For example, at the global levels, at the moment, I think the UNEP is now compiling Global Environment Outlook - or GEO - which is now in number three series. And I fortunately joined as a chair of the South-East ASEAN for the Global Environment Outlook for South-East Asia.

For the regional issues, I think in the ASEAN level where we are, ASEAN is now in the process of harmonisation of the environmental database, and with that I will touch on it later.

It aims to towards what is ecologically sustainable development, and information should be simple and easy to understand at all levels, especially the grassroots levels.

Then we should look at the pressure state response model. I think they are correlated for pressure. Human activities, and impacts, energy, transport, industry, agriculture, fisheries, put pressures on the state of condition of the environment through air, water, land resources, biodiversity, human settlements, culture and heritage.

For the response, institutional and \_\_\_\_ response, I think the information will be very beneficial to policy makers in coming up with good legislation, economic instruments, new technologies, changing community values and international obligations.

Specific data is needed for the decision making... driving forces are demographics, poverty and social developments - which are important factors at this moment - technology, trade and lifestyle; for example, research and development capacity, import and export of natural resources, commodity consumption rates, and natural disasters.

Specific data needs for the SOE reporting is; human activities, use of environmental resources, such as land agriculture, forestry, mining, transport and water agriculture, fishery, industry, tourism and recreation. These are the important parameters which we should look at.

Consumption of natural resources, such as water withdrawal, forest, harvest, aquatic fish, wildlife, mineral extraction and management patterns, intensity and monoculture.

As for the stress, level of contaminants, I think in this session you will hear also many researchers present about the contaminant level and pollutant level in environmental media such as soil, water, air, biota and others, and parameters like nitrates, dioxin, heavy metals, sulphur dioxide, CFCs, etc.

Source of the contaminants will focus on point and non-point sources, industrial sources, domestic sources, agricultural sources, and municipal sources.

And the last one, human activity stresses focus on waste production, urban growth, transportation, and ocean spills.

Contaminants for the environment will touch on biological, physical and chemical characteristics of atmospheric hydrosphere, and biodiversity of flora and fauna and micro-organisms.

For the ecological response to the stress, we look at the changes in the environment, like acidic deposition, or acid rain, global warming, loss of biodiversity, water degradation, and human health effects. I think these are the parameters which we have to use to set down the definition before we gather the information.

Specific data needed for reports should focus on societal and management measures of activity such as area protected, amount recycled, area planted, sites rehabilitated, sewage treated, species protected, energy and water use efficiency.

Institutional responses... I think these institutional responses are now very important. As Dr. Chua mentioned; in Thailand we have now come up with a new Ministry of Natural Resources and Environment from 1st of October. All the issues of water from 30 departments, will be compiled only into one department, so there are big changes. And this information will be very important on regulation, EIA, economic instruments, participation in international conventions, agreement treaties, environmental standards, technology innovation, monitoring, and reports of the state of environment. With this kind of information it should be adequate, accurate and reliable.

For the individual response, changing of community attitude and actions, I think we should share information for the benefit of all stakeholders.

On the data issues, institutional constraint is due to the lack of resources, expertise, no organisations mandated to report, time series data, intern....(?) and specific issues on (?) basis. I think, with this, if you take a look at the global environment outlook you will see that in each region they are different in the information. For America, for Europe, lots of information is really available, but in Asia there's really a lack of good information, and some information from some member companies for, example, ASEAN, are not comparable.

Data reporting units... the units are different from country to country. Some are in the U.S. unit, some are with the UK. And data management, lack of central compiling system, data remains scattered across many sectoral departments. This happens everywhere in developing countries where each department has their own compiling system and there is lack of communication among departments, and with that it is very difficult to compare results.

Not all countries collect data on each environmental issue, thus making global data sets incomplete.

For the technical constraints, I think definition differences - for example, with land - include different categories in different countries, coverage of monitoring networks, lack of permanent networks with adequate geographical coverage, sufficient resources, different reporting periods contribute to aggregation problems in regional and global assessment.

Gap filling... various statistical methods are used to fill data gaps and smooth curves, trend fitting. Conceptual and technical difficulties of measurement like biodiversity, ecosystem diversity.

And the most important one is the difference in measurement methods. I think this is something which we need to look at; not only the harmonisation of environmental databases, we should look at the sample collection, how often they collect the samples, method of measurement. For example, BOD. In Malaysia they use BOD three days, in other countries they use BOD five days. And the COD, some countries use permanganate method like Japan, and Thailand uses dichromate methods. These are something which should be looked at, for analysis and application.

Then, for raw data directly obtained from monitoring mechanisms, I think to make it possible to compare the result there's a strong need for a harmonisation process.

Why harmonisation? At this moment, as I told you, in the global level we should look at how we can compare among regions, and at this moment the global environment outlook has reflected what are the differences. And then regional level within the ASEAN, the ASEAN is now in the process of harmonisation.

I think harmonisation can only be successful if there is political will. In that case, Thailand initiated this harmonisation process of ASEAN. We did propose to the ASEAN a meeting of environment, and it has been endorsed by all ministers that all countries will come up with a harmonisation process. And we set the focal point, set up the workshop trying to train the people who are in charge of the environmental information database, and with that we have a very good cooperation with UNEP EAPAP which is stationed in Thailand.

And at the national level we should also look at, because ones in a country do not really have a good harmonisation process among departments concerned; if there is no understanding of the definition of parameters, unit system, it's also difficult to communicate at the regional level.

So harmonisation should facilitate integration of multi-sectoral environmental data, facilitate international comparability of variables, and facilitate analysis of issues of common concern, and transboundary pollution.

For the elements of harmonisation we should look at, as I mentioned, data definition, standard units, methods of measurement, sampling standards, time series requirements, and metadata standards.

So in the metadata standards we should look at different environmental statistics, like data, summary of contents, proposal database, name and address of organisation, contact persons, access methods, parameter variables, geographical coverage, data acquisition methods, user guide, units of measurement, period of record, update frequency - the hardware and software is also important - output formats, the language use and the keywords.

I would like to just give an example of what our Department of Environmental Quality Promotion, my department, is working on with the NGOs and local government to combine information on community forests. I think community forests is a very commercial issue, now, where many people now move to the forest where it is a conserved area, and with moving people out we need very good information related to the area of the forest. And with that, no one trusts each other in this data.

So, what we did is we set up a working group inviting NGOs at the local level, local government, and central government, and all related agencies in the central government, to sit together and come up with the handbook and manual, see how we are going to conduct the survey using geographic information systems, and also to have a ground survey. And with that, everyone should work together when they go to the field so that the data will be very reliable and will be trusted by all.

So, with that, we are now in the process of working together, which is one of the good examples of partnerships and cooperation, networking with our stakeholders.

Besides that, our department is also involved as a national focal point for information databases. We disseminate all the information. We prepare GIS, all provinces, and then let the local government or provincial government make use of all the databases, and train them - capacity building - train their people and let them try to provide their own information, and we have cross-checks once in a while so that our information will be sustainable.

In conclusion, I would like to say that good decision making should rely on adequate, accurate, reliable information gathering from researchers and monitoring activities, and the benefits of sharing information between stakeholders are significant. Partnerships are also a very important element to tap into each others' knowledge and technical capabilities. And coordination of the research requires a standardised method of collecting data and analysis, and standardised methods of organising data and networking among all researchers.

So I'd like to conclude my talk. Thank-you very much.

### **Art Hanson**

Thank-you very much, Dr. Monthip.

I'd just like to pull out a couple of points, there, just for our future reference when we come back to discussion. One is this role of having an integrative tool like GIS, which becomes so important. Secondly, and the point that you raise of upward harmonisation, the capacity to move from local and national up into regional and global. And finally, you focused on state of environment, and I would suggest that we also have to think about the state of sustainability, this broader aspect that includes much more on the social and economic side.

On either case, though, I think it's important to point out that here in Canada we don't have a State of the Oceans, or State of Coastal Reporting well sorted out yet, although I hope we will be moving in that direction, but certainly at a global level I think this is a very daunting challenge.

Now I'd like, if I could, to call upon Dr. Shear.

**Harvey Shear - Regional Science Advisor, Environment Canada**

Thank-you very much. Good morning, ladies and gentlemen. Bonjour, mesdames et messieurs.

I'd like to thank the organisers of the conference for giving us an opportunity to say a few words about some of the work that we're doing in the Great Lakes and how this work could serve as an example for other shared waters of the world.

And just a remark to pick up on what Dr. Hanson said, in fact we do have - as you'll see - a State of the Environment report on our Canadian south coast, i.e. the Great Lakes.

The Great Lakes basin is a complex geopolitical system, not quite as complex as the area that Dr. Chua was talking about, but we still have our issues. It's two countries, two provinces - Ontario and Quebec - and eight states in the United States. We have various bi-national commissions; the International Joint Commission, the Fishery Commission. We have hundreds of municipalities, many First Nations and tribes. The basin consists of 33%, roughly, of Canada's population, about 10% of the U.S. It's a major industrial driver for both countries, with auto-making, steel, pulp and paper, etc. It has vast forest in the north and very fertile agricultural land in the south.

And bear with me. Whenever you give one of these talks and other people have gone before you and you haven't seen their final presentation you realise, 'I would have written it differently had I seen the other material.'

I'm going to give you a quick overview of the Great Lakes, some of the history, and lead into what we're currently doing in terms of monitoring and environmental socio-economic indicators.

Very quickly, at the turn of the 20th century there really wasn't any organised management to speak of in the Great Lakes. The lakes were used as a source of drinking water,

industrial water, a sewage receptacle, transportation corridor, source of food - fish - without regard to how often these conflicting uses could compromise one another.

We tended to deal with issues such as cholera and typhoid outbreaks by chlorinating drinking water and waste water, but we still had essentially untreated discharge of waste from millions of people, so by mid-century we began to put primary treatment in place.

Then we discovered, in the 1960s, that phosphorus from human and agricultural waste was causing something called cultural eutrophication. So we tackled that problem by upgrading our sewage treatment plants, removing phosphorus from the waste stream, banning phosphorus in detergents and so on.

Then we discovered the world of persistent toxic chemicals through pioneering work of Rachael Carson and others. "Better living through chemistry" became an oxymoron.

We realised, in the late 70's that we couldn't manage the Great Lakes system piecemeal, and the ecosystem approach became the modus operandi for the Great Lakes management.

But this didn't happen overnight. It took many years for some of the dinosaurs in agencies to either retire or finally see the light of this management approach. The cornerstone of our management regime in the Great Lakes - as you've heard already - is the Great Lakes Water Quality Agreement, first signed in '72. It was renewed in '78 and was last amended by protocol in 1987. It is not a formal treaty, as you may have heard in previous sessions, it's pursuant to the boundary waters treaty from 1909. And it's the '87 protocol which really leads to what I want to talk about in terms of the broad ecosystem approach to management and reporting.

The purpose of the agreement's a very lofty one, as you can see here. We're currently within the process - that I'll describe in a minute - of going to try and tackle the issue of biological integrity; what does it mean, how do you measure it, how do you know when you've got there, so to speak.

Some of the programs that were outlined in the '87 protocol you can see here, and I won't go into a lot of detail with them. The ones that I've highlighted in white, there, at the bottom, are ones that are more relevant to the talk I'm giving, where the agreement calls for the development of ecosystem objectives to be developed for each of the Great Lakes and for indicators to be identified to measure progress towards these objectives.

In several parts of the agreement the governments of Canada and the U.S. agree to report on progress towards achieving the agreement goals and objectives.

And one way we do this reporting is through something called SOLEC and, actually, their last conference was held in this very room two years ago. SOLEC is the State of the Lakes Ecosystem Conferences.

State of the Lakes Ecosystem Conferences - SOLEC - are held every two years, and they're designed to report on the condition of the Great Lakes ecosystem components with respect to progress on the goals and objectives of the Great Lakes Water Quality Agreement.

Conferences are science-based rather than programmatic, and they're the result of consultation and collaboration between U.S. and Canadian agencies, between federal, state, provincial and local government agencies, environmental groups, industry and the public.

Our primary audience includes environmental managers and local decision makers throughout the basin. We try to meet the information needs of senior management and of the public. We believe that by providing sound science the information that's based on sound science on the state of the lakes, and continuing pressures on the lakes ecosystem, we can influence the decisions that are being taken in the Great Lakes. We use a set of biophysical and socio-economic indicators to provide these reports.

The framework in which we are working in the Great Lakes is the one that you see here. And I've been often accused of loving triangles, and you'll see another one in a second.

Basically, at the top of the pyramid is sort of the desired state, the ecosystem integrity, physical, chemical, biological integrity. Below that are a series of stressors; physical, chemical and biological stresses that affect that integrity, and below that are human activities which can either contribute to or mitigate those stresses.

Yet another triangle - this one inverted, just to turn you on your head - looks at another way of looking at how we manage things in the Great Lakes. For each of the Lakes, for example - or, indeed, for the entire basin - we have a vision, below that a series of goals - the specificity increases as you go down - a series of objectives, and then targets. And really, the indicators measure the targets and objectives and can be reported on any scale, geographic scale and time-frame that's applicable or appropriate.

Just to give you one example of the indicators, and one way in which we have reported, we have within the SOLEC process right now over 80 biophysical and socio-economic indicators, and the exact numbers I can't tell you because we're working through it now and we'll be discussing this at our conference coming up in October.

But what are the indicators telling us? This rainbow diagram, which we presented, is one of several showing conditions in open and near-shore waters for some of the indicators. Basically it tells us what the conditions are like in the lakes. This is one way that we present information.

For example; external anomalies - if you look at the star under "poor" for Lake Erie, that's basically, for the Northern Fisheries folk, those are lumps and bumps on fish, to use the scientific term. And we have determined for Lake Erie those levels are unacceptable and we have rated them as "poor".

Most of the ratings, as you see, are so-called "mixed". What does that mean? That means that some areas of the Great Lakes, geographically, are in good condition, some are in not good condition, and so we call that "mixed". Or it may be that within a geographic area we have some areas that are deteriorating and some that are increasing, that's why we've got the "mixed deteriorating" and "mixed improving".

The only area where we determined that things were in "good" condition is contaminants in water birds because we see the trends in contaminants continuing to decline over time, so we've assessed that as "good".

Our future work in this area is going to involve the development of indices. Clearly, reporting on what's probably going to be over a hundred indicators is not going to be very practical to the decision-making audience that we're considering, and so we may over time eventually report out on something akin to may 10 to 20 indices, an index being something such as the GDP, which everyone is familiar with on the economic side. So, we may have indices for contaminants, human health and so on, and below that would be the actual indicators.

Of course, indicators are not much use unless you have data to populate them, and that's what brings you into monitoring. Our past approach to monitoring... and by the way, we in the Great Lakes didn't face the kinds of issues that Dr. Hanson mentioned regarding spying and so

on, we've never faced those sorts of issues. I think our most significant issue is probably lack of funds over the years.

But in the past the monitoring programs have been often designed from the bottom up by the practitioners. For a variety of reasons, within the Great Lakes monitoring context, there is no really agreed-to framework. Very often - and I must confess I've been as guilty as anyone of this, I was involved in this back in the late 70s - they tended to be all-inclusive and very expensive, in other words, 'Go out and discover everything you can about the system.' They were not necessarily directed to any management question, and therefore were not necessarily owned by a particular agency because no one really felt that they were answering the specific questions that needed to be answered.

And very often, surprisingly, much of the information was never analysed or recorded, and when budget cuts came along people were astounded that their programs were cut. And someone was asked, 'Well, did you ever report this to anyone?' 'Well, no.' 'Well, then, how would they know the significance of your program?'

And so one of the things that we're ensuring within the SOLEC context is that we're trying to get as much information as we can from whatever source that fits in with our indicator system and report it out so that the data, the information, are out there in the public.

The present approach is clearly doing the most with the limited resources that we've all got, directing monitoring to specific management questions, and within a framework of lake-wide management plans. I won't go into the details of what those are - remedial action plans, reporting on indicators through our SOLEC process, and analysing the information, reporting it out on a regular basis, reporting out the results of monitoring on a regular basis.

Now, thinking about this three or four weeks ago, what lessons have we learned in the Great Lakes that might be applicable to other shared water jurisdictions? Some thoughts - in Dr. Chua's presentation I noticed - that's why I said what I did at the beginning about I would have written this differently - he's clearly identified some of the things I'm going to describe, and that's very good.

Establishing goals for the management areas with all your interested parties at the table is really important. Farmers, fishermen, urban dwellers, government folks, industry, financial institutions, etc. We think that's really important.

We may need to compromise on individual goals to get an agreed-upon final goal, because we live in a world where we have competing values, and so we may have to compromise at some point.

Set realistic objectives and interim targets. One thing you have to realise is we're not going to turn the clock back. Some people would like to see conditions in the Great Lakes the way they were in the 1600s. Well, guess what? We're not moving 33 million people out the Great Lakes basin tomorrow. So be realistic about what we have and what we can do. Set interim targets, and don't expect you're going to get there overnight, but be realistic about when you think you can get there, and celebrate your achievement when you do get there, because that really gives people a sense of, 'Yeah, we're actually doing something useful.'

Build your capacity. That does take time. I've been involved in this work, on and off, for 27 years, and I've seen the development of that capacity from the early public meetings in the IJC's Land Use Activity Study in 1976 to the lake-wide management plans and remedial action plan programming of today where the public's involved in every step of the way.

So be patient, it does take time, but the benefits are well worth it.

The science that you bring to a problem should be tied to specific goals and objectives. Be very specific to the issues that you're dealing with.

Use the ecosystem approach. Easier said than done, because as I've mentioned it took a long time for people to buy into it, but it's now accepted as the only way to go. The approach ensures that all interests are represented. You won't get people as part of a solution unless they've been part of designing that solution.

The relevant indicators - which we've been working on, now, for five years plus... well, actually, more probably, more like 15, but within this context five years - we have developed those indicators, it's a way that people can relate to and understand that they're making progress.

Identify the gaps in information and fill those gaps. It doesn't necessarily mean you have to design a \$150 million monitoring program to fill those gaps. There may be information already out there, but it has to be modified in a way that you can use it and report it.

Monitoring programs providing information for indicators... again - use whatever's available. Do you have local technologies? Can you rely on indigenous knowledge to provide

information? Again, without going out and spending millions of dollars on expensive technology.

Research the science base as required to answer the specific questions about ecosystem form and function. Recovery times, anticipated recovery times, socio-economic benefits... I can't over-emphasise the need for the socio-economic side of this. Many people will sit around a table and say, 'Well, so we restore that mangrove swamp. So what? What does it mean to us?' You can talk about it in ecological terms, but if you've got a hard-nosed banker or someone sitting there, they need to know what that means in dollars and cents, or rupees, or whatever the currency is.

Finally, for more information on the program, specifically on this State of the Lakes Program that I mentioned, we invite you to browse the Canada/U.S. web site, [binational.net](http://binational.net), where we have some of our bi-national programs, our State of the Lakes work, our bi-national toxic strategy; other bi-national programs will be up on that site shortly.

Our two domestic sites are also up there. If you want further information on Great Lakes programs you'll find a lot of information, probably more than you can digest in a lifetime.

Any questions you've got, feel free to contact me. My e-mail is [harvey.shear@ec.gc.ca](mailto:harvey.shear@ec.gc.ca).

Thank-you very much.

### **Art Hanson**

Thank-you very much, Dr. Shear.

I'd just like to pull out a few points, there, that I felt were really important. First of all, I think there's a lot of convergence happening between all three speakers so far. Gail, in a moment, we'll bring it to you to see whether there's further convergence.

But this notion of ecosystem or ecological integrity which you raised I think is a critical one. My own view is, as I said before, is that the Great Lakes is perhaps even the leading example in the world where you can take a look and see the hard science and how it's been applied for ecological integrity.

I still am of the view that it's going to be an extremely difficult thing to... even in the Great Lakes we're sort of there, for what we understand in terms of ecological integrity. For a lot

of the other areas in Canada, certainly, I don't think we're there yet at all, and for some of the areas where Dr. Chua works I'm sure we're very far from it. But this is key.

Secondly, your point about ownership of knowledge I think is a really critical one, and the point that people need to be part of the design of how that knowledge is collected, and also the language. I was tempted to use the word "street language" because I think some of the IJC work, in particular, has been very helpful on bringing complex ideas into street language. But it's also bringing it into lake language. I never thought that it would be possible for people to understand eutrophication and terms like that when they first came out, but it did happen.

But really importantly, I think you were also pointing out - as was Dr. Chua - that it's investment language as well as science language that's important, that if people don't see the need to invest, they won't.

And finally, your point about setting interim targets and celebrating achievement I think is a really important one that we should all keep in mind.

So, Gail, may I ask you to come forward?

**Gail Krantzberg - Director, Great Lakes Regional Office, International Joint Commission**

Good morning. I have the unenviable position to be between you and caffeine!

What I'll try and emphasise... and I'll try and shorten my presentation somewhat - because of the value of the comments you've had already this morning I need not repeat....I'm really going to be talking about the science/policy interface, and I'm going to be using remedial action plans - and those of you who know me find this is no surprise - to illustrate how measurement leads to management actions and how measurement leads to policy implications.

So let's get on with it, if I can. I'm going to try to skip through some of these slides, but I understand my computer's a little bit slow.

You've heard about the Boundary Waters treaty, and as I try and get past it I'll just say that it was incredibly visionary at the time, and really set the context for the Great Lakes Water Quality Agreement - which Harvey's just talked to you about - and gave us the bi-national or international framework for cooperation that our plenary speaker has spent years and years trying to achieve. We had the merit of the Great Lakes Water Quality Agreement to help guide us.

I'm going to skip straight to remedial action plans, and for those of you who do not know what they are I'll very, very quickly point out to you that once again... I'm not sure this is exactly street language, to "restore and protect beneficial uses", but basically what remedial action plans are designed to do is identify the problems; the environmental degradation issues in the geographical zone. So, that needs science and that needs measurement to identify what the problems are and to identify the sources.

Then, using a comprehensive ecosystem approach, identify the beneficial uses which are impaired, and they could be anything from an ability to eat the fish, swim in the water, drink the water, dredge the sediment without restrictions, have happy little creatures living in the mud, and eutrophication and so on.

A central core to remedial action plans is community involvement in the design and development and selection of the remedial measures. And this speaks to what we've just heard which is the only way that remedial action plans will work and get off the shelf, if you will, is if they're owned locally by the decision makers - decision makers being the community members - with knowledge and advice from scientists and technical experts. But I firmly believe decision makers have to be an informed community.

So, they're given the science in an understandable form - in the form of indicators, for example - and they make their decisions as to what the remedial measures are going to be.

So, for remedial action plans we start out with measurement. Monitoring tells us what's degraded, why it's degraded. The anthropogenic sources and natural sources lead us to selection of remedial measures to mitigate those stressors, and then to actually implement action plans.

So, a fundamental part of the remedial action plan is a commitment among the partners - and this is a true partnership - among the partners to actually, when they select the remedial action strategy they know as part of the community, that they will have some responsibility for implementing an activity.

So the implementation, the commitments for implementation are almost de facto in the development of the strategy, if it's done truly as a partnership with community-based decision making.

The next most fundamental place for measurement, for management purposes, is to monitor the recovery of beneficial uses. How is the environment responding to our

interventions? Are the beneficial uses being restored? Are we getting a recovery of our fish and wildlife communities?

And finally, the ultimate goal of remedial action plans is to restore beneficial uses and get off the list, called delisting. But I have to say, in my mind, delisting - although it's the crowing glory and everybody likes to celebrate that, and we heard in our plenary earlier, actually when Minister Andersen was here, of an area of concern very close to delisting - really, the celebration of incremental gains, in my mind - I want to echo what Dr. Shear said - it is most important to celebrate incremental gains to sustain the momentum, to continue remediation.

These next two slides are really the crux of what I want to focus on. I talked about the need to measure beneficial uses. Well, what does that mean? What do I mean when I say we can go swimming? I think many people would be able to identify. Swimming means e.coli counts below 100 mils, and there's a very specific standard; it's a government standard. The standards may be somewhat different in the different states and in Ontario, but the government standard is known. So you can set a very specific target that says at all times in the summer the beaches shall be open based on this indicator of e.coli counts.

Now, there's some fussing around there. Can we say, 'Okay, 24 hours after a storm in a big metropolitan area we'll live with not being able to swim.' That's where the societal, socio-economic elements, socio-political elements, come into the decision making about what it means to restore beneficial use. But this one's fairly straightforward.

So is drinking water. You can either drink the water or there's a boil water advisory. You either have cryptosporidium or you don't. You either have e.coli or you don't. So we can be very specific about what we mean; that that beneficial use is no longer impaired. We can, in an unrestricted way, drink treated water.

Fish consumption advisories. I saw Al Heighton here yesterday, the owner of the Ontario Sports Guide to Fish Consumption. We have very specific guidelines for PCBs, mercury, mirex, dioxin, a number of substances. Through the government advisories that are issued, science is ongoing to tell us whether or not the advisories are strict enough to protect human health based on emerging science, our emerging understanding of increased injury to human health at lower and lower concentrations of contaminants.

But we still do have advisories. We can say we have fewer advisories, because contaminated sediment has been remediated, or we've shut off the sources of pollution. We can track the restoration of that beneficial use by our measurement, by our monitoring that tracks fish consumption advisories, and if they change because concentrations are coming down we can make proclamations about beneficial uses being restored.

Now I'm starting to get into slightly more complicated ones; degraded benthos. Those are my friends and yours, those little insects and worms living at the bottom of the lake providing food for fish and other wildlife. How do we know when the benthos is healthy? How do you know if you have 12 species or 22 species, or this indicator species or that one, whose expert opinion do we use to say, 'Yes, that's good benthos.'

Now, I'm a sediment type, so I could probably look at a listing of creatures and tell you, 'That looks pretty good.' That's probably not good enough if you were to come to the IJC and say, 'Well, we're going to say this beneficial use is now restored because somebody who looked at the list said it looks good.' We need to be a little bit more specific, don't we, about the science behind what constitutes a healthy benthos.

And there are new methods. There's a very innovative method that Environment Canada did with Dr. Reynoldson, and many of you - or some of you - may be familiar with his procedure, but basically what it involves is comparing your community with a reference community that would appear, under conditions at the same kind of depth, latitude, longitude, sediment quality, nutrient content and so on, in the absence of contamination. And using some nice statistics you can look at whether your benthos looks like their benthos. So there's an ecosystem-based statistical model that can be used.

So it is science-based monitoring, ecosystem-based statistics, and we can start to make some statements about whether we've met this target. So the indicator is healthy benthos, the specific endpoint and target is what I'm trying to talk about, here.

Let's get on with a few more examples. And again, fish and wildlife populations.... I struggled a lot with some of these, personally, in my capacity as a RAP coordinator for one of the areas of concern. When do we know that the fish and wildlife populations are healthy? Here, I believe, there are reference locations in the Great Lakes, remote from human activity, of similar characteristics to the areas of concern. Well, we can look at their community composition, we

can look at the ratio of predators to benthivores and so on, we can look at the types of fish that ought to appear if there are cold water streams, and we can identify whether the diversity of fish is satisfactory.

But there's an ongoing science need, because as we continue to fight the challenge of alien invasive species disrupting food chain dynamics, we'll end up with very different types of fish and wildlife communities that may have nothing to do with... that diverge from what you would expect but may not have anything to do with the particular location, the regional location of an area of concern, but have much more lake-wide ramifications.

Fish and wildlife habitat... many of us who worked in the RAP field are familiar with the phrase, 'How much is enough?' When do we stop building homes? And I say this because when you look at remedial action plans, when you look at play space remediation you try and compare what can we see in terms of remediation of sediment, what do we see in terms of storm water management, what do we see in terms of habitat and wildlife restoration? And habitat and wildlife restoration is way out there. There's thousands and thousands of volunteers. When the Bring Back the Don folks decide they're going to have a planting day, hundreds of people come out, thousands of people come out. It's in your face, it's on the ground, you can see the change. You come out, there were no trees. You go away, there are trees. You come and there was no wetland, you go away and after some months there's a wetland. It's very gratifying.

And as a consequence, very often what we see is more habitat projects, and at a certain point we don't recognise whether we're building the right habitat for the right species. Is the critical habitat missing? Do we have lots of shoreline vegetation but not enough off-shore reefs? How much habitat is enough? There is, I think, a very large scientific uncertainty as to what constitutes sufficient habitat. We can measure, we can map, but do we know what the end point of the target is? I would argue that we don't.

Then there are some other complicated features - Restore aesthetics. So, 'How do you think it looks?' 'Oh, I think it looks pretty good compared to twenty years ago.' 'How do you think it looks?' 'Well, I just got here yesterday and I really think it looks terrible.' So, aesthetics... there's obviously no clear measurement, no science-based measurement. There has to be some social tools that allow us to evaluate the aesthetic quality of our near-shore waters.

Now, there is guidance. I mean, for eutrophication we have chemical and biological guidelines, we can tell you how many... you know, what your chlorophyll concentrations ought to be, what your phosphorous concentrations ought to be to prevent eutrophication, but I challenge anybody in this room to define the word “persistent” for me in terms of eutrophication.

This was a real problem for us in Collingwood, for example, where this one of the areas of concern was because of persistent eutrophication, persistent bad water quality, persistent algal blooms.

So, is one algal bloom per summer not persistent? Is if we have one algal bloom in one little corner of one little harbour, but the rest of the open waters is fine, is that not persistent? What is persistent? We tackled the problem by trying to link it back to the vision and the goals, which Dr. Shear was just mentioning. The goal was to be able to swim in the water safely, was to be able to boat in the water safely, was to have improved aesthetics, to have good oxygen penetration to the bottom for a healthy fishery, and if we ended up with chlorophyll above a guideline for a few days, or a few weeks, did it affect the goals and the objectives? And that was one of the ways we got around persistence.

Moving right along, three minute warning - and I’m almost through - measurement is central to management. “If you don’t measure it you can’t manage it” was the theme of a conference that the Water Quality Board put on with the governments in Thunder Bay, I think, in ’97, and it really is a question of being able to track the environmental response to our interventions, to have scientific end points that are meaningful and convey to the public in a way that is meaningful.

So, when the IJC looks at indicators, we were very encouraged that SOLEC was looking at drinkable, swimmable, ‘can you eat the fish’ because these are some of those indicators of environmental quality in the Great Lakes that have true meaning to people; indicators that people value.

We need to be able to display monitoring results in ways that are meaningful, as well, and here I refer to GIS mapping. There’s nothing more powerful than a good mapping tool to show how the environment is responding to interventions.

And one of the difficulties that we do have, however, is reaching consensus on environmental restoration, particularly in international waters where the standards are different.

What's clean enough sediment for me might not be clean enough, may be too clean compared to what's clean enough in the United States. Why is the fish that I eat cleaner than the fish that they eat in one of the U.S. states? Does it mean the folks in the U.S. are much tougher than us Canadians? So, there's a little bit of harmonisation... there's a lot of harmonisation that needs to take place.

I just want to conclude with a couple of observations. First of all, in my mind, keeping the plans, the strategies, off the shelf and into action really needs to be based on communities, understanding of where they're headed, a clear understanding of the end points, that they're achievable, that they're realistic, and that the community in that region has developed the solutions and is integral to the solutions, and share their vision.

In terms of setting end points - and there's differences in methodology and differences in standards and guidelines - I would quote some of the work of the Indicators Taskforce with the IJC, a phrase familiar to many of you; "perfect is the enemy of the good". SOLEC is grappling with this, and so are others developing indicators. There will never be the perfect measurement. We can strive for harmonisation, but in the interim let's work with what we have to measure where we are.

We had a project where we looked at, for example for fish contamination, an indicator of fishability. But can we collect this information uniformly across the basin? We hired searchers for truth and light, as Dr. Dodd referred to them, to speak with every single jurisdiction that was collecting information on fish contamination. The methodologies differed. The samples were sometimes whole fish, sometimes dorsal muscles, the analytical methods were different, yet the choice was let's begin with what we have, we'll use the information that we have, and we'll try and hone that down and improve upon it step-wise in the future.

And finally, for those of us who are trying to clean up our parts of the world, and manage our shared waters, I'd like to leave you with a little parting note from the Dalai Lama, which is, "If you think you're too small to make a difference, try sleeping with a mosquito." Thank-you.

### **Art Hanson**

I come from Winnipeg, I can tell you all about sleeping with mosquitoes right now. They just started in the last two days!

Well, you gave us some very thought-provoking ideas, there, and particularly this notion of how much is enough in terms of targets. And I guess I would add to it is “who decides how much is enough?”, particularly given that here in Canada - and in the United States, too - we’re moving towards a stewardship kind of agenda in which we’re trying to put more and more power to local people, all those people that are planting trees or cleaning up creeks, or whatever.

And one of the points that I’ve wanted to raise, not so much directly in response to the Great Lakes, but based on what you were saying, is that when we get into these issues related to integrated management of the oceans, in particular, we have such a very poor understanding of habitat, and particularly benthic habitats, that this issue of not only on the restoration side but on the prevention of damage side it’s a very crucial point, the question “how much is enough?”.

I liked the point that you raised - and it’s one at IISD that we almost use as one of our little maxims, as well - and that is that perfection can be the enemy of the good. It’s really an important point.

Finally, your point about the reference community I think is also very interesting, and however the reference community is defined as a holistic approach and that I think is very helpful in relation to the indicators question.

So, thank-you very much, Dr. Krantzberg.

We’re going to take a little bit of time, since we got a rather late start because the audience came in rather late but we do want to have the opportunity to have questions. There are three floor mikes available. We don’t want to cut too much into coffee but I would like to keep things going for about ten or fifteen minutes, depending on the volume of questions.

So, to any of the speakers, including Dr. Chua, if you have any questions please step to the mike and just identify yourself and your institution, and I’ll just open it to... you can your question either to the whole panel or to any individual.

### **Questions and Answers**

JM: Hello. My name is Jack Matthias. I work with Fisheries and Oceans in Winnipeg, particularly on Arctic issues, and I very much enjoyed this morning, and in particular I want to come back to Dr. Chua’s remarks.

Every time I hear Dr. Chua he has some new ideas cooking on the burner, and one that I just heard him speak very quickly about at the end of his talk was the concept of ISO certification of... I presume that's of a coastal zone management plan in China. And I wonder if you could explain and expand a little bit more, Dr. Chua, on how ISO certification applies to coastal zone management, what it means.

CT: Well, I actually tried to learn from Hamilton City, because Hamilton City is one of the earlier municipalities that got ISO 14001 certification.

If we now look at the ISO 14001 and the requirements you'll find that they are very similar to many of the integrated coastal management processes and frameworks that have been developed. And with that, one of the counties within our demonstration site in Siamun was able to put forward the requirements, and was able to get this compliance in January of this year, I think, they got this certification.

Now, this is important because when they received the ISO 14001 certification it shows that this county has done sufficient efforts to ensure that they are able to meet the requirements in environments, they are taking actions towards it, they're able to mobilise the various government departments and the various industries to comply with the process.

So, we are thinking that this may be one good example of moving forward to allow the countries' local governments to claim their achievement, something they can measure.

And at first I thought this is a very difficult exercise, but once the Hamilton City has got this one, the municipal government of Siamun has requested that we should help them to achieve that, and they're willing to take action to go through the process.

Then we had discussions with the network of local governments practising ICM programs, and there was some common consensus that this is a goal they would work towards. So if a municipality eventually can get this certification, it means they have done something right. And that actually has created an investment opportunity.

Now, in the case of Siamun, after they have gone through seven years of ICM operations, they make a survey of the industries to find out, 'Why do you want to invest in Siamun?' Out of 178 interviews almost 75% said they have chosen Siamun because of

its clean environment, because it has a clear policy, and they also feel that by investing in Siamun they can have a much better, even playing field.

So there is a lot of benefit they can get out of being certified ISO. Thank-you.

AH: Thank-you. Just to add to that, this is a very innovative and new thing, but we're going to see much more of this. To add to it, things like the Green Globe certification for tourism, which is very popular in the Caribbean, right now, the Marine Stewardship Council, the people that are going after aquarium fish and so on. I think this is a whole new sort of area that deserves a lot more attention for those of us working in marine and coastal management.

Next?

ZK: My name's Ziggy Klein. I'm with Great Lakes United. I was wondering, Dr. Krantzberg, what the sediments - actually, the toxic sediments - being disturbed in the dredging of the coastal areas, especially harbours on the Great Lakes, how would that affect the drinking water? Is it possible to get all these elements, toxic elements, out at the drinking water clarification plants?

GK: I'll answer that a couple of ways. If the dredging is done for an environmental dredging purpose then it's done in a way to minimise resuspension of sediment. There are dredge technologies that are specially designed, now, for environmental dredging, that reduce and almost minimise the resuspension of sediment, so the concern that you have would be quite well managed.

Another point that I would make is that the contaminants, even as they resuspend, the contaminants stick to the particles, so if the water is filtered the particles will hold the contaminants. Very little of the contaminants are soluble in water.

So, I'm not overly concerned that a dredging project would adversely affect drinking water. You'd have to see how close the project was to the water intake, surely, but with environmental dredging and the fact that the particles contain the contaminants there should not be impact on drinking water.

ZK: At the same time, I mean, the water levels in most of the Great Lakes are going down, so there's more concentration of toxins in the waters, so I guess we have to be very concerned about that, too. Thank-you.

AH: Thank-you very much. We have a question over on the far microphone.

DC: My name is Dale Campbell and I work for IUCN, the World Conservation Union. I just wanted to make a point about international ocean governance, because IUCN has recently published a document on a CD-ROM on using international law and organisations to manage marine resources sustainably.

Professor Chua was making quite a lot of comments about the UN system and the number of international and regional agreements, and this particular document outlines a lot of the relationships between the conventions and the regional agreements.

But I also have a question for Dr. Chua in terms of the impact of some of the countries of his region on other regions, because in Japan and South Korea, for instance - we had a presentation yesterday on West Africa - and the presenter was saying that these trawlers were depleting the resources off the coast of West Africa. So I was just wondering if you also look at inter-regional problems in terms of the impact of your region on other regions.

CT: Unfortunately, not yet. I think we have a lot of problems regionally, and those problems will have to be sorted out first. I think the subject of inter-regional issues is important. For example, in Asia - Japan, China and Korea, particularly with Taiwan - they have a lot of fishing vessels operating internationally, and if we can get them to really be concerned about their neighbours I think they will be slowly more conscious about this.

I've seen the international oceans governance document. It's excellent. I think that's why I'm trying to push the idea of integrated communications, so that countries can really collectively utilise the international conventions to realise their original objectives.

AH: Thank-you very much. That's a very good question, and it seems to me that we may not have to wait, we may have to pursue these things simultaneously but through different channels, but it's becoming an increasingly critical question.

Last question, now, we'll give to Jim Bruce.

JB: Hello, I'm Jim Bruce. I did most of my work on the Great Lakes before Harvey started!

I had one question for the Great Lakes folks and one question for our south-east Asian colleagues.

On the Great Lakes we always had trouble, in the early days, in linking the management of the levels of the lakes and the flows of interconnecting channels with the water quality ecosystem issues. And I had the impression from the presentations this morning, from the indicators put up on the board, that lake levels and flows of the interconnecting channels weren't a key part of your indicators. And so I just wonder if things have got better since my early days there on that issue.

For the people from south-east Asia, I wonder what proportion of the contamination of the seas in that region comes through atmospheric transport of pollutants into the water?

AH: We'll start with the Great Lakes.

HS: Jim, I didn't want to put everyone to sleep showing every indicator that we've got. We do in fact have indicators measuring water levels and particularly their impact on coastal wetlands, so that whole sort of physical aspect of the Great Lakes is there, it's part of our indicator suite.

AH: Okay. And on south-east Asia, atmospheric contamination? And we could broaden that to south-east and east Asia.

MT: For south-east Asia an acidic deposition network is now being established, and we are conducting the monitoring related to acid deposition also in the coastal area, also in the Gulf of Thailand. So I think it's in the process for this monitoring.

CT: Maybe I'd just like to add on to say that although there is not sufficient data to indicate how much of the contaminants move to the marine environment from the land, we have to bear in mind that in south-east Asia, close to 70% of the sewage is directly discharged into the sea. And I would say that in east Asian seas, more than 30 million tonnes of industrial waste goes right into the sea.

So the contaminants moving from land to sea is a well-accepted fact, because there are not sufficient treatment facilities being undertaken. And there is also quite a lot of problems arising from these conflicts between China and Korea, of the movements of Bo Hai Sea to the Korean Seas and all those problems.

So, in south-east Asia the contaminants issue is a real issue.

AH: And of course we're concerned about such things as persistent organic pollutants ending up in Arctic marine food chains, as well. So I think this is something we're going to hear a lot more about in the future, that's for sure.

Well, thank-you very much, Dr. Chua, and members of our panel. It's been a very informative morning. And thank-you very much for sticking to time and providing very concise and helpful summaries in each case.

And thank-you very much; it's now time for coffee. Thank-you.

[End of Day 3]