

THE ROLE OF THE MILITARY  
IN PROTECTING THE  
WORLD'S WATER RESOURCES  
PROCEEDINGS  
3 - 5 NOVEMBER 1999

Kent Hughes Butts  
Arthur L. Bradshaw, Jr.  
Brian D. Smith

July 2000

| Report Documentation Page                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                                     | Form Approved<br>OMB No. 0704-0188         |                                             |                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------|--------------------------------------------|---------------------------------------------|------------------------------------|
| Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. |                                    |                                     |                                            |                                             |                                    |
| 1. REPORT DATE<br><b>JUL 2000</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                    | 2. REPORT TYPE<br><b>N/A</b>        |                                            | 3. DATES COVERED<br><b>-</b>                |                                    |
| 4. TITLE AND SUBTITLE<br><b>The Role of the Military in Protecting the World's Water Resources</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                    |                                     |                                            | 5a. CONTRACT NUMBER                         |                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                            | 5b. GRANT NUMBER                            |                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                            | 5c. PROGRAM ELEMENT NUMBER                  |                                    |
| 6. AUTHOR(S)<br><b>Dr. Kent H. Butts, Mr. Arthur L. Bradshaw, and Mr. Brian D. Smith</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |                                     |                                            | 5d. PROJECT NUMBER                          |                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                            | 5e. TASK NUMBER                             |                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                            | 5f. WORK UNIT NUMBER                        |                                    |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br><b>U.S. Army War College 122 Forbes Avenue Carlisle, PA 17013-5234</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                    |                                     |                                            | 8. PERFORMING ORGANIZATION<br>REPORT NUMBER |                                    |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                    |                                     |                                            | 10. SPONSOR/MONITOR'S ACRONYM(S)            |                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     |                                            | 11. SPONSOR/MONITOR'S REPORT<br>NUMBER(S)   |                                    |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT<br><b>Approved for public release, distribution unlimited</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                    |                                     |                                            |                                             |                                    |
| 13. SUPPLEMENTARY NOTES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                    |                                     |                                            |                                             |                                    |
| 14. ABSTRACT<br><b>This is the report of a workshop held to explore the issue of use and impact on the worlds water resources by the worlds militaries. The workshop explored how militaries can accomplish their mission while lessening their impact on the environmental quality of water resources and the use of regular operations in risk management.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                    |                                     |                                            |                                             |                                    |
| 15. SUBJECT TERMS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                    |                                     |                                            |                                             |                                    |
| 16. SECURITY CLASSIFICATION OF:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                    |                                     | 17. LIMITATION OF<br>ABSTRACT<br><b>UU</b> | 18. NUMBER<br>OF PAGES<br><b>180</b>        | 19a. NAME OF<br>RESPONSIBLE PERSON |
| a. REPORT<br><b>unclassified</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | b. ABSTRACT<br><b>unclassified</b> | c. THIS PAGE<br><b>unclassified</b> |                                            |                                             |                                    |

Editors  
Kent Hughes Butts  
Arthur L. Bradshaw, Jr.  
Brian D. Smith

\*\*\*\*\*

Cover Composition  
Arthur L. Bradshaw, Jr.

\*\*\*\*\*

The views expressed in this report are those of the participants and do not necessarily reflect official policy or position of the United States Army War College, the Department of the Army, the Department of Defense, the Department of State, or any other Department or Agency within the U.S. Government. Further, these views do not reflect uniform agreement among the exercise participants. This report is cleared for public release; distribution is unlimited.

\*\*\*\*\*

Comments pertaining to this report or requests for additional copies are invited and should be forwarded to: Center for Strategic Leadership, U.S. Army War College, Carlisle Barracks, PA 17013-5049. Comments may also be conveyed by calling (717) 245-3226 or DSN 242-3226, or by electronic mail to: [perryj@csl.carlisle.army.mil](mailto:perryj@csl.carlisle.army.mil).

## TABLE OF CONTENTS

|                                                                                                                                                                     |                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| FOREWORD . . . . .                                                                                                                                                  | vii                            |
| EXECUTIVE SUMMARY . . . . .                                                                                                                                         | ix                             |
| Engagement Issues. . . . .                                                                                                                                          | xi                             |
| Research Issues . . . . .                                                                                                                                           | xii                            |
| <br>PRESENTATION AND DISCUSSION OF THE<br>STRATEGY FOR THE ROLE OF MILITARIES IN<br>PROTECTING THE ENVIRONMENTAL QUALITY<br>OF THE WORLD'S BODIES OF WATER. . . . . | <br><br><br><br><br><br><br>1  |
| <br>UNESCO'S INTERGOVERNMENTAL<br>OCEANOGRAPHIC COMMISSION (IOC) AND THE<br>POTENTIAL BENEFITS OF IOC-DOD<br>COOPERATION. . . . .                                   | <br><br><br><br><br><br><br>11 |
| <br>CONTRIBUTING TO ENVIRONMENTAL QUALITY:<br>REDUCING THE MILITARY'S IMPACT ON THE<br>ENVIRONMENT . . . . .                                                        | <br><br><br><br><br><br><br>17 |
| Executive Summary. . . . .                                                                                                                                          | 17                             |
| Introduction and Purpose. . . . .                                                                                                                                   | 18                             |
| Background . . . . .                                                                                                                                                | 19                             |
| Geographic Setting . . . . .                                                                                                                                        | 24                             |
| Annual AAV "Mud Ops" Maneuvers for<br>Widelife; Turning Swords into Plowshares. . . . .                                                                             | <br>27                         |
| "Grass Roots" Efforts at Alien Vegetation<br>Removal . . . . .                                                                                                      | <br>29                         |
| Erosion Control With Native Hawaiian Help . . . . .                                                                                                                 | 30                             |
| Lessons Learned From Examples . . . . .                                                                                                                             | 31                             |
| Conclusions . . . . .                                                                                                                                               | 37                             |
| Endnotes. . . . .                                                                                                                                                   | 39                             |
| <br>ENVIRONMENTAL QUALITY ASSESSMENT ON<br>THE CONTINENTAL SHELVES AND IN LARGE<br>BODIES OF WATER: CURRENT STATE OF THE<br>ART . . . . .                           | <br><br><br><br><br><br><br>45 |
| Introduction . . . . .                                                                                                                                              | 45                             |

|                                                                                                                |    |
|----------------------------------------------------------------------------------------------------------------|----|
| Assessments . . . . .                                                                                          | 45 |
| <i>Concepts</i> . . . . .                                                                                      | 47 |
| <i>Trends</i> . . . . .                                                                                        | 47 |
| <i>Indicators</i> . . . . .                                                                                    | 48 |
| <i>Dimension of Scale: Spatial and Temporal</i> . . . . .                                                      | 51 |
| Problem Areas . . . . .                                                                                        | 52 |
| <i>Coastal Areas More Threatened Than Open Ocean</i> . . . . .                                                 | 53 |
| Categories of Threat . . . . .                                                                                 | 54 |
| <i>Changing Preceptions of Marine Decline</i> . . . . .                                                        | 55 |
| <i>Land Based Pollution</i> . . . . .                                                                          | 56 |
| <i>Land Based Sewage</i> . . . . .                                                                             | 58 |
| <i>Nutrient Pollution</i> . . . . .                                                                            | 59 |
| <i>Exploitation of Living Resources</i> . . . . .                                                              | 60 |
| <i>Physical Alteration of Habitats</i> . . . . .                                                               | 60 |
| <i>Alien Species</i> . . . . .                                                                                 | 61 |
| <i>Conclusions</i> . . . . .                                                                                   | 62 |
| <br>RISK ASSESSMENT AND MANAGEMENT<br>ISSUES IN THE CONTINENTAL SHELVES<br>AND LARGE BODIES OF WATER . . . . . | 65 |
| Introduction . . . . .                                                                                         | 65 |
| Risk Assessment. . . . .                                                                                       | 66 |
| Priority Areas . . . . .                                                                                       | 68 |
| <i>Sewage</i> . . . . .                                                                                        | 68 |
| <i>Sewage Treatment</i> . . . . .                                                                              | 70 |
| <i>Physical Alteration</i> . . . . .                                                                           | 71 |
| <i>Overfishing</i> . . . . .                                                                                   | 72 |
| <i>Nutrient Pollution</i> . . . . .                                                                            | 72 |
| <i>Urban and Agricultural Run-off</i> . . . . .                                                                | 74 |
| Resources . . . . .                                                                                            | 74 |
| <i>Valuation of Alternative Courses of Action</i> . . . . .                                                    | 75 |
| <i>Integrated Management</i> . . . . .                                                                         | 75 |
| <i>Prioritization and Public Participation</i> . . . . .                                                       | 77 |
| <i>Limits of Technical Solutions</i> . . . . .                                                                 | 77 |
| <i>Long Term Planning</i> . . . . .                                                                            | 78 |
| <i>Future Challenges</i> . . . . .                                                                             | 78 |
| <i>Regional versus Local Prioritization</i> . . . . .                                                          | 79 |
| Unknown Effects. . . . .                                                                                       | 80 |
| <i>Iron Fertilization</i> . . . . .                                                                            | 81 |
| <i>Mineral Exploration</i> . . . . .                                                                           | 82 |
| <i>Deep Water Fisheries</i> . . . . .                                                                          | 82 |
| <i>New Maritime Developments</i> . . . . .                                                                     | 82 |

|                                                                 |    |
|-----------------------------------------------------------------|----|
| Appropriate Structures and Frameworks for Monitoring . . . . .  | 83 |
| <i>GOOS Monitoring</i> . . . . .                                | 83 |
| <i>Monitoring to Support Environmental Management</i> . . . . . | 84 |
| Questions and Answers . . . . .                                 | 87 |

|                                                                                                  |    |
|--------------------------------------------------------------------------------------------------|----|
| MAINTAINING ENVIRONMENTAL SECURITY AND MILITARY READINESS: THE SUCCESS OF TANDEM THRUST. . . . . | 95 |
| Introduction . . . . .                                                                           | 95 |

|                                                                             |     |
|-----------------------------------------------------------------------------|-----|
| WARSHIPS AND THE WORLDS OCEAN ENVIRONMENT. . . . .                          | 103 |
| Introduction . . . . .                                                      | 103 |
| A Negligible Impact . . . . .                                               | 103 |
| Legal and Political Requirements. . . . .                                   | 104 |
| Navy Policy. . . . .                                                        | 106 |
| Environmentally Sound Ships. . . . .                                        | 107 |
| <i>Military Requirements for Environmentally Sound Ships.</i> . . . .       | 108 |
| Ship Design, Integration, and Space Allocation . . . . .                    | 108 |
| Constraints on Warships . . . . .                                           | 110 |
| Methods to Achieve Environmentally Sound Ships . . . . .                    | 112 |
| <i>Technology Needs</i> . . . . .                                           | 112 |
| <i>International Cooperative Efforts.</i> . . . .                           | 113 |
| Liaison With Other Organizations . . . . .                                  | 114 |
| <i>The Future of Our International Efforts</i> . . . . .                    | 116 |
| Military Impact on the Oceans . . . . .                                     | 116 |
| The GIS Concept . . . . .                                                   | 117 |
| <i>Environmental Planning</i> . . . . .                                     | 117 |
| <i>Oil-Spill Response Strategies</i> . . . . .                              | 118 |
| <i>GIS: A Win-Win for Environmental and International Security.</i> . . . . | 118 |

|                                                                     |     |
|---------------------------------------------------------------------|-----|
| MILITARY CINC ENGAGEMENT ACTIVITIES: A POTENTIAL RESOURCE . . . . . | 121 |
| Introduction. . . . .                                               | 121 |
| What is a CINC? . . . . .                                           | 121 |
| Theater Engagement Plans . . . . .                                  | 122 |

|                                                                                          |     |
|------------------------------------------------------------------------------------------|-----|
| Meeting Peacetime Objectives Through<br>Engagement . . . . .                             | 126 |
| Environment as a Tool of Engagement . . . . .                                            | 128 |
| <i>Research in the Arctic</i> . . . . .                                                  | 128 |
| <i>Fires in indonesia</i> . . . . .                                                      | 129 |
| Engagement Planning in the Future . . . . .                                              | 129 |
| Questions and Answers . . . . .                                                          | 131 |
|                                                                                          |     |
| DISCUSSION AND RECOMMENDATIONS<br>FOR ACTION BY WORKING GROUP I . . . . .                | 143 |
| How do we Proceed from Here? . . . . .                                                   | 147 |
| Why Should They Care About These Types<br>of Activities? . . . . .                       | 147 |
|                                                                                          |     |
| CHARTING THE COURSE: PLANS FOR<br>FUTURE ACTION REPORTS BY WORKING<br>GROUP II . . . . . | 153 |
| Discussion . . . . .                                                                     | 159 |
|                                                                                          |     |
| APPENDIX A - WORKSHOP AGENDA . . . . .                                                   | 167 |
|                                                                                          |     |
| APPENDIX B - LIST OF PARTICIPANTS. . . . .                                               | 171 |
|                                                                                          |     |
| APPENDIX C - OTHER CSL ENVIRONMENTAL<br>SECURITY ACTIVITIES . . . . .                    | 173 |

## FOREWORD

“The Role of Militaries in Protecting the Environmental Quality of the World’s Bodies of Water” was a workshop hosted and conducted by the Center for Strategic Leadership (CSL) of the U.S. Army War College and sponsored by the Principal Assistant Deputy Under Secretary of Defense (Environmental Security) on 3-5 November 1999. The workshop was coordinated with UNESCO’s Intergovernmental Oceanographic Commission (IOC). The objective of the workshop was to explore the use of the military as an instrument of engagement in the environmental security context of assessing and protecting the environmental quality of the world’s bodies of water.

The Office of the Deputy Under Secretary of Defense for Environmental Security (DUSD(ES)) and IOC share an interest and concern for the future well being of the earth’s waters. The ocean is a significant global resource whose importance is growing as states increasingly depend on the quality and quantity of its resources for their continued growth and stability. Approximately 80 percent of environmental quality problems derive from terrestrial sources transported through watersheds. The military can play a significant role in maintaining and improving the quality of water basins, initially by lessening its own environmental impact, but also through engaging regional partners on environmental issues.

First, it is necessary to understand how the militaries can lessen their impact on environmental quality without compromising their ability to execute their mission. Raising awareness of the military impact on the environment helps facilitate necessary behavioral and cultural changes. It then becomes possible to shift the impact of military activity from having a negative impact to being neutral and, ultimately, to having a positive effect on the environment.

Second, it is necessary to consider the ways that peacetime military operations and activities may contribute to ongoing assessments of environmental quality and the management of risk. Regular training exercises, data exchanges, and other peacetime activities offer the opportunity to engage host nations and support the civilian government through assisting them with their own programs for scientific sampling and monitoring of environmental quality.

The workshop made a valuable contribution to the shaping mission of the regional CINCs by clarifying the range of applications of environmental security and their value as tools of engagement. Exploring the role of the military in the protection of water body quality offers opportunities for the regional CINCs to engage their regional partners and to support security and stability in their region. By drawing on the expertise of representatives of the IOC, EPA, NOAA, and the Department of Defense and partnering them with representatives of the regional CINCs and experts in the areas of engagement, the workshop identified the opportunities and parameters for successful bilateral and multilateral regional cooperation on research and management activities that support environmental quality of the world's water bodies and the CINCs engagement and shaping missions.

Douglas B. Campbell  
Professor  
Director, Center for Strategic  
Leadership  
U.S. Army War College

## EXECUTIVE SUMMARY

The quality of larger bodies of water is an environmental security issue because it directly impacts the physical security, health, and economy of riparian states. Ensuring water quality is a complex, difficult and often, multinational endeavor. The military can play an important role in addressing water body management and in so doing provide unique support to civil authority and build lines of communication with other regional militaries.

Thus, environmental quality of the world's water bodies presents CINC military planners with a number of opportunities to use environmental security as a tool of engagement. Engaging on environmental security issues in the world's bodies of water provides CINCs with an important tool for shaping their security environment, allowing them to approach regional militaries with a low-risk opportunity to cooperate with the United States and U.S. forces to influence events in the region through presence and diplomacy. Working mostly through shaping activities, environmental security provides the CINC with a subtle yet effective tool for engagement that has a reduced impact on the CINC's personnel, financial and technical resources. Environmental security can function as a confidence building measure, developing multilateral cooperation. It provides the opportunity to support newly democratic states by demonstrating that civilian control of the military and military support to civil authority are to the mutual benefit the military and the civilian government.

The role of the military in protecting the environmental quality of the world's water bodies starts with minimizing the negative impact of the military itself on environmental quality and moving it towards a positive outcome. The inherent environmental expertise possessed by the United States military can be used as an important tool for

engaging with the military of host nations and regional partners. By demonstrating how to incorporate environmental practices into their peace time operations and facilities management, the United States military can assist the militaries of other nations in reducing their impact on their local environments, which has the effect of improving the perception of the military held by the local population. Helping other nations to reduce the environmental impact of their militaries can positively contribute to the improvement of social and economic conditions near military installations and contributes to furthering civilian control of the military by bringing military installations into compliance with local regulations.

Through engagement on environmental security issues in the context of the environmental quality of local water bodies, regional partners can learn to better manage the resources of those water bodies through improved monitoring and effective risk management. By adopting the mission of natural resource stewardship, local militaries can contribute directly to the health and welfare of the populace and help to build regional stability and security. Globally, the direct impact of the military on the environmental quality of water bodies is trivial compared to the impact generated by localities and industry. Local militaries can contribute to the enforcement of civil environmental regulations and resource stewardship while providing important support to the civil authority and insuring the integrity of their territorial waters.

Over the course of the workshop, a number of key points were made by the speakers and participants which helped to identify opportunities for engagement on these issues and to establish the parameters that can be used to guide the development of engagement activities. These are broken down into two groups: Engagement Issues and Research Issues.

## Engagement Issues

- Clearly articulated regulations, early planning and coordination, comprehensive contingency planning and the inclusion of appropriate local environmental regulatory agencies eases opposition to exercises in environmentally sensitive areas and preserves the opportunity for training in unique environments.
- Connectivity is an important element in the planning and execution of engagement activities so the appropriate actors and resources can be coordinated and the maximum benefit can be achieved.
- Water body related engagement activities need careful planning, strong experimental design, and readily identifiable benefits to the military in order to be favorably considered.
- Engagement planners need to exercise care over the legal issues associated with conducting research which may involve national Exclusive Economic Zones.
- The UN is a critical actor in a number of situations and it is important to cooperate with them and to use their access to support exercises and deployments.
- Establishing a baseline level of engagement activity with a particular country in areas such as environment, education and humanitarian affairs, independent of the minor oscillations in overall relations would aid the engagement process and help regional CINCs to better shape their security environment.
- The development and use of operational oceanography in coastal and high seas outside of the Exclusive Economic Zone (EEZ) is a benefit to both navies and civilian users and has a high economic and

social value that could have significant utility in justifying it as an engagement activity.

- Naval vessels could be used as a “platform of opportunity” to carry automated “black box” sampling and monitoring equipment to areas that are difficult and expensive for civil research vessels to reach.
- Military installations may serve as excellent long term ecological research sites which would help civilian scientists better understand particular environments and aid the military in better managing its natural resources.
- The de-classification of data gathered by the military and its distribution to the civilian science community is a valuable activity that needs to be continued and expanded.

#### Research Issues

- Urbanization and the intensification of agriculture with their resultant run-offs are major drivers in the degradation of marine environments.
- Coastal areas and shallow seas are more threatened than the open ocean. The threat is due to the level of human activity in coastal waters.
- On a global level, there are four principal contributors to the degradation of marine environments:
  - Land based pollution;
  - Physical alteration of habitats;
  - Exploitation of living resources (i.e. over-fishing);
  - Introduction of alien species;

- Too much emphasis is placed on dealing with radionucleotides and heavy metals than on pollutants which are more prevalent on a global basis, such as run-off resulting from land use practices.
- Monitoring is not an end in itself, but it must be part of an overall management plan. The monitoring system, both the physical sensors and the system organization, needs to be designed to supply the information required to support the management of the resource.
- Because of its naval resources, technical capabilities, and potential to enforce state sovereignty, the military provides a unique and valuable water body research and management resource.

PRESENTATION AND DISCUSSION OF THE  
STRATEGY  
FOR THE ROLE OF MILITARIES IN  
PROTECTING  
THE ENVIRONMENTAL QUALITY OF THE  
WORLD'S BODIES OF WATER

Mr. Gary D. Vest  
Principal Assistant Deputy  
Under Secretary of Defense  
(Environmental Security)  
U.S. Department of Defense

The United States military has been formally engaged in environmental affairs and environmental programs for approximately 30 years. In the evolution of the Defense Environment Program, we have essentially come from having no formal environmental policies or programs, no budget, and no people, other than some specialists, to peaking about four years ago with a program that has an annual budget of over \$5 billion, a full body of policy, very comprehensively developed programs, and about 10,000 environmental professionals. From that baseline, we have been able to use our capacity and capability in a new way: to support engagement. At the beginning of this Administration, defense environmental security was created as a formal function in the office of the Secretary of Defense, through the establishment of the Deputy Undersecretary for Environmental Security. At the time it was created, we were given three tasks by the Secretary of Defense, in addition to having the responsibility for environmental matters, and they have remained in our charter since that time six or seven years ago. Those tasks are relevant to the subject of this conference.

The first task or element of our charter was to *aggressively pursue the state of knowledge on the relationship of environment to national security*. Is there a

relationship between environmental factors in a conflict and stability? We were charged to pursue or to encourage the pursuit of knowledge. Over the last 6 1/2 years, we have conducted a large number of activities in the pursuit of knowledge. These have ranged from the Environment, Intelligence, and Security Conference we sponsored at the State Department with the Director of Central Intelligence five years ago, to a series of studies, to numerous workshops and conferences both in the United States and abroad.

Second, we were charged with *aggressively and actively bringing defense environmental considerations to bear in the development of national security policy*. This means engaging other agencies of the United States Government in the development of policies and with this Administration, it was treated a little bit differently. For example, it was the first time, I believe, in the history of our government where there was a person on the National Security Council with an environment portfolio. Initially this was Eileen Claussen, who subsequently became the Assistant Secretary of State. She was replaced by David Sandalow, who just a week or two ago, was sworn in as the new Assistant Secretary of State for Oceans, Environment, and Science. The point is many things occurred in the last few years in terms of environment and defense that had not previously occurred.

In addition to the first two items, we were also charged to look at *how the Department of Defense, or components thereof, could be used as an instrument of national environmental policy*. In other words, how can we use the capacity and capability in the Department of Defense aggressively in the context of overall U.S. Government domestic and international policy on environment and national security.

So with those three statements of charter, as I indicated before, we have embarked on a number of activities including very substantial participation in a number of efforts within the framework of the North Atlantic Treaty Organization (NATO). That is where Professor Umit

Unluata, now with IOC, and I met some years ago. He and I co-chaired a NATO effort to look at the Black Sea. What were the data gaps, what kind of things needed to be done in the Black Sea. We have also done work on the Caspian Sea. Brian Smith mentioned the NATO CCMS Pilot Study on environmental security, which I co-chaired with a German colleague and its report "Environment and Security in an International Context." That document is in widespread use today with a number of international organizations including the Organization for Security and Cooperation in Europe (OSCE). We have embarked on many bilateral arrangements. Initially, some years back, we formed a bilateral arrangement on environmental cooperation with the German military. I believe it is in its 14th or 15th year, executive agent being the Army. A few years back we started one with Norway, then with Sweden and then with Finland. At the end of the Cold War in conjunction with NATO, the U.S. European Command (EUCOM) military liaison teams and the Partnership for Peace (PfP) countries, we began to use environment as an engagement tool. I think at last count there had been over a hundred team visits under the PfP environmental issues program, including the countries of the former Soviet Union and Warsaw Pact. As we continued, we expanded our bilateral relationships on environment and military to include Poland, the Czech Republic, and Hungary. Several years ago, we were asked to form a cooperation agreement as part of the Defense Committee of the bi-national committee formed between the U.S. and South Africa. We were asked to go to Argentina. We are in the process of forming bilateral agreements with China. In fact, that document is fully negotiated, simply waiting for the right time to be signed. Secretary Perry signed a bilateral agreement with Russia. We are in the process of developing bilateral agreements with Kazakhstan, Mongolia, Chile, and Georgia.

In the course of doing all of this, we look for opportunities. We look for the right topics. We look for the right productive areas for engagement. Wherever we go,

wherever we engage, the discussion always begins around the question of capacity and capability. It then moves to education, training and awareness and then you get to the more specific topics of concern. The topics differ from country to country, but some issues, like the cleanup of contamination from former military activities, are regular topics of discussion. As we continue in those discussions, inevitably we begin to talk about cross border issues. As we all know, environment does not respect political borders. We move rapidly from bilateral nation to nation discussions to multilateral regional issues. In the course of our discussions, we have recognized that water is a critical element. Whether it is water in watersheds, river basins, bays, or seas, it is one of the constant issues.

As we have looked at water issues, we have said there is probably great opportunity to build upon the activities that have been going on for years with the world's navies. Navies, along with the agencies like National Oceanographic and Atmospheric Administration (NOAA), and NOAA's counterpart organizations in many other countries, have been doing science on water bodies, whether it is through observation, monitoring, sampling, etc. Militaries are also users of watersheds. They have the ports and upstream facilities. The question is what are the opportunities for multinational engagement which are consistent with our national security or environmental policies, and are consistent with the applicable international conventions treaties? What are the opportunities to use the military as a tool of engagement, a tool of cooperation, with water being the focus.

Now, my experience with engagement, in the context of our discussion, is in places like the Baltic Sea and the Black Sea. And what we have done in those two places is not duplicate or recreate things, but capitalize on what has been done. Our Black Sea effort was intended to look at what had been done, the current status of those activities, the data gaps, the technology gaps, and to hopefully help the many groups working in the Black Sea to focus on some of these

things that need to be done. But what we have not yet done in the context of the Black Sea effort, is to look at where the military truly fits. That is what this meeting is about over the next three days. My office is in the business of working with other elements of the Department of Defense and other agencies to find the opportunities to develop the strategies that use a limited resource base for the highest return on investment. Now, in some of our endeavors, through workshops we have done in various parts of the world and on various topics, we have learned that our initial assumptions were wrong. We have learned in some cases what we should not do. What looked like a good idea when we started out, began to be taken apart for a variety of reasons. Doing something in a certain place on a certain topic in a certain time really was not the right thing to do. Now, I say that here because it is possible, although I do not think very probable, that in the course of the next several days, we could all conclude, there is not much of an opportunity, when we say there is a role for the military in protecting the environmental quality of water bodies. I do not think that is the case, but nevertheless, I raise it because we need to look at all of the pros, cons, and relevant dimensions, and see what really makes sense. If it does not make sense, we are not going to do it. If it does make sense, then we will look at how we might be able to do it.

Now, in my view, this topic has these dimensions: one dimension is how to capitalize on regular military activities to contribute to a broader range of tasks. For instance in the context of the Black Sea, is there an opportunity to use navies, such as using naval vessels as platforms to contribute in observation sampling and monitoring? On the surface, that contribution seems to be perfectly logical. On the other hand, navies do not necessarily like to do things that reveal what they are doing. I have learned that. So maybe there is some opportunity, maybe not. But we think that that is an appropriate thing to look at. Particularly when there are many civilian agencies and other interests really pursuing the state of knowledge on what is happening

in these large bodies of water. So is there or is there not a role? If there is, how could that be facilitated? How might we be a catalyst?

The second dimension and is that military activities can have deleterious effects on the environment. What we have learned through many years of working on environment in the military is that cleaning up is very expensive. Compliance with national or international environmental requirements can also be costly, but not non-compliance is costly not only in terms of money, but also in terms of political and public type values. Recognizing that, we, in our military as well as increasingly in other militaries, embrace the notion of pollution prevention. What does that mean? In its simplest form, it means to change the culture of the institution, to change the culture of the military in terms of its attitude toward the environment. The course of normal operations can contribute to environmental quality by not doing things that have adverse effects on the environment. In many cases it means making a very low cost adjustment. At the simplest level, it is properly disposing of hazardous materials. The broader implication is to ask what opportunity is there to change the culture and awareness of militaries worldwide in terms of their daily activities with reference to their effect on large water bodies. Now, immediately, most people would think, "Navies equal spill response and spill prevention." In my discussions with the International Oceanographic Commission (IOC), I am learning, that the bulk of the environmental quality problems with large bodies of water are near shore. In terms of the ocean, it is in the continental shelf area, where 75%-80% of the environmental problem comes from the land. So here what we are talking about is watershed issues and watershed management. It is not just navies, it is the armies, and it is the air forces. It is the way you operate the ports, it is the way you operate the airfields. It is what you put into the streams, onto the land and under the ground. It is point source pollution. It is non-point source pollution.

A little story will illustrate my point. Some years ago when I was with the U.S. Air Force, I visited the U.S. Air Force installation at Izmir, Turkey on Izmir Bay. And the United States Air Force, which prides itself on its environmental awareness, had just built a new motor pool. I visited that motor pool and it was beautiful. Constructed largely by Turkish workers, they had planted flowers and it was beautiful. I went into the maintenance bays, and in each bay there was a trench with a grate over it. I asked them how they did their work. They said they drained the oil into the trench and they put the antifreeze into the trench. I said where does it go? They took me to the center of the facility and they said, well, it goes into this bigger concrete trench. I said well, where does it go from here? They took me outside and we kept walking, and they finally took me to a ditch. All of the waste from this beautiful new facility was going into the ditch and the ditch went into Izmir Bay. Now, a few years later, I am back in Ankara talking to the U.S. Ambassador, Mark Grossman. And I said, "Ambassador, if there is an issue here in Turkey that we should be working on, what is it? Izmir Bay." Izmir Bay is incredibly polluted. There is an incredible amount of money being spent to try to fix Izmir Bay. Now, I hope the Air Force is no longer putting its waste into Izmir Bay, but that was not very long ago. It was just a cultural thing. Maybe it does not sound like much, but if you step back and you aggregate the world's militaries, put them all together, there is a lot of inherent potential. There is probably not a function or grouping in the world that offers more potential in terms of contributing to environmental quality through prevention than the world's militaries. How do we tap that potential? We simply change the culture. We have seen it in our military, we know you can change the culture. We have seen this occur in other countries. And yet, there are many countries with militaries where this transition, this cultural transformation has not yet occurred.

Now, the question for us, that we in part pose to you, is can we do something? Is there an opportunity here using

large bodies of water as an avenue, as a mechanism? We think there is. But we need help in framing it. We need help in understanding the activities that can be undertaken and which should not be. What is the best way of articulating what we are trying to accomplish? For example, how do we approach the Indian military from this perspective? We are currently not engaged with India on military environmental matters. Is there a possibility that there could be benefit in working with the Indian military and perhaps the other militaries around the Bay of Bengal on this topic? Could we, working with the State Department's environmental hub in Costa Rica, create an example of cooperation in Central America among Nicaragua, Honduras and El Salvador in the Gulf of Fonseca, where today we understand those countries do not work together in the environmental quality. Could we work with the navies of those countries through our Navy to encourage something? Will we be able to use this topic effectively in conferences we plan to co-sponsor with Kazakhstan for the Caspian, or with Georgia for the Black Sea? We are looking at those kinds of opportunities. There is a lot going on and there is a lot that has been done. We have absolutely no interest or intention in trying to change or duplicate any of these existing activities. We need to understand those activities and see how we can use the opportunities. On the basis of my very good and successful relationship with Umit on the NATO Black Sea project, we began to discuss opportunities for cooperation when he moved to the IOC. At Umit is invitation, I went to Paris and we basically asked the question, is there some potential benefit of a relationship between the IOC, and initially, the United States military? Could that cooperation be used to further some of our objectives of pursuing peace, stability and conflict prevention through engagement, while contributing to the IOCs function and their charter? We are here in part because we think the answer is yes. We also understand that this is only the beginning and that the question is really much bigger. It is my understanding that at least in terrestrial environmental issues, the United Nations

Environment Programme (UNEP) plays a major role and is willing to address that role. We have spent a lot of time, 20 years, in NATO, and we are in the process of systematically looking at relationships with other international bodies. For example, a few weeks ago, we requested the Woodrow Wilson Center conduct a series of workshops in Washington to ask the question, what is the environmental or environmental security role or potential role of the major multinational regional organizations in the world? OSCE is looking at that right now. They have never embraced environment before, but they are systematically looking at environment. At the summit in Istanbul in two weeks, there should be a proposal put forward to the 54 Heads of State in OSCE to begin an OSCE project on water resources in Central Asia. Why water resources? Because the people in OSCE think that the critical issue in Central Asia in terms of economics, in terms of stability, and in terms of security is probably water. So we have asked the Woodrow Wilson to look at that issue. What is the role of ASEAN? What is the role of SADC? What are their potential roles? But there is always one thing that seems to arise in these discussions, water, either water bodies or watersheds. So that is kind of what we are about.

I appreciate you joining us here and devoting your time to exploring this important issue. Thank you very much.

## UNESCO'S INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC) AND THE POTENTIAL BENEFITS OF IOC-DOD COOPERATION

Dr. Umit Unluata  
Head, Ocean Sciences Section  
Intergovernmental Oceanographic Commission

My presentation will be made on behalf of Dr. Particio Bernal who is the Executive Secretary of IOC. He regrets not being able to attend this meeting because of the ongoing UNESCO General Conference. In this presentation I will provide to you some basic information about the Intergovernmental Oceanographic Commission so that we can delineate potential areas of cooperation.

The Intergovernmental Oceanographic Commission is a part of UNESCO. It is a semi-autonomous body of UNESCO. It has 125 member states which constitute its Assembly. IOC member states are not necessarily the same as the UNESCO member states. For instance the United States is not a member of UNESCO, but it is a member of IOC.

In addition to the Assembly, which biannually instructs us on what to do about the issues before them, an executive council follows-up the decisions of the Assembly during the inter-sessional periods. The IOC secretariat is located in Paris.

The Mission of IOC is to initiate, facilitate and co-ordinate at an intergovernmental level the development of major international scientific research programmes, observing and forecasting systems, data and information services, and education, training and technical co-operation activities, for sustainable use of the oceans and coastal seas, in concert with Member States, and for the benefit of a wide range of users.

IOC carries out these activities through a series of major programs which I will touch upon as I go along. But to just briefly list the major ones, I would like to mention: the Global Ocean Observing System, GOOS, which is our flagship program; Marine Pollution Research (GIPME); Ocean Science In Relation To Living Resources (OSLR); Integrated Coastal Area Management (ICAM); Ocean Science In Relation To Non-Living Resources (OSNLR); Oceanographic Data And Information Exchange (IODE); Ocean Mapping; and Global Ocean Services System (IGOSS). Detailed information on these programs and the others are available on our website: <http://ioc.unesco.org>.

Now, just to continue to give you some ideas on what we do, let me commence by indicating that the primary roles of IOC are (i) technical, and (ii) political.

IOC has a close relationship with the scientific community that provides it with experts for the co-ordination of programmes. Because it is an intergovernmental body it has a close relationship with governments. It can therefore link both science and society. Its governing bodies are manned by national representatives who may be government department scientists or managers, eminent academics, or other representatives of government—including some naval officers since the national responsibility for marine data collection often rests with navies.

For each science programme, the governing bodies are advised by Groups of Experts, usually from academia or government departments. IOC is not primarily a funding agency, its ability to fund research is very limited. IOC's critical role is co-ordination at the intergovernmental level. Although its team is small, some 30 professionals, but its effect is magnified through expert advisory panels and committees staffed by top scientists and government representatives.

In effect the IOC is the UN system's default for an ocean agency. It provides the co-ordination needed to fulfil the

mandates of the UN General Assembly. In this context, the IOC chairs the UN wide co-ordination committee on Oceans and Coastal Seas.

Recognising the keen interests of the Member States there is a dual focus: (i) on coastal seas, and (ii) on the open ocean. The IOC provides an forum in which all countries can come together to agree on what needs to be done in both the coastal seas and the global ocean. Developing coastal states can benefit from what developed states are capable of observing in the open ocean (e.g. through the provision of boundary conditions for coastal models); in turn developed states need global measurements from the jurisdictional waters of developing coastal states. All have something to gain by contributing to a common global observing system.

Global monitoring, is carried under GOOS, which stands for the Global Ocean Observing System. It is a program carried jointly with WMO, UNEP and ICSU involving both the coastal and open ocean.

GOOS is designed to provide descriptions of the present state of the sea, and forecasts of these for as far ahead as possible, for a wide range of users, and to meet the needs of the Framework Convention on Climate Change by underpinning forecasts of changes in climate. It is not solely operational, but includes work to convert research understanding into operational tools. It is intended to provide nations with the ability to convert research results into useful products to meet societal needs, which is led by the IOC.

In addition to facilitating ocean observations, IOC it also facilitates the efforts for understanding of oceanic processes through its science programmes. In the coastal context this includes IOC's ICAM, climate (including CLIVAR), coastal ocean dynamics, El Nino, marine pollution, and harmful algal blooms.

IOC is the only organisation apart from WMO to have successfully developed a viable data and information

exchange system (IODE). IODE is probably the most successful system in the world for the exchange of physical data. IODE is a permanent body for monitoring the quality of data and for providing standards, formats, protocols and archives, through a network of designated centres. The centres are national or international; IOC pays for the coordination and planning meetings and secretariat. Of the 62 centres, only half are fully viable; the rest need further development through capacity building and other forms of investment.

Aside from its scientific, technical catalysing and co-ordinating roles, IOC also has the role of broker, e.g. between global science programs such as International Geosphere Biosphere Program's Land and Ocean Interactions in the Coastal Zone project (LOICZ) and Member States, in conveying the priorities of Member States to LOICZ and vice versa.

Not all of the work is done in-house. IOC contributes to WMO for the running of the WCRP, for example. It also contributes jointly with UNEP and the IAEA to the costs of running the IAEA's ecological laboratory in Monaco. This reflects another of IOC's roles, which is to provide standards and guidelines (not legislation, because IOC has no statutory power), as well as harmonisation.

IOC operates at both the global and the regional level. The IOC activities are in general demand-driven, with the sponsoring Member States and regions commonly operating as clients requiring services. It has several regional sub-commissions to ensure that its programmes are effective at regional levels. These commissions, which are staffed by representatives of government departments along with eminent academics, work with IOC HQ in Paris to ensure that the capacity building programme (TEMA) (which incorporates a study grants programme) is tailored to meet regional requirements. Only two of the sub-commissions have regional secretariats (WESTPAC in Bangkok; and IOCARIBE in Cartagena). The sub-

commissions hold their own regional meetings and set regional priorities.

IOC generates some of its programmes (for example GOOS). These may subsequently become co-sponsored (WMO, UNEP and ICSU have joined IOC as sponsors of GOOS). Some IOC projects are generated elsewhere and the IOC is invited to co-sponsor them (e.g. GCOS).

Where necessary IOC may encourage the creation of regional programmes, e.g. the formation of EuroGOOS, NEAR-GOOS, MedGOOS, PacificGOOS and so on, where the regional focus is on implementation at the regional level, following the GOOS design.

IOC is also involved in bringing related programmes together to create synergy between them. For example the Member States have asked IOC to play a co-ordinating role in the Mediterranean, where there is a plethora of overlapping national and international programmes, to eliminate confusion. In another case, the IOC has joined the sponsors of the observing systems and CEOS to form the IGOS Partnership to ensure that governments see each of the observing system as complementary elements of a single overarching strategy for global observation that involves remote sensing and *in situ* measurements.

In Africa, UNESCO, largely through IOC, has brought 53 African states together through the PACSICOM process to evaluate the technical options for the development of ICAM in Africa, and obtained ministerial approval for the implementation of ICAM in Africa (a good example of the application of the technical and political roles of the IOC).

# CONTRIBUTING TO ENVIRONMENTAL QUALITY: REDUCING THE MILITARY'S IMPACT ON THE ENVIRONMENT

Dr. Diane Drigot  
Senior Natural Resources Management Specialist  
Environmental Department, Marine Corps Base  
Hawaii and Research Affiliate  
University of Hawaii Environmental Center

## Executive Summary

The United States (U.S.) military is under increased scrutiny for environmental impacts of its training exercises by more outspoken and sophisticated publics all over the world.<sup>1</sup> Environmental quality issues are inextricably linked to the sustainability of military training areas and the military mission, just as they are to the enhancement of sociocultural well being and economic vitality of the affected communities. There are new mandates and promising opportunities to link regular peacetime military training operations with community-based efforts to improve environmental quality, such as in the areas of ecosystem-based management, water quality compliance monitoring, and restoring watershed health. The transdisciplinary scientific basis of these new directions is reviewed. Examples are provided from Marine Corps Base Hawaii of how ecosystem- and community-based water quality compliance and watershed health improvement efforts have enhanced the unique “social capital” resources of both the internal military base community and the external affected host community. Diverse participants from multiethnic, urban, suburban, rural, military, non-military, and native Hawaiian backgrounds have been involved. The community has also gained better understanding of the military mission and of the Marine Corps’ sustained commitment to resource stewardship. In

return, the Marines have avoided costly public protests and law suits against critical military training exercises in MCBH watersheds. While much remains to be done, progress is highlighted by national award recognition, favorable press, and praise from some of the military's strongest environmental critics.<sup>2</sup> Lessons learned and working principles that emerge from these examples are applicable elsewhere.

## Introduction And Purpose

Aloha! As I stated in the beginning of this workshop, I have been working with the Marine Corps for over 17 years now. I deliberately stayed at Marine Corps Base Hawaii because I thrive in thinking globally but acting locally. Of the five issues areas that Mr. Vest wanted us to work on, I focus my contribution on the last two:

- What are some current programs and opportunities for reducing the peacetime impact of the military on environmental quality;
- What opportunities are there for high value added cooperation and coordination in environmental assessment during regular peacetime military operations.

Specifically, I will addresses the following areas of interest:

- What are the latest watershed management science applications relevant to military mission sustainability;
- How to increase environmental sensitivity on military bases (particularly in the areas of water quality and watershed health);

- How to support local community efforts to improve environmental quality while gaining improved community support for the military mission;
- Provide working principles from these examples which are applicable elsewhere, not only in the domestic United States but in some areas of the world where we may want to test receptivity to military involvement in global water quality monitoring.

## Background

To set the framework, recall that the Federal Clean Water Act of 1972 had a rather lofty goal to restore and protect the integrity of our nation's waters. By the mid-1980's, we were going to have zero discharge of pollutants and fishable and swimmable waters throughout the United States. At the end of the 1990s, we have not yet achieved this desired end-state.

Although progress has been made in reducing point source pollution, the more pervasive non-point sources of water pollution remain. In the last twenty years, we have focused on control of end-of-the-pipe point discharges using command-and control enforcement techniques. What is harder to address is the more diffuse problem of non-point source pollution control. One authority attributes failure to achieve Clean Water Act goals to "failure to recognize the inter-related processes and important linkages in ecological systems of entire watersheds".<sup>3</sup> What is required is to look holistically at human communities, how they interact with the water in their watersheds, and address multiple non-point pollution discharge sources accordingly. The models for understanding, describing, predicting and even monitoring the health of communities in a given watershed are at an embryonic stage of development. Yet, this is one of the more important points of focus as we move into a new century.

The Clean Water Act amendments of 1987 began to address this need through application of Best Management Practices (BMPs) as a means of non-point pollution control. The focus of application is entire watersheds on a regional scale. Military installations are among the groups obliged to comply with these mandates.

Parallel to this more sophisticated approach to clean water compliance has been a change in perspective toward environmental issues. There is emergence of a transdisciplinary and integrated scientific perspective reflected in such terms as an ecosystem approach to resource management.<sup>4</sup>

What is an ecosystem approach? In 1996, the Department of Defense was one among fourteen federal land-use management agencies that signed a Memorandum of Understanding to Foster an Ecosystem Approach” to resource and environmental management.<sup>5</sup> The goal of ecosystem management is “to restore and sustain the health, productivity and biological diversity of ecosystems and their overall quality of life through a natural resource management approach that is fully integrated with social and economic goals”.<sup>6</sup>

Ecosystem Management has been defined as “a method for sustaining or restoring ecological systems and their functions and values”.<sup>7</sup> It is goal driven, based on a collaboratively developed vision of desired future conditions that integrates ecological, economic, and social factors. It is applied within a geographic framework defined primarily by ecological (not jurisdictional) boundaries. A very important theme central to the concept of ecosystem management is that one must consider humans as part of the ecosystem. Resource management decisions must be based not just on “best science” but on “associated cultural values,” “improved communication with the general public,” and “forming partnerships” with government, non-government agencies and other stakeholders”.<sup>8</sup>

At the installation level, resource managers were provided a Department of Defense Instruction (DoD Inst. 4715.3) to implement this approach. The ten guidelines in the instruction contain recurring reference to the term “ecosystem health.” Ecosystem health is one of those new transdisciplinary approaches to environmental management that emerged in the last decade. The other two are “ecological economics” and “ecological engineering.” Ecosystem health is the most integrative of them all because it marries knowledge of how environmental systems work with the knowledge of what is desirable and acceptable.<sup>9</sup> In other words, it gives social-cultural issues and perspectives equal footing with biophysical ones when applied to such resource problem areas as watershed management.

Ecosystem health has been further characterized not only by (biophysical) systems integrity... but by social and cultural as well as ecological values. A derivative concept is that of “watershed health.” Watershed Health has two components: (1) improving the biophysical integrity of the water bodies affected by human action at the watershed scale; and (2) considering social and cultural aspects of the people that live in or otherwise influence the watershed.<sup>10</sup>

There has been more research progress in the former than the latter. Jim Karr is a widely-recognized pioneer in operationalizing the first component. He developed the Index of Biotic Integrity, or IBI.<sup>11</sup> The IBI is a means of quantitatively comparing the “health” of various aquatic ecosystems to a reference standard (“Best Regional Stream”) The “health” of other streams or stream reaches in the same regional ecosystem or basin can be compared against this standard. While this method is still being perfected and is not fully applicable to highly altered urbanized watersheds, it represents a significant advance in environmental science and management. It shows how more meaningful water quality measurements can be if they include a measure of the intactness of the structure, function, and composition of an in-situ ecosystem.

The second component of watershed health is not so well operationalized; that is, consideration for the social and cultural aspects of the people that live in or otherwise influence the watershed. Jim Kent and Kevin Preister are pioneers in operationalizing consideration of the social/cultural aspects in watershed restoration.<sup>12</sup> They base it on a “Bio-Social Ecosystem Model of Productive Harmony,” which comes from field application of the environmental assessment mandate under the National Environmental Policy Act in numerous diverse community settings. Under this approach to community assessment, the health of a human community is partly measured by its ability to absorb outside intrusive forces such as the military coming in to establish a military base or to perform a training exercise.

Under this approach, there is an early warning system for finding out if a given community—whether domestic or international—is going to be receptive to such intrusion. This early warning system is an issue analysis system. One can enter a community and informally find out how a community perceives the potential presence of an outside disruptive force. One can detect whether an issue is at the “emerging,” “existing,” or “disruptive” stage. One can actually describe the existing “health” status of the community (without the intrusion), and then—based on that characterization and what “stage” of development are the related issues—one can predict whether the disruption can be assimilated without significant adverse effects.<sup>13</sup> In general, however, understanding the health of human communities, and how to marry it with the health of biophysical systems in a watershed are methodologies in an embryonic stage of development.

I believe Marine Corps Base Hawaii is in the forefront in forging an integrated natural and social approach to watershed management. That is to say, we are tackling needed improvements to water quality and watershed health by giving equal attention to the bio-physical and social-cultural, community-based components. The

military can play a unique and important peacetime role in this area while also fostering improved community-based understanding and support for a military presence in the region. This belief is based on my experience in implementing several million dollars worth of watershed restoration-related Marine Corps projects over the last 17 years, using a community-based ecosystem-management approach.

I will next share examples of how we are doing this, followed by a summary of lessons learned and working principles derived from these examples that are applicable elsewhere. But first, I would like to further define what is meant by a community based approach to watershed restoration and why it is essential. It is the planning, mapping, monitoring, and restoration of watershed health based on the discovery and strengthening of a community's "social capital." What is social capital? It is the features of social organization (e.g., the networks, norms, and social trust) that facilitate coordination and cooperation for mutual benefit.<sup>14</sup> It comprises the community of people in a self-defined geographic area; their survival networks of friends, families, and associates; their living patterns, routines, and manner in which they resolve issues (e.g., civic culture). It is the social capital of a community that is drawn upon to help cope with a crisis that might arise (e.g., a natural disaster or an intrusion of a disruptive element such as unwanted commercial development in a quiet neighborhood). Environmental scientists and natural resource managers are more familiar with how to measure the structure and function of a natural ecosystem and its resilience to stress. Less is understood about application of the same metaphors to a human community. A community with a high degree of social capital is more likely to be able to assimilate change and adapt without adverse disruptive effects, and/or modify the change to enhance the community's well-being, or resist the change if it has no considered beneficial effects..

What is the evidence that a community-based approach to watershed restoration is needed that focuses on enhancing the social capital of communities? The evidence is three decades of failed programs both in domestic and international resource and inner city development projects around the world. An interesting World Bank study (1994) performed a retrospective analysis of twenty-five development projects in Africa, Asia, and Latin America.<sup>15</sup> Thirteen or half of them failed years after because they ignored the social factor. Those that had sustained success did purposive institution building in host communities. They included grass roots participation and other sociological factors, along with economic and ecological ones.

There follows some examples of MCBH application of a community-based approach to watershed restoration. These examples will be more meaningful after a geographic orientation to the watersheds in which they occur.

### Geographic Setting

MCBH was created in 1994 as a consolidation of Marine Corps assets in Hawaii. Today, it consists of eight parcels of land covering a total of 4,642 acres, three of which comprise 90% of the total acreage, and are concentrated on the windward side of the Island of Oa'ahu in the Ko'olaupoko District: 2,950 acre Mokapu Peninsula, 1,0014 acre Marine Corps Training Area-Bellows (MCTAB), and 187 acre portion of Waikane Valley.

The Ko'olaupoko District is comprised of a topographically pronounced set of eleven watersheds. They are unique compared to the mainland. There are no extensive river basins. The hydrographic catchment areas are amphitheater-like, about a dozen square miles each, and are separated by steep wall-like ridges with slopes that vary from about 40 to 70 degrees. This pattern continues down the length of a 22-mile long stretch of mountain peaks known as the Ko'olaus mountain range. Most of these

stream courses are subject to flash floods and many of them are severely altered in their lower stretches.<sup>16</sup> One of them drains Kawai Nui Marsh through a channelized stretch adjacent to Marine Corps Base Hawaii's Mokapu Peninsula. During the last severe flood event in this watershed (1987), Marine amphibious vehicles were deployed to rescue residents from their flooded homes adjacent to this canal.

Upstream of the Marine Corps Training Area-Bellows (MCTAB) in the Waimanalo watershed, runoff from a



largely agricultural landscape contributes heavy non-point pollution to the stream courses that flow through this training area and out into Waimanalo Bay. Waimanalo stream has been declared part of a Water Quality Limited Segment and it is currently subject to U.S. Environmental Protection Agency scrutiny through a Total Maximum Daily Load (TMDL) study.<sup>17</sup> The bay into which it flows is co-shared by Marine amphibious vehicle maneuvers, community subsistence and recreational activities. Marine amphibious vehicles enter the water at Mokapu Peninsula and swim through coral reefs to perform beach landings and maneuvers in this critical MCTAB training area.

Since MCBH's MCTAB is downstream of everyone else in the Waimanalo watershed, whatever debris has accumulated upstream ends up in the lower stream stretches of the training area. Sometimes, after a flash flood

or a heavy rain, the debris accumulated downstream causes backup flooding upstream, making the military appear to be a major cause of what is actually a more diffuse watershed-wide problem.

The Ko'olaupoko watersheds range from largely urbanized, ethnically mixed and relatively affluent to mainly rural, native Hawaiian, and low-income. Despite the pollution problems, the watershed region overall represents an almost idealized example of tropical watersheds extending from forested peaks to fringing reefs. Sufficient ecological integrity and public concern about associated socio-cultural values exist in and about this region to cause the State of Hawaii Department to rank the Ko'olaupoko region of watersheds as Priority 1 for restoration of watershed health.<sup>18</sup>

The collaborative vision of restored watershed health articulated by many local government documents and community groups in Hawaii is to recapture elements of the ancient *ahupua'a*-based management system in pre-contact Hawaiian times.<sup>19</sup> An *ahupua'a* is a wedge-shaped land/water integrated management unit extending from the mountain tops to beyond the reefs, similar to what are referred to as watersheds today. Residents in an *ahupua'a* were allowed access to the bounty of land and sea. Also, a system of *kapu* (law) determined how resources were conserved and distributed among these units. People in an *ahupua'a* were governed by: (1) a protocol to *malama* (share and take care of) the limited but diverse resources within the area; (2) an awareness that there is an interconnected relationship between land-based and marine-based natural resources; and (3) that all actions taken by people within an *ahupua'a* were governed by certain principles such as those reflected in the current federal mandates to follow an ecosystem-based management approach.<sup>20</sup>

The *ahupua'a*-based management system in the watersheds of the Ko'olaupoko District in early Polynesia resulted in an abundance of natural wetlands, taro terraces

(lo'i) and Polynesian-built fishponds. These features enhanced the human population, preserved wildlife habitat, filtered pollutants from stormwater runoff, and provided flood protection in a manner such as advocated in Best Management Principles today.

Over the years, these functions have been impaired by accelerated siltation and polluted runoff from urban development and agricultural activity. Many downstream fishponds in the contiguous ahupua'a of the district have vanished entirely due to deliberate filling. Others are



choked with alien vegetation which degrades their sponge-like ability to absorb sediment runoff. Thus, the exit channels from these wetlands to the ocean are filled with very visible plumes of non-point particulate pollution, especially after a heavy rain. Sometimes, the beaches affected are temporarily closed, while the pollution dissipates. This is very bad for a tourist-based economy. In this kind of regional setting, Marine Corps Base Hawaii functions.

Annual AAV “Mud Ops” Maneuvers For Wildlife;  
Turning Swords Into Plowshares<sup>21</sup>

The Nu'upia Ponds Wildlife Management Area straddles the neck of MCBH's Mokapu Peninsula, separating it from the rest of this watershed region. The

Ponds comprise the last remnant of thirty ancient Hawaiian fishponds that once existed around Kane'ohe Bay. The Marines have kept this resource relatively intact as an endangered waterbird habitat, protected wetland, national historic property, and valuable security buffer from non-military ground/air traffic encroachment.

It is one of the primary breeding habitats for the endangered Hawaiian stilt (Himantopus mexicanus knudseni). It is also a refuge for hundreds of other native waterbirds, migratory shorebirds, and seabirds, as well as sixteen species of native fish.

One of the biggest threats to the birds' survival is alien vegetation, which invades the shoreline, shallow water and mudflat areas and displaces the native waterbirds from feeding and on-ground nesting. In Hawaii, the most significant vegetation threats are pickleweed (Batis maritima) and mangrove (Rhizophora mangle) in this and other equivalent wetland areas.

About 20 years ago, we found that the most appropriate technology to control these invasive plants is the Amphibious Assault Vehicle or AAV. Normally used in securing a beachhead, these 26-ton tracked vehicles are able to easily maneuver in soft mud and aqueous areas to mechanically clear the weeds.

By its sheer weight, using back and forth plowing action, an AAV can also contour the landscape to create a checkerboard mosaic of "moat and island" terrain favored by the stilt for feeding and nest building. Newly-hatched stilt thus gain more ready access to their water-resident food sources within this terrain (e.g., insects, crustacea, small fish). This is a critical factor in their survival since they must largely fend for themselves from birth.

By annually using this technique for habitat restoration, just before nesting season, the weed re-growth is kept in check and the Marines exercise a novel training opportunity. This practice represents a "win-win"

balancing of seemingly incompatible wildlife and military training objectives. The Marines have become an integral part of the “working landscape” of this protected wetland, both providing and receiving a valuable “service” in a web of functional inter- dependencies. Without their help, the habitat available to the birds would rapidly diminish through aggressive weed regrowth. (The same effort by contractor equipment would be too costly).

By annually repeating this habitat restoration technique, not only do we enhance the biophysical “capital” of the area (a documented doubling of endangered birds counted over the last 17 years), but the “social capital” in the Marine community is also enhanced. The environmentally friendly use of AAVs, recognized in wide media coverage, builds upon the Marine Corps’ strong sense of pride in doing what is right and being protectors.

The Marines have coined their own name for this ritual—they call it their “Annual Mud Ops”.<sup>22</sup> The fact that the Marines have invented their own name for this regularly recurring annual event shows they have developed a cultural attachment with the place and the restoration role they serve. This is an important achievement, especially considering the transient nature of the individual Marines involved. When a ritual is born and acquires a name, it is a true sign that the event has become firmly embedded in the civic culture of the Marine community as “the right thing to do.” So, the activity is sustained, regardless of the rotation of individual Marines in and out of the area.

#### “Grass Roots” Efforts At Alien Vegetation Removal

There follows an example of cultivating the social capital of the external support community. It stems from the fact that Marines cannot use AAVs for habitat improvements in parts of the pond complex which are archaeologically sensitive or otherwise inaccessible. In these areas, we use a platoon of volunteers instead.

Starting in the early 1980s, small volunteer units such as Girl Scout troops have been invited to remove weed mangrove trees by hand. The intention was that, with limited labor and funds, the relentless march of this invasive habitat-hogging tree could be discouraged from further penetration into this wetland/fishpond complex.

As time went by, and more and more groups were brought in, a regular clientele of return volunteers was developed and began to make substantial headway in clearing major viewplanes into the pond habitat. In so doing, a collaborative vision of what is possible emerged as more people were drawn into the landscape to connect with the resource. Numerous schools and community groups, both on- and off-base, incorporated annual mangrove pulling events into their regular service schedules. They were provided opportunities to earn wildlife badges or get service project credits. Thus, the Marines serviced the social needs of the surrounding community at the same time the weeds were being removed. A regional perception of the sustained commitment and camaraderie involved in promoting ecosystem health was also fostered.

Recall the definition of “social capital.” In a community with a high degree of social capital, there is a lot of mutual trust and respect. You can bank on that when you are in a jam somewhere else. That is exactly what we have done. A feeling of trust and partnership has grown between host Marine and external volunteer communities of interest by literally “pulling weeds” together. It extends into other areas of cooperation and management as a result.

#### Erosion Control With Native Hawaiian Help

There follows one more example of social capital enhancement in addressing coastal dune erosion. The 17.6 km shoreline of MCBH Mokuapu Peninsula is bordered by legally protected sand dunes containing thousands of ancient Native Hawaiian burials and native sea strand vegetation. Marines train along controlled areas of the

beach in amphibious assault vehicles a few yards away from these sensitive areas. We have signs, restrictive access zones, and educational programs to keep people away from sensitive areas. Sometimes, however they do not work. For example, some irresponsible Outdoor Recreation Vehicle (ORV) users ignore signs and are becoming a threat to these sensitive coastal resources.

Project funding was secured for erection of barrier fences in these sensitive locations. Arrangements were made for recycled plastic material to be used in the design. Recycled plastic was considered the right thing to do by environmentally-sensitive technical project managers. Upon consultation, however, with the Native Hawaiian community (whose ancestral burial remains were to be better protected by this effort), the alternative emerged to employ Native Hawaiian stonemasons to build a more traditional Hawaiian wall instead of a recycled plastic fence.<sup>23</sup>

We followed their advice, and the desired barricades were built with a design that helped restore a traditional cultural landscape while also reviving the ancient Hawaiian art of mortarless masonry (*pa hakahaka*). This collaborative approach enhanced the social capital of the contemporary Native Hawaiian community. It provided employment that contributed to cultural recovery. At the same time, it helped control the erosion problem and allowed Marines to be perceived as better environmental stewards.

### Lessons Learned From Examples

What these examples of watershed and coastline resource recovery projects share in common is that when one deliberately works through the civic culture of a community to enhance the “social capital” of the communities involved, then appropriate pathways toward watershed health and continued mission sustainability are found.<sup>24</sup>

The real challenge for military agencies is to integrate peacetime military training mission work into the social fabric of affected communities at the level of entire landscapes or regional ecosystems (including urbanized watersheds) which harbor diverse human populations and cultures. The Marine Corps learned this lesson the hard way during their recent repulsion from an urban warfare training landing exercise at the Presidio in San Francisco.<sup>25</sup> How can we do a better job of this around the world? Now, I would like to discuss this subject.

One of the problems at MCTAB in the Waimanalo watershed is algal blooms along the Bellows beach coastline offshore near where Marines train. There are a lot of theories about what is causing this but it is widely believed that underground seepage of agricultural pollution is a contributing factor. MCBH shares the need to address the problem because of coastline management responsibilities. There are formal environmental and para-governmental organizations with funding support who believe it is too hard to get the diverse and disparate elements of the community to cooperate to reduce non-point water pollution in this watershed. These groups are floating a proposal that the military bear the burden of solving the problem by building a large wetland right in the MCTAB training area to filter out pollutants from Waimanalo stream before they enter Waimanalo Bay. If this alternative were to take effect, the Marines would shoulder disproportionate share of the non-point pollution cleanup problem in the watershed and training use of the lands affected might be significantly impaired.

By contrast, our community-based approach to working with the Waimanalo community provides us a different perspective on the problem and solution options. We have found that the people of Waimanalo have inherent stewardship values and a sense of shared environmental responsibility. We believe that a community-based solution can be found such that all can share in the responsibility to address non-point pollution in the watershed.

We have already started to implement this kind of community-based watershed restoration approach at Mokapu Peninsula and are extending the approach into Waimanalo. A 1998 Strategic Integrated Resources Management Plan<sup>26</sup> and a 1998 Manual for Watershed Health and Water Quality<sup>27</sup> documented the need to conceptualize the whole problem as not just the cleaning up of a wetland/endangered waterbird habitat at Nu'upia Ponds. We looked upstream and off-base. We interviewed old timers. We compiled oral histories of people who used to live on this Peninsula. We found out that this pond complex was once a large estuary extending north along the present-day drainage channel. We used old maps, photos, people's stories and "best science" principles to create a vision of future possibilities, to include restoration of some of the earlier, healthier characteristics of this estuary.

In order to enact this vision, we began projects to shift public attitudes toward the central channelized drainage ditch. We said, how do you get people to feel positive toward a drainage ditch? We are doing it in a number of ways. At the very "headwaters" of this ditch is a golf course. We are enhancing endangered waterbird habitat in the golf course drainage ponds. Further downstream, a barracks is being built alongside the ditch. A wetland/water quality basin is being built next to the barracks and the ditch. At a motor pool further downstream, a smaller, malfunctioning drainage ditch will be replaced with a series of wetland infiltration ponds to filter non-point stormwater runoff from nearby motor pool parking lots while also enhancing wildlife habitat. Finally, we are getting people involved to revegetate the streambanks of the whole drainage ditch system.

We started with an Earth Day "walk the watershed" event in March 1999.<sup>28</sup> We brought the on- and off-base community together for educational teach-in, water sampling, and riparian native planting activities. People came from volunteer sources we cultivated over the years as well as current Marine residents. Now that we have

eradicated much of the weeds in the Nu'upia Ponds complex, we are redirecting their energy toward re-vegetating the drainage ditch and pond complex with native vegetation. We are instructing teachers in the elementary schools of the watershed, both on and off base, how to do watershed education.<sup>29</sup> The teachers are implementing lesson plans that have their students do water quality monitoring at the tributary storm drain ditches. We have a fluvial geomorphologist mapping the watershed.<sup>30</sup> This will provide needed baseline data to help restore some of its natural configurations. We have kids demonstrating and displaying the results of their water quality work. We are cultivating partners with a sense of environmental stewardship for the whole watershed in future generations. The water quality monitoring activities are not just sticking a test tube in the water. They also involve biological investigations, visual stream assessments, reviving interest in the chants, legends, hula and stories associated with the watershed. The teachers are being trained to improve the way the students deal with the watershed upstream and off-base as well as on-stream within the base community. We are also moving with the same philosophy and collaborative, community-based approach to watershed restoration at Waimanalo stream in the MCTAB area of the Waimanalo watershed.

As indicated earlier, most of the non-point pollution in Waimanalo stream originates off-base and upstream. We are working with the community in such a way as to develop clean up options other than converting valuable training land into a wetland filter. We are working with a health center, not a science center, which has their own project to reduce the non-point pollution problem upstream of the base. Our Marines are getting educated by the community on what are the Waimanalo stream problems. We are talking to elected officials, such as the Neighborhood Board. But we are also working with the informal networks and community leaders. For example, the fishermen. The way we are doing that is we go to their gathering places. We do

not ask them to come to a public meeting. They will never come to a public meeting. We go out and talk to them where they gather and where they fish. We find that two really important groups to work with in the community are halau hula (hula schools) and halau wa'a (outrigger canoe clubs). They are the source of many local and indigenous knowledge-based leaders of the community. These people use the ocean. By finding out what their uses of the ocean are and working with their local knowledge of the drainage system, we find that community partnerships can develop to share the burden of watershed cleanup.

Through informal community leaders, the military was recently invited to participate in a community event to raise money for the local youth groups. The Marines and the other branches of the military were there with static displays of their equipment. The kids crawled up and around it. There was a real genuine interaction between the two communities, both military and civilian. Such interaction opportunities build upon the social capital of both sides to increase the sense of mutual trust and cooperation.

We just celebrated "Make a Difference Day" nationally. There was an Army Ranger in Hawaii that was interviewed in the local press about this event. To him, Make a Difference Day was important because it was not just the military going in by themselves to clean up a local stream. They took high school kids up into the mountains and taught them wilderness survival skills and how to read a map. That is the kind of interaction we are encouraging in this watershed. Water quality monitoring and watershed stewardship in the community starts with activities such as this. Working collaboratively with the community, helping them learn how to read and create maps of the stream, do visual assessments of water flow and quality, and cultivate a sense of place and responsibility to take care of that place. We are using these kinds of approaches with the community and making a difference.

What are the lessons learned that we can take away from here? How do you do this nationally? Internationally?<sup>31</sup>

1. First, do not perpetuate “top down” programs. With “watershed management” becoming a buzzword and major source of funding, many state, university, para-governmental, and consultant projects have initiated top down efforts with little community involvement. As a result, much effort is expended by community-based advocates to deflect the intrusive, fragmenting effects of externally-imposed water quality monitoring programs and the like that attempt to “do for” rather than “do through” the affected communities.

2. Give balanced attention to restorable health of the natural and the human community in whatever water quality project is being initiated.

3. Work collaboratively with informal as well as formal networks in a community.

4. Involve the natural community leaders, not just the elected leaders.

5. Help make visible to the communities their own strengths and work with them when projects are implemented.

6. Tap into the social capital of the community and its civic culture.

7. Explore whether various options for an improved environment comply with the community’s own vision of what is an improved environment.

8. Offer appropriate technology to help an affected community make choices in pursuing various water quality and watershed improvement schemes.

9. Facilitate horizontal community-to-community linkages. That means not just internal military community to external host community. It also means the Army, Navy, Air Force, and Marine Corps need to talk and work with

each other informally more at the community level and through the Commander-in-Chief, Pacific (CINCPAC) in Hawaii. This kind of interaction, at the community level, such as around joint use training areas, is just beginning to happen. We are not really cross-fertilizing enough and we need to do that.

## Conclusions

I began my presentation by saying I would contribute to the issue areas of this workshop dealing with:

- Current programs and opportunities for reducing peacetime impact of the military on environ. quality;
- Opportunities for high value added cooperation and coordination to enhance environmental assessment during regular peacetime military options.

I further stated I would do this by sharing:

- Some of the latest watershed management science applications;
- Giving examples of how to increase environmental sensitivity on military bases and gain external community support for the military mission;
- Providing working principles applicable elsewhere.

I encourage you to reflect on what I have said about the value of:

- An ecosystem approach to resource management;
- Watershed health as an environmental quality goal worth striving for, as measured by progress in both the biophysical and socio-cultural realm. Both are essential to ensuring sustainability of military training areas and public support;

- The need to follow a community-based approach to water quality and watershed health improvements, in which discovering and strengthening the community's inherent "social capital" is a vital and central component.

Military readiness is based on the ability to create an armed forces that is flexible, always ready and prepared to respond to local, national, and international crises. Training is pro-active in that the military learns how to minimize casualties up front by following time-tested procedures when entering new/hostile environments.

It is time that we apply this same "can do" commitment and energy to working with communities and stewardship programs. It is necessary to create and sustain mutually beneficial partnerships between informal networks in the civilian and military communities—in addition to and in some cases, instead of with large formal top-down organizations. Otherwise, military training areas and military help in areas such as water quality monitoring could be perceived as intrusions into tightly networked communities with a strong sense of culture and place. The ability to avoid being perceived as an intruder largely depends on a local community's ability to absorb the intrusion as measured by the extent to which they are involved in the planning process and perceive it as a locally beneficial event.

Support of citizens at the local, community level is a critical key to future health and readiness of our military forces. During war and times of military stress, communities have made sacrifices to insure the readiness of our armed forces. The post-cold war years have brought a shift in the public's attitudes toward military presence in their neighborhoods and communities. More investments must be made in the social capital of these communities, and in support of a mutual vision of sustainable options for military preparedness and local community health. Working through community-based channels to provide

appropriate technical assistance in water quality monitoring and watershed health recovery actions may offer one of the highest rates of return on our investments.

## Endnotes

1. See, for example, Brown, Justin and Richard Rubin, "Puerto Rico Chafes under Navy Authority," *The Christian Science Monitor*, Wednesday, November 10, 1999, pg. 3.

2. Regarding national awards, for example, Marine Corps Base Hawaii has most recently received top Secretary of Defense awards in the areas of Natural Resources (FY95) and Pollution Prevention (FY98). MCBH has also received the top Secretary of the Navy Natural Resources Conservation Award six years in a row (1992-1998). This has been coupled with associated recognition by the Hawaii State legislature, as well as various awards from City and County of Honolulu, non-profit conservation, civic, and commerce groups. Regarding favorable press, a recent example is the front page headline article, "Military becomes eco-friendly" in *The Honolulu Advertiser*, July 10, 1999. In this article, a representative from one of the military's severist critics, the Earthjustice Defense Fund, is quoted as calling the MCBH Marines "enlightened" for their resource conservation programs.

3. O'Conner, Katherine A. 1997. Clean Water Act Problems and Watershed Solutions, <http://www.epa.gov/owowwtrl/watershed/Proceed/oconnorl.html>

4. See, for example, Grumbine, R. E. 1997. Reflections on "What is ecosystem management?" *Conservation Biology*. 11: 41-47.

5. Council on Environmental Quality, U.S. Departments of Agriculture, Army, Commerce, Defense, Energy, Housing and Urban Development, the Interior, Justice, Labor, State, Transportation, Environmental Protection Agency, Office of Science and Technology Policy. 1995. Attachment in Memorandum of the Undersecretary of Defense, Environmental Security (ES)/EQ-CO) Letter of January 23 1996. Prepared by Office of the Under Secretary of Defense, ES. Pentagon, Washington D.C.

6. Quoted from Memorandum of Understanding, *ibid*.

7. *Ibid*.

8. Ibid.

9. Rapport, David "Defining Ecosystem Health," Chapter 2, pp. 18-33 in Rapport, D., Costanza, R., Epstein, P.R., Gaudet, C. and Levins, R. (editors) *Ecosystem Health* (Oxford, England: Blackwell Science, Inc., 1998).

10. See for example, the discussion in Section 2.2 , pp. 2-10 and 2-11 in Wilcox, B. A., Guinther, E. B., Duin, K.N., and Maybaum, H. Mokapu: *Manual for Watershed Health and Water Quality* by Institute for Sustainable Development and AECOS, INC., for Marine Corps Base Hawaii, 1998 (Found at the DoD Office of Environmental Security website [www@denix.osd.mil](http://www.denix.osd.mil))

11. Karr, James R., Kurt D. Fausch, Paul L. Angermeier, Philip R.Yany, Issac J. Schlosser. 1986. *Assessment of Biological Integrity in Running Water. A Method and Its Rationale*. Illinois Natural History Survey Special Publication 5. 28 pages.

12. Preister, Kevin and James A. Kent, "Social Ecology: A New Pathway to Watershed Restoration," Chapter 3 in Williams, Jack E., Wood, Christopher A., and Dombeck, Michael P. (editors) *Watershed Restoration: Principles and Practices* (Bethesda, Md: The American Fisheries Society, 1997).

13. James A. Kent's issue-based approach to Social Resource Management was refined into a training course during the 1980s for the U.S.DA National Forest Service for which he received a Gifford Pinchot Award. This approach has been further refined in the field in numerous consulting projects and is being taught to federal resource management professionals and others as part of a series of courses on "Community-Based Partnerships and Ecosystems for a Healthy Environment," co-developed by U.S. Bureau of Land Management, U.S.DA Forest Service, U.S. Fish and Wildlife Service, U.S.DI National Park Service, and Natural Resources Conservation Service through the Bureau of Land Management National Training Center in Phoenix, Arizona. (1999)

14. Putnam, Robert D., "Bowling Alone: America's Declining Social Capital," *Journal of Democracy*, Vol. 6. No. 1, January 1995, p. 67.

15. Cernea, Michael M. "The Sociologist's Approach to Sustainable Development, in I. Seragoldin and A. Steer (Editors), *Making Development Sustainable, From Concepts to Action* (Washington D.C.: The World Bank, 1994) Environmental Sustainable Development Occasional Paper Series No. 2, pg. 8.

16. For more information on unique island issues regarding non-point pollution, see State of Hawaii, Hawaii's Implementation Plan for Polluted Runoff Control, Draft of October 1999, a joint product of the Hawaii Department of Business, Economic Development and Hawaii Department of Health's Clean Water Branch.

17. Waimanalo Stream is among eighteen so-called "Water Quality Limited Segments" in the State of Hawaii as designated in several plans: State 303(d) List, State 305(b) Report, and Clean Water Act Section 208 Water Quality Management Plans. A Water Quality Limited Segment is defined in Section 303 of the Clean Water Act and EPA regulations as those water areas where existing water quality does not meet, and will not meet, applicable water quality standards even after effluent limitation requirements on point source discharges are applied. For thus-declared streams, the State is required to reduce pollution loads through the computation and implementation of Total Maximum Daily Loads (TMDLs). TMDLs are numeric estimates of the maximum pollutant delivery rates that can be assimilated by water bodies without exceeding State Water Quality Standards for that water body type. For further information, see *ibid*.

18. Under watershed restoration priority setting guidance outlined in the U.S. Environmental Protection Agency's Final Framework for Unified Watershed Assessment, Restoration Priorities, and Restoration Action Strategies, Hawaii submitted a list of watershed restoration priorities in October 1998, reflecting public input. The Ko'olaupoko District within which Waimanalo Stream flows, has been declared through this process as in the Priority One category of eligibility for restoration (and follow-on federal funding support). One of the criteria for selection is the presence of waterbodies on State Dept. of Health's Section 303(d) List of Water Quality Limited Segments. Waimanalo Stream is one of three such streams in the Ko'olaupoko District.

19. A key element of the vision of Koolaupoko's future in the Draft Koolaupoko Sustainable Communities Plan of the City and County of Honolulu, June 1999 is to "adapt the concept of ahupua'a in land use and natural resources management (p. 2-2). A major coalition of citizen groups in Hawaii working toward watershed restoration objectives has the name "Ahupua'a Alliance," which further signifies the importance of this vision

20. Much has been written on the ahupua'a concept and its application. Good basic references for further information on the subject are: (1) Handy, E.S. Craighill and Handy, Elizabeth G., *Native Planters in Old Hawaii, Their Life, Lore, and Environment* (Honolulu: Bernice P. Bishop Museum Press, 1972) Bernice P. Bishop Museum Bulletin 233;

and (2 ) Wise, John H. "The History of Land Ownership in Hawaii":Chapter 7 in Handy, E. S. Craighill, Kenneth Emory, Edwin Bryan, Peter Buck, John Wise, et. Al, in Ancient Hawaiian Civilization, A series of lectures delivered at Kamehameha Schools (Rutland, VT: Charles E. Tuttle Co., 1973).

21. This example has been more thoroughly written up in Drigot, D. "An Ecosystem-based Management Approach to Enhancing Endangered Waterbird Habitat on a Military Base," in Studies in Avian Biology series of the National Cooper Ornithological Society, Allen Press, forthcoming, 1999. The doubling of endangered Hawaiian Stilt waterbird numbers at the Nu'upia Ponds in relation to resource management actions has been scientifically documented and reported by consultants. See for example, Rauzon, M.J., L. McNeil, and L. T. Tanino. 1997. Final Report: Biological Investigations at Nu'upia Ponds Wildlife Management Area, Kaneohe Bay, Marine Corps Base Hawaii, a report prepared through Scientific Consultant Services/Cultural Resource Management Services (SCS/CRMS), Inc, Honolulu HI for MCBH.

22. Compton, W. , Sgt. U.S.MC. 1997. "Annual Mud Ops, Nu'upia Ponds Get Torn Up," in Hawaii Marine, February 13: A-4.

23. This story is documented by Kakesako, G. K. 1997, "Hawaiians, Marines Win with Construction of Walls," Honolulu Star-Bulletin, February 21: A-6.

24. This reference to working through the civic culture of a community to devise appropriate pathways to ecological restoration is further discussed in a presentation by Dr. Diane C. Drigot and Dr. Bruce A. Wilcox, "A Community Renewal Approach to Ecological Restoration: Reinforcing the Link between Social and Natural Capital." At the 11th Annual International Conference on the Society for Ecological Restoration (September 23-25, 1999), at The Presidio, San Francisco, CA.

25. This story is documented in Curtius, Mary. "San Francisco Gives Marines' Water Games Plan the Boot," Los Angeles Times, January 9, 1999, pg. 1.

26. Wilcox, B. A. 1998. Strategic Integrated Resources Management Planning for Marine Corps Base Hawaii, Kaneohe Bay. Prepared by Institute for Sustainable Development, San Francisco, CA and Kailua, HI for MCBH, Environ. Dept.

27. Wilcox. B. A. et. al., op. cit., footnote 10.

28. Dr. Diane Drigot, MCBH Senior Nat. Res. Mgt. Specialist and Research Affiliate, University of Hawaii Environmental Center and Dr. Rich Johnson, Graduate Chair, Teacher Education & Curriculum Studies, University of Hawaii Dept. of Curriculum & Instruction, Elementary and Early Childhood Education, are co-teaching a University of Hawaii Graduate Credit Course, EdEf 686, Environmental Education, for elementary education teachers in this watershed on how to integrate environmental education on watershed health into the curriculum using an Environmental Encounter Approach. This approach was pioneered by Dr. William B. Stapp, professor emeritus, University of Michigan School of Natural Resources and world-renown leader in Environmental Education (director of first UNESCO international conference on Environmental Education, 1974). Dr. Stapp also founded the Global Rivers Environmental Education Network (GREEN) which is working with students in over 130 countries on watershed education through water quality monitoring and related activities. For an overview of GREEN's local and global activities, visit their website at: [green@earthforce.org](mailto:green@earthforce.org) or read one of numerous publications: For example, William B. Stapp, Arjen Wais, Michele Moss, and Joanne Goodwin (editors), *International Case Studies on Watershed Education* (Dubuque, Iowa: Kendall/Hunt Publishing Co., 1996). Dr. Drigot has an invited chapter in this book based on MCBH work.

29. Yurek, Roman. "Community Effort Improves K-Bay Watershed," in *Hawaii Marine*, April 1999, pg. 1.

30. Fluvial geomorphology work being performed by Ms. Laurel Collins, from the staff of the San Francisco Estuary Institute. Visit their website, <http://www.sfei.org> for more information on the role of watershed science to support environmental planning and resource protection (Sep 1998).

31. Lessons learned more thoroughly discussed in the Drigot and Wilcox presentation, op. cit., endnote 24.

# ENVIRONMENTAL QUALITY ASSESSMENT ON THE CONTINENTAL SHELVES AND IN LARGE BODIES OF WATER: CURRENT STATE OF THE ART

Dr. Mike Huber  
Global Coastal Strategies

## Introduction

I was asked to speak on two related topics. In fact in preparing for the talks, I had a hard time figuring out how to clearly segregate these two issues because assessment is obviously clearly related to risk assessment in management, and should flow through all of it.

The first talk is the environmental assessment talk. Though I do not mean to be flippant or sarcastic, the short answer to the current state of the art is that it is not very good. There have been a number of large scale assessments. These are just some of the ones that I happen to be relatively familiar with or have seen lately. A number of large bodies of water around the world have or are undergoing assessments and some of them are very good technically in terms of the measurement strategies and design strategies, etc. The last one, the Global Program of Action for the Protection of the Marine Environment from Land Based Activities is a global program administered by UNEP. It involves a number of regional seas assessments around the world that are just getting started. Virtually all the regional seas are engaged in assessment programs, looking specifically at the effects of land based activities.

## Assessments

Now assessments in principle, I think, are fairly simple. The questions that people want answered are very simple. First, is the sea in good or bad shape, and is it getting better

or worse? If you can answer those questions, the next questions are where and in what way? What parts of the body of water are improving or degrading and with respect to what variables? The biggest question of all, of course, is

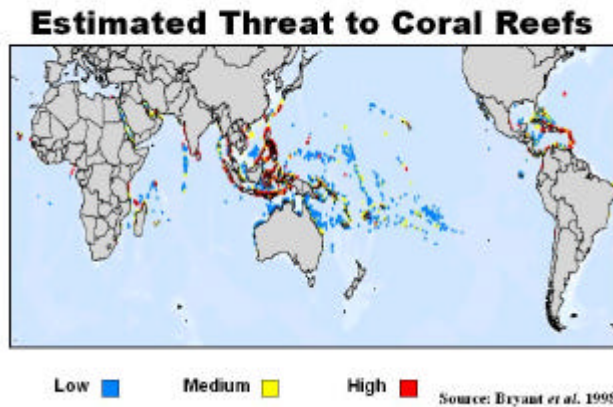


Figure 1. Estimated Threat to Coral Reefs

why? Now, these are fairly simple questions, but not necessarily simple to answer.

I said that I think the state of the art with large scale assessments is not very good. What are the limitations on large scale assessments? You can do very good assessments on a estuary or a very small bay, but when you are trying to talk about regional bodies of water, it gets difficult. The scientists will always tell you that the big problems are problems with the data. There is not enough data. The data taken by different states bordering a large body of water are not necessarily intercomparable. There are always problems with quality assurance and the temporal continuity is not good enough. We do not have measurements over a long enough period of time and there is usually not a baseline. They are only scientific limitations.

## *Concepts*

Beyond those sorts of practical limitations, there are some real major conceptual uncertainties in the scientific understanding at large geographic scales. The critical piece in all assessments is we almost never have a good handle on natural variability. So, we do not have a baseline or if you observe a change in some parameter through time, you do not know whether that reflects natural variability or human signal, etc. We also really do not understand the sorts of ecosystem linkages that work at large scales. One of the sort of trendy topics now is the LME, Large Marine Ecosystem, concept, trying to understand how these big bodies of water function. We do not know how systems at these large scales respond to pollutants. We do not know the pathways through the environment, the ultimate fates of the pollutants and very rarely do we really understand the biological responses to pollution. We can not say a given level of PCB or whatever the contaminant is in the environment is going to produce these responses in terms of population size, reproductive rates, etc. There are conceptual uncertainties as well as the strict data limitations.

## *Trends*

The critical question in every assessment relates back to the identification of trends. The question is it getting better or worse? I will use an example. NOAA recently did a state of the coast assessment based on the mussel watch program, which is available on the world wide web. It shows very encouraging looking trends in decreasing contamination on the North American coast, at least for things like DDT and chlordane. Well, this looks good if you are worried about these sorts of contamination. If you look at it on a site by site basis, it looks like there are more sites with decreasing trends than with increasing trends. But in all cases, the vast majority of sites are unable to demonstrate a trend. There really is no statistical basis to say that the situation is

getting better or worse at most sites. So there is always the difficulty with figuring out the trends in the state of the environment.

### *Indicators*

The third real problem that pops up is the lack of synoptic indicators. People want to know is the environment in good shape or is it in bad shape. Well, what does good shape mean? What is the health of the oceans? There are lots of philosophical arguments about what does “health of the oceans” mean. If you can say, in the case of chlordane, the coast of the U.S. is definitely looking up, but if you look at lead and well it looks like lead contamination

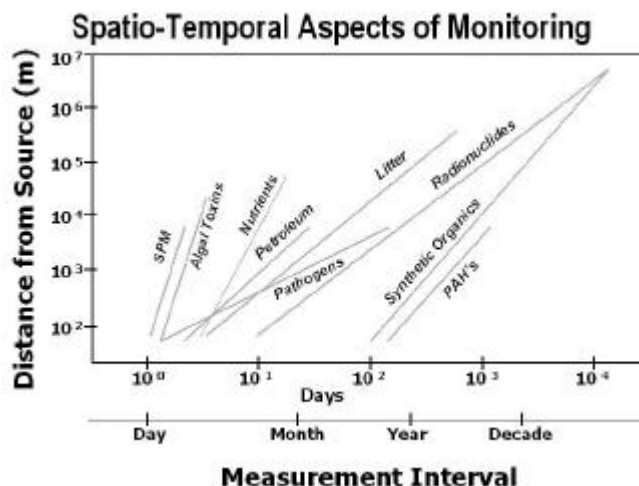


Figure 2. Spatio-Temporal Aspects of Monitoring

may be increasing, is the ocean in good shape or bad shape? How do you combine chlordane contamination and lead and come up with a single index of whether it is getting better or not. It obviously gets even more difficult if you are not talking just about contamination. But if you have got synthetic organic contamination going down, heavy metal

contamination going up, algal blooms occurring, but the striped bass fishery on the East Coast is coming back, how do you boil it down to a single indicator that tells the policy maker and the man on the street that the ocean is getting better or it is getting worse? How do you aggregate it into an indicator that measures the performance of your environmental management and your environmental managers?

There have been a number of attempts to do that both on individual bodies of water and also for specific issues. One of the efforts that I am familiar with is the desire to get a statement about the global state of coral reefs in the world. And the first major project was actually a regional one. It was a joint effort between Australia and ASEAN and they did a massive monitoring program on coral reefs using percent coral cover as a primary indicator. They wanted one indicator of the health of reefs and came up with some pretty frightening estimates of the state of coral reefs in Southeast Asia, which were then projected globally. The biological indicator, when people started to look at it, they found it varied dramatically over different parts of the same reef and the percent coral cover also varied dramatically on the same

| Relative Priority<br>by Area |  | Caribbean | FSU | North Sea | West Africa | Baltic Sea | Mediterranean | Red Sea | Persian Gulf | E. Asian Seas | Black Sea | Gyres |
|------------------------------|--|-----------|-----|-----------|-------------|------------|---------------|---------|--------------|---------------|-----------|-------|
| Synthetic Organics           |  | L         | M   | M         | M           | M          | M             | L       | L            | L             | H         | L     |
| PAH's                        |  | L         | M   | M         | M           | M          | M             | H       | H            | M             | M         | L     |
| Trace Metals                 |  | L         | L   | M         | L           | L          | L             | L       | L            | M             | L         | L     |
| Petroleum (Oil)              |  | H         | M   | M         | M           | L          | M             | H       | H            | H             | H         | L     |
| Herbicides/Pesticides        |  | H         | L   | M         | H           | H          | M             |         |              | H             | H         | L     |
| Dissolved Oxygen             |  |           |     |           | M           | H          | M             |         |              | M             | H         | L     |
| Artificial Radionuclides     |  | H         | M   |           |             | L          | L             |         |              |               | H         |       |
| Pharmaceuticals              |  |           |     | M         | L           | L          | L             |         | L            | L             | L         |       |
| Phytoplankton Pigments       |  | M         | L   | H         | L           | H          | M             | L       |              | H             | H         |       |
| Human Pathogens              |  | H         | L   | H         | H           | M          | H             | M       | H            | H             | H         |       |
| Nutrients                    |  | H         | L   | H         | H           | H          | H             | L       | H            | H             | H         | H     |
| Algal Toxins                 |  | H         |     | M         |             | M          | M             | L       | L            | H             | M         |       |
| Litter/Plastic               |  | M         | M   | L         | H           | M          | H             | M       | L            | M             | H         | L     |
| Suspended Particulates       |  | H         | L   | L         | M           | M          | L             | L       | H            | H             | M         |       |
| TOTALS                       |  | 25        | 18  | 27        | 25          | 29         | 27            | 16      | 20           | 30            | 37        | 10    |

Figure 3. Relative Priority by Area

square meter of reef through time. People began to be uncomfortable with it. So the next step to try and come up with a synoptic indicator. Figure 1 – Estimated Threat to Coral Reefs was recently published by World Resources Institute. It is a map-based estimate of threats to coral reefs worldwide, but it is actually based, only to a small extent, on actual observations of reefs. It looks at maps and sees how close the reef is to a city, to a tourist resort, to a garbage dump, to an oil refinery, etc. They had 13 indicators that they tried to boil down into a single index of threat. These sorts of efforts are pretty good. The one message that comes

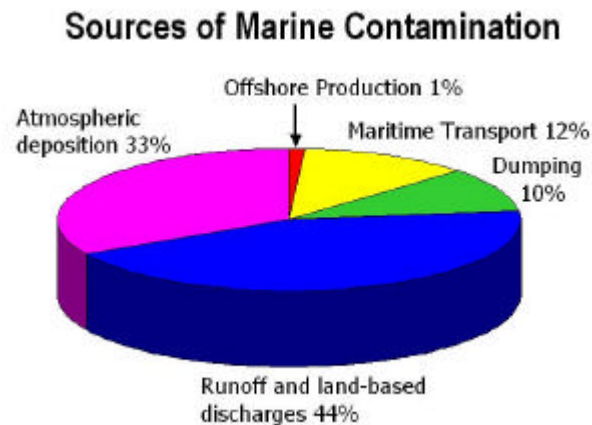


Figure 4. Sources of Marine Contamination

out that is almost indisputable is that the big threats to coral reefs worldwide are in Southeast Asia and the Caribbean. They really did not need to go through this assessment procedure to know that and then when you try and use this assessment on smaller scales, it breaks down, too, because of the lack of ground truthing.

It is very difficult to come up with indicators that say, yes, the ocean is in good shape or it is in bad shape, our management's working or it is not. In at least all of the large scale assessments that I have been involved in, the result of

that is that they turn out to be very subjective. People sitting around in a room saying, “what do you think the situation is in this part of the world?” To reassure that the rest of what I am going to say is not just my own sort of off the cuff opinion, what I am going to do basically in the rest of this talk and the second talk is reflect a few efforts that I have been involved with through IOC in sponsoring my participation.

The first one is GESAMP, which is a multi-agency UN group. The core of GESAMP’s brief is assessment of the marine environment, and they have produced several state of the marine environments reports. We have just come out with a short report and the work that we have really been focusing on the last two years or so is the Global Program of Action on Land Based Activities. We have been trying to do an assessment of the threats to large bodies of water, specifically from land based activities, and based on regional assessments of their own water bodies. The third group is the Global Ocean Observing System (GOOS), I have been involved with one of the five modules of that observing system, the Health of the Oceans Panel, looking at its strategic design for a global monitoring system.

#### *Dimension of Scale: Spatial and Temporal*

Now the critical thing with all assessments are the dimensions of scale, both spatial dimensions and temporal dimensions. If you are looking at monitoring or even one-off assessment, you really have to look at optimizing your measurement frequencies relative to scale. Now, this is just for a few selected categories of contaminants. Basically, it looks at the persistence of contaminants through time, some obviously do not persist as long as others, and how far they are transported. Those are the things that determine how frequently you have to measure or assess, and how far apart you have to do assessments. There is no point in doing a global assessment, say of synthetic organics on a yearly basis because they just hang around too long, and you will

not see significant change occurring that quickly. If you want to do assessments of algal blooms, and there is an IOC program underway doing that, you have to look on a much shorter time frame, because algal blooms do not hang around very long. You also have to look with much more spatial resolution because they tend not to be transported very far. See Figure 2 – Spatio-Temporal Aspects of Monitoring.

This means that if you are doing global assessments, and applies even for large scale water body assessments, that there are two ways that an environmental problem can be a global issue. One of them is that you are talking about something that affects the whole planet. The one everybody knows about is climate change. Some of the pollutants that are transported globally, such as mercury, hexachlorahexane, that are transported through global distillation, they are a global problem because they are globally distributed. Even if there was only one source, they would ultimately become globally distributed. The second category are of concern at large scale assessments are at this other end. Algal blooms and particulate matter might not be more than local problems around the source in terms of their effect, but the sources are so numerous that the problem is ubiquitous. So sewage pollution and habitat destruction, only occur perhaps locally, but if they occur locally everywhere, they become a global or a large scale problem.

### Problem Areas

Returning back to the four questions, they are clearly interrelated. The way people usually determine whether the environment is in good or bad shape is not by any absolute measure, but by whether it is getting better or not. People say, “ah, you know, my base is no good anymore.” It is because it is different from what it was and usually they are relating it to some fairly recent timeframe. The “where”

question, though, when you are talking about large scale bodies of water is actually pretty easy to answer.

**Land-Based Activities: Scale and Impact Matrix**

| Source of Degradation | Scale of Impact | Ubiquity of source | Food Security | Health & Safety | Impact On: Living Resources | Ecosystem Health | Overall Impact |
|-----------------------|-----------------|--------------------|---------------|-----------------|-----------------------------|------------------|----------------|
| Sewage                | Local           | H                  | M             | H               | M                           | H                | High           |
| Physical Alteration   | Regional        | H                  | M             | M               | H                           | H                | High           |
| Nutrients             | Regional        | H                  | M             | M               | M                           | H                | Medium         |
| Sediment Fluxes       | Regional        | H                  | L             | L               | H                           | M                | Medium         |
| POPs                  | Global          | M                  | L             | L               | L                           | M                | Low            |
| Oil                   | Local           | M                  | M             | L               | L                           | L                | Low            |
| Heavy Metals (Hg, Pb) | Local Global    | M                  | L             | L               | L                           | -                | Low            |
| Litter                | Regional        | H                  | -             | L               | L                           | L                | Low            |
| Radionuclides         | Regional        | L                  | L             | -               | -                           | -                | -              |

Figure 5. Land Based Activities: Scale and Impact Matrix

### *Coastal Areas More Threatened Than Open Ocean*

Figure 3 – Relative Priority by Area is the result of a delphi exercise that a group of us on the Health of the Oceans Panel did. It was not an attempt to be comprehensive in terms of all the causes of marine environmental decline, it was specifically with regard to pollution. We have not listed all the pollutants, although we probably listed most of them and we certainly have not listed all the regional seas, We took seas where people had some expertise and tried to rank the importance of different contaminants in that water body. The clear message is that problems in continental shelf, seas and enclosed bodies of water are much worse at present than in the open ocean. The problems in the ocean are close to shore. They are not out in the central gyres, by and large, and there are obvious reasons for this.

Gary Vest mentioned one of them, marine pollution mostly comes from the land. Figure 4 – Sources of Marine Contamination comes out of GESAMP's 1990

State of the Marine Environment Report, a little less than half comes directly from land. Of almost all of atmospheric deposition, the ultimate sources are on land. In fact, in the last ten years, this dominance of land based sources is almost certainly increased because the maritime industry in particular, probably more than any other large industrial sector has cleaned up its act in terms of operational waste discharges. So pollution comes from land.

### Categories of Threat

Pollution is by no means the only threat to the oceans. All the other human activities that effect the oceans, fisheries, habitat use, mining, shipping, all of those things are concentrated near where people are or in shallow water where you can get to the resources. So most of the threats are concentrated in shallow seas. I have alluded to the threats to the marine environment. The first one, obviously,

| Land-Based Activities: Regional Priorities |                     |                     |                     |                     |                     |
|--------------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| East Africa                                | Sewage              | Physical alteration | Nutrients           | POPs                | Sediments           |
| West Africa                                | Sewage              | POPs                | Heavy metals        | Oil                 | Litter              |
| East Asia                                  | Sewage              | Nutrients           | Sediments           | Physical Alteration | POPs                |
| Persian Gulf                               | Oil                 | Physical alteration | Sediments           | Sewage              | Nutrients           |
| Red Sea                                    | Physical alteration | Sewage              | Nutrients           | Sediments           |                     |
| SW Atlantic                                | Sewage              | POPs                | Heavy metals        | Nutrients           | Sediments           |
| SE Pacific                                 | Sewage              | Nutrients           | Heavy metals        | POPs                | Physical Alteration |
| Arctic                                     | Heavy metals        | POPs                | Physical Alteration | Radionuclides       |                     |
| Black Sea                                  | Nutrients           | Sewage              | Radionuclides       | Oil                 | Sediments           |

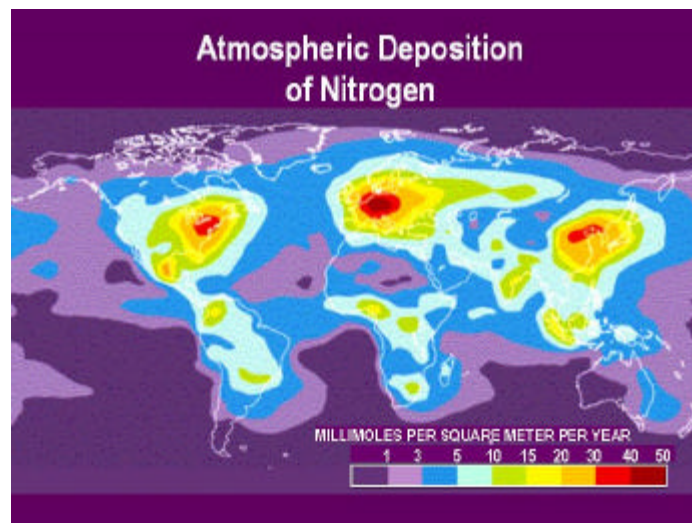
Figure 6. Land Based Activities: Regional Priorities

that everyone thinks about is pollution and for a long time that was almost the only one that people thought about. We know that in the last ten years or so it has become clear that over exploitation of resources, overfishing, is another obviously global and critical threat to the oceans, as is

physically altering the habitats. For example, bulldozers coming and removing mangroves or filling in wetlands. You do not have to pollute a habitat to destroy it. Another one that is becoming increasingly worrisome is the introduction of exotic species. Things that do not belong in a place and get out of hand when they are introduced.

### *Changing Perceptions of Marine Decline*

Now, there is been a change in perspective over the last 30 years with regard to the relative severity of these threats.



There is a decreasing relative emphasis on what I call the classical pollutants, oil and toxic chemicals. For a long time, concern about the ocean was focused on oil pollution, synthetic organics, and heavy metals. There was a historical reason. Concern about the oceans began only in about the 1950s and 1960s and there were three incidents which you probably all know about that really catalyzed public opinion and political attention to the problems. The outbreak of Minimata disease, because of mercury contamination and methelation in Japan, the Torry Canyon oil spill, Rachael Carson's book, ***Silent Spring***, and the crash in pelican and other bird populations because of DDT.

These really inspired a sea change in thinking about the ocean. Until then, I think there was a perception that ocean was infinite and had infinite capacity to absorb things. Possibly related to this focus on these pollution events, I think, for a long time, there was an inflated view of the ocean's capacity to feed the world. I can remember even in university being told that the ocean is going to feed the world. We now know that that is not going to happen. There was also a neglect of some of the critical sort of habitat issues and ecosystem issues with the focus on contamination. Well, over time, the perspective changed. In the case of heavy metals and particularly mercury, many of the places where there was panic about mercury contamination such as the Mediterranean, it was subsequently discovered that there was a naturally high base line. The watershed had high levels of mercury in it,

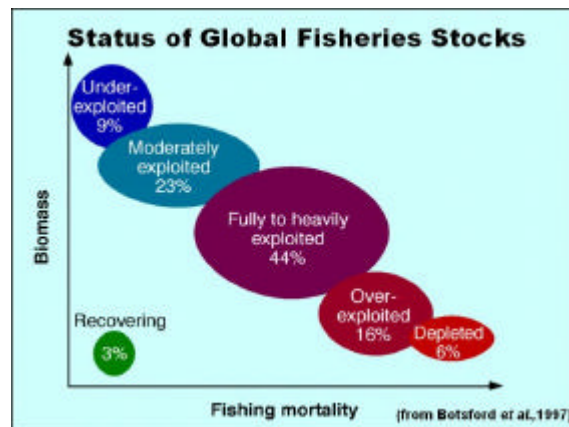


Figure 7. Status of Global Fisheries Stock

etc. For many of the metals, we also discovered that the effects are very localized. Except for mercury and lead, most of the heavy metals are particle reactive and they stay in the sediments pretty close to the source. One of the good things that has happened is there has been a genuine improvement in the reduction of operational discharges of oil from shipping.

### *Land Based Pollution*

We are increasingly aware that land based activities are the major source of oil to the marine environment, not oil spills. The effects of oil spills are also generally localized and



Figure 8. Fishing Down Food Webs: Estimated Mean Trophic Level of Global Fisheries: 1950-1994

ecosystems are resistant, so go back 10 years later and, although there are some very subtle effects, but basically most ecosystems can come back from oil spills quite readily. In the case of synthetic organics, when DDT was banned and a few other things, we saw quite rapid recovery which shows that action can be effective and the ecosystems can rebound. We have also learned more about the fact that some of these synthetic organics are distributed globally, and that is quite worrisome. If you live up in the Arctic, for example, you are very likely to be potentially affected by synthetic organics. We are becoming increasingly uncertain about the effects of these things in the environment. Figure 5- Land Based Activities: Scale and Impact Matrix is from the land based assessment that I am involved with through GESAMP. These categories on the first column, they come right out of the global program of action. They are the categories defined by the protocol. We looked at the scale both in terms of how big and area is

effected by that particular contaminant and how ubiquitous it is. We are defining things as a global problem either if they are so common that they effect every place or that they are transported large distances. We did a Delphi exercise and we tried to rank the severity of the impact, in terms of present day contamination, etc., on various human uses or interests in the environment.

### *Land Based Sewage*

Basically, we came up with sewage and physical alteration as the two biggest problems facing the global marine environment. Nutrients and sediments flux are ranked as medium just because we had high, medium and low. But really our feeling is that sewage and physical alteration should be very high, nutrients and sediment fluxes should be high and everything else is relatively low. We are fully expecting we are going to take a lot of flack, because the environmental community and public concern has so long been focused on things like radionuclides, which we think is not even an issue on a global scale, and heavy metals, etc. The real shift, is in the case of nutrients and sediments have not classically been thought of as pollutants instead of toxic materials that are poisoning the ocean. We are talking about large, bulk movements of material that actually alters ecosystem function.

While we were preparing our report as a sort of global group of scientists, all the regional seas were doing assessments of their own problems. FThese are for the regions where the assessments have been available and every regional sea does theirs a little differently, so I categorized their priorities in a standard format. In terms of sewage being the number one problem, we can see in Figure 6 – Land Based Activities: Regional Priorities that in most regions, they agree that sewage is the number one problem in their region. In most of the areas where sewage is not rated as the highest priority, for example the Persian Gulf and the Arctic, it is easy to understand why

sewage is not considered a big problem. In the case of the Persian Gulf, they have got a bigger problem which is oil. In the case of the Arctic, the population is so low that all their problems are things that the rest of the world is sort of inflicting upon them through long range transport. So there is some basis for our rating in terms of the importance of sewage, nutrients, physical alteration and sediments as being the big global scale problems.

### *Nutrient Pollution*

Now, sewage, of course, is also a major source of nutrients particularly in local areas near seas. On larger scales, the biggest source of anti-biogenic nutrient input is fertilizer use – runoff from agriculture. This is a trend of nitrogen, nitrogen is basically the big problem with nutrients. Going from 1961 to 1995, fertilizer use has rapidly increased in recent decades. It hit a bit of a peak in the 1980s, and in some developed countries, it is sort of leveling off. The expectations are that there is going to be rapidly increasing use of nitrogen fertilizers globally over the next 10-20 years. Now, another major source of nitrogen input to the oceans that is often not recognized is atmospheric input. This is a map of atmospheric deposition of nitrogen through the oceans.

Atmospheric inputs are now the largest source of nitrogen input to the open ocean, to the central gyres. In some areas, it is also a dominant input in not just the open oceans but also the coasts. But the atmospheric deposition of nitrogen is more than just significant, it is a major component of the total input and most of that comes from the burning of fossil fuels. Now, the other thing about atmospheric deposition is that it is increasing. Large sections of the world are going to get 50% increases in the input of nitrogen from the atmosphere, and in some parts of the world, it is going to go up by a factor of four. So this is a problem that is going to become of more and more concern.

### *Exploitation of Living Resources*

The next big threat is the over exploitation of living resources. Figure 7 was produced from an FAO report, and they classified fisheries into four different phases ranging from a virgin stock through developing fishery. Mature basically means fully fished and senescent means overfished and in decline. You can see in Figure 7 – Status of Global Fisheries Stock that now we have no undeveloped fisheries, and more than half of the world's fisheries are either maximally fished or in decline. There is another way of expressing that, this is a plot of mortality versus biomass and the percentages are percent of the world's fisheries stocks. Almost 70% are either fully exploited or basically over exploited to commercially extinct.

The other thing that is happening in fisheries is, instead of catching, say, tuna, we are now fishing for bait. We have caught most of the tuna. Figure 8 – Fishing Down Food Webs: Estimated Mean Trophic Level of Global Fisheries: 1950-1994 is a fairly controversial graph from a paper that was published in *Science*, a year, year and a half ago, on fishing down food webs. As we overfish stocks, we are progressively fishing at lower and lower levels of the food web, so before people were going for the top predators and now they are going for the bait. We are actually having ecosystem level effects.

### *Physical Alteration of Habitats*

Physical alterations of habitats is clearly a major threat. I am not sure how relevant it is to large bodies of water because most of the habitats are coastal habitats, but just some examples of the kind of alteration. As of the mid 1980s, it was estimated that United States had basically filled or drained about almost half of its wetlands. There are probably over 50% by now. Globally, it is estimated that about half of the mangrove forests are gone, and most of that

is through direct clearing for aquaculture or for landfill and other developments. In the case of coral reefs, it is estimated that 27-40% of them are critically threatened, and by that, it means they are in bad shape or else they are beyond hope, with another 30% are under significant threat. It is not just physical alteration that is threatening coral reefs, but mining, improper fishing methods and those sorts of things are a major component of the threats to coral reefs. A recent review of the effects of dredging estimated that dredged benthic fauna can take up to a decade to recover, though sometimes it can be much quicker. Another source of physical alteration or disturbance to habitat, which is receiving increasingly more attention, is trawl damage from fisheries. There are large sections of the sea floor that are regularly torn up by bottom falls. Some places are trawled up to eight times a year, each square meter of bottom, the trawl going over. So, in certain areas, it can be a massive source of disturbance to the benthos.

### *Alien Species*

The last critical threat that we see is the introduction of alien species. The first one is one that Gary Vest and Umit Unluata will know about, this is a ctenophore or comb jelly that was introduced into the Black Sea. Eventually, I think it was over 90% of the entire biomass of the Black Sea. The biomass was 10 times the production from fisheries and it just had obvious, tremendous effects on the ecosystem. Another fairly well known example, at least in my part of the world, is the dinoflagellate introduced from Japan in ballast water. It has become established in New Zealand and in the southern part of Australia, and now is a regular cause of toxic algal blooms with fairly significant effects, for example on shell fisheries. For the U.S. West Coast, it is the shore crab. It happens to have a taste for juvenile dungeness crab and oysters, I think, and it is having an impact on some fisheries on the west coast. It was introduced into San Francisco Bay and has spread rapidly. I think it is all the way up into Vancouver by now. These tales

of woe from introduced species go on and on. The introductions in ballast water are a major worry, and IMO has a program going on trying to control that.

## Conclusions

The conclusions are first, that most of the large scale assessments that have been done, and I would say all of them but I do not know that I know all of them, are limited, and particularly with regard to identifying clear trends in the state of the environment. We can say in terms of what the state of the environment is, there have been localized improvements. There have been reductions in some indicators, for example, synthetic organic contamination in harbors, etc. But on the whole, the feeling of GESAMP is

| Evaluation Factors                                                                                                                                                                                    | Incineration<br>Landfilling | with Ash<br>4 units | Land<br>Application* | In-Vessel<br>Composting | Drying &<br>Product Use | Landfilling  | Ocean<br>Disposal |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------|----------------------|-------------------------|-------------------------|--------------|-------------------|
|                                                                                                                                                                                                       | 6 units                     |                     |                      |                         |                         |              |                   |
| Economic Analysis<br>(Total Equivalent Annual Costs)                                                                                                                                                  | \$21,259,000                | \$19,053,000        | \$20,218,000         | \$28,735,000            | \$15,176,000            | \$24,704,000 | \$8,164,000       |
| Operability (includes reliability, flexibility, and maintainability)                                                                                                                                  | Moderate                    |                     | Moderate             | Moderate                | Low                     | Low          | Low               |
| Implementability (includes public acceptability and management requirements)                                                                                                                          | High                        |                     | High                 | Moderate                | Moderate                | Low          | Low               |
| Potential Adverse Environmental Impacts                                                                                                                                                               |                             |                     |                      |                         |                         |              |                   |
| Air Impacts                                                                                                                                                                                           |                             |                     |                      |                         |                         |              |                   |
| o Stack Emissions                                                                                                                                                                                     | x                           | x                   | x                    | x                       | x                       | x            |                   |
| o Odor Emissions                                                                                                                                                                                      |                             |                     |                      |                         |                         |              |                   |
| Water Impacts                                                                                                                                                                                         |                             |                     |                      |                         |                         |              |                   |
| o Surface Water                                                                                                                                                                                       | x <sup>1</sup>              | x <sup>1</sup>      | x <sup>2</sup>       |                         |                         | x            | x                 |
| o Groundwater                                                                                                                                                                                         | x <sup>1</sup>              | x <sup>1</sup>      | x <sup>2</sup>       |                         |                         | x            |                   |
| Land Impacts                                                                                                                                                                                          |                             |                     |                      |                         |                         |              |                   |
| o Transportation <sup>4</sup>                                                                                                                                                                         | x                           | x                   | x                    | x                       | x                       | x            | x                 |
| o Land Use Conflicts                                                                                                                                                                                  |                             |                     | x                    |                         |                         |              |                   |
| o Nutrients Overloading                                                                                                                                                                               |                             |                     | x <sup>3</sup>       | x                       | x                       | x            |                   |
| o Landfilling Capacity                                                                                                                                                                                | x                           | x                   |                      |                         |                         |              |                   |
| o Aesthetics                                                                                                                                                                                          | x                           | x                   |                      |                         |                         |              |                   |
| Other Environmental Considerations                                                                                                                                                                    |                             |                     |                      |                         |                         |              |                   |
| <sup>1</sup> Potential impact at landfill; leachate generation from ash is minor; <sup>2</sup> Impacts are possible but extremely low because of guidelines and regulatory controls.                  |                             |                     |                      |                         |                         |              |                   |
| <sup>3</sup> Potential for nutrient overloadings are remote if state guidelines are followed; <sup>4</sup> Every alternative will require some type of hauling including ash from the incinerators; * |                             |                     |                      |                         |                         |              |                   |
| Preferred option                                                                                                                                                                                      |                             |                     |                      |                         |                         |              |                   |

Figure 1. Evaluation Factors

that the marine environment is deteriorating. We can not put that into a comprehensive index or quantify it, but that

is the sense of this group of experts. The major problems on global scales that we see in our assessments are:

- sewage, nutrient, and sediment pollution;
- physical alteration to habitats – just directly going in and ripping things up;
- overfishing;
- and introduced species.

# RISK ASSESSMENT AND MANAGEMENT ISSUES IN THE CONTINENTAL SHELVES AND LARGE BODIES OF WATER

Dr. Mike Huber  
Global Coastal Strategies

## Introduction

My address will examine risk assessment and management issues. I have divided the topic into four general areas. The first area is a little bit on risk

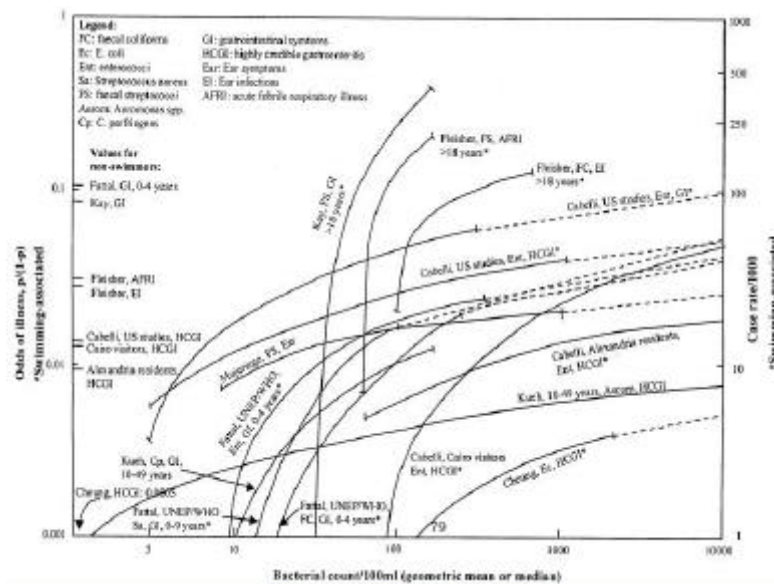


Figure 2. Bathing Water Contaminants

assessment, which I will not go into in much detail, and then I will identify some of the issues that are on the horizon that are coming up that people are starting to get concerned about. I will discuss monitoring, which always comes up when you talk about management. What is the role of

monitoring and describe the Global Ocean Observing System (GOOS), or at least the parts with which I have been involved.

## Risk Assessment

In talking about risk assessment, people often think of chemical and radiological risk assessment. Basically they are looking at a chemical, identifying the level of hazard, and multiplying it by the probability of exposure. Hazard times exposure is risk in very simple terms. Technically, the procedures are well developed for chemical risk assessment, but there are other frameworks that are used that are not technically considered to be risk assessment, however they are methods for assessing environmental risk that are used in management.

One very common method is environmental impact assessment, which attempts to predict the likely environmental consequences resulting from development. It is very useful for large scale developments but not so

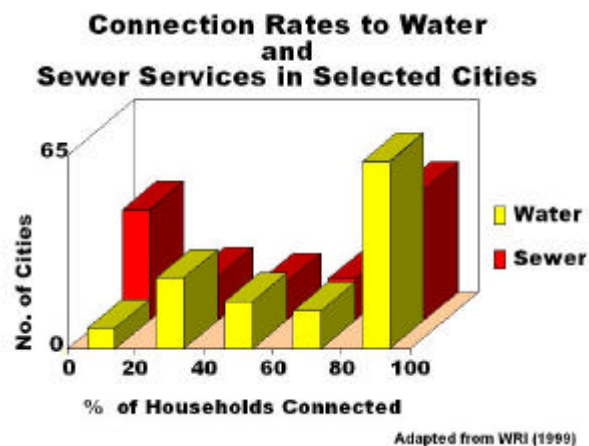


Figure 3. Connection Rates to Water and Sewer Services in Selected Cities

useful for creeping degradation problems, such as cumulative impacts of small changes in watersheds.

Another method that is not often formally considered to be risk assessment, but is critical to numerous management programs, uses public health issues based on evaluating risk from epidemiological evidence. Economic evaluation is an area that is not usually considered in risk assessment but it is becoming more prevalent. Economic evaluation includes both evaluating the inherent economic value of a given habitat or body of water, but more importantly, trying to predict the economic consequences of environmental change.

An attempt to combine different risk assessment paradigms is multi-criteria analysis. See Figure 1 – Evaluation Factors. This was produced by the EPA on disposal of waste from ships. These columns are basically the options for disposing of the waste. The rows are different criteria by which the risk or the best management option can be selected. The top one is looking at what each option costs. The second row is the operability, how reliable it is, how maintainable it is and so forth. The next row is how easy it is to implement. And then you have the environmental impacts. A matrix like this is supposed to give a manager a way to arrive at the optimal solution to a given management problem.

Now the basic risk management cycle starts at the top by identifying a hazard which is the inherent danger posed by a given development. You look at that inherent danger and also the probability that that danger will actually be realized such as the probability that the chemical will be absorbed by an organism. That is your risk assessment. Then you develop a policy to control that risk to manageable levels or to acceptable levels. Following the implementation of the policy, it is evaluated and the cycle begins again.

The critical thing that is often not explicitly recognized is that whatever the real risks are in terms of public policy, it is how the public or the policy maker or the manager perceives the risk that is as important as the actual risk itself. The reality of the level of risk is irrelevant in terms of

public policy unless you can educate the public about the real risks. The public and political perceptions of risk are critical to the overall risk management cycle in terms of being able to implement policies.

There are much more important issues or questions from the policy maker's point of view. The first one is "so what?" The environment is changing, we have contaminants increasing, we have fisheries in decline and limited resources. Why should I focus on it? Why should the public spend money on the issue? If we are convinced these issues are a priority, then what is the proper course of action? Those are the real questions I think from a policy and management point of view that are important.

### Priority Areas

I will identify the four primary issues and focus on the "so what" question. Specific courses of action are too detailed and technical for me to cover here in any depth, but I will address them generally.

### Sewage

The first big issue is sewage. When we were doing our assessment, there is a section stating that tens of millions of

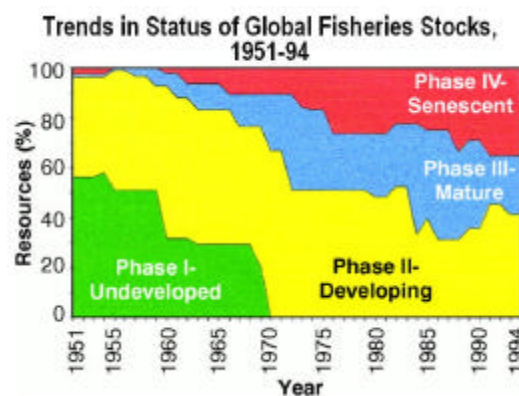


Figure 4. Trends in Status of Global Fisheries Stocks, 1951-1994

people get sick every year from bathing in sewage contaminated waters. The basis for that statement was challenged, so we sought more information.

Our first question was why do not we know about this if this is so prevalent. It turns out the reporting rate for these sorts of diseases is very low, perhaps as low as one in a hundred. People get sick, they miss a couple days work and they do not report it. But preliminary estimates indicate that a lot of people are getting sick. DALYs are Disease Adjusted Life Years, an indicator that WHO uses, combines not just getting sick but the seriousness of the illness. If you go bathing in sea water, get sick and miss a day's work, that is not nearly as bad as if you get hepatitis and die. So, one case of hepatitis is worth a lot more DALYs than one case of gastrointestinal infection. Just for comparison, these are some other diseases that are global problems. Hepatitis from eating lightly steamed shellfish is not up there with the two biggest diseases, malaria and tuberculosis, but it is clearly of global significance in terms of human health. Another point I will make is this is not necessarily talking about bathing in what is considered to be polluted waters.

These figures were based largely on waters that meet existing water quality standards. Going back to the bathing, Figure 2 – Bathing Water Contaminants is from a draft World Health Organization report. It is looking at several studies of basically dose response. This is the odds of getting sick if you go bathing in sea water with the given contamination level. This is a log scale and is expressed in case rate. This is the bacteria count for 100 ml which is the standard way of assessing microbiological contamination, so it is a 100 fecal coliforms per 100 ml. Most standards worldwide are in the 200 to 400 range. You can see that the threshold level is lower in the chart. These are all different studies using different groups of subjects bathing for different lengths of time, so there is a lot of scatter, and looking at different diseases in fact. The threshold level for illness in most of these studies is down around 10 to 30 coliforms per 100 mls. So water that is “clean” and is

supposedly fine for bathing, still has a good chance of communicating disease. It took all the fun out of going to the beach for me.

### *Sewage Treatment*

Now the standard solution in the developed world comes up with is sewage treatment. Aid organizations are always pushing conventional sewage infrastructure. It is a problem. This is from the latest report from the World Resources Institute and I just took all the cities for which they had data in that report. See Figure 3 – Connection Rates to Water and Sewer Services in Selected Cities.

This is the percentage of households connected to the central water system to pipe water and to piped sewerage. There are a large numbers of cities where most of the people in a city are not hooked up to a sewage system, so sewage treatment is a completely unfeasible option. You may talk about the first thing you do is you put in sewage infrastructure. The investment that is required in places like Bangkok or Manila to put in reticulated sewage is massive and what typically happens is if you can come up with that investment, you build your sewage system and there is no money left to build a treatment plant. The result is a concentrated point source of untreated sewage. Most of these cities are cities in the developing world and they are experiencing such rapid growth that basically is impossible for them to keep up with the new settlements. So sewage treatment is not necessarily an option in much of the world.

The other thing I run into are requirements that are imposed for high levels of sewage treatment. Nobody wants primary treatment anymore, which they believe is not good enough. They believe that they must have secondary and sometimes tertiary treatment. In many cases, there is not a recognition of primary, secondary and tertiary, but officials in local environment agencies sometimes tend to view it as good, better, and best. The only reason to invest in tertiary treatment, probably most people in this room know, is if you

have a nutrient problem. If they do not have a nutrient problem, but they do have a suspended solids and a pathogen problem, this does not go over well. You are not getting any marginal benefit or very minimal marginal benefit in the reduction of most of your pollutants by

| <b>Mediterranean Action Plan<br/>Estimated 10-yr Investment Requirements</b> |                          |
|------------------------------------------------------------------------------|--------------------------|
| <b>Action</b>                                                                | <b>\$US<br/>Billions</b> |
| Hot Spots                                                                    | 6.45                     |
| Sensitive Areas                                                              | 0.20                     |
| Protocol Area Cities                                                         | 2.80                     |
| Capacity Building                                                            | 0.01                     |
| National Programmes                                                          | 0.01                     |
| Clean Production                                                             | 0.46                     |
| Monitoring & Enforcement                                                     | 0.04                     |
| Information and Public Participation                                         | 0.003                    |
| <b>TOTAL</b>                                                                 | <b>9.97</b>              |

Figure 5. Mediterranean Action Plan

spending a lot of money in higher levels of treatment. If you try and make this argument in a lot of developing countries, you are told you are trying to give them “second rate” technology and they want to go first class.

#### *Physical Alteration*

In terms of physical alteration, one reason that it should be a priority is just pure economics. In Costanza’s paper that has appeared in a couple of journals looking at the value of the Earth’s ecosystems, and you can see these ecosystems do have inherent economic value. When remove them, you are losing that value. In some cases, the value of what you are removing them for may justify the loss, but that value is almost never considered. From a management point of view, this inherent value tends not to be very important. What is important to the policy maker or the

manager is how much of that value will be lost by a given development activity. I think in our assessments we really buy into the idea of pushing contingent valuation of development as a way of trying to provide an indication of whether or not a given development is justified.

### *Overfishing*

What makes overfishing a priority? Overfishing results in the loss of catch value of at least tens of billion dollars a year. By definition, an overfished stock is one that is producing less production than it would if it was optimally managed. So there is a clear loss there.

See Figure 4 - Trends in Status of Global Fisheries Stocks, 1951-1994. FAO came up with an estimate that the global fishing industry is losing on the order of \$50 billion a year. This is a very rough estimate. They found out that the revenue was \$54 billion less than the expenditure, so the global fishing industry is not making a lot of money. Part of the reason it is still surviving is because governments are spending an estimated up to \$20 billion a year subsidizing the fisheries industry, according to a World Bank estimate. Trade agreements and so forth have really affected a lot of the subsidies so this may now be a overestimate, but the report was published in 1998.

There are high economic costs for depleting fisheries resources and not managing them. There are also undoubtedly major ecosystem impacts, but they are not very well understood except in a few cases. In terms of coral reefs, overfishing of key species on reefs is considered to be one of the two or three greatest threats to the health of coral reefs worldwide. In the Caribbean, for example, it is considered the major threat and the major reason for the decline of a lot of reefs.

### *Nutrient Pollution*

Why is nutrient pollution a priority? There is an increase in harmful algal blooms. Harmful because they are defined in terms of causing paralytic shellfish poisoning, and toxic algal blooms. The same pattern is occurring around the world. There is good evidence, although it is somewhat uncontroversial, that the frequency of algal blooms worldwide is increasing. Certainly not the only cause is eutrophication, but there is good evidence that in at least some places, nutrient addition is what is causing the problem. The Seto Inland Sea in Japan has had reasonable data over the long term on the frequency of harmful algal blooms. They started out pretty low, but in the early 1970s, the watershed started to develop and a lot of organic effluent started getting pumped into the sea and there was sharp rise in the frequency of algal blooms. About 1973 they started to take steps to reduce the influx of this pollution and given a few years lag time, the frequency fell. There is good evidence in some other places, too. Our colleague from Hawaii will have heard about Kaneohe Bay and the problems of eutrophication there. So we do know that there are clear problems. One that probably everyone has heard of is these anoxic zones, or dead zones. The one in the Gulf of Mexico has gotten a lot of publicity lately and that is clearly related to excess nutrient inputs as a result of agriculture. It is looking like the solution to that is going to be construction of artificial wetlands among other things to absorb those nutrients before they get into the system. This problem is not restricted to the Gulf of Mexico. Anoxic zones or dead zones around the world are known in some cases to have been caused by anthropogenic nutrient inputs, or BOD inputs. It is a global problem but very coastal as you would expect.

What is the proper course of action to address these management issues? In general terms, the first thing you do is you look at the source of the problems. What are the

human activities that are causing or contributing to these problems?

### *Urban and Agricultural Run-Off*

Industrial waste is very often the first thing that people think of when they think about problems in the marine environment. But in fact, things that in many countries are still thought of as benign, agriculture and forestry, are a major impact. The agricultural developments in many countries are explicitly exempted from EIA requirements because agriculture is considered a beneficial activity. Urban and tourism development are again, often thought of as a point source, but much of the problem is actually non-point source pollution from urban areas. But in developing countries where people are not hooked up to a sewage system and where they have pit latrines or cesspools or whatever it may be a greater threat to human health. Urban run-off is nasty stuff and it is a big problem and is more difficult to deal with than point source discharges.

Urban run-off tends to come in pulses after a big rain, especially if it has not rained for a while. In terms of total load, is it important? At least for some things, it can be. You are probably talking about a least a quarter and potentially much more of the total world input of petroleum into the marine environment is from urban run-off. It is particularly nasty because it mostly comes from used lubricating oils, crank case oil and so forth. Also, it is not just oil. The oil has heavy metals in it and PAH's and all sorts of other things because it has been used in vehicles.

### Resources

One of the key management issues obviously, is always resources. How expensive is it going to be? If you want to try and deal with large scale problems, you have to deal with a lot of different sources and a lot of different countries. This is from the Mediterranean Action Plan. And this is their estimate over ten years of the source of public investment

that is going to be required to address environmental problems in the Mediterranean. See Figure 5 – Mediterranean Action Plan. It is probably not enough but at least it is a serious effort to try and address some of the problems in that area.

### *Valuation of Alternative Courses of Action*

The critical issue, whenever you are talking about a lot of public investment is people want to be assured that their tax money is being spent wisely and that you are getting a lot of return on your investment. One of the big problems with management is the tendency to focus on particular issues without really considering the broader picture. You can spend a lot of money on addressing nuclear reactor safety, which you may want to do for reasons other than purely environmental. However, in weighing the cost, it is necessary to address alternatives for those resources such as sewage, urban run-off, or storm sewers. You do not want to look just at the cost effectiveness of different options for radiological removal, but the cost effectiveness of your whole management program. Any intervention to protect the environment must have a cost or there would be little resistance to with doing it.

The problem with activities, the reason they become a management concern, is if they are causing the value of the environment to decrease in some way. The benefit of the intervention of course is to try and increase the environmental value. All activities have alternatives. All interventions have alternatives. You need to get the alternative intervention out of these that gives you the most improvement environmental value at least unit cost. For activities, you want to get the most unit benefit with the least decrease in environmental value and that is the whole principal of environmental management. It can become a problem because it is not an easy valuation, but it is tractable on a single environmental issue.

## Integrated Management

There are a number of issues facing the environment but the threat is from four major global problems. Each of these things has a different series of interventions and alternatives. If you are trying to manage large bodies of water, you want to know where to put your money, which issue to put it into and then go seeking the alternatives and activities. You have to balance not only across issues, but across the various interests of society, public versus private interests, interests of development today versus options for future generations and so forth. Probably everyone is sick to death of hearing about integrated coastal management

| Relative Priority<br>by Area |  | Caribbean | Northern FSU | North Sea | West Africa | Baltic Sea | Mediterranean | Red Sea | Persian Gulf | E. Asian Seas | Black Sea | Gyres |
|------------------------------|--|-----------|--------------|-----------|-------------|------------|---------------|---------|--------------|---------------|-----------|-------|
| Synthetic Organics           |  | L         | M            | M         | M           | M          | M             | L       | L            | L             | H         | L     |
| PAH's                        |  | L         | M            | M         | M           | M          | M             | H       | H            | M             | M         | L     |
| Trace Metals                 |  | L         | L            | M         | L           | L          | L             | L       | L            | L             | M         | L     |
| Petroleum (Oil)              |  | H         | M            | M         | M           | L          | M             | H       | H            | H             | H         | L     |
| Herbicides/Pesticides        |  | H         | L            | M         | H           | H          | M             |         |              | H             | H         | L     |
| Dissolved Oxygen             |  |           |              |           | M           | H          | M             |         |              | M             | H         | L     |
| Artificial Radionuclides     |  |           | H            | M         |             | L          | L             |         |              |               | H         |       |
| Pharmaceuticals              |  |           |              | M         | L           | L          | L             |         | L            | L             | L         |       |
| Phytoplankton Pigments       |  | M         | L            | H         | L           | H          | M             | L       |              | H             | H         |       |
| Human Pathogens              |  | H         | L            | H         | H           | M          | H             | M       | H            | H             | H         |       |
| Nutrients                    |  | H         | L            | H         | H           | H          | H             | L       | H            | H             | H         | H     |
| Algal Toxins                 |  | H         |              | M         |             | M          | M             | L       | L            | H             | M         |       |
| Litter/Plastic               |  | M         | M            | L         | H           | M          | H             | M       | L            | M             | H         | L     |
| Suspended Particulates       |  | H         | L            | L         | M           | M          | L             | L       | H            | H             | M         |       |
| TOTALS                       |  | 25        | 18           | 27        | 25          | 29         | 27            | 16      | 20           | 30            | 37        | 10    |

Figure 6. Relative Priority by Region

(ICM), but that is the umbrella that is supposed to somehow guide people through doing this balancing of different interests and different issues to come up with the suite of interventions that is most cost effective globally. ICM should embrace all of these other tools that are used to address specific management issues.

The basic idea is that the environment should be managed and steps should be taken that produce the greatest net benefit per unit investment. You can not do that by taking a narrow view on a specific issue, you have to look at all the issues and see where you can shift. If you can have a single indicator of environmental health it would be very useful in terms of making those decisions. This is almost never done. ICM in most countries is just not going to be a reality. Institutional structures do not allow for this sort of integration.

In the short term, I think the approach is to look for coordination among management agencies so that at least they are talking to each other and they are not pulling the horse in different directions. Even that is not really done and often there is not even much attempt made to maximize net benefits and that has a number of factors behind it.

#### *Prioritization and Public Participation*

One of the really common challenges is people do not consider or do not know the relative importance of various problems. For example, radionuclide contamination of the oceans versus nutrient pollution. If you mention radionuclides in a TV report, people panic and it gets a lot of attention, but if you talk about nutrient pollution it does not have the same appeal. The real relative importance in terms of the environment is not really taken into account and relates again to the distorted perception of relative risk. You can not eliminate risk, there is some risk with every activity, and you need to assess risks in a sort of unified framework.

#### *Limits of Technical Solutions*

In many countries, another problem often is a preoccupation with technical fixes. People want to find easy engineering solutions that can be bolted onto the end of a pipe that will fix a problem, rather than large scale changes in agricultural practice or transport policy. For issues like

nutrient and sediment pollution that are broad scale and have non-point sources, the quick easy technical fixes are just not easy. Sometimes the problem just gets pushed away as too hard when you can not put a treatment plant on the end.

### *Long Term Planning*

The other thing of course is the failure or inability to take a long term perspective. This occurs in a lot of development and management agencies that have two or three or five year budget cycles. They can not do anything in the longer term and most of these problems require much longer approaches. Politicians, of course, have a two or four or six year election cycle and that is the span of their attention. In much of the world, people just do not have the luxury of looking at things in the long term. For many, they are just trying to survive and cannot afford to do what is best in the long term.

### *Future Challenges*

In our reports, we considered some of the issues that we see that are on the horizon. These include both new things that are happening, but in most cases, they are not new occurrences, just new information that provides cause for concern.

- The affects of nitrogen input on the open ocean. Most of the gyres as you all know are naturally nutrient poor. We really do not have the knowledge to predict what adding large amounts of nitrogen over large geographic scales is going to do to the global system, particularly the carbon system. The potential changes are great and I do not know of anybody who claims to have a good idea of what is going to happen if you start fertilizing the ocean.

- Another problem is ozone depletion and the affects of increasing ultraviolet radiation. We do know that increasing UV will affect the photo chemistry right at the sea surface. There is evidence of possible affects on fish eggs and larvae and there is evidence of the affects on phytoplankton production. Again, I do not think scientifically, there is any good basis for making predictions about how the ocean system is going to respond to this.
- Another area that I have talked about synthetic organics, organic chemicals, or sometimes called persistent organic pollutants (POPs). In our assessments, rated them as fairly low in terms of impact on the global system based on existing evidence. But everybody has a bit of disquiet about it. There are a lot of questions.

One of the questions is the number of new compounds that are coming out. The global effort at UNEP to address synthetic organic chemicals is focused on the “dirty dozen”. A group of twelve categories of chemicals that are persistent organic pollutants such as DDT, dioxins. It is a very small number of chemicals compared to the total number of chemicals that are being produced and released into the environment. In fact, some people think that the global chemical industry is very happy to have UNEP and the world community focus on those dirty dozen because those are old compounds that really do not have much commercial value to them anymore. In the mean time, every year companies are bringing hundreds or thousands of chemicals into use for a variety of uses for which there are no toxicological data, very little monitoring and no protocols in place for management. There is a big worry about that, especially coupled with the globalization of the chemical industry and the increasing use of discharges.

### *Regional versus Local Prioritization*

Although GESAMP's assessment was that POPs were a relatively low priority on a global level, some of the regions rated them quite highly in terms of their list of priorities. See Figure 6 – Relative Priority by Region. In many of these regions – West Africa, East Asia, East Africa, the South East Pacific – they listed POPs as high on their list of priorities, in the top five, even though their own data said the levels of contamination are low or do not actually have any contamination. There is no evidence of ecosystem impacts, but we are still calling this a priority. Why is that? It is because with population increase and intensification of agriculture, they are expecting over the next decade or so a fairly dramatic increase. Pesticides sales have been increasing rapidly over the last twenty years. As agriculture intensifies and becomes increasingly dependent on these chemicals, these regions are worried about more discharges of these chemicals. It is a problem that is on the horizon.

### *Unknown Effects*

There is also a lot of concern at the moment about unknown affects of these activities. The typical risk assessments have been done on LD50, lethal dose 50, measurements of toxicity but there is increasing concern about the affects of chronic low level exposures. Some materials are in the environment for a long time. One effect that has recently garnered a great deal of attention recently is endocrine disruption. Some of these chemicals are known to have subtle affects on the reproduction systems of organisms. We do not really have a handle on how severe these are.

One example is the imposex phenomenon following exposure to TBT. It turns out a lot of these chemicals probably have the capacity to disrupt ecosystems in subtle ways that we presently find hard to predict. In the near future, it could become important. There is also a lot of

uncertainty about transport and fate. It has been fairly recently that we have learned about global distillation, the process of evaporation, precipitation, and re-evaporation that carries a lot of substances towards the poles. TBT is another example. It is turning out to be more persistent in the environment than people had predicted. We are uncomfortable as well about how well we understand what is happening to materials once they are released into the environment.

There is some research being done on the possibility of injecting CO<sub>2</sub> in large amounts into the deep ocean as a way of getting it out of the atmosphere because of concerns about global change. There has even been a trial in Hawaii of injecting a small amount down a pipe into deep water. As far as I know, no biological monitoring was undertaken in conjunction with that experiment. This project may create a problem, it may not be. But potentially, it can have large scale affects on the carbonate balance, the lysocline and so forth or direct affects on organisms over large areas of the sea floor.

### *Iron Fertilization*

Another thing that has come on at the horizon is the possibility of large scale iron fertilization. In the last decade or so, it has been learned that big areas of the ocean are not limited by the bulk nutrients, nitrogen and phosphorus, silicate and so forth, that people of my generation were taught were the limiting nutrients in the ocean, but a lack of iron. The good thing about this, if you want to manipulate the planet, is that you do not have to add very much iron. It is only necessary in trace amounts. It is feasible, not just in theory but almost in practice to deliberately increase the productivity of large areas of the oceans by adding in relatively small quantities of iron. There is a famous quote "give me a freighter of iron and I can bring on an ice age". And in fact, there have been proposals to do this deliberately as a way of removing CO<sub>2</sub> from the atmosphere. There is

also a private company, who has negotiated with the Republic of the Marshall Islands, which has developed some buoys that can release iron in small amounts over long periods of time. He wants to fertilize large areas of the EEZ of the Marshall Islands to enhance tuna fisheries. So, there are proposals on hand to deliberately fertilize large areas of the surface ocean. Again, the impacts of this on the global system at this present stage are impossible to predict.

### *Mineral Exploration*

Mineral exploration and development are not new issues, but what is going to emerge is that oil drilling, for example, is going to go progressively deeper and deeper, progressively further off shore. There may be environmental problems associated with this. There is also potential over the next ten to twenty years for the economics for some of the continental shelf mining to come to the point where it becomes a serious proposal. Extracting gas hydrates also has tremendous global potential as a huge source of energy. If these are released, it is not inconceivable that starting to mine these things could release large amounts of methane into the atmosphere, which is a very powerful greenhouse gas, much more powerful than CO<sub>2</sub>, and have global climate effects.

### *Deep Water Fisheries*

Deep water fisheries are also going to emerge as a major problem. Most of the traditional stocks that have been fished are over fished or fully exploited. Fish prices continue to rise so there is always going to be pressure to find new stocks. Where people are looking is deeper into the ocean and they are starting to harvest some very deep water species. At least some of these deep water fishes turn out to reproduce slowly and be long lived. The Orange Roughy is the classic example. Typically they are fished before anybody knows anything about their biology and these stocks could be wiped out in a very short order.

### *New Maritime Developments*

The last emerging issue that we see is new maritime developments. Port development and vessel construction are not going to continue the same way they do now. Deep draft freighters with much deeper drafts than the current vessels, are going to come into play, probably in the next decade. This is going to require radical changes to harbor infrastructure around the world. Some of the ports are already lining up to bid on these new facilities and get the traffic. Port development is going to take on a quantum jump in accommodating much deeper draft vessels than the present fleet.

### Appropriate Structures and Frameworks for Monitoring

Almost all management projects have monitoring. Sometimes monitoring is a knee jerk response so you can say we are doing something about it. There is a lot of mindless monitoring that goes on that is not clearly targeted at meeting management needs. There are good reasons to monitor. The common ones are surveillance. Surveillance just means finding out what is the state of the environment. What are the problems out there? How much stuff is there? Related to this is the critical area trend assessment, being able to tell how the environment is changing. That is a key issue for all managers. Another common reason, of course, is compliance. Cities and businesses need to know if they are complying with regulations and environmental standards for quality. Perhaps most important of all is performance evaluation. Are our management systems working? Are our regulations achieving the degree of environmental improvement or protection that we had in mind from the beginning?

### *GOOS Monitoring*

At the global level, the Rio Convention called for the establishment of a global system to detect, understand and monitor change in the ocean. This was basically the impetus for the creation of the GOOS, or Global Ocean Observing System which the IOC is now been developing. This observing system is separated into different categories. One of those is health of the oceans, basically environmental health. But first, all GOOS monitoring, as laid out in the strategic plan is supposed to be systematic. It requires being scientifically sound in terms of your monitoring locations and frequency and being consistent in terms of the geographic and temporal scales of the change that you are trying to detect. It is a global program so you want monitoring that is relevant to the global system, rather than local or regional scale problems. Clearly, you want a monitoring program to be long term. One of the big problems with trend assessment is you almost always never have a long enough database to be able to separate the signal from the noise and identify the trend. Practically, for any monitoring program to be long term, there are some pragmatic requirements. Clearly, the program is going to have to be cost effective. This means that the program needs to be routine. It can not be a project that people get involved with and it ends in five years. It has got to become part of the normal workload of the agencies that are involved.

### *Monitoring to Support Environmental Management*

Monitoring has to be designed right from the beginning for management needs. There are good scientific reasons to monitor, but if you want something that is useful to management, it has got to be developed as a management exercise and driven by the managers and not the scientists. You are going out there with a specific purpose, trying to answer questions. The objectives need to be stated clearly and quantitatively. We want to detect changes in this factor in the environment. These are the things we are interested

in knowing about. We want to be able to detect a 10% change or a 30% change in which management is interested. There are monitoring programs that have no possibility of detecting change at the level of a regulation that has been promulgated for example. The outputs and the uses of the information need to be specified from the outset. Again, probably everybody has seen monitoring programs that end up in these great data sets that you can not actually use for the purposes that you want to use them for at the end. You have to try and specify as much as you can the information products that you are going to generate, and how the information is going to be used. Is it going to be communicated to the public? Is it going to be used strictly for technical purposes? But of course, your perspectives change as you get information in, so you need to allow enough flexibility to cover yourself. You want to pick measurements that give you some early warning of impending problems so you can have a management response.

Management's response should, ideally, be predetermined. Some of the better monitoring programs actually specify the next step when certain levels of change are observed in the environment. Do we monitor more intensely? Do we crack down on certain industries? But if your early warning works, it does not do you any good if you spend the next three years arguing about what to do. You have thrown away the advantage that you got from your early warning.

In the Health Of The Oceans panel, (HOTO), there are several different categories of measurement. First are the standard pollution monitoring areas, chemical, biophysical and physical. Some of them are pollutants per se, others of them are reflections of the environmental response, like oxygen levels and phytoplankton pigments. One of the things we looked at in terms of the cost effectiveness was how hard they are to measure and also their impact or their relevance to environmental change. It is again a qualitative assessment but they really break down into three categories.

The first category, these are the things you want to start monitoring right now. They are cheap and easy and they have a high degree of relevance to change in the environment. The second category, we felt that at least in present situation, consists of factors that are on a global scale and have relatively little impact on the environment. Even if they were easy to measure, they are just not that important. Category three measurements, those are the things where you direct your research efforts to try to improve. What you want to do is develop new monitoring techniques and methodologies to shift these things down here on a difficulty of measurement so they can come up and cheaply, quickly and reliably measure these factors in the environment.

The second thing that is important to measure is the biological response. It is really irrelevant to know how much material is in the environment unless you know what it is actually doing to the system such as its impact on human or ecological health. The HOTO system is going to be built on measuring biological effects at a range of levels that range from very subtle cellular changes, changes in membrane structure, induction of stress proteins and that sort of thing, through levels of biological organization up to populations and communities. In terms of the general public and managers, it is this high level question, how is the ecosystem changing, that is of interest.

Ecologically what is significant are things like loss of habitat, changes in diversity and so forth, but those occur relatively late in the game. In terms of what is meaningful to management, it is these high level things that are important but they do not give you an early warning capability. The ideal monitoring program would include a mix of early warning indicators and ultimate high level response. The idea is to both provide the early warning but also to learn more about the linkages among higher level biological responses and subtle behavioral and physiological changes.

There is a program that has just had a field trial, Rapid Assessment of Marine Pollution, which is related to HOTO and it is trying to develop quick and easy field measurements for a number of these biological responses. The idea is to try to develop low cost test kits that can make both the contaminant assays and the low level biological response assays a routine, cheap, quick procedure thing that can therefore be used in a large scale monitoring program to instead of having to go out and take samples and send them to one of the few laboratories in the world that are inter-calibrated. The final conclusion of the Health Of The Oceans panel was a series of recommendations of what government should do in terms of fostering development of global ocean observing. They are all fairly straight forward, such as making existing data available. There is a lot of data that exists that is not readily available to monitoring systems. Data products that do exist should be distributed, though much of this data resides with the military and even basic hydrological information is classified. There are still programs that could be done relatively easily to greatly improve the existing base of information about the state of the oceans from an environmental standpoint.

#### Questions and Answers

Shrimp farming in Southeast Asia has had deleterious affects on mangroves. Is it spreading or not, how have the governments dealt with that, and do you have any other comments on that.

Actually, it is almost stopped. Partly from government pressure, partly, I think, from consumer pressure. The problem with shrimp farming and mangroves is that when you rip out mangroves and put in a pond, you have got sulfate soils. Within two or three years you start getting a lot of sulfuric acid production, and so they have to put in large quantities of lime to avoid disease and it eventually becomes unprofitable and they move on. In places like Thailand, the destruction of mangroves for shrimp farming

has pretty much stopped, primarily because all of the mangroves are gone. There has been a lot of pressure on the industry, and worldwide the destruction of mangroves for shrimp farming has really been brought under control.

Is there a potential for reintroduction of mangroves, possible role of militaries or other governmental organizations?

Certainly mangroves are pretty easy to plant. They are one of the habitats that can be rehabilitated quite readily as long as you remove the stresses that have damaged them. So, I would say there is probably a high potential there. There is also a lot of analyses showing that economically it makes a lot more sense in most cases to leave the mangroves standing and use them for charcoal for fisheries, etc. For stopping saline intrusion, so there is a good economic argument for rehabilitating mangroves.

One of the things that we have been looking at extensively is linking planned infrastructure development in countries, with large scale regional monitoring for sewage infrastructure development. What I am wondering is in your review of things, have you ever seen a coupling between plans for infrastructure developments, either in municipalities or ports around the world with regional or local environmental measurements.

It certainly occurs at local scales. Boston Harbor is a good example. The development of their monitoring program was quite tightly linked to their planning for offshore outfalls. At regional scales, no, I do not think it exists, that I know of.

Actually, it does. In the Northwestern U.S., agreements between the U.S. and Canada, where they have started such planning. The University of Washington actually is doing a lot of modeling in that regard.

You will also find to a greater or lesser degree a very integrated model of that in the Great Lakes between not only the Great Lakes states, but the U.S. and Canada. Sewage was the primary identified source of some problems for the Great Lakes in the 1960's. The Great Lakes were suffering eutrophication and in 30 years they have come back. And they have come back because there is been that type of sewage treatment integrated regional agreement. And it is an international agreement, as well as interstate. Globally, in terms of the developing countries I think is what you were more interested in, right?

Yes, I have not seen it in developing countries.

We have looked into border disputes involving sewage plumes released in the coastal ocean water. Mexico and the U.S. is one example, and then the Red Sea between Saudi Arabia, Sudan and Egypt is another local area where you know they are having tremendous infrastructure development concepts. One of the best things to help them resolve those disputes, is the use of certain naval assets, in particular the use of sonar technologies for tracking and distinguishing where this plume is going, which I think is appropriate for this meeting.

I am just curious, in any of the global assessments that have been done, have the militaries ever been implicated as one of the major contributors to any of the major problems that you have talked about?

Yes, we have actually had some debates. We have had a few people on the groups who wanted to include the role of the military. Not in protecting the environment, but in degrading it. We have had actually some quite heated arguments about it. The consensus ultimately was that the role is really, compared to other things, is trivial. You can talk about, well we had one member who had a thing about unexploded ordnance being dumped in the Mediterranean and the one that really stands out, probably more than

anything, is TBT. A lot of the harbors are obviously contaminated with TBT, and that is a problem. But it is not restricted to the military. Large ships, military or not, still use TBT. A military base has the same problems as a city in terms of waste disposal and other things, but from the things that are specific to the military, none that we as a group felt were of the scale of importance as these other threats. A nuclear accident will obviously be a major threat.

Do the military vessels, i.e., the navy vessels, do they have any substantial ballast water or transportive water from one area to the other in terms of their systems. Do the systems generate ballast water discharges from military vessels?

I think I can speak to that a little bit. For the most part, it is just a fraction of ballast water that commercial ships will generate, but a number of navies, the U.S. Navy started well over five years ago, as a policy, to ask navy ships outside 25 local miles from sea to turn over the water. To actually flush the tanks with fresh clean water well before any national/international regimes were put in place. Given the sensitivity, I do not see the military vessels being a major contributor, although there is a unique sensitivity to that aspect.

How good are the anti-fallowing programs? Are there much growth on the bottom of the vessels?

The U.S. Navy does not use TBT, and has never used TBT. And many other navies also do not. There is an enormous R&D program, several programs, in place to find substitutes, environmentally friendly biocides. For the most part, some of the tests that we have run, looking specifically at tests, for example, from Puerto Rico up to Norfolk to look at both what is in the tank and outside the ships, Navy ships have typically proven to be the best of all the ships, whether it is the kind of paint that we use or the process that we use, or the long times at sea or the heat, we are not sure exactly why. But the efficacy of the kill of these species is excellent. They have not quite figured out why we are as good as we

are. I do not see that being a major contributor in terms of warships.

Let me say this correct in relation to U.S. Navy, but navies, other navies, in certain regions where this is absolutely not valid and it may be one area where we can do something. Like oil pollution generated by ships in the Black Sea is enormous. It is also true in some parts of the Mediterranean. I think that the ballast water problems also exist, but because the navies are untouchables, you can not make them comply with any conventions. I think that one area where we can try to do on a regional basis to start with, where we can try to get navies to act and to follow the example of the U.S. Navy anyway. That is one area I think we could concentrate on in future discussions.

In looking at the four principal contributors to degradation of the marine environment, the four look like they are fairly tightly coupled, at least in spatial terms, to population densities. Is that fairly true, and what factors would influence the transport of say pollutants or exotic species that would tend to fan that out beyond traditional population centers?

They are not actually specifically linked. Sewage, clearly, is linked to population. Nutrients and sediments, are much more related to land use, agriculture and forestry are the big sources of those, leaving out the atmospheric deposition of nitrogen. The two big factors are urbanization of the coasts, which is happening very rapidly, that is increasing sewage. It is also increasing some forms of atmospheric deposition. Urban runoff has a lot of nutrients in particular. But the second thing is the intensification of agriculture and the increasing use of nutrients and fertilizers. It is not just the population centers that are producing these things.

But it is all human activity?

Absolutely, yes.

Returning to the military for a moment, I was told that the U.S. Navy developed a new sonar system where the environmental impact statement indicates some potential problems for turtles and other aquatic species. I wondered if you were familiar with that at all and if so could you comment?

This came up during the biennial report, which is supposed to be every two years, twenty five page assessment of the state of the marine environment. In the Emerging Issues chapter we talked about the effects of sound. Not just turtles, there is been a lot of talk about the effects on whales, the stranding in Greece or something that coincided in time with some testing of some military sound equipment. I think there is been more concern about that because there is been a couple of experiments proposed recently using sound over very large distances to look at warming of the ocean and so forth by mapping the change in the time it takes the sound to go across. They were talking about low frequency sounds going across the Pacific. There is been concern about the effects on whales in particular, and probably a few other things. Our perspective is it is an interesting thing and it might have problems, but in terms of the global ecosystem it is probably just not of the same order of magnitude.

Do you know what is the policy of the various militaries around the world with regards to treatment or disposal of sewage from bases. Also, the dredging involved with the bases. Is there any sort of uniform policy, or does it vary from country to country?

I do not know for sure, we have not actually been able to get much information on things like that but as far as I know it varies radically from country to country. Some countries where we have tried to get information about military things we just get nothing. Some countries you can not even get maps.

Looking at your major problems, you have made some comments on this, it would seem like internationally we expend a lot more effort in areas like radionucleotides and do not spend, with maybe the exception of alien species, nearly as much effort in those areas if those are in fact the areas of major concern for the oceans' ecosystems?

We did not come up with these specifically with regard to the military. We feel that there has been too much attention given to things like radionucleotides and heavy metals and so forth and not enough to these major land use issues. In terms of the military perspective though, it depends on what your interests are. Certainly a local harbor contaminated with anti-fouling agents generates a lot more local attention and pressure than large scale problems that are affecting the whole oceans. To the extent that you are sort of driven by public relations with the community where your base is, then the local focus is obviously important. All these other problems that I said we write as medium and low, there are places where they are the number one problem. There are places where releases of radionucleotides are a serious issue, or where heavy metal contamination is serious. We are trying to take the perspective of the global ecosystems and say where the big problems lie. The military does not always necessarily have that perspective.

Are you saying that the other problems, radionucleotides, heavy metals, will never become a problem?

No.

So are your major problems here, your major problems in the near term?

We think these are the major problems right now.

## MAINTAINING ENVIRONMENTAL SECURITY AND MILITARY READINESS: THE SUCCESS OF TANDEM THRUST

CDR Michael J. Boock, U.S.N  
U.S. Department of Defense Representative  
for Ocean Policy Affairs  
International and Operational Law Division

### Introduction

I am going to start off with a ten minute segment of a video that we did in connection with Tandem Thrust '97. We are only going to show you the first 10 minutes of the video. It will give you an idea of the area in which the operation and the exercise took place. Also, it will give you an idea of something we did in connection with the exercise that we felt was very effective. And then given the time constraints of the day, I will take about 15 minutes to talk about the exercise and that will give you a couple of minutes for any questions, if you have any questions about the exercise afterwards. [video] The tape you just saw was important because it shows the pristine beauty of Showater Bay. We descended upon this area with 21,000 U.S. personnel, 5,700 Australian personnel, 23 U.S. ships, including an amphibious group and a carrier battle group, 20 Australian ships, 200 U.S. aircraft and 29 Australian aircraft. This was not a small exercise that we brought to Showater Bay.

In the few minutes that I have today, I am going to talk to you about how we went about ensuring that not only were we able to participate in this exercise, we will be able to go back to Australia and participate in other exercises because of our performance there. First thing that was important in this, obvious but it is often lost in the exercise planning, is we had involvement of the environmental representatives of the various concerned parties, both in Australia and in

the United States, both in the military and the civilian side of the house, in the planning cycle.

Including being involved in the initial planning conference that took place in February of 1996; realize the exercise is going to take place just a little over a year after that. And the follow-up conferences, the environmental planners were there at each and every stage. And the resulting exercise plan came out in November of 1996 and there was an annex T to it which has to do with just the environmental concerns of the exercise. And we are not talking about exercising environmental concerns, we are talking about those mitigative matters that were inserted into the exercise plan to ensure that the exercise could be continues without damaging the environment of Showater Bay and the Great Barrier Reef.

Now, when that annex was drafted, and when the exercise plan was put together, there really were a number of plans that we had to take into account in this process. This is a situation where you had two very sophisticated players. Australia has a very sophisticated system set up for the preservation of the environment and a sophisticated system set up for the military's use of Showater. So we had all sorts of rules that were already in place and these were not going to be put aside. The other thing that was important is, we have a level of sophistication within the U.S. military when it comes to dealing with the environmental restrictions we find when we operate within the United States. And so they drove us basically, I think, to the treatment that we found when we wanted to do this exercise.

But all these plans, the Queensland Disaster Response Plan, Showater Bay Training Area Standing Orders, the Reef Plan, the Queensland Coastal Contingency Pan and the Australian National Plan were all adapted into the Exercise Plan at Annex T. The Showater Bay Training Area Standing Orders were adapted in total by reference.

Now for Tandem Thrust '97 a couple of key things had to take place before we could do the exercise. First, we had to have an Australian Environment Assessment. It commenced in February of 1996 and was completed in November of 1996. The Australian Environmental Assessment was facilitated by the fact the operating area already had a very developed set of rules, based on previous operations. The result was some substantive experience that was useful in completing that Australian Environmental Assessment. We were not going to be able to hold the exercise without that. For folks that are familiar with the U.S. system, you are probably very familiar with the idea of doing this type of an assessment. Like I said, we had an environmental annex to the Exercise Plan. It was based on all the mitigative requirements that were identified in the Australian Environmental Assessment and we incorporated the Standing Orders for the Showwater Bay Training Area.

After the completion of the environmental assessment and because of the past history in this area for conducting military training, we received an Australian Environmental Certificate Of Compliance. This was of a way to obtain authorization to commence the exercise and avoid any other delays. Once the clearance was given in February of 1997, the exercise followed right on its heels, so it was in a very tight timeframe. One of the lessons learned is, even though this was considered very successful, we needed to begin this process even earlier because it was getting too tight. The players that were involved here, the parties that were concerned, the people we had to bring on board, and this does not really do it all justice because to use the term of art, there are a lots of stakeholders in Australia that we had to get on board with this exercise.

First for us, for the military persons, for the uniform persons, we had to get the exercise planners on board with the fact that this was important. They are concerned with all sorts of things, not just these environmental requirements or necessary actions to be taken, to let their

exercise take place. They are concerned with what all those troops, ships and aircraft are going to be doing during that period of time. One key was the creation of an environmental monitoring group who was responsible for monitoring the environmental impacts during the exercise, and to ensure that the mitigation measures that were identified in the Australian Environmental Assessment were undertaken promptly. We had the Great Barrier Reef Marine Park Authority, the Showwater Bay Environmental Management Advisory Committee, the Queensland Department of Environment, and a laundry list of other folks who are involved in the planning system for Tandem Thrust '97.

The Environmental Monitoring Group was very useful because they were primarily technical folks who were well versed upon the requirements of both the plans that were in Australia, the Australian Environmental Assessment and the mitigative measures that were identified in the Assessment and incorporated into Annex T. Formed by the Director of Environmental Heritage of the Australian Department of Defense, it was staffed from 28 January 1997 to 29 April 1997. It monitored the impacts associated with the exercise. They did a number of other things that were really important, including providing environmental advice to the exercise command, and conducting environmental inspections before the exercise took place to try to again determine what was going to be necessary to ensure that the exercise took place properly and without any unnecessary damage to the environment. They conducted inspections during the exercise and they conducted inspections after the exercise. They liaised with the participating units and they responded to reports of environmental incidents. I am very happy to say, there were no reports of any significant environmental incidents during the exercise. They undertook active inspections of the exercise area to detect any unnoticed or unreported situations, i.e., they were supposed to be out there to provide some oversight of things which the troops in the field might not take notice. They

were also supposed to deal with the civilian authorities in those circumstances.

We identified key areas where we focused most of our attention, because these were the areas we thought were going to be the most exposed. These were the target areas, the ordinance areas in those circumstances, the beach landing areas, obviously recognizing that there were going to be a more exposed area of the environment, and the Great Barrier Reef Marine Park.

The conclusion was there were no impacts that were considered to be significant as defined by the Australian Environmental Assessment and that is also the position of the Australian Government, the environmental folks who were involved with the government, the Australian Defense Forces and ourselves in the circumstances. We were very



Figure 1. Typical Military Ship Discharges

fortunate. We had things that came up, small oil spills ashore; no oil spills at sea, I might add and we took measures to mitigate any damage to the environment.

Now, we had a couple lessons learned that we got out of this. Not all things are perfect in the circumstance. One I already talked about. There was a real need or requirement

to start earlier in the planning cycle. Even before the planning meetings took place because of the sophisticated rules that were developed both in Australia and in the United States for conducting this exercise. Something else, and this is something that goes back to sort of the macro world we heard first today, we did not have an adequate database. As a result, there were probably things that we did consistent with the Australian Environment Assessment that were not necessary. But lacking the database to make a better judgment, we had to err in favor of making sure that we took protective or mitigation measures in those circumstances. Those are the primary two lessons learned out of this exercise.

I know that is really fast in that circumstance, but I think it shows you that there is an ability outside of our domestic area to conduct major exercises how you can go about preserving this ability to conduct major exercises giving the environmental consequences you find out there

## IMO & MARPOL 73/78

- ❖ **International Maritime Organization (IMO): a Forum for International Agreements Affecting Maritime Industry (Individual Nations Then Ratify as National Law)**
- ❖ **Pollution Control=International Convention for the Prevention of Pollution by Ships (MARPOL 73/78)**
  - Annex I -- Oil Pollution
  - Annex IV -- Sewage
  - Annex V -- Solid & Plastics Waste
- ❖ **MARPOL Actually Excludes Public Vessels, But Many Nations Expect Their Naval Vessels to Comply**



Figure 2. International Convention for the Prevention of Pollution from Ships (MARPOL)

in the current world. It is something we are going to have to do, if we want to exercise with our partners like Australia. The question of course, and it is open for discussion, is what did we learn from this for the unsophisticated exercise partner, where we do not find the sophistication on the other end of the line.

# WARSHIPS AND THE WORLD'S OCEAN ENVIRONMENT

Larry Koss  
GeoCenters, Inc.

## Introduction

My focus today will be on warships. I will not talk to broad ocean issues or any requirements for additional ocean science or research. These topics have been covered already by recent national conferences, such as the National Oceans Conference held last summer in Monterey, CA, and published in the proceedings, "Oceans of Commerce/Oceans of Life."

We have heard already today that some 85 to 90 percent of ocean pollution come from land-based sources, not from ships at sea. Given that the military has very few ships in comparison to the maritime industry worldwide, one can reason that the military impact on the oceans is negligible in a substantive sense. Recognizing the visibility of navy warships, however, not only do we need to comply with applicable and appropriate environmental laws and regulations, we need to show leadership and stewardship in the care of our oceans.

## A Negligible Impact

My discussion of warships will first describe ship-pollution-abatement regulations and talk to the technology strategies to meet these regulations. Figure 1 presents a typical array of ship discharges, many of which are very challenging to control, especially for a warship. One of our major successes, however, is that in the brief period following the development and enactment of an international treaty and its enabling legislation, the U.S. Navy has developed affordable technology to satisfy the

requirement. This ability to establish the technological breakthrough is due to our solid investment in organizational structure, committed people, and a unique research, development, test, and evaluation (RDT&E) laboratory expressly dedicated to environmental technology. Most important, we built a culture in the Navy's environmental community to understand the complexities of warship design and operation and to find specific technologies that can achieve environmental compliance and operate aboard ships in a pragmatic and affordable way. About 20 years ago, to help find solutions, we began working with other navies around the world to leverage expertise, determine what is affordable, and frame policy so that we could always show leadership. The result is a win-win-win situation—for the military mission, the environment, and the taxpayer.

#### Legal and Political Requirements

During the last 15 years, several international regulations have been adopted that significantly affect navies. The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) (see Figure 2) contains several annexes, of which some are in effect and some have yet to enter into force. Annexes in effect include Annex I which essentially eliminates all oily waste discharges at sea, and Annex V, which prohibits the discharge of plastics anywhere and the discharge of solid wastes (except food waste) into "Special Areas" of the oceans. Annexes yet to come into force include Annex IV, which proposes to prohibit the discharge of untreated sewage (blackwater) within specific distances from Special Areas' shores, and Annex VI, which proposes to limit air emissions from ships. Proposed regulations include restricted use of certain underwater hull coatings that protect ships from fouling marine growth and a protocol for managing ballast water to prevent the introduction of non-indigenous species of marine life into ports around the world. The other significant international treaty of concern

to military ships is the Montreal Protocol, which eliminates production of certain ozone-depleting substances, including chlorofluorocarbons (CFCs) and Halons.

Sovereign nations have the right to determine which international regulations they will ratify regarding environmental requirements. Nations then determine the applicability of specific international regulations to their military ships through domestic legislation. The decision by a nation to apply the requirements of MARPOL 73/78 and/or the Montreal Protocol to its military ships demands the development of new technologies and management procedures and the installation of equipment into densely packed ships. Complying with these regulations affects ship operations, endurance, manning, maintenance, and the quality of life on ships. Additional impacts on planning, programming, and budgeting are also incurred from the costs of compliance at sea and the costs of installation and use of shore-reception facilities.

In addition to international regulations, increasingly complex and stringent national environmental regulations are being legislated in many nations around the world. The national regulations are concerned with controlling ship-waste effluents in territorial waters and affect the off-loading of all ships' waste in port. Military ships have sovereign immunity, but when authorities adopt these regulations as conditions of port entry, they could challenge the ability of navies to enter ports they previously visited without restrictions. Any mistake has the potential for financial, legal, and political repercussions as well as damage to the public image of visiting navy ships.

The total burden of international and national regulations has the potential to severely affect the performance of ship's mission. The **post-cold war Alliance** requires sustained naval power projection and visible deterrence, anywhere in the world and at any time. New mission areas such as peacekeeping, conflict prevention, and stabilization require navies to provide trained and

ready forces for sustained operations other than war in littoral areas of the world, some of which may be environmentally sensitive. NATO's Partnership for Peace (PFP) Program encourages NATO forces to conduct training and exercises in certain geographic areas, including other nations' territorial waters, heretofore infrequently used. Navies cannot permit environmental requirements to jeopardize mission performance by constraining ship operations in some waters. To this end, naval ships operating in the 21st century must be environmentally sound.

### Navy Policy

Navies must provide properly equipped, trained, and ready forces that execute their military mission with minimal impact on the environment. In so doing, the navies may be required by national law, regulation, or policy to comply with applicable national and international laws and regulations. Perhaps most important and relevant is MARPOL 73/78, Article 3 of which states the following:

The present Convention shall not apply to any warship, naval auxiliary or other ship owned and operated by a State and used, for the time being, only on government non-commercial service. However, each Party shall ensure by the adoption of appropriate measures not impairing the operations or operational capabilities of such ships owned or operated by it, that such ships act in a manner consistent, so far as reasonable and practicable, with the present Convention.

Although naval vessels are exempt from MARPOL through Article 3, it is the policy of the navies to take into account the need to be consistent with the Convention so far as is reasonable and practicable, while not impairing the operations or operational capabilities of these vessels. Accordingly, it is the policy of navies to pursue the development of reasonable, practicable, and affordable management procedures and technologies. The navies' policy is also to exercise sound judgement, fiscal

responsibility, and environmental leadership in ship design, equipment development, naval operations, logistic support, and ship maintenance.

### Environmentally Sound Ships

The concept of an “environmentally sound ship” historically has meant a ship that could operate in any water body worldwide while causing no significant adverse environmental impacts and complying with all applicable environmental regulations. All shipboard waste streams would be sufficiently treated or destroyed on board, such that processed waste could be discharged or released without harm to the environment, or returned to shore for recycling or disposal. The concept has evolved to include more elements related to integrating environmental protection into a ship’s design, management procedures, interface with shore facilities, minimal use of hazardous materials on board, and minimal logistical costs for waste management. An ***environmentally sound ship***, therefore, should have the following attributes:

- Environmental compliance;
- No significant adverse environmental impacts;
- Minimal use of hazardous materials on board;
- Minimization of air emissions;
- Wastes treated or destroyed on board to the extent practicable;
- No inappropriate dependence on shore facilities for waste off-load; and
- Minimal logistical costs for waste management.

### *Military Requirements for Environmentally Sound Ships*

From a strictly military standpoint, naval ships should be fully mission-capable, able to operate in all international waters and visit any port without being constrained by environmental regulations. Currently, ship operations may be constrained in some international and territorial waters because ships lack appropriate shipboard waste-management systems to comply with waste-discharge limitations. The MARPOL-designated Special Areas are particularly problematic for naval operations because virtually no solid-waste discharges are permitted there.

Under current regulations and with existing shipboard waste-management capabilities, ships cannot remain close to shore for extended periods without moving specified distances offshore to discharge oily and solid wastes. Similarly, ships cannot operate very long in Special Areas, where all oily and solid-waste discharges, except food wastes, are prohibited. Without satisfactory on-board waste-storage capacity, volume-reduction equipment, or treatment systems, ships may be forced to avoid visits to some non-naval ports, where ships face high local waste-off-load charges. Ideally, the worldwide operations of environmentally sound ships would have minimal potential for restrictions by environmental regulations.

Another military reason for minimizing waste discharges from ships is to reduce their “waste signatures.” Floating debris discharged by ships may provide helpful information for potential adversaries. Floating debris also causes problems for naval operations. For example, during coalition operations in the Persian Gulf action, floating plastic bags caused problems for warships and commercial vessels because the bags resembled floating sea mines.

### *Ship Design, Integration, and Space Allocation*

The general problem faced by navies is identifying and quantifying the waste streams and finding appropriate

solutions for controlling them. Consideration must be given to eliminating, treating, destroying, or processing each waste stream on board, so that discharges are environmentally acceptable or the processed waste can be safely stored on board and returned to shore for reuse and/or recycling.

However, developing shipboard waste-management equipment is only part of the solution for achieving environmentally sound ships. The equipment must be



Figure 3. Strategy for Environmentally Sound Ships of the 21st Century (ESS-21)

integrated with other shipboard systems and operations. Moreover, to achieve optimal configurations and operations, shipboard pollution-control systems should be developed in close coordination with and integrated into the early stages of ship design. Ship operations and waste management can only be optimized if the sources, quantities, and treatment of wastes are considered as integrated systems when a ship is designed. Designing ships to minimize waste generation and on-board distances

from waste sources to treatment units to facilitate waste collection would greatly improve waste management.

Navies are actively investigating the location and amount of space needed on board to accommodate waste-management equipment and systems in future ship designs. The space needs depend on the amount of waste generated on board, crew size, and the planned processing technology.

### Constraints on Warships

Military warships are unique because of their mission and special operating constraints. The wastes generated on larger warships and auxiliaries are very similar to those generated by shore-side industrial facilities and commercial vessels, but waste-management practices on warships are not. Ships travel worldwide and have no continuous access to land-based facilities for waste management. A ship conducting operations, frequently far from home port, cannot have its solid waste collected by a waste-disposal company, cannot pipe its liquid wastes to a municipal wastewater-treatment facility, and cannot have its medical and hazardous wastes taken away by specialized haulers. Warships also differ significantly from commercial vessels in the following ways:

- Warships remain at sea for long periods, whereas commercial ships usually travel from point to point as quickly as possible;
- Warships are designed as platforms for weapons systems, so passengers are incidental to a ship's mission;
- Warships have significantly larger crews that live on board even when the warship is in port;

- Warships experience greater hourly fluctuations in waste generation because of regimented crew schedules;
- Warships have greater space and weight constraints; and
- Navy personnel do extensive maintenance on board.

### *An Integrated Approach to the Future*



Figure 4. Key Components of an Integrated Approach to the Future

Shore facilities and the private sector share the problem of treating waste streams, but the specific solutions are typically quite different for ships. Waste-treatment technologies and equipment that work effectively on shore often do not work on warships because of the space and weight limitations, special military requirements, and harsh, rolling ship environments.

Any equipment or system put on navy ships must not only perform its intended function effectively, it also must meet strict requirements for reliability, maintainability, shock, vibration tolerance, size, space, weight, manning, electromagnetic compatibility, acoustics, noise,

survivability, ship services, safety, health, and other “environmental” factors.

As a consequence of these special requirements, navies have determined that they must undertake thorough test and evaluation of commercial pollution-prevention and pollution-control technologies before embarking on an expensive development program. Navies have found that most “off-the-shelf” commercial waste-management equipment is generally not suitable for installation and operation on board ships without significant marinization. We can take advantage of some treatment processes used on shore, but it must develop special equipment and systems to use the processes on NATO warships.

### Methods to Achieve Environmentally Sound Ships

Navies have already developed equipment and systems for managing some of the waste streams and have other pollution-control technologies in various stages of development. To comply with more stringent pollution-control requirements than are now in place for some waste streams, navies have made significant progress by identifying candidate control technologies, but they need to explore them further and develop the ones most suitable for shipboard use.

Figure 3 illustrates the strategy and treatment concepts for ultimately achieving Environmentally Sound Ships of the 21<sup>st</sup> Century (ESS-21).

### *Technology Needs*

Navies have made substantial progress toward developing suitable shipboard equipment for processing ship waste streams. Many of the technologies will have dual-use applications within the commercial shipping industry. Still, navies need to develop more technologies to achieve ESS-21. For oily wastes, advanced oil-filtering equipment (OFE), advanced treatment systems (such as

ultrafiltration, microfiltration, reverse osmosis, and ion exchange), and oil-content monitors (OCMs) need to be developed or improved. For non-oily wastewaters, navies



Figure 5. The Navy's Environmental Requirements

need to perfect vacuum-collection systems, waste-concentration methods (such as ultrafiltration, microfiltration, reverse osmosis, and evaporation), waste-treatment methods (such as bioreactors, perhaps in conjunction with membrane filtration), and advanced thermal-treatment systems (such as advanced incineration). For solid waste, more RDT&E is needed for an advanced thermal-treatment system (such as advanced incineration) to destroy solid waste on board. Additional RDT&E is needed for medical-waste processors (MWP). Advanced thermal destruction for shipboard used/excess hazardous materials must also be investigated.

#### *International Cooperative Efforts*

International cooperative efforts to achieve environmentally sound ships are under way among navies. In response to the environmental challenges affecting NATO navies, the **NATO Naval Armaments Group's**

**Special Working Group (SWG/12)** on Maritime Environmental Protection was formed as a forum for promoting increased information exchange and cooperation on a variety of complex environmental matters.

SWG/12's task is to promote the development of capabilities among NATO navies to comply with national and international environmental regulations and to foster cooperative efforts for achieving environmentally sound ships. SWG/12 focuses on three major work areas: information exchange and preparation of documents; identification of cooperative technology-development opportunities; and coordination with other NATO organizations. Figure 4 summarizes the three oach to the Future key components—environmentally sound ship technology design, environmentally sound operations, and

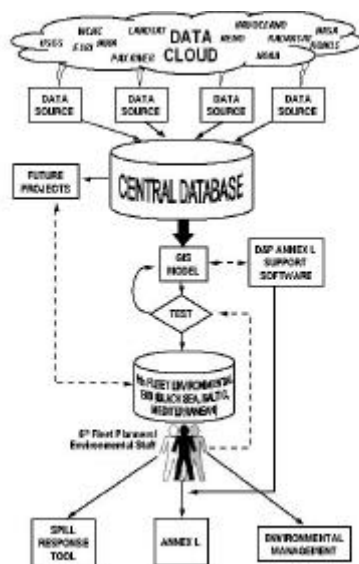


Figure 6. The GIS Concept

environmentally sound logistics—into an overarching visionary strategy for domestic and international mission successes in the 21<sup>st</sup> Century.

## Liaison with Other Organizations

SWG/12 provides a forum for NATO navies to identify and pursue opportunities to save time and money by entering into cooperative technology-development projects. Liaison with other organizations within NATO (e.g., the **Research and Technology Organization** and the **Committee for the Challenge of Modern Society**) will help NATO navies avoid duplicating technology efforts and represent naval interests on environmental issues that may affect maritime forces.

Liaison with the **Maritime Environmental Protection Committee** (MEPC) of the **International Maritime Organization** (IMO) is critical to SWG/12's ability to anticipate future regulations and, through national delegations, provide sound technical advice to the MEPC on technically viable and affordable solutions to the proposed regulations. For this reason, the SWG/12 plan of work is being aligned with the MEPC plan of work. Perhaps the best example of this has been the drafting of a technical paper on oily water separation (OWS) testing and certification requirements for oily water containing emulsions. This paper was submitted to the MEPC through a SWG/12 member national MEPC delegation and was accepted by the MEPC for discussion. MEPC is forming a correspondence group that will develop the procedures for membrane-based OFE testing and certification. Through national participation in the MEPC correspondence group, NATO navy experts will be able to provide technical advice leading to commercially available, IMO-certified OFE that meet navy requirements.

Liaison with the **European Union** (EU) and its development of environmental protection regulations is also particularly important to the European NATO navies. EU Directives can be drafted and issued relatively easily, yet have profound impact on the European members of the Alliance. The EU has no policy to exempt the military from environmental regulations, and each proposed regulation

needs to be closely monitored for potential impact on navy equipment and operations. SWG/12 provides a vital forum for discussing pending requirements and their implications. National delegations can then inform their chain of command to determine if overriding national-security requirements necessitate modifying the draft legislation to exempt the military from some or all provisions.

#### *The Future of Our International Efforts*

The future efforts of SWG/12 are being driven by the evolution of MARPOL 73/78 Convention, the Montreal Protocol, and, for individual navies, changes in national law and regulation. Of primary concern to SWG/12 are the pending entry into force of MARPOL Annex IV on sewage and Annex VI on air emissions and the development of new annexes or other international instruments regulating anti-fouling paints and ballast water. Additional developments with respect to the Montreal Protocol and the associated directives issued by the EU are also of concern to navies. SWG/12 will also monitor the developments associated with the not-yet-in-force Kyoto Protocol on Global Climate Change for any impacts they may have on military ships.

#### *Military Impact on the Oceans*

I will now refocus my presentation to the issue of military impact on the oceans. I will move past the challenge of ESS-21 and Environmentally Sound Logistics (ESL-21) to a means (worth pursuing for international cooperation) to reduce our operational impact on the oceans. Using **Geographical Information System (GIS)** technology and remote sensing can facilitate environmental planning and create oil-spill-response strategies for military operational commanders. In fact, GIS, together with remote sensing, is a useful tool for many military applications (Figure 5).

## The GIS Concept

Figure 6 illustrates the concept of integrating satellite imagery, remote sensing, data acquisition, and environmental-observation platforms into a database to be managed through a GIS for major military applications, ranging from environmental planning and oil-spill response to overall environmental management.

### *Environmental Planning*

Naval Warfare Publication 4-11 (NWP 4-11) requires that an environmental annex (Annex L) be developed for a U.S.-Navy-operations order or plan. The purpose of Annex L is to ensure that naval operations succeed while maintaining the highest level of environmental protection and compliance. The Navy is therefore creating a GIS tool that will help fleet planners create an Annex L.

GIS technology helps create coastal maps enhanced with environmental information and remote sensing. Using such techniques to develop practical applications will help fleet planners collect, maintain, and analyze environmental data.

For the initial project, existing environmental data on a selected area of the Black Sea coastal zone were collected, sorted, harmonized, and transposed onto a rectified multispectral satellite image of the area in a GIS format. Multispectral analysis performed on the image located environmentally distinct zones. The resulting multi-layered GIS map provides useful representation of coastal environmental sensitivities, and in many ways surpasses conventional GIS systems. The satellite image provides an accurate and real-time map of the area, while the multispectral data locate common ecosystems, such as wetlands. This allows for the rapid prioritization of coastal areas and the ability to pinpoint specific environmentally sensitive areas. Fleet planners can then quickly and economically create an environmental analysis to support

Annex L development. This system will provide reliable, timely information for protection strategies, identify environmental and public risks, and offer a basis by which to avoid potential environmental impacts, especially in areas where environmental reference data are limited.

### *Oil-Spill Response Strategies*

The application of remote-satellite imaging, coupled with GIS technology, has been used to create coastal maps enhanced with environmental information. The use of such techniques for oil-spill response requires the development of practical applications to assist responders with real-time decision making. In a joint effort with regional navies for Black Sea oil-spill contingency planning, the U.S. Navy has developed methods by which a quick, accurate, and economical application of existing technology can be used to produce data-rich maps for a large area of interest. This combines various existing techniques to create practical applications and usable documents for Sixth Fleet planners and responders.

### *GIS: A Win-Win for Environmental and International Security*

A powerful tool, GIS can expand to cover the Sixth Fleet's area of responsibility and applies to fleet planning for joint and combined exercises, its methodology is suitable for other applications, and it is a fruitful area for international cooperation.

GIS applications include the following:

- Provide operators with environmental data needed to write the Annex L;
- Describe the quality of the environment potentially affected by an operation; and
- Allow operators to:

- Rank alternative operating areas in terms of environmental impact;



Figure 1. Engagement Planning Cycle

- Assess environmental risk;
- Identify operational limitations resulting from environmental protection; and
- Determine what areas should be avoided.

In a broader sense, GIS will support fleet planners by improving environmental decision-making capabilities and helping to support training, planning, and response; reflect current conditions; consolidate data resources; explore alternatives; and leverage available technology.

In summary, each major component of the GIS concept lends itself to international cooperation, which will save resources and encourage progress based upon experience and lessons learned. With GIS and remote sensing, we are at the forefront of a new beginning in international cooperation. It is a sure win-win for everyone that cares about environmental and international security.

## MILITARY CINC ENGAGEMENT ACTIVITIES: A POTENTIAL RESOURCE

CAPT Robert Brandhuber, U.S.N  
Chief, Regional Engagement Division  
U.S. Pacific Command

### Introduction

While putting together a regional engagement plan for U.S.PACOM, I came to recognize the importance of environmental issues as a means to impact security relations in the Asia-Pacific. The National Military Strategy alludes to shape, prepare and respond as foundations of our strategy. Under the shaping pillar of the National Military Strategy are topics entitled engagement, deterrence and alliances. I work on engagement strategy. In a broad sense we use engagement planning to determine what we do with our resources in the Pacific in a peace time environment to positively influence the outcome of events in conjunction with the State Department and the Interagency process.

### What is a CINC?

Obviously, the main function of the U.S. Pacific Command, as is any regional CINC, is to be prepared to fight and win the nation's wars and be prepared for contingencies or crises. Admiral Blair is the Commander in Chief of the Pacific Command, a four-star Admiral, who, reports directly to the Secretary of Defense. He has at his disposal somewhere in the neighborhood of 300,000 sailors, soldiers and marines. These forces have to be prepared to fight and win the nation's wars when called upon. And that is what they are trained and ready to do. But, in peacetime what we do besides train and prepare to fight the nation's wars, is something we consider in planning engagement

events. We examine how we can use these resources to positively influence military-to-military relations with countries in the Asia Pacific. Utilizing these resources in peacetime to enhance National Military Strategy is what we coordinate.

## Theater Engagement Plans

So with that as a backdrop, I would like to give you an update on what we call our theater engagement planning system. And obviously in the military we have to have systems and cycles and bureaucracy and oversight to get things done. But it is, I assure you from having been involved in it now for the past year, a very complex process to try to orchestrate the goals and objectives of many different organizations into a focused response for each individual country. PACOM has 43 countries that the CINC is responsible for in addition to those 300,000 troops. And



Figure 2. Country Assessment Team

those countries range from the Maldives, Vanuatu, American Samoa to Japan, China, Korea and India. So just from that perspective, there is a plethora of opportunities

and challenges. From our perspective, we try to target the correct military engagement event to the correct country for the correct reasons, which is the reason that I personally have spent time with Curtis, Gary Vest and Kent Butts, to examine how the environmental peace may be a tool to use in our engagement strategy. See Figure 1 – Engagement Planning Cycle.

I attended a seminar this past summer at the Asia Pacific Center for Strategic Studies in Hawaii. The conference discussed small island nations in the Pacific. The major issues were global warming, fisheries enforcement, coral reef issues, and good governance. They are very interested in environmental issues. So we try to coordinate those activities that can be conducted by our Component Commanders, (Army, Navy, Air Force and Marines, and the Coast Guard, although not part of the Department of Defense) to work with the host countries to help them resolve the issue. We link Component activities to the U.S. and country interests to help achieve enhanced regional stability.

Some of the Theater Engagement Planning is coordinated through the Engagement Working Group. Out in Hawaii, we had our first group for the kickoff for the fiscal year 01 plan, last week. We try to link the planning cycle to the budgeting process so that we can try to connect those groups and organizations together to maybe get a chance to match the resources with the plan and actually get something accomplished rather than just writing the plan. There is an engagement steering group that oversees the working group. We have an operational plans and a concept plan. The operational plan is the one year execution plan. That is what we give our components after they have had inputs, and tell them to execute. The concept plan is a longer range plan that covers 7 years and tries to put the building blocks in place to achieve our objectives in each country.

I do not want to belabor the details, but I do want to let you know that there is a process that we go through to integrate all the different organizations and their activities into a reasonable plan. Because we work on the fiscal year cycle in the Department of Defense, our plan is from October to October. And that in and of itself creates problems because to many countries of the world, our fiscal year does not mean anything. So even the simple thought of trying to agree to when it is that you are going to have time to talk with them to coordinate this plan and make it all come together is sometimes a very difficult process. Finally, we must coordinate with the U.S. Ambassador's Mission Performance Plan mandated by the State Department.

So, we bring in this engagement working group (EWG), report the results to the engagement steering group in December in preparation for a February EWG that brings

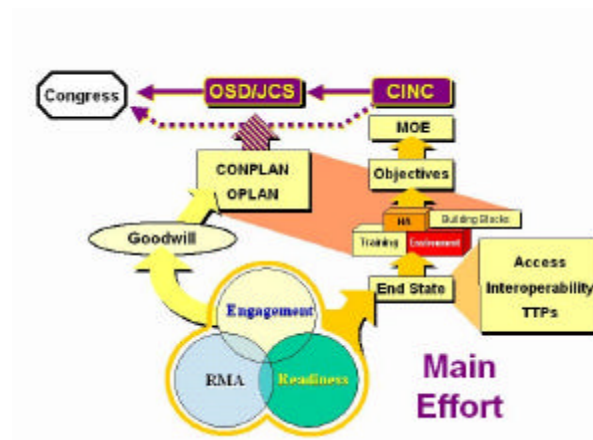


Figure 3. Theater Engagement Plan Management Information System

the country Defense Attaches to Hawaii to represent the country and Ambassador in our planning process. Our overall objectives in each country are delineated. The DATTs review our plan and take it back to their staff, work it with the Ambassador and their country team Reps, and the country. We wait for some feedback from the DATTs.

And through the steering group to keep the Admirals and Generals informed of the direction that we are going to take ensuring that there are no concerns or consternation. We then get back from the DATTs what their input is from the individual countries and try to meld that together with the components. We get components together again and try to mediate differences of opinion or intentions to get an executable plan. See Figure 2 – Country Assessment Team.

Back to the steering group. We then give the CINC our engagement brief. Admiral Blair personally signs off on what it is that we intend to do in PACOM for that next year. Obviously, he gets the last vote. Then back to the engagement working group to make sure that everybody understands what the guidance was from the CINC. I think it is important for you all to understand that the CINC does not act alone. Each one of the regional CINCs is tasked with this same type of engagement planning process. Those plans are integrated in a “global family of plans”. So other CINCs may do the process in a different manner as far as dates, times and how they do it, but the idea that there is coordination of resources in the AOR across the CINCs is not something that we just do solely in PACOM. At the end of the process, we publish what we call a country campaign plan (OPLAN). It delineates what the activities and events are in pretty excruciating detail— who is going to do it, what timeframe we are planning on doing it, what is the purpose of the activity, how it ties to prioritized regional objectives etc. We submit our plan to the Office of Secretary of Defense and to the Joint Staff, not only for the execution year, but for the next 7-years, to match what is called the fiscal year defense plan (FYDP). So, it is an attempt to optimally coordinate and orchestrate use of the military resources that we have in a peacetime environment to create and execute an engagement program in PACOM.

The plan serves to support the CINC's peacetime objectives of access, interoperability and coordination on tactics training and procedures. We want access in a

peacetime environment as well as in the event that we need to have access in wartime. And we want to work with those countries to achieve these objectives. I would like to give you a short example: Consider the Philippines. Many of you may not know that within the past year we signed a visiting forces agreement with the Philippines. We are back into the business of working together to try to help bolster our common interest. As part of that visiting forces agreement, ship visits, and more military-to-military interactions are important. But the issue of environment is a big issue also. The Republic of Philippines is concerned about the environmental status of Clark Air Base and Subic Bay. And when we talk about how we would like to gain access to the RP, we do not mean permanent access, we do not mean we want basing in the Philippines, but, being able to get air traffic control so that we could fly in and fly out, being able to conduct port visits, exercises and training is important. But the government is concerned due to the allegations that previously we left Clark Air Base and Subic Bay in such an environmentally bad situation, that we are looked at skeptically with regards to future intentions. The environmental situation impacts PACOM objectives.

A couple other that I will go through while it is on my mind is Coast Guard and coral reefs and fisheries. There is a need for the Coast Guard to support, train, educate and teach countries how to control fisheries and coral reef exploitations. The Army Corps of Engineers also concerns themselves with being environmentally compliant and supportive of engagement strategies. So, you can see the environment is important as we coordinate peacetime engagement.

#### Meeting Peacetime Objectives Through Engagement

That is what we would like to have ideally in the end game, is access, interoperability for various levels of interaction and the training tactics and procedures that

allow us to work effectively with friends and allies. How do we do that? By engagement events that meet our objectives. The CINC codified engagement events as “good will” and meeting our objectives. The idea is that many of things that we do are necessary and do have good will value, but they may not contribute to meeting our objectives. I will give you an example that I think is not offensive to anyone, I hope. The different services have bands and are called upon at various time to go “show the flag” and be participants in various events in different countries to represent the United States of America. There is nothing wrong with that from a perspective of good will, and if the funds are available, we try to support that. But, as far as meeting any objective of access, interoperability or training tactics and procedures, it is hard to tie a band visit to something that is going to help us alter the destination of the countries of the world in the future.

Now from the measures of effectiveness standpoint, now everybody subjectively can say, well sure, it shows the flag, it does good things, it gets people together to interact. We spend a little resources in their country. They feel good about us. But to get some type of real measure of effectiveness about a band visit is very difficult to do. So we have kind of separated the ideas here that there are certain things that go on that are good will related and have an intrinsic value, but are not really what we are trying to do with the 300,000 resources we have in our area. See Figure 3 - Theater Engagement Plan Management Information System.

Our main effort is trying to achieve those end states. Some basic building blocks are essential and shown. That environmental piece is not on there just because I am at this meeting today. I have been showing that for quite a while because I believe personally and I think it is something that the CINC is now beginning to believe that there is a lot of value added, and it is the reason that brought me to this conference, to talk to you about it. Because there is a lot of value added that is also marketable at higher levels with the

environmental piece. Because if we would go into a country, as an example, with troops from, the Special Operations Command Pacific (the Green Berets, the Special Forces Units) teach people how to do special military operations there is hesitancy from a DC perspective and from a political perspective to support that activity. Why do we spend U.S. resources to do that type of work? Why are we doing that?

### Environment as a Tool of Engagement

So, to gain politically acceptable access and military-to-military engagement which meets the objectives of the National Security Strategy, we build those building blocks of interoperability and exchange that we have capabilities with in the military, we may look to the environment as a means of gaining access. We can use that, and that is not offensive to anyone with regard to establishing contact. Getting some of those training, tactics and procedures together, understanding each other better and using something a vehicle that is not potentially contentious as other things could possibly be is important.

### *Research in the Arctic*

I will give you an example from my own community. For about the past five years, submarines go to the Arctic and do scientific research. The University of Washington and a couple other universities have put people aboard through the Arctic sub-lab and an organization back in DC. They go to the Arctic and study environmental impact of global warming, pollution, etc. And some people from my community would say how in the world could we ever possibly consider using a nuclear submarine to do that type of work? Why would we ever want to do that? We certainly do not build nuclear submarines to do that. But if it is available, it has proven to have intrinsic value in studying global warming. So it has value added for all. So the environmental piece is not something that is just there for

show. It is something that we believe has some inherent intrinsic value that is capable of achieving some objectives.

### *Fires in Indonesia*

Another environmental example is the fires in Indonesia that periodically come up that cause some significant air pollution problems in Southeast Asia. How do we resolve that? How do we get Singapore and Malaysia and other countries to stop accusing Indonesia of being insensitive to the environment just because they can not seem to control or get a better way to go after their fire issue. And we have, as you know, the resources and assets within the United States to train Indonesians and work together to help them control fires. And I think that is something that is inherently more politically palatable than some other military events that we may have done with Indonesia in the past. We should use our resources to help train, equip and prevent this environmental catastrophe from happening with its associated political ramifications among countries in SE Asia.

### Engagement Planning in the Future

Where are we now in future issues, regarding engagement planning. I would reinforce that all the CINCs do have a peacetime engagement plan to facilitate utilizing the resources at our disposal effectively. Not to detract from our prime objectives, but to use appropriate resources in an effective manner to achieve country objectives. There is a plan and we are developing measures of feedback, to evaluate our effectiveness. Issues, I think, is worth talking about just for a minute. Acceptance is difficult. Some people would say we, the military, absolutely have no business at all concerning ourselves with environmental issue. Our purpose is to fight and win the nation's wars if tasked upon to do that. And the components would tell you under Title X law, my responsibility is to train and be ready and operationally capable of fighting and conducting war. And

that is my job, train my people and be ready, so that if you tell me that we need to go and fight, we are ready to go do that. Well, other people would say, as you know, boy that is an awfully big organization for 90% of the time that you do not fight wars. And hopefully, if we do our shaping properly, we will not fight wars. But this idea of acceptance, of using the military in an optimal manner to influence events in countries through engagement, is difficult to achieve. Some military members say, "Hey, wait a minute, that is not our job!" Our job is to be ready to fight and these engagement events are detracting from our ability to prepare. We have to overcome the hesitancy, continue to be prepared to fight and win, but optimally use resources in peacetime to prevent future wars.

Connectivity is an issue within the organization that integration with the State Department's mission performance plans is still a difficult process. The State Department, just like us, has some difficulty in evolving to this. Different Ambassadors have different degrees of acceptance of the idea that we are going to integrate and work together. And how they write a plan, the quality of the planning effort, is sometimes subject to the individual Ambassador and size of his or her support structure. Ankle biters is just the everyday stuff that everybody else has to do on a continual basis that does not make engagement planning their number one priority. To tell you how important engagement planning is, all of the CINCs get together about three times a year at a conference. In February they are going to get together with the President during one of those conferences and at that CINCs conference in February they are going to talk about peacetime engagement. And you can imagine of all the different things they can choose to talk about, the fact that they are going to talk about how we do this peace time engagement planning and resourcing, tells you that this process, at least within the Department of Defense has some legitimacy and maturity to it, and is here to stay. I hope, since Dr. Butts did not stay here to listen because "he knows

it all,” I hope this kind of sets the table for and meets the mark for what the Dr. asked me to talk about with regards to how we conduct engagement planning. And I would be willing to either here in the group or privately answer any questions that you may have on anything that I presented. Subject to any questions, that concludes my presentation. Thank you for your time and attention.

### Questions and Answers

I know that you had talked a little bit about working the interagency process, and in looking through your step by step cycle, in either the engagement working group or in the steering group, are there interagency members involved in those meetings?

At our level, no. I also represent PACOM in DC with an engagement group within the OSD. And there is Department of State representation. The interagency from my perspective at the local level is through U.S.CINCPAC's political advisor, Ambassador Twining working with the State Department. We have contacts, like in the J4 organization in PACOM, that is how the engineers get in touch with people like Curtis Bowling in OSD who have leverage and connections with people in other areas of the government. We do use Coast Guard, that is transportation, and that is interagency. I would say Coast Guard and State are the biggest agencies that I deal with on a local basis, and then we work with OSD and if we need more help, they know where to go.

I was in some discussions with the Corps of Engineers recently where we were talking about infrastructure programs in the Pacific and their relation to coral reefs. In order to provide discussion or have discussions with representatives from your area, is the Corps of Engineers a suitable venue?

Absolutely. Curtis [Bowling] knows that is something that I have been very interested in. There is a Pacific Corps

of Engineers Group in Hawaii on the Army base. I went down and briefed their General and talked to them about this very same subject. We have a parochial interest in this if I may say so, sir. It is embarrassing to the CINC if somebody starts to talk about something that is going on in a country in our AOR, especially being accomplished by the military groups, and he does not have insight, visibility or awareness. The Corps of Engineers, as an example, should not be out there marketing their own wares to some country without the rest of us ensuring it fits into the CINC's objectives. It is much more easily conceptualized and thought about then it is actually put into action, even with technology as it is today. That is why one of my slides showed Connectivity. I do not want to bore you again with details, but that is basically a secure wide area network that would get us into the country teams and all the components at the Action Officer Level so that we can all be talking on a secret level network to ensure that we understand and coordinate the plan. But, yes, the Corps of Engineers is a critical portion. The other one I would tell you is the State partnership programs — National Guards and the Reserve Contingents. I do not know if you are aware of this or not, but the state partnership program strives to get a state to country relation. Then the Adjutant General from the National Guard follows up to establish relations with an individual country and its military. Is their agenda necessarily our agenda? As TEP develops over time, how do we ensure that from a national perspective that we are doing what the Ambassador and State Department want us to do; so that we are taking the right steps in the peacetime environment. TEP has only been in effect for about a year and a half now. Lots of struggles within the Department of Defense with regard to acceptability and understanding, but it is working. It is not going to go away. Last year I would not have said that. This year I am convinced.

From the perspective of the international community, I wanted to see how something would fit into this picture. There are efforts at the Offices of

Intergovernmental Oceanographic Commission, and the World Meteorological Organization to assist Ecuador, Columbia, Peru and Chile developing a regional ocean observing system that is going to improve their full cost capability for climate related events. The primary contact in each of those countries are military. The navy is responsible for the ocean observations and if they have the capability to do this, the information is also of use to U.S. military because it is going to provide an additional data set to improve full costing in general. What is the appropriate mechanism for that to fit into one of these CINCs?

Those particular countries are not in my AOR. I would say it is a SOUTHCOM, Southern Command, issue in Miami, FL. But that is where I would say the relationship here with Curtis and OSD is good. He can get it to the right people in that area and the right CINC. I know that General Wilhelm is the CINC in SOUTHCOM. He is more forward leaning in environmental and other areas than some other CINCs are for various reasons. But I would think that he would be: (a) receptive; and (b) at least put in contact with appropriate people that would make that connection. And I think there would be interest in that.

I would be happy to talk with you off line. Those are the types of opportunities, I think, we are looking for. We are building relationships now with the Argentine military and that would be a great regional effort. It would be very worthwhile pursuing.

If I may be very candid with you because I think sometimes it is very helpful to understand. There are certain people in the military that would say, what value added does that have to us. The term, if I can be frank and a little bit blunt, the term is in some cases "training down". I think there are people who do not understand well enough. If you represent the United States and you are a four star admiral or a general that runs a large organization, there is

a lot of other countries that do not have the inherent capability and resources that we have. There are some people in our military who say we do not gain any value added by interacting in that area. I think that is – on a personal note – that is not the way we should be heading or are going in the future. There are some people out there who would say we have got to be ready to fight the wars and organizations. Peace keeping operations, involvement with non-government peace enforcement operations, search and rescue, humanitarian assistance are all things that as we go forward into the 21st century are incumbent upon us to understand are part of our role. How we influence and shape the events of the world in the future using a military structure appropriately is critical. We have some acceptance issues in our own organization regarding that. We must be prepared to fight and win, but appropriate utilization of U.S. military resources in peace is essential.

I think that SOUTHCOM has really – that they were going through a process in the summer to try and determine how they could incorporate environmental considerations into the theater engagement plan. We had a session with them at the Woodrow Wilson center in Washington where we brought in an interagency group, NGOs, and a lot of folks who were working in that area got to give them a perspective of the types of things that were going on and the types of interests that were out there. They used that input then to come up with an Annex that would incorporate environmental activities into the theater engagement efforts. Again, I think they might be receptive to at least listening to the ideas. One of the points I want to make. My office, I guess is not really a new player into the environmental engagement but I think we are becoming more of a willing partner and trying to do better communication/coordination with the theater commanders and also on the interagency basis. I think that is one of the things that we bring to the table. There are a lot of things going on in Washington that the CINCs may not have visibility over and we can bring that to the table when we go

through the theater engagement process. Hopefully get everybody understanding what is going on and have the transparencies so we do not, as you say, step on each others toes.

If that occurred in your AOR, if you had three or four nations whose navies were cooperating on addressing an energy issue that was important to their national security and there was an opportunity for the U.S. military to support them with, data or monitoring in some fashion, would that qualify as an acceptable engagement activity?

Yes sir, it would. I think people have to – to be honest with you, I will go back to the one I am very familiar with. The segue is this Arctic research using a submarine. That creates a lot of consternation among people. What is the value added? What are we doing? Why are we – we who have constraints for operational tempo, personnel tempo, dollar restraints on resources, why are we taking that resource and using it to accomplish this mission? There has to be some tie. Even if it is a good will event, like I alluded to, there has to be some logical tie to why there is some value added to a U.S. force to do that job. Anyone who is asking that type of question, or wants to bring that together or knows that it is going on, should be well prepared to articulate why they think it is to our advantage to do that mission and at least explain what the rationale is for considering it. That sometimes gets lost in the shuffle with regards to why. It depends who you talk to, as you know, 300,000 people, is a large organization; some people do not have the total picture. If you are interested in doing that, and Kent does that very well, if you get the door shut on you in one place because you did not talk to the right person, there probably is someone else who would understand it from a different perspective and be able to do it in a different venue and with a different vehicle. But I think you have to think through about what is the value added and using the resource to accomplish the objective. I think that is important.

So for our regional CINCs then, we would stress civil support or military support to civil authority and promoting the strength of newly democratic regimes. Regional stability and interaction between our militaries and theirs in a new technical area?

Absolutely. From our perspective, take China as an example, We can not do anything with China right now. We worked very hard to establish some things in search and rescue, humanitarian assistance, disaster relief with China and we are literally at all stop because of the embassy bombing incident. We are not doing much with them right now. But I think the point is if you wanted to do something, and I do not think in this organization, that is really the area that you are going to head to, but we would not do anything that would help China become a stronger military power. We just would not do that. But, in the area of peace keeping, in the area of humanitarian assistance, in the area of search and rescue, Admiral Blair has been very specific. Invite them. Let them say no! But any type of bilateral or multilateral event that would involve law of the seas, that would involve anything to do with environmental, that involve peace keeping operations, that would involve dialogue on a military to a military basis to enhance our understanding of them and them of us and what is important, why not? He is very frustrated personally that we do not get more of them into our schools. Education! Why do not we just have them exposed to our system?

You are talking about this acceptance issue from the perspective of the U.S. Military. Is the same issue is valid also from other nation's militaries. So, if when you cooperate in a region, can you foresee some major problems? They would also say well our mission is not worried about environment. We do not care if the U.S. military is so up about the environment.

Very good. We have heard that. I am sure you have all heard this. The U.S. has plundered and pillaged the

environment 150 and 200 years ago in its industrial revolution and now it wants to apply new standards with us. We are not interested in talking about that right now. Yes sir. That is why I think the coordination with the Ambassador, what the country feels like they are willing and able to accept and what we believe that we are willing and able to help them with is critical. We are not trying to serve on them a plan that says we are from America, we want you to do this. That is not the intent. Do we get subliminal benefits out of working with them? Yes sir, you know that. But it is not the intent for us to write a plan in absentia and say as a military, this is what we think would be beneficial to Japan or, whoever. It is to try to work a mutually agreeable, acceptable type of orchestrated steps that would allow us to show that we are accomplishing things together. Difficult. Very difficult.

This may be one issue where you may need a UN agency, or an agency type of organization to be a facilitator?

Yes sir. I think that is a very good point. And we have found out just recently with the East Timor situation, how critical it is to use the good auspices of the United Nations and the information and the access that they have to work things together and be involved. The discussion with UN contacts is very important.

Understanding a different opinion about UN too. Another problem?

Yes sir, another problem.

It seems to me that the most important thing that the U.S. can do in this area is to emphasize the near term social and economic benefits to these countries of their participation. For example, this region that we are speaking about, severe storm prediction. That is a really big issue. I know that is not the military's goal and purpose in life, but to have these people in these governments see the impact on their

economies. For example, collecting more ocean data and cooperating with us.

I think the military role, if Admiral Blair were standing right here, I think he would tell you that storm prediction is important to us because what happens when Taiwan or another country has an earthquake or severe storm? The U.S. Navy gets called upon to help, and if we can do a better job of helping other people predict and prepare then we should have less of a crisis response role. That is the idea of shaping, to see what we can do to work together to ensure that we minimize the impact and demand on our resources and assets in either crisis response, contingency operations or full fledge war. We do respond as you know frequently to those humanitarian disasters that occur in AORs throughout the world. If we can do a better job of preventing, in the end game, I think it would help.

How big is the environmental piece now? You mentioned 2500 actions a year?

I doubt that it is 10%, 5% would probably be more realistic.

How big could it be?

That is a tough question. I am not trying to duck it. As always, resources drive everything. Partnering and cooperation of resources and things of that nature are required. But it is certainly not going to be 100% that is for sure. Depending upon other partnering and resource issues, I do not want you to get the wrong impression, Doctor, I am not here to stand up to say that we the military are ready to say that we need to work on environmental at 100% of everything. It is a piece, it is an important piece, and the amount of the important piece is something that is dependant upon the country, the situations, the partnering, the resources, etc.

I think one of your primary tools of engagement right now is exercises?

Yes, sir.

Exercises can have environmental component, the way we behave during an exercise with a partner or if you incorporate environment as part of the exercise like doing a spill response as part of an exercise. So there are other ways to get environment into an engagement strategy other than just making it purely an environmental engagement activity?

That is a very good point. We are very concerned about A) improving and B) not making things any worse due to our presence. We environmentally plan for events that we have and take into account potential environmental impact. admiral McClelland is the Coast Guard Commandant in Hawaii and I think recently, I did not study it all, but I think recently, did not the President just sign something to do with the coral reef issues? That is an issue that the Coast Guard are very active and concerned about and feel like within the military “arm” of the Pacific that they are the ones who carry the mantra of making sure that people understand the importance of the environmental coral reef issue. They are perfectly willing expand that type of dialogue. As they travel throughout the AOR, I assure you that the environment is constantly on their plate and part of what they think is their Coast Guard mission.

On a specific nation by nation basis, suppose that there is an incentive and there is enthusiasm and energy with regard to a specific engagement with nations but all of a sudden, the military starts to back off but you have civilian or academic interests that you could have a relationship with. And in that same context, suppose the military and the civilians are not getting along in the most ideal way. How do you abide in that sort of complex situation?

A very good question. Again, not speaking for Admiral Blair nor would I want him to be necessarily quoted through me on this, but he is very interested in exploring the idea

that there is a certain baseline of engagement events. That was one of my charts. Humanitarian assistance, environment and education are part of the “baseline” of activities. Mr. Smith I think is from the State Department and has not commented at all yet and I do not want to “get out of my lane” with regards to OSD versus State, but the thought process I have heard the CINC articulate is this frustration of ups and downs of relations with countries, “on again, off again relations”. If the Ambassador is in the country, why is the military not capable of doing some baseline level of engagement activities on a continual basis independent of the cyclic oscillations of relations. We would include in that baseline of acceptable activities I think, the environmental piece, a humanitarian assistance piece, and a basic education piece. No question about it. I will give you an example that really frustrated the Admiral a lot with the Indonesia situation here recently. We have some Indonesians who are taking English language training in the United States, being paid for by the United States. As a result of East Timor, the government ordered a stop to all military-to-military relations. People stopped going to school. Why? We need to have a longer term view & have certain engagement activities be permitted, like education, independent of the current political situation.

We have been receiving a lot of requests from a number of delegations from China, three in the last 12 months for projects with them in three areas. One is hurricane or typhoon research. Another is infrastructure development, sewage, dredging. And the third is for development of technology to sell on the world market in oceanography. These advances and delegations that came to visit are basically unaffected by anything that occurred in the world over the last 18 months, as though they did not occur. They just continued to come forward. Is being aware of these kinds of things or joining in these kinds of things of interest?

Absolutely. If I may give you a China related example. The South China Sea, Spratley Island issues. The CINC has personally tried to call every chief executive officer of oil corporations in the world who might have an interest in that area to try to figure out the answer to the great question – are there really natural resources of worth in the South China Sea that would impact the strategic situation in the future? And if so, what do we think they are, what would the cost of a barrel of crude have to be to make driving economically viable and feasible? All of that information is very critical to the way we see the future. So, yes, we are very interested in what is going on, of other levels different sources of information. It goes back to the reason that I am standing here at all, is I was extremely skeptical about all of this with regards to the environmental piece and engagement. What struck me was when the Secretary of Defense was going to go in to China last year and exchange some agreements with China was that one of the three agreements was an environmental piece that did not get signed because of the bombing. It was an environmental piece, and it was socially and politically acceptable. We could not get the military-to-military engagement plan approved, but we could get an environmental agreement. We need to use all facets of engagement planning to foster our objectives.

I would just like to point out that this morning's Post had an article that said there was potentially a high level military delegation that is coming to Washington in December. So we are very much encouraged that we might be able to move with the environmental MOU that the Secretary of Defense...

Sir if I may, I see in what we try to do with China, what we would like to conduct; what they would lay out as far as where we would like to go; transparency, reciprocity, etc. We get all wrapped up in those terms– it seems that we spend an awful lot of time working on trying to get those things worked out and on the side over here is the Secretary of Defense going to China to sign an MOU on the

environment. You kind of go, wait a minute! What is that all about? Why did we not have some transparency into that? Why did we not try to influence and coordinate and be involved in that? But be no doubt, we are a fighting CINC, if you call us to tell us go, we are ready to go. There is that balance of resources and balance of responsibility. But we are very definitely interested at trying to influence. We would want to know and coordinate what is going on in the military-to-military area to ensure U.S. interests are met.

## DISCUSSION AND RECOMMENDATIONS FOR ACTION BY WORKING GROUP I

Dr. Ned Cyr  
International Oceanographic Commission

Why should the military be concerned, what is the military role in protecting the world's water bodies and why should the IOC, other organizations and the military work together on this issue?

The U.S. military continues to improve its own sound environmental practices; many speakers have addressed this over the last two days. Moreover, the military can share information about its environmental practices with other militaries in the world, and work with them to raise their level of environmental responsibility. In terms of common interests between the scientific establishment and the military, the military obviously needs more data and information to improve their forecast capabilities. This is the operational oceanography that the militaries need and the civilian community would like to improve our knowledge and capabilities in the same area. We also have a common interest in terms of development and use of operational oceanographic products in coastal waters and in the high seas areas, which are outside of individual national Economic Exclusion Zones (EEZs). The latter offers a good initial opportunity for a military role because it obviates the constraints of having to clear our research efforts with nations in their own EEZs.

So where do the scientific research needs of the civilian community intersect with military capabilities?

This is the crux of the presentation, and there are some good concepts on how we can cooperate together. One of the more obvious areas is to use vessels, primarily naval vessels, as platforms of opportunity to allow the scientific

community to expand the range of its sampling capabilities. There are large areas of the world's oceans that are under sampled from an oceanographic perspective. The reason is the high cost of sending a research vessel out to these areas to make observations. There may be naval vessels that are transiting these areas, which may be instrumented or supplied with instrument packages to collect data. Simply having a platform of opportunity that the scientific community can use to collect some data would be tremendously useful.

What are the impediments to this?

There are limitations to the platforms of opportunity. One is the legal constraint that I mentioned. Conducting marine scientific research, in other countries' EEZs, would obviously be a very difficult process and simply decided that at this point it would not be feasible to conduct our research using military vessels as platforms of opportunities in other EEZs.

Now, a given country's navy could certainly do that, yes?

That is correct.

And in fact, is it not true that most navies in the world typically stay close to their shores anyway?

Yes.

So at least in terms of engagement, you would not be advancing the proposition that the host nation navy would do that sort of thing at its own EEZ?

Yes, sir. Operating in their own EEZ, they could very well collect this type of data.

And then it principally becomes an issue of resources for the instrumentation and the training?

Correct, the second limitation is resources. This effort requires an inexpensive black box technology that can be

deployed easily using little manpower. It should be technology that is compatible with other systems on a vessel. This system needs to be automated so that it does not take the manpower on board. There is a civilian ships of opportunity program that collects meteorological data from merchant vessels globally and we think that military platforms of opportunity is a good idea, however these constraints should be addressed before it can be applied.

Has anyone ever done a survey or inventory of what is actually being done in this regard? For example, how many navies in the world actually do this sort of thing?

I am not aware of any surveys that have been done of navies. I know that I have seen some compilations of observing systems from ships of opportunity.

We have some recommendations towards the end of the presentation on how to proceed in terms of investigating the feasibility of the approach with the OSD, so we can pick up the discussion again at that point. In terms of whether there is been, or whether there could be a study that could be done on where this approach needs to be applied from the standpoint of the scientific community, the planning that is gone into the global ocean observing system, GOOS, specifies requirements for observations. In some cases, those observations are accompanied by a specific geographic location. I think those could be used to identified where better observations need to be made, and if this sort of technology could be applied if it was determined to be feasible.

A second broad category of cooperation that showed great promise stemmed from the presentation that Dr. Diane Drigot made about the work eradicating mangroves and other invasive species on the installation in Hawaii. Military installations in coastal areas could essentially be used to function like the National Science Foundation's long-term ecological research sites, where a team of researchers there on site could actually make repeat,

routine long-term observations on the ecosystem. They could determine how the ecosystem may change, either in response to very local anthropogenic forces or to longer term changes such as those driven by climate variability. Many of these military installations are going to be in place for a long time, and they may provide a good opportunity for doing that type of long term research.

A third area of cooperation is to continue identifying and declassifying data. There is already quite a bit of this work being done in terms of identifying data sets that are being held by militaries and declassifying them. We need to continue that work, it has been very fruitful.

Cooperative development of advanced remote sensing systems would also offer great benefit. Quite a bit of marine remote sensing goes on right now. An AVHRR is one of the real workhorses of the oceanographic community in terms of providing sea surface temperature data. We also get altimeter data from Topex Poseidon and synthetic aperture radar data from various platforms. However, there could be an entirely new generation of sensors available to which the civilian research community does not have access, but for which part of the data could be de-classified with no threat to national security. By the research community expressing to the military what its observational needs are, we may be able to move forward in terms of developing advanced new sensors that would be useful to both groups.

A fifth area of cooperation lies in testing and validating forecast models and data simulation. Operational navies need forecast models, particularly hydrographic models of how currents are going to behave in certain areas. Scientists in the civilian community could use that sort of information as well to help test and validate their own models. It would be a good pilot activity to use naval vessels, perhaps during an exercise, to test and validate some of these forecast models.

The existing SOSUS technology offers further opportunity. SOSUS is a system of large submarine

detection arrays in the Atlantic and Pacific. It has proven to be extraordinarily sensitive in detecting marine mammal noises to the point where, in some cases, individual mammals can be identified. As far as I know, it has only been used in this research mode to date, but it has been proposed, that it could be used also to do counts of marine mammals, which is difficult and expensive. It could also be used to detect trawling activity and earthquakes. The SOSU.S. array is currently operational, but it needs a mission and it needs some operational funds to continue operating. It is a resource the research community could and should use. These are the general classes of our recommendations for research.

How do we proceed from here?

First of all, we need better dissemination of the information. It was the idea that a lot of the navy data is already available on the Internet, but many in the civilian scientific community were not even aware of that. So, it is important to communicate the location of readily available data.

Second, the U.S. military should be used to engage other militaries. The U.S. military could share the best environmental practices as well as gather scientific techniques that the militaries are currently using. Of course the host nation militaries would need demonstrations of how it benefits them, either through operational oceanographic products or through environmental compliance. An awareness campaign should be initiated that markets the benefits of environmental stewardship to the militaries.

Why should they care about these types of activities?

Through these operational products they can have better knowledge of oceanographic conditions for their own operations, increase their compliance with local environmental regulations, and increase the level of engagement with other militaries. But there needs to be an

awareness-raising campaign within the military as to why this is of benefit to them.

The Global Oceanographic Observation System (GOOS) has already done quite a bit of work identifying the operational oceanographic observations. A major multi-lateral naval exercise could be used to help collect the information that would be useful for GOOS.

GOOS is operational oceanographic system and that means not only collecting data, but also forecasting. So, as compared to getting continuous data available, you must also carry out some exercises in which you test how good you are in forecasting the state of the ocean. We start with the physics. One way to get several navies together, for instance, is to perform a multi-ship exercise in which everybody participates in how to forecast the state of the ocean in a given small area. And through such an exercise, one can also transfer knowledge. Because the U.S. Navy is the best at operational forecasting, other navies will learn the state-of-the-art. This is one exercise that could be generated on a regional basis.

NAV OCEANO currently has an ongoing program where they are reviewing data sets and they are constantly declassifying information and making it available to the public as it become declassified. However, that raises the issue how and why it was collected and that may have a bearing on whether or not information is going to be released. It is an on-going program and it was recognized in Year of the Ocean at the Monterey conferences as one of the things that the President wanted the DOD to continue to do. The Navy may also have the technology to address the introduction of exotic species through ballast water. There should be closer cooperation between civilian researchers working on this and the Navy.

Some of you may have been involved in the effort that started about eight years ago when DCI Gates formed the Environmental Task Force, and founded what became the MEDEA group to look at U.S. intelligence

information for declassification or downgrading intelligence for environmental purposes. Was anyone here engaged in that or aware of the existence of the program? Did we do that very well for this purpose? I do not know because I was involved in it but not in this particular part. You are suggesting there is more opportunity that is unrealized?

We are suggesting that there is potential for that type of sharing, but we do not know the extent to which it is feasible because no one in our group is working with remote sensing.

Before you leave this, I do not know what other opportunities there are in other countries? Because as some of you may know, we, under the Gore/Chernomydrin Commission that was a very specific thing that we worked with the Russians.

Honestly, I think that for a long time other countries have not had the capabilities. We and the Russians and a handful of other countries were the only people that really had the capability to go out and get this data. That is not so much true today.

There is also a NATO oceanographic research vessel that is run by the Germans and they collect a lot of data as well for NATO? They also do forecasting from the ship.

We discussed the possibility of using military operations, exercises, in order to test or validate forecast models or collect information that may be useful to GOOS and whether the program would have a geographic focus. We decided to stay away from recommending specific geographic areas.

Where do we go from here?

One of the suggestions was for IOC and Defense to convene a regional symposium involving other international agencies, NGO's, and other militaries to

further develop the ideas and broaden those and get input from the international community on whether or not these are really fruitful areas for cooperation. We mentioned earlier that it would be useful, if we were going to conduct some sort of regional exercise, if the DOD could review prior exercises to look at what lessons had been learned, a retrospective study, how could the environmental benefits of the exercise been enhanced if there had been more data gathering that had gone on. We need to go ahead and identify multi-lateral military exercises that could incorporate this proposal those exercises as soon as possible.

In terms of the ships of opportunity concept, all agree has potential, DUS.D(ES) should request that the Navy review this issue to see whether its feasible to deploy sensor packages on naval vessels. In turn, someone should also review the development of sensor packages. How close are we to having a black-box technology sensor that can just be taken, switched on when we need to collect and switch off when we go into someone's EEZ. That is the type of study that could be done fairly easily by the civilian community. There are a lot of people who are working on developing those sensor packages right now. Identify the types of passage systems that are available on the platforms where they can be placed. There also needs to be some awareness-raising about GOOS. We all felt GOOS was an appropriate framework to provide a sort of operational oceanographic capability and not just research, but it is not clear how many of the world's militaries are really aware that there is a GOOS that is being formed and how it could benefit them in the future. So, we need to let them know what is being planned right now, how they can participate and what they can get out of it. Some of the products that will be developed from GOOS will be useful to navies. For example, the coastal module of GOOS concerns itself greatly deal with predicting things like wave height and sea level in port areas.

Now if you look in terms of U.S. Navy, you probably do not need the GOOS because you are probably doing all that forecasting observation yourselves, and you are probably doing a very good job. If you are willing to transfer this knowledge, this capability, to other nations, then you are really helping the improvement of the global environment. So I think that is the issue we should look at. The U.S. Navy is probably about 700 miles ahead of GOOS in its capabilities and you interact very well with the scientific community. So are you willing to transfer some of what you know to protect the modern environment on a global basis, that is one thing, and from this you can get benefits because if you transfer this knowledge, then those countries who do not have those capabilities will probably give you the data back, that you could never have access to. So I think those are the lines we should really follow.

The other problem that was raised is oceanographic data, unlike meteorological data has implications for the exploitation of resource. There is nothing that grows in the air that we can sell. Whereas in the sea, there are significant resource implications in everyone's EEZs, and consequently, that is an impediment to sharing that information..

My comment with respect to Chile, is that there are two main things that they were concerned about, for which the military is responsible. One was the protection of the fisheries, and one was the protection of the environment in general. Also falling into that category was improving weather forecasting capability. They have a proposal to spend \$20 million dollars within the budget of the military to put in an observing system under the auspices of GOOS, and it follows the plans of GOOS, so their intent, that would provide improvements in oceanographic information, atmospheric information, off-shore the coast, that would ultimately improve their forecast capability, and at the same time increase their monitoring of their ocean habitats. That is embraced primarily by the military.

In relation to the declassification of data, I would like to make a couple of remarks. We do have a program that we run with the U.S. Government and the Russians. Everyone is involved in it on a global basis. It is called Global Ocean Data Archives and Rescue Operation. This is all data rescued. And of course, declassified data is a part of this story. I have the following information to date concerning classified data. So far, only Argentina, Australia, Turkey, Russia, United Kingdom and U.S.A have declassified and contributed to the World Data Center.

## CHARTING THE COURSE: PLANS FOR FUTURE ACTION REPORTS BY WORKING GROUP II

Dr. David Huber  
Global Coastal Strategies

The original order of our questions asked us to identify the water bodies that might be suitable for projects at the end, but to make sure we retain the kind of regional focus, we have come up with a sort of shopping list of water bodies that might hold promise for potential promise. In the Black Sea, for example, there is already been a lot of multi-lateral efforts going on there. Each of these seas had an almost obvious opportunity without coming up with a defined project or more precise explanation of why. Some of the areas have already had active IOC participation. Some of them are already of interest to the U.S. military. The Arctic, for example, there is already scientific cooperation going on there. So there is a number of places around the world that just might at face value have interest. The Bay of Bengal, Strait of Malacca, Sea of Japan, those obviously have strategic interest, so these would be important areas or potentially important areas for military engagement.

One of the ideas that was interesting was that rather than looking at a regional sea area, to take almost a thematic approach, the 25 degree north, 25 degree south, the tropical latitude band around the world that is characterized by coral reefs, small island states that have common problems. And there is sort of commonality of interest based on similar physio-graphic conditions rather than regional proximity.

There is also opportunity to cooperate not on a sort of regional or geographic basis, but on the basis of activities. For example, looking in the climate area, the rainfall measurements that are already being taken by the U.S. military, that effort could be expanded, and it is this 25

degree north to 25 degree south band where that is particularly critical in understanding the global climate system because of the importance of rainfall measurements in estimating heat exchange budgets and so forth, so that would fit into that tropical thematic idea. I will not say much more about physical oceanographic measurements since Group 1's presentation covered those quite well, but one program that NOAA's presently involved in with the IOC is the ARGO float, which are automated drones, buoys that are deployed and drift around in the water collecting oceanographic data and there is opportunities for militaries to assist in the deployment of those. There is also the creation of joint capacities, cooperation on the U.S. side between NOAA and the Navy in terms of data collection, archiving, processing and dissemination capabilities. There is also potential for the military to assist not in actually cleaning up, in fact I think there is a congressional barrier, a prohibition on doing cleanup of accidents, but to develop the contingency plans and assist other countries and other militaries with the technologies and the techniques and so forth of cleanups in the case of spills or other sorts of disasters, or in the design of facilities, and bases where on-board ship systems and so forth can provide for environmental protection. Another idea in terms of general activities with thematic areas was the protection or environmental data gathering on coral reefs, and this fit in with this 25 degree north 25 degree south thematic ideas. So there is a lot of areas, both geographical and thematically where there is already activities that sort of easily fit in to the idea of military cooperation or engagement. So this is basically a shopping list rather than a set of discrete proposals.

If you have this shopping list, what would be the conditions that you would use to start to narrow it down. What are the things that have to be in place before military cooperation, and specifically regional military cooperation, becomes a sort of attractive proposition. Well, for it to be regional there would have to be opportunities for

multi-lateral opportunities. There has to be more than one country interested in it. There is got to be the basis for cooperation and so forth. There clearly has to be a confluence of national and military interest, and this applies on at least three levels. You have to have nations with common interests, with a reason to cooperate, and something both nations have to gain. There is got to be a confluence of interest in each country between the civilian sector and the military sector. And following through from that, that means there has to be something in it for the military, and it is been stressed over and over that any of these programs have to forward the military interest. Obviously militaries have a mission and it has to support them being able to fulfill their mission. Now, another more pragmatic condition is that whatever program is designed has to be in accordance with the relevant policies and laws and so forth.

Now, in the case of the U.S. military, congressional restrictions, specifically required to only undertake environmental activities when they support the Defense purpose and the military mission. And they are also banned from undertaking clean up or remediation of problems. They can clean up their own spills, but they cannot go over to another country and clean up somebody else's mess. Every country is going to have a similar set of restrictions, and under international conventions there are likely to be restrictions as well. So these things have to be clearly thought out and where they conflict with these constrictions, then the project has to be re-designed or scrapped. There has to be a need obviously to match the need of the project and of the individual partners, what they want to get out of it, with the capabilities and assets that everyone can bring to the table. There is no point in trying to put together a project where nobody has the tools to do it. These all seem pretty well straight forward, but I guess sometimes they get forgotten in international projects anyway. There needs to be a really well defined program, clearly specified goals and objections, the budget has to be

well thought out, the realistic availability of assets that are going to be required, and so forth, and the return on investment and benefits for each party. All of these are obvious pre-conditions to any kind of success in a cooperative regional project. The barriers—there are a number of them—are not in any priority order. But one of them is that all militaries have a primary mission that does not involve environmental protection, and any sort of scientific or environmental project has to be designed in a sort of way so that if the military's called on to perform it is primary mission, it does not destroy the project. The military's role cannot be mission-critical to any science program because military is not a scientific organization. Any region or any thematic area is always going to have political constraints and sensitivities. There is going to be areas where it is going to be difficult for the U.S. military, or any particular military to go. There are going to be cultural constraints and internal political constraints and sensitivities with any partner country.

In any program, lack of funding and resources is a problem. This is probably likely to be more severe constraint on partners of the U.S. military. At least from the outside the U.S. military does not seem to be at the same level of constraints as say a developing country military or some of the science programs. There are legal constraints that we have already talked about—the congressional prohibitions in the case of the U.S. military, there will be restraints in terms of international law, the law of the sea, and the whole set of legal frame works that may apply. I have mentioned the social and cultural barriers. The key one that has been brought out several times is the acceptance issue, and this applies both acceptance within the military of their role in these sorts of endeavors, it applies to acceptance to civilian society of a credible role for the military, and in many countries there is a lot of suspicion of the military for example. There is conflict between the military and civilian sectors. There is an acceptance issue for all partners that can potentially really be a barrier to a project succeeding.

We said that a clearly defined project was a condition of success.

Well, if you do not have a clearly defined project, a clear idea of what you are trying to get out of it and what it is going to take to get there then it is unlikely that a project is going to be successful. The implementation barrier for every project I have ever been involved in is critical. It is easy to come up with concepts and conceptual designs and ideas for projects. It is not so easy to actually get it to work on the ground. To get the right people to the table, to get the political will among all the partners to actually make it happen, to sustain the project over time and to give it the priority that is necessary for it to get the resources and etc. An example is the idea that in the Black Sea, great strides could be made if there were simply uniform standards for requiring port reception facilities and waste disposal procedures. That seems like a fairly easy idea but getting it implemented among all the countries of the region is not necessarily an easy task.

One of the questions we were asked in the general model was how to proceed in the process. The first question of course, everything is going to depend on what is the genesis of the project. Who is it that wants the project to continue, who is initiating it. What are the reasons for doing it and then move on to define the project and what the outcomes of it will be. So, the process is obviously going to flow on a different track depending on how its genesis. The critical part early on is to sort out the interagency process. And this is going to have to occur within each camp. For example, within the U.S. there is an interagency process potentially between NOAA and the military and other agencies, State Department, perhaps EPA and so forth. On the international community side, there is potentially an interagency process between say IOC and UNEP and IMO depending on the nature of the project. Following this interagency process, one of the goals is to identify who are the appropriate partners. At this level it goes beyond internal within the individual camps. It is not just the U.S.

government deciding whether the military is an appropriate partner. But beyond that, identifying other appropriate military partners within a particular project region or theme area. The question was raised, is the IOC necessarily always going to be a critical partner in these sorts of issues. Might IMO perhaps be more appropriate for certain sorts of activities. For example, reducing pollution for military vessels. These are the sorts of questions that have to be followed through in the process.

We thought it was critical in any of these sorts of programs, first to build on existing mechanisms whenever possible. Examples of existing planning mechanisms within the U.S. Navy for example, or the U.S. military command, you have already got theater engagement plans. There is an existing process for identifying the military priorities, interests, and goal. You obviously can not throw that aside. You have got to take that on board. That is an easy step to identify priorities. Similarly on the scientific side, there are already strategic plans developed that say what we want to do, what we think is important, what we need to do first. The idea is, you build on those mechanisms, and then overlay them and say where are the overlaps. Where do we have a confluence of priorities and interests. These are just examples. There are other planning mechanisms, many other planning mechanisms that would have to be taken into account. The other thing we thought was important was to focus on clearly bounded planning processes. This says regional, most of the ideas we came up with were regional seas, but there are also, thematic areas or particular program activities that you need to focus on small bites rather than big global programs. Even the GOOS itself is being developed on a regional basis. Most of the operational implementation plans are for regional areas. The planning needs to be done on a regional area where you have a manageable sort of problem that can fit into discrete priorities. Where do we go from here? Well, I have already foreshadowed the first one: directly address the decision makers' current priorities. The whole idea of building on

those existing planning mechanisms is to make sure that the things people are already interested in doing are addressed and current needs are addressed.

To assess the array of opportunities that are out there, after you have identified priorities, Working Group 1 basically came up with very similar sorts of ideas. Look to see what has already been done, what people want to do and what their needs are and see where you can pick the low hanging fruit. Clearly involved in this is going to be an analysis of cost, likelihood of success and the return of investment. This return on investment idea is not just what the benefits you get out of a given investment might be if you are successful, but also what might the down side be if you go into an area with a program that is poorly designed or poorly executed or just go sour because things go wrong. What is the risk involved in other words. Clearly, how do the opportunities or the programs, how do they support the mission of the military. This is again a point that was brought up repeatedly that this is a necessary precondition for any successful program from the military point of view.

## Discussion

Once we have looked at the array of given opportunities, is there something new that needs to be generated. Is there a new opportunity, something that is not on the table currently that would fit the particular situation. In doing so, do we need to readjust the sets of priorities that are currently in place. Is this new initiative raised to the top?

Clearly, one of the earliest things that has to be done, you have to decide who is going to do what and when they are going to do it. Strictly practical consideration. One of the first things and first opportunities, again, this coincides very much with what group was to identify the data sets that are in existence and could be used and to find out how to integrate them. Everybody talks about all the data that is out there. But it is not necessarily easy to take data sets and

use them in a coherent way unless they are archived in an similar format. There is a real need to look at integrating all this data into data products and what was specifically mentioned was GIS systems for example that can be used for something. Data is just bits in an electron in a computer. But again, the caveat there is that all of this work has to support military operations and/or environmental compliance. I just wanted to take you back to our shopping list and we spent some time after we came up with all these conditions and potential barriers. We looked at our shopping list, not exhaustively, but at a few of the areas, and said how do these areas fit in. I will talk about the first two. The Black Sea was suggested and I think was the first regional sea that came to everybody's minds. Primarily, there is a receptivity of the countries of the area. There are already ongoing efforts and ongoing cooperation. So there is a basis for multilateral action there. There is already a potential through military-to-military cooperation to reduce the impacts of the military itself in terms of waste disposal from ships for example and port operations. Another important confluence of interest is all of the countries or most of the countries of this region see the Black Sea as a critical component of their economic development interests. So again, there is an overlap of national interests as well. So there is a basis for cooperation and engagement there.

There are a lot of things ongoing in the Black Sea, in fact, there is a conference going on involving militaries within the last two to three weeks. Is this in fact an area where we ought to put some emphasis? Or is it already overpopulated?

We did not explicitly discuss it in the group. There was certainly a feeling in the group that the Black Sea was sort of a natural. We did not talk about the issue of whether it is already being done and there is no need to do it.

I do not know what our criteria are exactly, choosing a region, but in a region like the Black Sea, if you

want to operate there, it means you need a lot of funds, because all six of the littoral states are in an economically terrible situation. The only country that was in a little better shape was Turkey. Any activity in the Black Sea will require a lot of funding to get those naval ships and naval facilities operating because these guys can not even pay their Naval officers for the last year or so. I think we should really consider in selecting a region with this type of formation because, after all we are trying to do something in which we really need success in our first go at it. That should be one criteria in choosing the region.

High likelihood of success should be another condition. That makes sense. Maybe the next one would come up to that standard. There is an interesting sort of progression within the group when we went back to these areas. The Red Sea was actually suggested by Dr. John Proni from NOAA. The genesis of the project was that the Saudi's had submitted a request to the EPA to assist them with construction of sewage disposal infrastructure. One of the big concerns is the possibility for trans-boundary pollution, migration of sewage plumes into the sovereign waters of the neighboring countries. So potentially there is a U.S. national security interest there for conflict prevention and so forth. In the course of discussions, it came out that the U.S. Navy has good oceanographic models. They may be classified, they may not. No one in the group knew for sure.

The first being just making data available, or this model, or the tools necessary to do the exercise, up to potentially providing satellite imagery or even sonar data from its own platforms. It would also give the military the option as to the level of visibility would suit its own needs. It could either simply do this behind the scenes and it not be known that the military was involved, up to the military having a high profile in the exercise. So, that was another sort of example of the way the process might proceed. Some of these other

areas, for example, the Western Pacific, came up after we set our conditions. To do a Western Pacific project, or program, would not meet our conditions. It would be very hard to come up with something that had clearly defined goals and objectives, a nice self-contained sort of activity for an area the size of the Western Pacific. If you wanted to do something in IOC's Westpac Region, you would have to come up with a much more narrowly designed, well focused program, rather than saying lets do a Western Pacific exercise. We did not go through all of the things on the shopping list. These are just some of the examples of how the sort of conditions and process might apply to a particular region.

Would something with relative finite geography like Sea of Japan or Bay of Bengal lend themselves ?

Well, both the Sea of Japan and the Bay of Bengal and even the Straits of Malacca were on our original shopping list, but we did not go through as a group and apply our process to those areas.

But those were not left excluded because they were not?

No, we have not excluded any of these. We just made the point that in looking at the Western Pacific that would not be something you would want to put at the top of your shopping list unless it was defined much more closely.

I think your group brought a very interesting point. Namely that some civilians may not want to interact with the militaries in certain countries. I think that this is something that we have to handle with affection and care, because it is critically important. Some scientists in certain countries much prefer not to do any science rather than dealing with their own militaries, because their militaries are typically involved in other activities than protection of the marine environment.

If I may add, however, many militaries in the world are going through a transition period from a past role in their society and a past set of functions to a new set of responsibilities. In general, you could characterize this as a process of militaries existing in what used to be essentially totalitarian type governments to those that are struggling with, at their own pace and in their own way, some degree of a democratic process. I think, although I agree completely with what your saying, is that we tend to view that as opportunity and probably one of the more important points of that whole equations is to work with the militaries to enhance their relationships and open up new avenues of cooperation with the civilians and that is a two way thing. That includes NGOs. It is clearly something that is at play but from our perspective, the U.S. military, that is tremendous opportunity. I am sure that would be Admiral Blair and his counterparts....

No question sir, no question at all. Indonesia is a classic example as we step through TNI and what is going on there and the election process and interaction and things of that nature. I would expand, if I may sir, one more point, I think, although I am still relatively new to the whole process, this idea of engagement and everything like that, I think our own military is struggling with a different role as we go forward in the twenty-first century of military involvement of engagement. We are still not all coming to grips with exactly what we do in some ways.

Actually, picking up on Diane's point, it may be that looking at watersheds is perhaps more useful in that regard than blue water oceanography because it is much more visible to people.

Well, that and the fact that the armies tend to run the militaries in many if not most of the countries in the world and they always have bases and they would be interested while the Navy may be a marginal part of the military structure in developing countries.

Not sure how what I am about to say is going to fit into anything the Department of Defense can actually do about, but one of the biggest threats in my view right now to the environmental security, if you will, of the United States in terms of the big issue of diversity for the East Coast and the Great Lakes is the exchange of species between the Black Sea, the Baltic and our coast. It is going both ways. The comb jelly fish, that has basically devastated the Black Sea food web, is believed to have originated from our East Coast by ballast water transport. As I think I previously mentioned, in the Great Lakes since about 1980 or 1985, eight of ten of the new invasive species including the very expensive Zebra Mussel. It is now spreading throughout the entire eastern half of the United States, originated from the Black Caspian Azou Sea area, but most of these have also spread to the Baltic Sea before they have probably come here.

That topic was a major part of our Darwin conference...

You are absolutely right, you are one hundred percent right that the invasive species thing is a major...The militaries of the world really do not understand their role in that process.

See, and I do not either. I am just saying that this is something to bear in mind. I know what the issue is, and one aspect is just access to those regions. One of the other things we are looking at is trying to tie in genetically the existing species that have invaded the United States, with their species in both the Black Sea and the Baltic to prove where their coming from. The other interesting thing is the reason why they are getting over to the Baltic is not necessarily, as you might believe by ship traffic through the Mediterranean, but there are now river routes that connect the Baltic to the Black and Caspian seas.

The hope, perhaps oversimplifying is, that what we need to do in the militaries is you need to understand the source, the path and the receiver, where you fit into those things and what are the appropriate

precautionary things that you can do. The example that I use most often to get this point across is the brown tree snake in Guam. The question is what will happen to the economy of Hawaii if and when the brown tree snake is introduced in Hawaii and does what it did on Guam?

Yet if that is tracked back to a military transport then the military will be paying for all that economic damage. So we are investing substantial amounts of money today in Guam looking at the source, the path and the receiver. You have got to look at it in all respects. The military also introduced the Japanese Beetle.

Well, I think that for the most part, you have to integrate certain standards and practices into the normal operations of military. I certainly think aspects of invasive species issue are true too. There is things that you ought to do and things that you should not do. Now is that fool proof? No, of course not, but how many navies of the world have integrated into their normal practice things that would address the issue your talking about?

Very few.

Well, its only recently arisen as a real issue.

Part of our discussion this morning has not been on terrestrial sources and the question of degradation of water quality or marine environmental quality in coastal regions as a result of terrestrial sources. Going back to your presentation on the first day, in looking at the water bodies that are listed, and one that is not listed because it was not seen as a potential for success, which is the South China Sea. If we start talking about the correlation between where population is and the degree of economic development under which those populations are undergoing at any one particular time, that begins to really jibe with this particular list. Bay of Bengal, Sea of Japan, Strait of Malacca, Southeast Pacific, you are starting to see the

states that are bordering those particular regions are fairly populous, undergoing economic development and are, in large cases, heavily resource constrained. They do not have a lot of other places to move their waste. Especially in the case of the Bay of Bengal, you have several rivers, at least one major delta that dumps into that bay. Looking at the states that feed that bay, there are considerable numbers of people who are dependent on that particular source. It seems like the supposition we made early on of looking at the correlation between populations and rate of economic development maybe a better predictor of which water bodies will be of a critical nature. Then by imposing our perception of the strategic or political importance, boosting some of those even higher in the prioritization scheme.

## APPENDIX A - WORKSHOP AGENDA

### The Role of Militaries in Protecting the World's Water Resources

U.S. Army War College  
Carlisle Barracks, Carlisle, PA  
3-5 November 1999

Sponsored by the Office of the  
Deputy Under Secretary of Defense  
(Environmental Security),  
U.S. Department of Defense

#### AGENDA

Wednesday, 3 November

- |      |                                                                                                                                                                      |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1130 | Begin registration                                                                                                                                                   |
| 1300 | Opening Remarks<br>Mr. Gary D. Vest, Principal Assistant<br>Deputy Under Secretary of Defense<br>(Environmental Security)                                            |
| 1320 | Presentation and Discussion of the<br>Strategy for the Role of Militaries in<br>Protecting the Environmental Quality<br>of World Water Resources<br>Mr. Gary D. Vest |
| 1400 | Presentation of the Background<br>Papers“Environmental Quality<br>Assessment on the Continental Shelves<br>and in Large Bodies of Water: Current                     |

State of the Art”  
Dr. Mike Huber

1445      *Coffee Break*

1515      “Risk Assessment and Management Issues in  
the Continental Shelves and Large Bodies of  
Water”  
Dr. Mike Huber

1600      “Contributing to Environmental Quality:  
Reducing the Military’s Impact on the  
Environment”  
Dr. Diane Drigot, U.S.MC Hawaii

1630      “Maintaining Environmental Security and  
Military Readiness: The Success of Tandem  
Thrust,”  
CDR Michael J. Boock, U.S.N

1700      “Military Impact on the Oceans”  
Mr. Larry Koss, GeoCenters

1800      Conclude the session.

Thursday, 4 November

0830      Morning Plenary and Administrative  
Remarks  
Dr. Kent Butts, Center for Strategic  
Leadership

0845      “ Military CINC Engagement Activities: A  
Potential Resource,”  
CAPT Bob Brandhuber, U.S.N Chief,  
Regional Engagement Division, U.S. Pacific Command

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0915 | <p>Presentation on UNESCO's<br/>Intergovernmental Oceanographic<br/>Commission (IOC) and the Potential Benefits<br/>of IOC-DOD Cooperation<br/>Dr. Umit Unluata, IOC</p>                                                                                                                                                                                                                                                                                                                                                                                                       |
| 0945 | <p>Break into Working Groups</p> <p>Working Group #1: Environmental Research<br/>Issues for the Continental Shelves and Large<br/>Bodies of Water: Potential for Military<br/>Cooperation Civilian Co-Chair: Dr. Ned Cyr,<br/>IOC DOD Co-Chair: CDR Peter<br/>Pedrozo, U.S.N</p> <p>Working Group #2: Assessing and Managing<br/>Risks to the Continental Shelves and Large<br/>Bodies of Water: Potential for Military<br/>Cooperation Civilian Co-Chair:<br/>Dr. Mike Huber, Global Coastal Strategies<br/>DOD Co-Chair: Mr. Thomas Nelson, Office of<br/>Naval Research</p> |
| 1000 | Working Groups Meet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1030 | <i>Coffee Break</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1100 | Working Groups Re-convene                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 1230 | <i>Lunch</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1330 | Working Groups Re-convene: Military<br>Representatives Leave Workgroups 1 & 2 to<br>form "What it Means to Military?" Workgroup                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1500 | <i>Coffee Break</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

- 1530 Groups reconvene—leaders and recorders  
prepare initial briefing slides
- 1600 Afternoon Plenary  
Working Group Presentations
- 1730 Conclude session

Friday, 5 November

- 0900 Morning Plenary and Administrative  
Remarks  
Dr. Kent Butts
- 0915 Working Group Session: Discuss  
recommendations for action and Phase II  
“Policy” Conference.
- 1000 *Coffee Break*
- 1030 Charting the Course: Plans for Future Action  
Reports by Working Groups
- 1200 Session Conclusion  
Mr. Gary Vest  
Dr. Umit Unluata

## APPENDIX B – LIST OF PARTICIPANTS

Mr. Bill Bailey  
Geocenters, Inc.

CDR Michael Boock  
U.S. Navy

Mr. David Booker  
Department of the Army

COL Art Bradshaw, U.S.A (Ret.)  
Center for Strategic Leadership  
U.S. Army War College

CAPT Bob Brandhuber  
Chief, Regional Engagement Division  
U.S. Pacific Command

Dr. Kent Butts  
Center for Strategic Leadership  
U.S. Army War College

Ms. Susan Clark-Sestak  
Institute for Defense Analysis

Ms. Muriel Cole  
Office of the Chief Scientist  
NOAA

Dr. Ned Cyr  
Intergovernmental Oceanographic Commission

Dr. Diane Drigot  
Environmental Affairs Division  
Marine Corps Base Hawaii

Dr. Michael Huber  
Global Coastal Strategies

Mr. Larry Koss  
GeoCenters, Inc.

Mr. Frederick Lorenz  
Adjunct Professor  
University of Washington

Mr. John Mentz  
Conventional Treaty Manager  
U.S. Department of Defense

Mr. Ed Miller  
Office of Deputy Under Secretary of  
Defense (Environmental Security)  
U.S. Department of Defense

Mr. Thomas Nelson  
Office of Naval Research

CDR Pete Pedrozo  
OSD Policy  
U.S. Department of Defense

Dr. John Proni  
Director, Ocean Acoustics Division  
Office of Oceanic and Atmospheric Research NOAA

Dr. David Reid  
Office of Oceanic and Atmospheric Research NOAA

Dr. David Rogers  
Director, Scripps Institution of Oceanography  
University of California, San Diego

Mr. Brian Smith  
Analyst  
Evidence Based Research, Inc.

Prof. Umit Unluata  
Head, Ocean Sciences Section  
Intergovernmental Oceanographic Commission

Mr. Gary Vest  
Principal Assistant Deputy Under Secretary of Defense  
(Environmental Security)  
U.S. Department of Defense

## APPENDIX C - OTHER CSL ENVIRONMENTAL SECURITY ACTIVITIES

Copies of previous Environmental Security publications by the Center for Strategic Leadership, U.S. Army War College can be requested by one of three methods.

Mail:

Center for Strategic Leadership  
U.S. Army War College  
ATTN: Ms. Julie Perry  
650 Wright Avenue  
Carlisle, PA 17013-5049

Electronic mail:

perryj@csl.carlisle.army.mil

Telephone:

Ms. Julie Perry at (717) 245-3226 or  
DSN 242-3226.

*Report of the Executive Seminar on Special Material Smuggling.* Institute for National Security Studies, U.S. Air Force Academy, and Center for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, September 13, 1996.

*Environmental Security and Preventive Defense*, Game Report. Deputy Under Secretary of Defense (Environmental Security), and Center for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, August 1997.

*NATO/CCMS Environmental Security Conference*, Preliminary Report. Center for Environmental Security, Pacific Northwest National Laboratory, and Center for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, September 1997.

*Environmental Change and Regional Security*, Conference Report. Asia-Pacific Center of Security Studies, and Center

for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, September 1997.

*International Environmental Security: The Regional Dimension*, Game Report. Deputy Under Secretary of Defense (Environmental Security), Deputy Assistant Secretary of State for Energy, Sanctions & Commodities, and Center for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, November 1997.

*Regional Asia Pacific Defence Environmental Workshop*, Executive Seminar Report. The Environmental Security Trilateral Partners of the Australian, Canadian, and United States Departments of Defence, and Center for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, December 1998.

*Caspian Sea International Environmental Security*, Game Report. Deputy Under Secretary of Defense (Environmental Security), Deputy Assistant Secretary of State for Energy, Sanctions & Commodities, and Center for Strategic Leadership, U.S. Army War College, Carlisle, Pennsylvania, July 1999.