Objectives and Methods

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Objectives and Methods

Overall Goal

• build a network among environmental managers, analytical laboratories, and other appropriate governmental agencies in countries of the Wider Caribbean Region (WCR) that will be effective in measuring, evaluating and then reducing pollution from POPs and other PTS in the coastal marine environment.

Specific Objectives – Years 1 & 2

• We start with the assumption that there is a real need for action on POP/PTS pollution in coastal waters
• And with the expectation that, for most participating countries, effective methods for monitoring or remediating this do not currently exist
• And with the belief that partnering can build new strength and unexpected capacity for change

Specific Objectives – Years 1 & 2

• Build network of coastal managers and technical laboratories
• Evaluate lab capacity, then commence training and equipment upgrade
• Extend data on PTS pollution in coastal waters
• Engage stakeholders, public, politicians on risks due to POP/PTS pollution, build consensus on need for action
• Draft proposals for funding for subsequent years

Specific Objectives – Years 3 to 5

• Extend training and equipment upgrade to expand analytical capacity in the region
• Extend monitoring of coastal waters as a permanent regional program
• Trace two cases of coastal pollution back to their sources, and motivate action to eliminate these problems
• Engage wider community to remedy POP/PTS pollution in coastal waters
• Proudly advertise the success of south-south partnerships for solving shared environmental problems

Suggested Actions – Years 1 & 2

• Two initial workshops held in the region with additional participation
• South-North expert team to visit selected labs, evaluate capacity, recommend upgrade
• Short secondments to Canada of lab staff (3-4) for advanced training in POP/PTS evaluation, limited upgrade in 1-2 labs
• Sample coastal ecosystems to extend baseline data on POP/PTS presence
• Follow-up workshops, publications to build community awareness, motivate effort to remedy cases of POP/PTS pollution.
IAEA activities in POPs related projects in the Caribbean and elsewhere

Marine Environmental Studies Laboratory
MEL, IAEA, Monaco
Jae R. OH

The only Marine Laboratory in UN System

1961 - Laboratory established in the Oceanographic Museum
1988 - Temporary facilities in the Louis II Football Stadium
1998 - Permanent facilities on the Port of Monaco

Inauguration of MEL by HSH Prince Rainier and Dr ElBaradei 1998

IAEA Monaco Seat Agreement

MEL Laboratory Plan

Mission Statement of the Marine Environment Laboratory

The Marine Environment Laboratory will provide Member States with

1. Research for the protection of the marine environment from radioactivity and pollution
2. Applications of nuclear & isotopic techniques and solutions for tracking oceanic processes, marine ecosystems and pollution impacts
3. Expertise, Training & Reference Materials essential for Member States' commitment to the Sustainable Development and Monitoring of their marine environments.
4. Strategic partnerships with International and other UN ocean agencies (IOC/UNESCO, UNEP, UNDP, IMO) to deliver the UN- WSSD programmes on sustainable development of the ocean.
**IAEA-MEL ORGANIZATIONAL CHART**

**Expertise of MEL’s 3 Sections**

- **RML:** Marine radionuclides, RMs, geochronology, ocean tracers; radiochemistry, u/w detection; modelling; training
- **REL:** Radioecology; biological tracers; carbon export; ecotoxicity; Harmful Algal Blooms, training
- **MESL:** Organic micropollutants; heavy metals; RMs, survey & training in UN partnerships

**Objectives:** To develop and improve capabilities to reduce the degradation, due to anthropogenic and natural impacts, of the coastal ecosystems of the wider Caribbean region by using nuclear techniques to support integrated coastal zone management.

**Field(s):** Radioecology, Environmental Assessment and Remediation Strategies, Isotopes and Radiotracers in Ecotoxicology and Pollution Studies, Marine Environment and Coastal Zone Management, Quality Management of Analytical Measurements, Radiocological and Isotopic Solutions for Coastal Marine Problems

**Project period:** 2007-2010 (4 years)

**Budget:** US$ 1,460,700

**Recipient institute(s) and Counterpart(s):** 11 Countries 23 Organizations

- Columbia(2), Costa Rica(2), Cuba(2), Dominican Republic(2), Guatemala(2), Haiti(2), Honduras(2), Jamaica, Mexico(3), Nicaragua, Panama(2), Venezuela(2)

**Supporting Regional Seas Programmes**

- Technique development in marine analytical chemistry
- Formulation of reference methods and guidelines
- Intercomparison exercises
- Production of reference materials (RMs)
- Education and training in analytical techniques
- Capacity building
- Monitoring programmes
- Research activities

**Reference Methods for Marine Pollution Studies**

- Formulation of reference methods and guidelines
- Sanitary quality of coastal waters
- Analysis of chemical contaminants in organisms, sea water and sediments
- Effects of pollutants on organisms and ecosystems
- 56 reference methods and 2 technical bulletins
- All are available in English, some have been translated into French and / or Spanish
Intercomparison Exercises

- Marine samples (sediment or biota) are periodically distributed free of charge
- Results are reported to MESL and evaluated statistically
- Intercomparison exercises offer analysts means to:
  - Test analytical methods
  - Control laboratory performance
  - Assess accuracy of results

<table>
<thead>
<tr>
<th>IAEA – Code</th>
<th>Sample Type</th>
<th>Analyte Groups</th>
<th>Year</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAEA-356</td>
<td>Hot Spot Coastal Sediment</td>
<td>TM &amp; MeHg</td>
<td>1994</td>
<td>No</td>
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<tr>
<td>IAEA-357</td>
<td>Hot Spot Coastal Sediment</td>
<td>Organic Contaminants</td>
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<td>No</td>
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<td>IAEA-350</td>
<td>Tuna Fish</td>
<td>TM</td>
<td>1992</td>
<td>No</td>
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<tr>
<td>IAEA-SD-M-2/TM</td>
<td>Marine Sediment</td>
<td>TM</td>
<td>1991</td>
<td>No</td>
</tr>
<tr>
<td>IAEA-MA-M-2/TM</td>
<td>Mussel Tissue</td>
<td>TM</td>
<td>1991</td>
<td>No</td>
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<tr>
<td>IAEA-SD-M-2/OC</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>1989</td>
<td>No</td>
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<tr>
<td>IAEA-MA-B-3/OC</td>
<td>Fish Tissue</td>
<td>Organic Contaminants</td>
<td>1989</td>
<td>No</td>
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<tr>
<td>IAEA-351</td>
<td>Tuna Fish</td>
<td>Organic Contaminants</td>
<td>1989</td>
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<tr>
<td>IAEA-SD-M-1/OC</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>1986</td>
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<td>IAEA-MA-M-2/OC</td>
<td>Mussel Tissue</td>
<td>Organic Contaminants</td>
<td>1986</td>
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<tr>
<td>IAEA-MA-A-2/TM</td>
<td>Fish Flesh</td>
<td>TM</td>
<td>1980</td>
<td>No</td>
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<tr>
<td>IAEA-MA-A-2/OC</td>
<td>Fish Flesh</td>
<td>Organic Contaminants</td>
<td>1980</td>
<td>No</td>
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<td>IAEA-SD-M-2/OC</td>
<td>Sea Plant Homogenate</td>
<td>Organic Contaminants</td>
<td>1986</td>
<td>No</td>
</tr>
<tr>
<td>IAEA-MA-B-1/OC</td>
<td>Sea Plant Homogenate</td>
<td>Organic Contaminants</td>
<td>1989</td>
<td>No</td>
</tr>
</tbody>
</table>

Interlaboratory studies and the resulting marine RMs for TMs and MeHg or organic contaminants produced in MESL and distributed through the Analytical Quality Control Services (IAEA, Vienna)

<table>
<thead>
<tr>
<th>IAEA – Code</th>
<th>Sample Type</th>
<th>Analyte Groups</th>
<th>Year</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAEA-436</td>
<td>Tuna Tissue</td>
<td>TM &amp; MeHg</td>
<td>2006</td>
<td>Yes</td>
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<tr>
<td>IAEA-433</td>
<td>Tuna Tissue</td>
<td>Organic Contaminants</td>
<td>2006</td>
<td>Yes</td>
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<tr>
<td>IAEA-432</td>
<td>Marine Sediment</td>
<td>TM &amp; MeHg</td>
<td>2004</td>
<td>Yes</td>
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<tr>
<td>IAEA-431</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>2005</td>
<td>Yes</td>
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<tr>
<td>IAEA-430</td>
<td>Fish Tissue</td>
<td>TM &amp; MeHg</td>
<td>2003</td>
<td>Yes</td>
</tr>
<tr>
<td>IAEA-429</td>
<td>Fish Tissue</td>
<td>Organic Contaminants</td>
<td>2002</td>
<td>Yes</td>
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<tr>
<td>IAEA-428</td>
<td>Fish Tissue</td>
<td>Organic Contaminants</td>
<td>2000</td>
<td>Yes</td>
</tr>
<tr>
<td>IAEA-427</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>1999</td>
<td>Yes</td>
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<td>IAEA-426</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>1998</td>
<td>Yes</td>
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<tr>
<td>IAEA-425/TM</td>
<td>Sea Plant Homogenate</td>
<td>TM &amp; MeHg</td>
<td>1997</td>
<td>Yes</td>
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<td>IAEA-425/OC</td>
<td>Sea Plant Homogenate</td>
<td>Organic Contaminants</td>
<td>1997</td>
<td>Yes</td>
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<tr>
<td>IAEA-424/TM</td>
<td>Mussel Homogenate</td>
<td>Hg &amp; MeHg</td>
<td>1996</td>
<td>No</td>
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<tr>
<td>IAEA-424/OC</td>
<td>Mussel Homogenate</td>
<td>Organic Contaminants</td>
<td>1996</td>
<td>No</td>
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</table>

Number of laboratories reporting more than 50% outliers for OCPs, PCBs and PHS during the recent IAEA interlaboratory studies

<table>
<thead>
<tr>
<th>IAEA – Code</th>
<th>Sample Type</th>
<th>Analyte Groups</th>
<th>Year</th>
<th>Participants for OCPs</th>
<th>% lab with &gt; 50% outliers</th>
<th>CV range for OCPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAEA-356</td>
<td>Hot Spot Coastal Sediment</td>
<td>Organic Contaminants</td>
<td>1994</td>
<td>10%</td>
<td>19 - 88</td>
<td></td>
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<tr>
<td>IAEA-357</td>
<td>Hot Spot Coastal Sediment</td>
<td>Organic Contaminants</td>
<td>1992</td>
<td>10%</td>
<td>11 - 160</td>
<td></td>
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<tr>
<td>IAEA-350</td>
<td>Tuna Fish</td>
<td>TM</td>
<td>1992</td>
<td>10%</td>
<td>20 - 120</td>
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<tr>
<td>IAEA-SD-M-2/TM</td>
<td>Marine Sediment</td>
<td>TM</td>
<td>1991</td>
<td>10%</td>
<td>10 - 140</td>
<td></td>
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<tr>
<td>IAEA-MA-M-2/TM</td>
<td>Mussel Tissue</td>
<td>TM</td>
<td>1991</td>
<td>10%</td>
<td>6 - 140</td>
<td></td>
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<tr>
<td>IAEA-SD-M-2/OC</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>1989</td>
<td>10%</td>
<td>10 - 140</td>
<td></td>
</tr>
<tr>
<td>IAEA-MA-B-3/OC</td>
<td>Fish Tissue</td>
<td>Organic Contaminants</td>
<td>1989</td>
<td>10%</td>
<td>6 - 140</td>
<td></td>
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<tr>
<td>IAEA-351</td>
<td>Tuna Fish</td>
<td>Organic Contaminants</td>
<td>1989</td>
<td>10%</td>
<td>10 - 140</td>
<td></td>
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<tr>
<td>IAEA-SD-M-1/OC</td>
<td>Marine Sediment</td>
<td>Organic Contaminants</td>
<td>1986</td>
<td>10%</td>
<td>10 - 140</td>
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The No of laboratories (histogram) and countries (line) participating in laboratory performance studies organized by the MESL for the determination of organic contaminants

The No of laboratories (histogram) and countries (line) participating in laboratory performance studies organized by the MESL for the determination of inorganic contaminants
Global participation in recent laboratory performance studies for the analysis of organic contaminants (\(\text{I}\)) in mussel tissue (IAEA-432) and trace metals (\(\text{I}\)) in marine sediment (IAEA-433).

Field Studies in the ROPME Sea Area

- Countries within the ROPME Sea Area: Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.
- Contaminant Screening Project: surveys of contaminants in water, sediments and biota for a suite of inorganic and organic pollutants.
  - MESL undertakes a quality assurance programme with Member States in the region involving:
    - site visits
    - training courses
    - capacity building
    - split sample analyses
    - intercomparison exercises

ROPME

Cruise Plan

For the Oceanographic Cruise in the ROPME Sea Area Winter 2005

For submission to Regional Organization for the Protection of the Marine Environment

Map of the ROPME Sea Area

Major Activities

Onboard Sampling Activities

- ADCP Current Profiling
- Temperature Measurement
- Sediment Core Sampling
- Pollution Source Identification
Distribution of Σ DDTs (DDT + DDD + DDE + DDMU) in pg/g in sediments from RSA

Distribution of Σ DDTs, the sum of DDT and the breakdown products DDD, DDE and DDMU, (pg/g) in various bivalves (clams and oysters) from RSA

Total Chlorinated Hydrocarbons and Lipids contents in Rock Oysters (Saccostrea cucullata)

Rate of accumulation of Chlorinated Hydrocarbons in relation to lipids contents and levels of organic matter in bed sediments of Rock Oysters
Course Syllabus

1. Introduction and objectives
2. Environmental samples
   a. The "Mussel Watch" concept
3. Sampling and sample processing
   a. Documentation
4. Wet laboratory
   a. Documentation
   b. Sample processing for multiple residue analysis (Aliphatic and aromatic hydrocarbons, chlorinated hydrocarbons, sterols and dioxins/furans)
      i. Analysis of Sediments
         1. Extraction
         2. Ancillary parameters: dry weight determination
         3. Clean-up procedures and fractionation
         4. QA/QC samples in the laboratory (blank, spiked blank, spiked sample, duplicate sample, reference material, analytical control sample)
5. Measurements

Course Syllabus

4. Measurements
   - Determination of Aliphatic Hydrocarbons by GC/FID
   - Determination of Aromatic Hydrocarbons by GC/HRMS
   - Determination of Chlorinated Hydrocarbons by GC/ECD & GC/LRMS
   - Determination of Sterols by GC/FID
   - Determination of Dioxins/Furans by GC/HRMS or GC/LRMS

Research in the MED POL Programme

Marine biocides in waters from marinas along the south of France

Training Course

"NATIONAL TRAINING COURSE ON THE ANALYSES OF CHLORINATED ORGANIC CONTAMINANTS AND STEROLS"

Central Environmental Lab, Qatar, April 15-26, 2007

The main objective of the training course is to provide, to those interested in the analysis of trace organic contaminants in environmental samples, the tools needed for:

- the critical knowledge of fundamentals aspects of Good Laboratory Practices and
- the quality assurance/quality control of the final data and report.
Trace Elements in Black Sea Sediments

Map showing the distribution of PAHs in marine sediments from the Black Sea

Co & Pb versus Al in Sediments

Nickel

• Ni displays very high levels in sediments throughout the central and southern Caspian Sea.
• NOAA ERL (21 mg g⁻¹) was always exceeded and the ERM (52 mg g⁻¹) values at several sites.
• The highest concentrations were found near the mouth of the Kura River, but the Ural River influence is also evident.
• The elevated content reflects a high natural background, but could be augmented through mining activities. Similar behaviour was apparent for Cr and As.
Mercury

- The mercury content is low in the northern sector having sediments that are relatively coarse or composed mostly of carbonates.
- Mercury concentrations are high at a number of sites in Azerbaijan, where Hg content exceeds the NOAA ERL value of 0.15 μg g⁻¹.
- In particular, the sediments to the south of Baku Bay are polluted.

Total Petroleum Hydrocarbons (TPH)

- The concentrations of TPH range in concentration from 29 to 1820 μg g⁻¹ in Azerbaijan where generally the highest amounts were found.
- It should be noted that sediments from Turkmenistan were not available.
- Compared to other global locations, the levels of PH in the most contaminated of these sediments, just south of Baku Bay (H-4-1 & H-5-1), are relatively high.

Lindane in Sediments

- Lowest values were found in the Iranian and Kazakhstan sectors.
- Several stations in the Russian coastal zone had elevated levels.
- The maximum concentration 609 pg g⁻¹ exceeded the ISQG value of 320 pg g⁻¹.
- As lindane degrades rapidly in the environment, elevated levels reflect ongoing usage.

Endrin in Sediments

- Low levels were found in Kazakhstan and Russia.
- Highest values were observed in the coastal zone of Azerbaijan (85 pg g⁻¹) and Iran (81 pg g⁻¹).
- Maximum concentrations did not exceed the ISQG value of 267 pg g⁻¹.

Total DDTs in Caspian Sea Sediments

- NOAA ERL is 1600 pg g⁻¹.
- Total DDT levels exceed this quality standard at a number of locations, especially in Azerbaijan and Iran.
- The maximum value (13400 pg g⁻¹) shows a strong signal from the Kura River.
- The lowest concentrations were found in the North Caspian Sea, particularly in the north-eastern shallow area.

Relative Contributions of DDT and Degradation Products DDD & DDE

- Relatively high proportions of DDT indicate recent influxes and, by implication, ongoing DDT usage throughout the region.
The Future: New Priorities

- Strengthened co-ordination with national institutes and regional organisations
- Broadening of activities in response to the changing needs of UN bodies:
  - Global Programme of Action for the protection of the marine environment from land based activities
    - Tracers to characterise sewage and ground water discharges
  - Convention for Biological Diversity
    - Biomarker studies
    - Biological effects studies
  - IMO regulations on the use of tributyltin (TBT) as a marine antifoulant
    - Environmental chemistry and ecotoxicology of alternative marine biocides

Thank You
UNU Coastal Hydrosphere project
Monitoring of POPs in the Asian Region

POPs Planning Workshop
27 November 2007, Hamilton
Dr. Zafar Adeel
UNU-INWEH

What is the project about?

Project Overview - 1996-present

- This project has a thematic focus on:
  - Water pollution (POPs) monitoring in coastal and river systems
  - Protection, restoration and management of coastal resources impacted by pollution
- The project concept follows:
  - Monitoring requirements for the Stockholm Convention
  - Section 30 of WSSD Plan of Implementation
  - Chapter 17 of Agenda 21
- Key elements of the project:
  - 11-Country Pollution Monitoring in Asia
  - Partnership with Japanese institutions (ORI of U Tokyo, Iwate Gov.)
  - Coastal Ecosystem Management (with UNESCO, ISME)
- The project is funded by the following partners:
  - UNU, Shimadzu Corp., Iwate Prefecture, UNESCO

Project Activities - Monitoring Programme

- Pre-designed sampling programme
- Conducted annually
- Two sampling rounds
- QA/QC and data archiving by UNU

Key Partner:

Pre-designed sampling programme
Conducted annually
Two sampling rounds
QA/QC and data archiving by UNU

Project Activities - Capacity Building

- Equipment for chemical analysis - GC/MS
- Hands-on training for young professionals

Project Activities - Researcher Network

- UNU-ORI Joint International Workshops on Marine Environment
  - Focus: Asia and Pacific
- Supported by:
  - Iwate Prefectural Government
  - UNESCO
  - Japan Society for Promotion of Science
- Web-based dissemination of research results

12/13/2007
Project Activities – International Meetings

International Symposia:
- POPs: Global Transport, Best Environmental Practice, and Risk Perception
  Jakarta, Indonesia (2005)
- POPs in Asia: its status and future
  Manila, Philippines (2006)
- Ecosystem Impacts of POPs
  Bangkok, Thailand (2006)
- Impacts of POPs from Urban Areas
  Beijing, P.R. China (2004)
- Tracing pollutants from agrochemical use
  Hanoi, Viet Nam (2002)
- Industries and EDC Pollution
  Seoul, Republic of Korea (2001)
- EDCs in East Asian Coastal Hydrosphere
  Kuala Lumpur, Malaysia (2000)
- Environmental Issues Related to EDC Pollution
  Tokyo, Japan (1999)

International Workshops:
- Sustainable Management of Coastal and Marine Resources
  Tokyo, Japan (October 2005)
- Marine Ecosystems and Bio-logging Science
  Tokyo, Japan (April 2006)
- Ecosystem Conservation in Coastal Areas
  Tokyo, Japan (June 2005)
- Capacity Development for Monitoring of POPs in the East Asian Hydrosphere
  Tokyo, Japan (September 2005)
- Environmental Quality Guidelines and Capacity Development
  Seoul, Republic of Korea (June 2005)
- Coastal Ecosystem, Nutrient Cycles and Pollution
  Otsuchi, Japan (April 2005)
- Coastal Ecology, Nutrient Cycles and Pollution
  Otsuchi, Japan (December 2004)

International Conferences:
- Man and the Ocean
  Tokyo, Japan (July 2005)
- Future Challenges in POPs Management
  Tokyo, Japan (April 2003)
- Conserving Our Coastal Environment
  Tokyo, Japan (July 2002)

Project Activities – Policy-Relevant Synthesis

Policy synthesis reports
Targeted publications

Project Findings – challenges & opportunities

- Selecting Sampling Locations
  - Identifying potential hot-spots
  - Correlation to agriculture, industries or concentrated urban areas
  - Trial and error approach
- Ensuring Data Quality
  - Consistency in laboratory analyses
  - Cross-calibration exercises
  - Centralized data quality control
- Data Interpretation
  - Sampling variability and seasonal impacts
  - Long-term evaluation
  - Understanding spatial distribution
  - Cross-referencing with other data sets
- Limitation of Resources
  - Constraints on number of samples and frequency of sampling
  - Shortage of trained technicians

Project Findings – scientific issues

- POPs pollutants in coastal waters are
  - Highly-localized spatially and
  - Variable temporally
- Organochlorine pesticides continue to be introduced in coastal waters,
  despite existing bans
  - Continued use of pesticides
  - Leaching from soils and sediments
- Input from agricultural areas is apparent
- Possible accumulation of DDT in coastal sediments
- Overall declining trends for DDT?
Project Findings - **policy issues**

- Governments play a key role in monitoring and governance
  - Government as a facilitator rather than provider
  - Management and dissemination of information
  - Smoother coordination of sectoral planning related to coastal management
- Human and institutional capacity development
  - Focus on trainers and managers
  - Development of researcher networks
  - Improved developing-country collaboration
- Focus on community-based coastal development
  - Creation of increased opportunities for the rural poor
  - Raising local living standards
- Need for consistent, long-term monitoring and assessment
  - Systematic collection of ecosystem health and threats data
  - Synthesize data into policy-relevant information
- Mapping of threats and prioritizing action
  - Focus on identifying vulnerable populations
  - Prioritizing financial resource allocation

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Key Project Accomplishments

- Sustained focus on pollution monitoring and coastal management
- Successful capacity development
  - Extensive utilization of laboratory facilities in participating countries
  - Development of an international network of experts
- Brought policy focus on pollution, endocrine disruption and POPs issues
  - The project has emerged as a model for:
    - UN-private sector partnerships
    - Multi-agency UN collaboration
El Programa Ambiental del Caribe

&

Contaminantes Orgánicos Persistentes en la Región del Gran Caribe

Alexander Cooman
Coordinador Proyecto GEF-REPCar

Contenido

- Unidad de Coordinación Regional para el Caribe del PNUMA y la Convención de Cartagena
- Programa Evaluación y Manejo de Contaminación Ambiental (AMEP) y el protocolo FTCM
- Proyecto GEF-REPCar
- Programa de monitoreo ambiental de REPCar

Unidad de Coordinacion Regional para el Caribe (PNUMA-UCR/CAR)

La Convención de Cartagena

Único tratado regional con obligaciones legales, para la protección y el desarrollo del medio ambiente marino de la región del Gran Caribe

CONVENCIÓN DE CARTAGENA
Adoptado en 1983
En vigor desde 1986

Objectivo:

• Evaluación y manejo de contaminación ambiental
• Coordinación implementación protocolos LBS y relativo a co-operación para combatir derrames de hidrocarburos:
  - Prevenir, reducir y controlar contaminación de zonas costeras y marinas
  - Apoyo a desarrollo de planeación integral y manejo de zonas costeras

Sub-Programa AMEP
AMENZA: Sedimento y contaminación de origen terrestre

- Aguas negras
- Deforestación
- Mal manejo y uso de tierras
- Escurrimiento de fertilizantes y plaguicidas

AMENZA: Contaminación y daño de origen marino

- Descargas de aguas de balastro y basuras
- Derrames de hidrocarburos y escapes
- Daño por anclas

Protocolo relativo a fuentes terrestres de contaminación marina

**Obligaciones generales:**
- Desarrollo e implementación de planes nacionales de acción
- Manejo integrado de áreas costeras
- Monitorio y evaluación

Protocolo relativo a fuentes terrestres de contaminación marina y COPs

**Obligaciones específicas relativo a fuentes prioritarias**

- Listado de COPs: fuentes, categorías, contaminantes asociados (Anexo I)
- Limitaciones para la emisión de aguas negras de origen doméstico, con cronograma para implementación (Anexo III)
- Fuentes dispersas de contaminación agrícola, implementación de mejores prácticas de manejo (Anexo IV)

Áreas temáticas AMEP

- Programas Nacionales de Acción
- Planes para el manejo integrado de cuencas hidrográficas – reformas políticas y legislativas
- Evaluación y monitoreo ambiental – p.ej. Know Why Network Project, REPcar, IWCAM, IAEA, BASEL
- Mejores Prácticas de Manejo para la reducción de contaminación agrícola – p.ej. REPCar Programa de pequeñas becas para MPM en agricultura
- Manejo integrado de desechos, incluyendo desechos marinos

Know-Why-Network

**Objetivo:**

- Aumentar la capacidad de países de la región para la implementación de protocolo LBS
- Establecer datos sobre estado ambiental de aguas marinas: diagnóstico de áreas críticas
- Mejorar la capacidad en uso de SIG y Percepción Remota
- Desarrollo de guías de clasificación de aguas
Know-Why-Network

**Ejecutores:**
- RAC-CIMAB
- RAC-IMA
- Instituto de Investigaciones Marinas y Costeras de Colombia (INVEMAR)

**Otros Participantes:**
- IOCARIBE
- IAEA

Financiado por Sida

Apoyo a manejo de desechos peligrosos

**Objetivo:**
Desarrollo de estrategias integradas y comunes para la reducción y el control de contaminación del medio ambiente marino por desechos sólidos y tóxicos

**Ejecutores:**
- Centros Regionales de Actividad (RACs)

Resultados:
- Estrategia regional para manejo de baterías usadas
- Avances en estrategia regional para manejo de aceites usados
- Apoyo a formulación de proyecto GEF para plaguicidas vencidas

GEF-REPCar
Colombia, Costa Rica y Nicaragua
Reduciendo el Escurrimiento de Plaguicidas al Mar Caribe

Programa de Naciones Unidas para el Medio Ambiente
Programa Ambiental para el Caribe
Ministerio de Ambiente, Vivienda y Desarrollo Territorial – Colombia
Ministerio del Ambiente y Energía – Costa Rica
Ministerio del Ambiente y Recursos Naturales – Nicaragua

Con el apoyo financiero del Fondo para el Medio Ambiente Mundial
Antecedentes

- Actividad agrícola en el Caribe Suroccidental
- Riesgos para el medio ambiente
- Deterioro potencial del medio marino

Objetivos

- Proteger del medio marino de la región del Gran Caribe, implementando prácticas de manejo integrado y medidas específicas para el control sobre el uso y la aplicación de plaguicidas en el sector agrícola
- Apoyo a los países en la implementación del Protocolo Relativo a la Contaminación Procedente de Fuentes y Actividades Terrestres (LBS), como parte del Convenio de Cartagena

Impacto

Impacto difícil de estimar de forma directa a través de indicadores de estado ambiental
- Indicadores de proceso y de reducción de estrés ambiental aplicados a subsectores y regiones donde el proyecto es activo:
  - Disminución en cantidad de plaguicidas persistentes usados por ha
  - Número de agricultores con BPA implementados en la región
  - Reducción de escurrimiento de plaguicidas en fincas piloto con implementación de Buenas Prácticas Agrícolas

Antecedentes

- Propuesta de proyecto (PDF-B):
  - Desarrollada de 1998 a 2001
  -Inicio del proyecto:
    - Fines de 2006
    - Necesidad de revisión de:
      - alcances
      - actividades
      - co-financiación
      - arreglos institucionales

Presupuesto global

- Aportes:
  - Fondo FMAM: 4,295,000
  - Co-financiación (países): 5,185,000
  - Co-financiación (CropLife LA): 440,000
  - Costo total del proyecto: 9,920,000

  - Propuesta de proyecto (PDF-B) desarrollada de 1998 a 2001
  - Inicio del proyecto a fines de 2006

Participantes

- Agricultores (asociaciones)
- Productores y distribuidores de agroquímicos
- Universidades y entes de IDC
- NGOs, organizaciones de consumidores, certificadores, ...
- Ministerios de Agricultura y otros entes oficiales
- Ministerios de medio ambiente:
  - Colombia
  - Costa Rica
  - Nicaragua
- UNEP: CAR/RCU y DGEF
**Proyectos demostrativos en BPA**

**Actividades**
- TDyR proyectos demostrativos
- Selección de 2 cultivos objeto por país
- Selección agencias implementadoras
- Desarrollo guías de implementación BPA y capacitación
- Desarrollo protocolos de monitoreo
- Implementación de 12 proyectos
- Capacitación a capacitadores y agricultores

**Monitoreo impacto ambiental plaguicidas**

**Actividades**
- Monitoreo uso de plaguicidas
- Marco de programa
- Desarrollo de protocolos
- Capacitación en monitoreo costero
- Evaluación en zona marina (1-10 millas)
- Monitoreo plaguicidas zona costera
- Publicación base de datos SIG
- Retroalimentación sector agrícola

**Fortalecimiento de la capacidad de reducción de escorrimiento de plaguicidas**

**Actividades**
- Revisión de marcos legales para mejorar control y desestimular uso de plaguicidas tóxicas
- Apoyo a programas de certificación de cultivos para generar fuerzas positivas en el mercado
- Disseminación de la información

**Coordinación de proyecto**

**Actividades**
- Organización de Unidad de Coordinación de Proyecto
- Coordinación regional:
  - CDP
  - Paneles de asesores
- Coordinación Nacional:
  - CCN
  - Coordinadores Nacionales

**Programa de monitoreo costero de plaguicidas**

**CURSO – TALLER**

**Estandarización de Técnicas de Muestreo y Análisis para la Determinación de Plaguicidas en matrices Marinas**

Estandarizar a nivel regional (Caribe) las técnicas de análisis y muestreo, para la determinación de plaguicidas en diversas matrices marinas:
- Proveer a los participantes el conocimiento necesario para la evaluación crítica de los aspectos fundamentales de un buen muestreo y manejo de laboratorio en los análisis de plaguicidas.
- Asegurar la calidad e integridad de los resultados que se obtengan en los análisis de plaguicidas en muestras ambientales marinas

25 h de teoría y 60 h de práctica.
Bases teóricas, por medio de clases magistrales, discusión de artículos y participación de experiencias.
Parte práctica, dos salidas de campo, una en el Buque Bi/Ancon en la zona marina costera del departamento del Magdalena, y otra en embarcaciones menores a la CGSM.
Fase de laboratorio, desde la preparación de reactivos, obtención de extractos, concentración, purificación en cromatografía de columna, análisis por GC y HPLC. Así mismo, se contemplará el control de calidad de los datos, sus cálculos y presentación del informe.
Programa de monitoreo costero de plaguicidas

Establecer la línea base de concentración de plaguicidas en la zona marina (1-10 millas):
- Agua
- Sedimento
- Biotas

Monitoreo de plaguicidas en zonas de desembocaduras, lagunas costeras y cuencas hidrográficas

País | Sitio
---|---
Nicaragua | Lago Cocibolca, Río San Juan y la salida al Mar en San Juan del Norte
| Río Grande de Matagalpa (Cuenca 55)
| Laguna de Bluefields, Río Escondido (Cuenca 61) y Río Kubra
Costa Rica | del Colorado
| Río Matina
| Río Moro
| Río Estrella
| Cahuita
Colombia | Ciénaga Grande de Santa Marta (CGSM)
| Desembocadura del río Magdalena
| Bahía de Cartagena
| Golfo de Morrosquillo
| Desembocadura río Ónix
| Golfo de Urabá (zona fronteriza con Panamá)

Programa de monitoreo costero de plaguicidas

Unos antecedentes de investigación por las instituciones participantes

Programa de monitoreo costero de plaguicidas

Por definir
- Número de estaciones
- Frecuencia
- Plaguicidas a monitorear
- Co-variables
- Presentación de resultados en GIS-IMS

PLAGUICIDAS ORGANOCLORADOS E HIDROCARBUROS AROMÁTICOS POLICÍCLICOS (PAHs) EN AGUA Y SEDIMENTOS DEL LAGO COCIBOLCA Y EN SUS PRINCIPALES TRIBUTARIOS

Preparado: Jorge Cuadra Leal
2. -- Plaguicidas organoclorados en sedimentos

- Algunos plaguicidas persistentes:
  - DDT, DDE y DDD
  - Dieldrín, aldrín, endrín
  - Gliondano
  - Endosulfán
  - Lindano

Secto SAREC → SIDA

Cuadro 6. Plaguicidas en sedimentos y ríos.

<table>
<thead>
<tr>
<th>Año 2004</th>
<th>Total analizado</th>
<th>Reacciones</th>
<th>Compuestos encontrados</th>
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LA REDCAM

SISTEMA DE COOPERACIÓN INTERINSTITUCIONAL PARA LA VIGILANCIA DE LA CALIDAD AMBIENTAL MARINA EN COLOMBIA
Programa de monitoreo costero de plaguicidas

**Intereses:**
- Desarrollo de capacidades en la región
- Uniformidad metodológica
- Acceso a resultados

![Mapa de monitoreo en el Caribe](image)

![Mapa de resultados en el Caribe](image)

GRACIAS

[www.cep.unep.org.repcar](http://www.cep.unep.org.repcar)
The GEF-IWCAM Project

GEF-IWCAM Background

- Funding: Global Environment Facility (GEF)
- Project Cost: US$112M (includes co-financing)
- GEF Funding US$14M
- Implementing Agencies: UNEP & UNDP
- Executing Agencies: CEHI, UNEP-CAR/RCU, and UNOPS
- Project Coordination Unit: based at CEHI

PROJECT OBJECTIVE

To assist Caribbean Small Island Developing States to adopt an integrated approach to watershed and coastal area management.

13 countries involved in the Project: Antigua & Barbuda, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, Trinidad & Tobago

All have agreed to adopt the IWCAM approach

Required to address policy and legislative issues to fully mainstream IWCAM at the national level.

IWCAM CHALLENGES

- Coordination: national, regional
- Linkages and coordination with other initiatives/partnerships
- Sustainability of IWCAM after project life (requires programmatic approach)
- Need for re-orientation among relevant decision-makers and technocrats
- Political willingness
- Public awareness and participation

COMPONENT 1: DEMONSTRATION, CAPTURE AND TRANSFER OF BEST PRACTICES

- Implementation and management of 9 demonstration projects in 8 countries
- Capture of lessons, best practices, alternative technologies from Demonstration Projects
- Development of national, regional and global replication strategies and mechanisms
GEF-IWCAM Component #1 - Demo Projects

- Antigua and Barbuda: Mitigation of Groundwater and Coastal Impacts from Sewage Discharges from St. John's
- Bahamas: Land and Sea Use Planning for Water Recharge Protection and Management in Andros
- Bahamas: Marina Waste Management at Elizabeth Harbour in Exuma
- Cuba: Application of IWCAM Concepts at Cienfuegos Bay and Watershed
- Dominican Republic: Mitigation of Impacts of Industrial Wastes on the Lower Haina River Basin and its Coast

GEF-IWCAM Project Components

COMPONENT 2: DEVELOPMENT OF IWCAM PROCESS, STRESS REDUCTION AND ENVIRONMENTAL STATUS INDICATORS FRAMEWORK

- Review existing national and regional level indicator frameworks
- Development of template for national level Indicators
- Conduct hotspot diagnostic analyses (HSDA) at (non-demo) hotspots in each country
- Establish Regional centre for storage of Indicator information and for Indicator training
- Pilot IWCAM process, stress reduction and environmental status indicators (1 country)

COMPONENT 3: POLICY, LEGISLATIVE AND INSTITUTIONAL REFORM FOR IWCAM

- Review of national policy, legislation and institutional structures identifying barriers to IWCAM
- A set of regional guidelines for national policy, legislative and institutional reform
- Regional programme for amendment of national legislation and policy
- IWRM Plan development

COMPONENT 4: REGIONAL & NATIONAL CAPACITY BUILDING & SUSTAINABILITY FOR IWCAM

- National workshops on awareness and multi-sectoral sensitisation to IWCAM issues
- Stakeholder involvement in regional IWCAM
- Training and education activities
- A regional strategy for the sustainable promotion and implementation of IWCAM
- Project Networking
- A regional IWCAM Information Clearing House

COMPONENT 5: PROJECT MANAGEMENT AND COORDINATION

- Project Management (by Project Coordination Unit)
- Project Steering Committee (to provide policy level guidance)
- National Inter-sectoral Committees (to capture IWCAM concepts)
- Implementing Agency/Executing Agency Management Group
- Regional Technical Advisory Group
- Project Reporting on activities and outputs, and reviews of project work-plan and budget
- Project Evaluation ensures that indicators are measuring sustainable project success
- Develop an Information Management System for the project
Laboratory Capacity Building

- Environmental monitoring and surveillance
  - Need for building capacity, both nationally and regionally, to monitor and evaluate environmental water quality in all participating SIDS.
  - Supports indicator development and application (Component #2)
  - Enhancement of laboratory capacity and capability are needed – provision of equipment, technical training including QA/QC

Plans for Increasing Laboratory Capacity

- Conduct of monitoring needs capability assessments planned for first half of 2008
- Conduct training in environmental water quality monitoring
- Strengthen laboratory capabilities through acquisition of equipment
- Upgrade monitoring capabilities of regional laboratories

Similarities and Synergies between GEF IWCAM and INWEH

- Both are dealing with LBS issues and the interconnection between terrestrial and marine systems
- Both projects include Ja, DR, TT, SLU
- DR demo project is looking at industrial waste, with monitoring in the coastal area and upstream and might be relevant as a site to trace POPs and PTS from source to coastal zone
- A laboratory network is to be established and could be expanded to include non-IWCAM countries

Similarities and Synergies between GEF IWCAM and INWEH

- An environmental information database (capturing results of monitoring) is being developed under IWCAM and can be linked to the INWEH database.
  - Physical location could be CEHI, housed as part of the IWCAM PIMS
- Both will be assessing laboratory capacity with a view to upgrading participating laboratories
  - Acquisition of equipment
  - Training in use
  - Training to improve QA/QC
  - Proficiency testing participation

Plans for Increasing Laboratory Capacity

- Provide regional and national training in environmental water quality monitoring including QA/QC
- Create and manage a regional network of laboratories for sharing of technical information and online training

Field and lab activities, St. Lucia
Conclusion: Many areas of overlap and many potential synergies.

Both projects will require close coordination to maximise outputs.
TRINIDAD AND TOBAGO

Current Situation and Capacity regarding POPs and PTSs in Coastal Waters

RICHARD BRATHWAITE AND WENDY NORVILLE
(University of the West Indies, St. Augustine; Institute of Marine Affairs)

UNU-INWEH PLANNING WORKSHOP
Assessment, Monitoring and Management of Persistent Organic Pollutants (POPs) and Persistent Toxic Substances (PTSs) in Coastal Ecosystems of the Wider Caribbean Region, 26-28 November 2007

Overview

- Introduction
- Current Situation
- Studies Conducted
- Testing Capabilities
- The Way Forward

Trinidad & Tobago

- Area: 5128 km²
- Population: 1.3 million (1998)
- Economy: largely oil & gas based
  - Oil refining, methanol, ammonia, urea, LNG
  - Other-iron & steel, cement, food processing, rum distilling
  - Diversification-tourism, manufacturing, agriculture

Current Situation

Major Sources of PTSs

- Energy- exploration, production, service stations
- Industry
  - Ammonia, urea, paints, batteries, wood, paper, cloth, iron & steel, cement, metal fabricators, power generation
- Waste- incinerators, crematoria, landfill, vehicles
- Agriculture & vector control- pesticide use
- Marine- ship building, repair, antifouling paints

Trinidad & Tobago

- Area: 5128 km²
- Population: 1.3 million (1998)
- Economy: largely oil & gas based
  - Oil refining, methanol, ammonia, urea, LNG
  - Other-iron & steel, cement, food processing, rum distilling
  - Diversification-tourism, manufacturing, agriculture
New Industrial Developments

- Polyethylene production plant
- At least one aluminium smelter
- Pitch-based products

Actions to Date

- Acceded to Stockholm convention (Dec 2002)
- Participated in UNEP/GEF project
  - Regionally based assessment of PTSs
- Steering committee formed to guide implementation process
- Proposal submitted for UNDP/GEF funding for initial assistance to fulfill obligations
  - Approved by GEF, Cabinet
  - Awaiting final signatures following review by AG

Legal Instruments Available

- Management of POPs & PTSs
- Pesticide & Toxic Chemical Act (1979, 1986)
- Trade Ordinance No. 19 (1958)
- Environmental Management Authority Act (2000)
- Customs Act (1980)
- Rotterdam Convention

Pesticide Use

- No POPs under the Stockholm Convention are currently imported or registered for use
- Never manufactured here; some used previously:
  - Chlordane - termicide
  - Mirex - control of “bachac”
  - Aldrin/dieldrin - agriculture, termicide
  - DDT - control of mosquitoes (malaria)
  - Toxaphene - agriculture
- Monitoring done by Pesticides & Toxic Chemicals Control Board

Pesticide Inventory

- Inventory of obsolete pesticides & toxic chemicals for disposal (1999)
- Government, private laboratories
- Government agencies
- Research stations
- Ports
- Agrochemical shops
- Sugar cane estates

Pesticide Inventory

- Over 15,000 litres & 26 tonnes of pesticides identified
  - Insecticides, herbicides, fungicides, growth regulators
  - POP pesticides:
    - Mirex (26 kg)
    - DDT (24,000 kg)
  - Other pesticides:
    - Atrazine (108 kg)
    - Endosulfan (0.75L)
Importation of Pesticides into Trinidad & Tobago (2003-2006)

<table>
<thead>
<tr>
<th>Imported Products</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
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<tbody>
<tr>
<td>Imports (kg)</td>
<td>1,406,453</td>
<td>2,395,051</td>
<td>1,750,901</td>
<td>1,748,438</td>
</tr>
<tr>
<td>% Insecticides</td>
<td>67.53</td>
<td>46.54</td>
<td>60.94</td>
<td>59.58</td>
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<tr>
<td>% Herbicides</td>
<td>21.12</td>
<td>47.59</td>
<td>24.62</td>
<td>30.63</td>
</tr>
<tr>
<td>% Fungicides</td>
<td>7.79</td>
<td>4.13</td>
<td>9.63</td>
<td>7.24</td>
</tr>
<tr>
<td>% Growth Regulators</td>
<td>0.09</td>
<td>0.04</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>% Rodenticides</td>
<td>1.17</td>
<td>1.11</td>
<td>1.73</td>
<td>1.86</td>
</tr>
<tr>
<td>% Other Pesticides</td>
<td>2.16</td>
<td>0.60</td>
<td>3.08</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Studies Conducted

Studies Conducted in Trinidad

- Sampath (1982) - organochlorine pesticides & PCBs in biota & sediment from the Caroni Swamp, mouth of the Blue River (not detected in water)
- IMA (1980) - chlorinated hydrocarbons below 1ppb in water, sediment & biota from central Gulf coast
- IMA (1998) - detectable levels of DDE found in sediments of the Nariva Swamp (not detected in water)

PAHs in Sediments from the Gulf of Paria (GOP), ‘98

- Concentrations < 22,000 ng/g (Apparent Effects Threshold)
- Elevated concentrations
  - Port-of-Spain
  - San Fernando
  - Point Fortin

Hg in Sediments from the GOP (1998 - 1999)

Lead in Sediments from Point Lisas (1979-1998)
TBT in Sediments from Chaguaramas (2001)

- TBT conc range: 100-3000 µg kg⁻¹ (ppb)
- TBT concs > 2 ng l⁻¹ (ppt) can affect marine life
- All metals tested > SQGs (CCME, 1998)

PAHs & Metals in Bivalves from the GOP (2002)

- 6 harvesting sites
- Oysters, mussels, “mok”
- **PAHs**
  - Benzo(a)pyrene > British Columbia standard at 4 stations
- **Metals**
  - Pb & Hg acceptable (Australian limits for seafood consumption)

Testing Capabilities

- CARIRI
  - Facilities recently upgraded
  - Multi-residue screen for up to 750 pesticides
- Ministry of Health (Chemistry Food & Drugs Division)
  - Some testing capabilities
- The University of the West Indies, St Augustine
  - Equipment available for testing

The Way Forward

- Strengthening of coordinating mechanism
- Public information & awareness
- Training
- Elaboration of inventories
  - Unintentional POPs
  - Existing POP pesticides, PCBs

The Way Forward

- Strengthening/improvement of capacity:
  - Legal framework
  - Monitoring & analysis
  - Risk assessment
  - Hazardous waste management
  - Best environmental practices
  - FUNDING

Acknowledgements

- Government of the Republic of Trinidad & Tobago
- Institute of Marine Affairs
- The University of the West Indies
- Ministry of Health (Chemistry Food & Drugs Division)
  - H. Ali
- Ministry of Public Utilities & the Environment
  - D. Persaud
- Environmental Management Authority
  - W. Rajkumar
TRINIDAD AND TOBAGO

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Current Situation and Capacity regarding POPs and PTSs in Coastal Waters
INTRODUCTION

CEHI was established as a legal entity in 1988 by the Governments of the Caribbean Community (CARICOM) to respond to the environmental health concerns of CARICOM Member States.

CEHI MANDATE

“provide technical advisory services to Member States in all areas of environmental management, including:
- water supplies,
- liquid waste and excreta disposal,
- solid waste management,
- water resources management,
- coastal zone management including beach pollution,
- air pollution, occupational health,
- vector control,
- disaster prevention and preparedness,
- natural resources conservation,
- environmental institution development and the socio-economic aspects of environmental management.”

CEHI Member States

CEHI’s Activities/Programmes and Services

- Solid/Liquid Waste Management
- Water Resources Management
- Coastal Resources Management
- Environmental Impact Assessments
- Environmental Monitoring and Surveillance
- Training Courses/Internships
- Laboratory, Information & Engineering Services
POPS WORK IN THE REGION

- There has been little work carried out in the Eastern Caribbean;
- POPs work done in:
  - St. Lucia
  - Antigua
  - Barbados
- The focus of this monitoring was on POPs in soils, not coastal water.

ST. LUCIA

- Work done in St. Lucia in the 1980s focused on pesticide levels in the fresh water and marine environment.
- Pesticide Levels in all samples analysed were below detection limits.
- Results suggested that pesticide contamination of the environment was not a serious concern at the time. However
  - Study was a one time survey
  - Did not test for metabolites

ANTIGUA

- Very low levels of POPs pesticides found in soils tested.

BARBADOS

- Work carried out on soils for National POPs inventory

Summary of issues on POPs Management at National Level

<table>
<thead>
<tr>
<th>BARBADOS</th>
<th>STATUS</th>
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<tbody>
<tr>
<td></td>
<td>Signed on to Stockholm Convention</td>
<td>Guidance in training of operators</td>
</tr>
<tr>
<td></td>
<td>Pesticide inventory in 2003-2004 for POPs, PTSs and obsolete pesticides</td>
<td>Strengthen regulations, monitoring and enforcement</td>
</tr>
<tr>
<td>Country</td>
<td>STATUS</td>
<td>NEEDs</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------------</td>
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<tr>
<td>GRENADA</td>
<td>- No Basel, Stockholm and Rotterdam Conventions</td>
<td>- Inventories</td>
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<td>ST. KITTS/NEVIS</td>
<td>- Party to Conventions</td>
<td>- Inventory</td>
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<tr>
<td></td>
<td></td>
<td>- Regional Database</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to promote harmonization</td>
</tr>
<tr>
<td>ST. LUCIA</td>
<td>- Party to Conventions</td>
<td>- Capacity building for chemicals management</td>
</tr>
<tr>
<td></td>
<td>- No specific Act or regulations to deal with POPs, but management through various Acts/regulations</td>
<td>- Data gathering and analysis related to health risks.</td>
</tr>
<tr>
<td></td>
<td>- Inventory of POPs conducted</td>
<td></td>
</tr>
<tr>
<td>ST. VINCENT &amp; THE GRENADES</td>
<td>- Have legislation but no enforcement</td>
<td>- Awareness, education and training</td>
</tr>
<tr>
<td></td>
<td>- No stockpiles of obsolete pesticides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Have attempted ID of possible sites where PTSs are used</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Landfill storage of PCBs</td>
<td></td>
</tr>
</tbody>
</table>

**Laboratory Services:**
- Gas Chromatograph (GC), HP 5890 II
- High Pressure Liquid Chromatograph (HPLC), HP 1100.
- Atomic Absorption Spectrophotometer, Varian 220 FS with flame and graphite furnace.
PESTICIDE ANALYSIS DONE BY CEHI

<table>
<thead>
<tr>
<th>Pesticide class</th>
<th>Sample Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arachidons</td>
<td>OCPs, OPPs, Carbamates, Paraquat/Diquat</td>
</tr>
<tr>
<td>Aroclors</td>
<td>X</td>
</tr>
<tr>
<td>OCPs</td>
<td>X</td>
</tr>
<tr>
<td>OPPs</td>
<td>X</td>
</tr>
<tr>
<td>Carbamates</td>
<td>X</td>
</tr>
<tr>
<td>Paraquat/Diquat</td>
<td></td>
</tr>
</tbody>
</table>

WHAT CEHI CAN OFFER

- Training in POPs and PTS identification
- POPs and PTS identification
- Technical assistance & advice (e.g. to do inventories)
- Provide platform for supporting network of laboratories

THANK YOU!
COUNTRY PROFILE – SAINT LUCIA

- Saint Lucia is a small island developing state (SID) located in the chain of islands making up the Eastern Caribbean.
- It is situated between the French Island of Martinique to the North and St. Vincent and the Grenadines to the South, lying at 14 degrees North and 61 degrees West,
- It has a total land mass of 238 sq. miles, being 27 miles long and 14 miles wide,

- St. Lucia’s terrain is characterised by an interior mountainous topography and flatter terrain along the coastline.
- The island’s highest peak, Mt. Gimie, rises to 3,145 ft.
- St. Lucia is rich in biodiversity, with the mountainous interior being home to a wide variety of tropical plants and birds, including the indigenous St. Lucia Parrot Amazona versicolor.

- St Lucia is also home to one of the more recent sites to be designated as a World Heritage Site, the Pitons Management Area.
- It is one of a few heritage sites to have both a land and marine component.
- St. Lucia experiences tropical climatic conditions with a marked rainy season from June to November and dry season from December to May.
- Drinking water on the island is supplied from rivers.
SELECTED METEOROLOGICAL DATA FOR SAINT LUCIA

<table>
<thead>
<tr>
<th>Average</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>158.6mm</td>
</tr>
<tr>
<td>Max Temperature</td>
<td>28.3°C</td>
</tr>
<tr>
<td>Min Temperature</td>
<td>23.2°C</td>
</tr>
<tr>
<td>Daily Temperature</td>
<td>25.8°C</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>74%</td>
</tr>
<tr>
<td>Daily Sunshine hours</td>
<td>8.1</td>
</tr>
</tbody>
</table>

The population is approximately 164,700.
The main industries are tourism and agriculture, with tourism taking the top spot recently due to a decline in banana production.
The use of agrochemicals and fertilizers in agriculture and chemicals used in the small industrial and hotel sectors are of increasing concern.
Hence a number of initiatives related to chemicals management have been undertaken.

MAIN ENVIRONMENTAL ISSUES

- Degradation of the marine and coastal systems
- Poor land management and clear land use zones
- Loss of biodiversity
- Degradation of fresh water systems
- Improvement of waste management systems
- Poor management of chemicals

CHEMICAL STUDIES DONE IN SAINT LUCIA

A project “Impact and Amelioration of Sediment and Agro-Chemical Pollution in Caribbean Coastal Waters” was funded by the United Kingdom Department for International Development (DFID).
In the component on the “Fate of agro-chemicals in the land water interface”, the findings were as follows:

- Very few studies had been done on the impact of agrochemicals in the St. Lucian environment.
- Information on fertilisers was particularly lacking.
- Studies conducted focused on levels of pesticides in potable water, watercourses, the marine environment and aquatic organisms.
- No studies have been done on bioaccumulation of pesticides and on the fate and transportation of pesticides.

Limited studies on the effects on human health (occupational exposure to pesticides).
Pesticides pollution was mainly associated with the banana industry.
In another component of the same project, a snap shot environmental survey was done on 3 watersheds in 2001.
To assess the fate of agrochemicals (selected pesticides and fertilisers) in water, sediment and biota along the length of the watershed.
This was done from plantations in the upper catchment to the point of entry into coastal waters. The results were as follows:
Pesticides levels in samples were below minimum detectable limits for the selected pesticides. For fertilisers, high levels of potassium were found in two of the watersheds. It was recognised that the project could not do any “in depth” study and that an environmental plan was needed. A document outlining the recommended components of such a plan was produced.

POPs Project

St Lucia became a party to the Stockholm Convention in 2002. Although no POPs pesticides are used in St. Lucia, it was recognised that unintentional POPs, PCBs etc were being produced as a result of industrial, commercial and residential activities. An inventory of POPs was conducted and a National Implementation Plan was developed, showing St. Lucia’s commitment to the sound management of chemicals.

The inventory showed that small quantities of POPs were present at institutions in the island. An earlier inventory conducted for obsolete pesticides and toxic chemicals revealed that there were approximately 7 metric tonnes to be disposed of. A POPs National Implementation Plan has been developed for Saint Lucia and funding is being sought to implement the various activities.

National Priorities and Key Issues

- Institutional strengthening in chemicals management.
- Overall public awareness on chemicals management.
- Assessment of hazardous risk associated with stockpiles.
- Development of related legislation.
- Environmental monitoring.
Capacidades Analíticas y de Campo para COPs y PBSs en México

Comisión Nacional de Áreas Naturales Protegidas (CONANP)
Colegio de la Frontera Sur (ECOSUR-Chetumal)
Centro de Investigación y de Estudios Avanzados (Cinvestav-Mérida)

La CONANP-RPYCMexicano en la Institución responsable de parte de México en el Proyecto para la Conservación y Uso Sustentable del Sistema Arrecifal Mesoamericano (SAM/MBRS)

Áreas Marinas Protegidas en el Caribe Mexicano

Comisión Nacional de Áreas Naturales Protegidas, Región Península de Yucatán y Caribe Mexicano

La CONANP-RPYCMexicano en la Institución responsable de parte de México en el Proyecto para la Conservación y Uso Sustentable del Sistema Arrecifal Mesoamericano (SAM/MBRS)

México

LABORATORIOS INSTITUCIONALES
ECOSUR

Ing. Adriana Zavaa Mendoza
ECOSUR-UNIDAD CHETUMAL

• El Colegio de la Frontera Sur es un centro multidisciplinario de investigación y educación a nivel postgrado, enfocado en el desarrollo y la vinculación de México en la Frontera Sur.

• ECOSUR-Unidad Chetumal está ubicada en la ciudad de Chetumal Quintana Roo, México.

AREA DE INFLUENCIA
ECOSUR-Unidad Chetumal

• El Colegio de la Frontera Sur tiene gran influencia en toda la región de la costa del caribe mexicano, con 8 líneas de investigación y 21 investigadores y de Sistemas de Producción Alternativos con tres líneas y 5 investigadores, tres de estos últimos enfocados a pesquerías artesanales y dos a recursos forestales y silvícola.

LABORATORIOS INSTITUCIONALES DE ECOSUR

Apoyar con análisis físico-químicos a todos los proyectos de investigación de ECOSUR.

Apoyar análisis físico-químicos de instituciones con convenio con ECOSUR.

Ofrecer a la comunidad servicios externos.

Proceso de Acreditación de Métodos de Ensayo

• Utiliza la NMX-EC-17025-IMNC-2006 para acreditar métodos de ensayo ante el organismo de acreditación en México.

• Se encuentran en proceso de acreditación 21 métodos de ensayo en una primera fase. Dentro de esta fase metales pesados en agua marina y continental, aguas residuales, sedimento marino y continental.

• En la segunda fase (2008) se acreditarán los métodos para hidrocarburos y plaguicidas.

LABORATORIOS INSTITUCIONALES

Laboratorio de Análisis Instrumental: 4 métodos.
Laboratorio de Bromatología: 6 métodos.
Laboratorio de Diagnóstico Fitosanitario: 1 método.
Laboratorio de Química: 4 métodos, CHETUMAL
Laboratorio de Análisis de Suelos y Plantas: 4 métodos.
Laboratorio de Genética: 2 métodos.
APOYO AL PROYECTO SAM

• Participación de la Secretaría de la Marina para el muestreo de muestras de agua en México.

• Análisis de calidad del agua en muestras de México durante dos años.

• Análisis de calidad del agua en muestras de Belice durante 8 meses.

• Participación en reuniones de trabajo.

• Asesorías para análisis de calidad del agua a Honduras y Guatemala.

Análisis de Calidad del Agua
Proyecto SAM

• Se determinó la concentración de nutrientes (amonio, nitratos, nitritos y o-fosfatos) en 6 sitios prioritarios del Manual de Monitoreo Sinóptico del Proyecto del SAM.

• Tres sitios en la Bahía de Chetumal y tres sitios en la costa sur del estado de Quintana Roo.

• Se tomaron cinco réplicas en cada sitio representativo.

Análisis de Calidad del Agua
Proyecto CAPA-USAID

• Análisis de 14 parámetros para la evaluación de 10 plantas de tratamiento de aguas residuales (PTARs) de Quintana Roo.

• Entre los parámetros que se midieron están 8 metales pesados, grasas y aceites, coliformes totales, sólidos en todas sus formas, nitrógeno y fósforo total.

• En 2008 se realizará la evaluación de otras 10 PTARs en Quintana Roo. Se incluirán los análisis de hidrocarburos y plaguicidas.

CAPACIDADES DEL LABORATORIO DE QUIMICA
Chetumal, Quintana Roo., México.

EQUIPO

• Dos cromatógrafos de gases equipados con detectores FID, PID, ECD, ELCD y concentrador de purga y trampa, para análisis de plaguicidas, hidrocarburos y compuestos orgánicos volátiles.

• Un cromatógrafos de líquidos con detector ultravioleta.

• Dos espectrofotómetros de absorción atómica equipados con quemador de flama, generador de hidruros, horno de grafito y 19 lámparas de elementos.
SISTEMA DE CALIDAD

- Los laboratorios Institucionales han implementado un sistema de calidad basado en la norma NMX-EC-17025-IMNC-2006

- Los métodos de ensayo se realizan bajo las normas oficiales utilizando métodos normalizados, métodos estándarizados y otros desarrollados por los mismos laboratorios.

- Todos los métodos de ensayo en proceso de acreditación están validados.

Centro de Investigación y de Estudios Avanzados
Unidad Mérida

- El centro cuenta con 650 investigadores de tiempo completo
- En siete campus en todo el país
- Cerca de 40 programas de postgrado
  - En promedio
    - Se gradúa un maestro en ciencias al día
    - Se gradúan tres doctores en ciencias por semana
- Se cubren áreas de la ciencia desde las ciencias básicas (matemáticas, química, física, biología molecular) hasta control automático, nuevos materiales y ciencias sociales (investigaciones educativas, ecología humana)

Laboratorios

- El Departamento de Recursos del Mar cuenta con 20 laboratorios. Para este proyecto son importantes:
  - Geoquímica Marina
  - Patología de Organismos Acuáticos
  - Ecotecnología Molecular
- Además, tenemos en otros departamentos:
  - Difracción de rayos X
  - Espectrofotometría no-intrusiva con transformada de Fourier
  - Microscopía electrónica
  - Etc.

Equipo Analítico

- Para análisis relevantes a los COPs se cuenta con:
  - Tres cromatógrafos de gases
    - Dos con FID y FID
    - Un GC/MS
  - Un HPLC con detectores UV/VIS y fluorescencia
  - Dos equipos de absorción atómica
    - Uno con atomizador de llama
    - Uno con vaporización electrotérmica
  - Espectrofluorómetro sincrónico
  - Espectrofotómetro UV/VIS con módulo de cinética
Otras facilidades

- Para estudios sobre efectos de los COPs se cuenta con:
  - Criadero de peces, moluscos y crustáceos
  - Área de acuicultura
  - 250 peces individuales para bioensayos
  - Equipo para análisis histológico
  - Equipo para PCR y PCR-RT
  - Ultracongelador
  - Suscripción en línea a más de 1200 revistas internacionales

Líneas de Investigación

- Estados y tendencias de contaminantes tóxicos (COPs, PAHs, metales) en ecosistemas acuáticos tropicales.
  - Efectos biológicos de la presencia de contaminantes tóxicos en ecosistemas acuáticos tropicales:
    - Biomarcadores
      - EROD, CYP-1A, Inhibición de Colínesterasas
      - peroxidación de lípidos, metabolitos de PAHs
      - Catalasa, Superóxido dismutasa, GST, expresión diferencial de genes, etc.
  - Relación con estructura comunitaria:
    - Bentos
    - Parásitos
    - Relación con lesiones histológicas

Gracias por su atención

Quejas, reclamaciones e interjecciones a:

gold@mda.cinvestav.mx
gerardo.gold@gmail.com
Planning Workshop
Assessment, Monitoring and Management of Persistent Organic Pollutants (POPs) and Persistent Toxic Substances (PTS) in the Coastal Ecosystem of the Wider Caribbean
26 – 28 November 2007
UNU-INWER
Hamilton, Canada

Background
- Jamaica signed the Convention on Persistent Organic Pollutants (POPs) at the Conference of Plenipotentiaries in Stockholm in May 22-23, 2001
- Implemented obligations under the Convention to ratify it with the support of funding by the Global Environmental Facility

Actions Taken
- 1998 - Known stocks of the POPs pesticides were collected and shipped for destruction.
- 1999 - Jamaica banned the importation of all eight pesticides and hexachlorobenzene included in the Convention as provided in Regulations passed under the Pesticides Act
- Some stocks of PCBs have been collected and either destroyed locally or shipped overseas for destruction.

Actions Taken
- 2006 - Air Quality Regulations passed which include air emission limits for incidentally produced POPs (dioxins and furans)
- The Regulatory Agenda includes the conduct of a Regulatory Impact Assessment of intra-island movement of hazardous wastes.

Actions Taken
- Draft Wastewater and Sludge Regulations developed which includes limits for PCBs
- Development of a draft hazardous waste policy

Project Concept
- To reduce the current level of pollution in streams and rivers and the marine environment by pollution prevention methodologies and control of agricultural run-offs into these areas
Thank You for Your Kind Attention

Paulette Kolbusch
Acting Director
National Environment and Planning Agency
10 & 11 Caledonia Avenue
Kingston 5
Tel.: 876-754-7540 -876-1271 (Mobile)

Telefax: 876-754-7599
E-mail: pkolbusch@nepa.gov.jm
Proyecto Asistencia Al Gobierno de Honduras Para el Cumplimiento del Convenio de Estocolmo sobre Contaminantes Orgánicos Persistentes (COPs)

Proyecto PNI COPs Honduras*

Noviembre, 2007
Sara Avila

Objetivo del Convenio:
Proteger la salud humana y el ambiente de los contaminantes orgánicos persistentes (COPs).

Se elabora para:
Cumplir con las compromisos y metas del Convenio de Estocolmo

Propósitos del Proyecto PNI....

• Elaborar un PNI basado en un diagnóstico nacional, que logre identificar y priorizar las necesidades del país en relación a la gestión de las SQ y RP.
• Lograr un PNI desarrollado a través de un proceso participativo y con representación de los diferentes actores interesados e involucrados.
• Transferencia de conocimiento y fortalecimiento de capacidades.

Propósitos del Proyecto PNI.....

Proceso de Elaboración del PNI

Fase I
Establecimiento de Prioridades para el PNI
Proceso participativo

Fase II

Alternativas a los COPs
Manejo Ambientalmente Racional.

Proceso participativo

Fase III

Socialización y Aprobación de PNI

Unidad Coordinadora del Proyecto, UCP

Unidad Coordinadora del Proyecto, UCP

Unidad Coordinadora del Proyecto, UCP

Unidad Coordinadora del Proyecto, UCP

¿Por qué un Comité Nacional de la Gestión de las Sustancias Químicas y Residuos Peligrosos (CNG)?

Problema
• Uso inadecuado de las SQ y RP afecta la salud humana y el ambiente lo que requiere de la participación activa de todos los hondureños.

Organización
• La necesidad de contar con un espacio de diálogo y coordinación que aglutine a todos los sectores relacionados con el ciclo de vida de estas sustancias; gobierno, sociedad civil, empresas privadas, ONGs, Cooperación internacional y el sector académico e investigación.
**Sectores que Actualmente Conforman el CNG:**

Gubernamental: SETRA, MINAGRI, INICA, INFORCOH, INFORKIDS, SETCO, SOPTRAVI, COHCT, SANA, Cuerpo de Bomberos de Honduras, COPECO, SGJ, Marina Mercante, ENEE, AMDC, SEFIN, Secretaria de Relaciones Exteriores, Secretaria de Trabajo.

Privada: ANDI, COHEP, FEDECAMARA, CROPLIFE Honduras, HONDUCORP

Social: FUNDEMUN, FUNDAACIÓN VIDA, CARTAS

Organismos Cooperantes: PMU, OPS, PMA, ORSA, FAO

Académico: UNAH, UNICAH, EAP, UPNFM, UCENM

---

**Visión del CNG**

- La visión del CNG es convertirse en una plataforma de incidencia política multisectorial y multidisciplinaria, que aborde la problemática nacional y defina las estrategias para una gestión adecuada de las SQ y RP, para el cumplimiento de los Convenios Internacionales y normativas nacionales en torno a la reducción de riesgos a la salud humana y el ambiente.

---

**Objetivos del CNG**

- Formular políticas y estrategias en torno a la reducción de riesgos por sustancias químicas y residuos peligrosos.
- Facilitar y coordinar la implementación de los convenios internacionales relacionados con la gestión de sustancias químicas y residuos peligrosos.
- Propiciar el intercambio de experiencias y de información con respecto a las iniciativas internacionales, regionales y nacionales en torno a las SQ y RP.
- Gestionar proyectos específicos para el MAR de las SQ y RP y para el fortalecimiento de las capacidades nacionales.

---

**Gracias por su Atención**

Proyecto PNI COPs Honduras
Teléfonos: 211 0943, 3770 3604
Correo: SaraAvila1@gmail.com
www.cescco.hn
Persistent Organic Pollutants (POPs) in Guatemala

Bessie Evelyn Oliva Hernández
Escuela de Química
Universidad de San Carlos de Guatemala

Guatemala

- Caribbean Sea
- Izabal Lake
- Polochic River
- Río Dulce and Izabal Lake
- Motagua River


There is no available information regarding pesticides in use and stored in Guatemala. This is due to lack of financial and human resources to establish and inventory.

Pesticides importation in Guatemala 1978-1997 (En miles de kilogramos)

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<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecticides</td>
<td>12,694</td>
<td>69</td>
<td>1,498</td>
<td>30</td>
<td>659</td>
<td>16</td>
<td>648</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicides</td>
<td>1,856</td>
<td>8</td>
<td>703</td>
<td>14</td>
<td>1,722</td>
<td>42</td>
<td>1,536</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fungicides</td>
<td>586</td>
<td>3</td>
<td>2,607</td>
<td>51</td>
<td>1,501</td>
<td>37</td>
<td>1,764</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>4,994</td>
<td>20</td>
<td>237</td>
<td>5</td>
<td>224</td>
<td>5</td>
<td>95</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>22,694</td>
<td>100</td>
<td>5,075</td>
<td>100</td>
<td>4,106</td>
<td>100</td>
<td>4,042</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Intoxications according to chemical class and type of pesticides.

- 1994, 51% of intoxications were caused by cholinesterase inhibiting pesticides:
  - Organophosphorous pesticides (OP) 41 %
  - Carbamates 10 %

- In 1997, cholinesterase inhibitors caused 62% of the total intoxications reported:
  - OP 47 %
  - Carbamates 15 %

- In 1997, endosulfan caused 15% of the intoxications reported to IGSS; paraquat 9%, other herbicides 7% and fosfina 3%.
DDT residues in human milk

- In 1971 a maximum level of 12.2 mg/L of DDT, was found in Escuintla.
- In 1982 the maximum level of DDT was 3.37 mg/L, Escuintla.
- Other pesticides were also found in high percentages, as residues of organochlorine pesticides HCH, dieldrin, heptachlor epoxide and endrin.

Malaria in Guatemala

- Problem of Public Health
- Registered among the 10 diseases of higher morbility.
- 80% of the country (endemic)
- MSPAS, 2007

Until 2006 more than 14000 cases of malaria were registered.
Almost 14,500 Tons of insecticide are stored in risky conditions in Guatemala.
Source: Programa de Malaria del Ministerio de Salud guatemalteco.

Guatemalan general legislation regarding pesticides

- Constitución Política de la República, Artsos. 93-95 (1985)
- Cotton Cultivation. Decreto Ley 375 (1965)
- Law for Protection and improvement of the Environment. (Decreto 68-86) (1986)
- Integral Program for Agricultural and environmental Protection PIPAA (Acuerdo Ministerial 23-91 del MAGA) (1991)
- Código de Salud (Decreto 90-97) (1997)
- Ley de Sanidad Vegetal y Animal (Decreto 36-98) (1998)

Forbidden pesticides in Guatemala

- Aldrin
- Arsenicals
- Campheclor
- Chlordane
- Dichloro (Kepone)
- Chlordeconeform
- Creosota
- Dapinoxide
- DDT
- Dibromochloropropane
- Dieldrin
- Dinosob acetato
- Endrin
- Eth paraathion
- Heptachlor
- Hexachlorbencene (BHC)
- Lindano
- Lindano
- Methylmercurials
- Sodium cyanide
- Sodium fluoroacetate
- 2,4,5-T
- 2,4,5-Ti
- Chlorofluorocarbons as aerosol

Pesticides in water

- Significant levels of organochlorine insecticides have been found in Amatitlán Lake.
- High levels of cipermetrine and organophosphorus pesticides have been found in Motagua River, which discharges its water to Caribbean Sea.

Fuente: Willy Knoedel, Proyecto CONCYT 08-97, Estudio de los Niveles de plaguicidas en las cuencas del lago de Amatitlán y de Motagua.
Concentrations of metabolites of PAHs in bile of Ronco Blanco fish (Haemulon plumieri) collected in Punta de Manabique

<table>
<thead>
<tr>
<th>Muestra</th>
<th>Piranitos (ug/mL)</th>
<th>Naftalenos (ug/mL)</th>
<th>Fenantrenos (ug/mL)</th>
<th>Benzo(a)pyrenes (ug/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.066</td>
<td>52.593</td>
<td>28.943</td>
<td>0.236</td>
</tr>
<tr>
<td>2</td>
<td>0.192</td>
<td>120.695</td>
<td>36.315</td>
<td>1.231</td>
</tr>
<tr>
<td>3</td>
<td>0.039</td>
<td>49.875</td>
<td>60.482</td>
<td>0.169</td>
</tr>
<tr>
<td>4</td>
<td>0.138</td>
<td>49.016</td>
<td>78.505</td>
<td>0.336</td>
</tr>
</tbody>
</table>

Fuente: Monitoreo del Sistema Arrecifal Mesoamericano, 2006

Concentrations of organochlorine pesticides in liver of Ronco Blanco fish (Haemulon plumieri) collected in Punta de Manabique

<table>
<thead>
<tr>
<th>Muestra</th>
<th>PAHs (ug/g)</th>
<th>Ciordanos (ng/g)</th>
<th>DDTs (ng/g)</th>
<th>Plaguicidas (ng/g)</th>
<th>PCBs (ng/g)</th>
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</thead>
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<tr>
<td>1</td>
<td>17.547</td>
<td>ND</td>
<td>17.996</td>
<td>25.408</td>
<td>49.078</td>
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<tr>
<td>2</td>
<td>11.053</td>
<td>ND</td>
<td>13.106</td>
<td>65.414</td>
<td>104.752</td>
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<td>3</td>
<td>6.171</td>
<td>ND</td>
<td>24.244</td>
<td>26.762</td>
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<tr>
<td>4</td>
<td>44.458</td>
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<td>75.101</td>
<td>80.397</td>
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<tr>
<td>5</td>
<td>12.640</td>
<td>2.282</td>
<td>11.291</td>
<td>15.571</td>
<td>39.867</td>
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Fuente: Monitoreo del Sistema Arrecifal Mesoamericano, 2006

Concentrations of organochlorine pesticides, sorted by chemical family, Proyecto SAM, 2006

<table>
<thead>
<tr>
<th>Lugar colecta</th>
<th>Peso (Kg)</th>
<th>Longitud (cm)</th>
<th>p,p´-DDT</th>
<th>p,p´-DDD</th>
<th>p,p´-DDE</th>
<th>DDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahía Santo Elena</td>
<td>3.613</td>
<td>2.643</td>
<td>1.612</td>
<td>ND</td>
<td>ND</td>
<td>8.16</td>
</tr>
<tr>
<td>Santa Elena</td>
<td>2.118</td>
<td>0.543</td>
<td>0.532</td>
<td>3.324</td>
<td>0.24</td>
<td>7.318</td>
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<tr>
<td>Punta de Manabique</td>
<td>1.637</td>
<td>0.178</td>
<td>1.613</td>
<td>0.639</td>
<td>1.09</td>
<td>9.156</td>
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<tr>
<td>Riviera</td>
<td>2.498</td>
<td>0.872</td>
<td>1.199</td>
<td>0.171</td>
<td>0.024</td>
<td>2.822</td>
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<tr>
<td>Río San Juan</td>
<td>1.554</td>
<td>0.895</td>
<td>1.012</td>
<td>0.247</td>
<td>ND</td>
<td>3.807</td>
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<td>Río Danta</td>
<td>3.183</td>
<td>0.599</td>
<td>0.296</td>
<td>0.529</td>
<td>0.4</td>
<td>5.284</td>
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<td>Río Dulce</td>
<td>2.322</td>
<td>0.624</td>
<td>0.932</td>
<td>0.696</td>
<td>0.168</td>
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<td>2.699</td>
<td>0.618</td>
<td>0.535</td>
<td>0.387</td>
<td>0.147</td>
<td>4.702</td>
</tr>
<tr>
<td>Cahui</td>
<td>2.822</td>
<td>0.618</td>
<td>0.535</td>
<td>0.387</td>
<td>0.147</td>
<td>4.702</td>
</tr>
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</table>


DDTs in Blanco fish (Petenia splendida) (ng/g dry weight)

<table>
<thead>
<tr>
<th>Lugar colecta</th>
<th>Peso (Kg)</th>
<th>Longitud (cm)</th>
<th>p,p´-DDT</th>
<th>p,p´-DDD</th>
<th>p,p´-DDE</th>
<th>DDT</th>
</tr>
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<tbody>
<tr>
<td>1 Santa Elena</td>
<td>0.386</td>
<td>31.0</td>
<td>0.837</td>
<td>1.930</td>
<td>5.412</td>
<td>8.179</td>
</tr>
<tr>
<td>2 Santa Elena</td>
<td>0.075</td>
<td>19.5</td>
<td>0.661</td>
<td>1.541</td>
<td>20.165</td>
<td>22.367</td>
</tr>
<tr>
<td>3 Santa Elena</td>
<td>0.107</td>
<td>18.5</td>
<td>0.930</td>
<td>0.804</td>
<td>5.651</td>
<td>7.385</td>
</tr>
<tr>
<td>4 Cahui</td>
<td>1.207</td>
<td>1.414</td>
<td>10.775</td>
<td>13.396</td>
<td></td>
<td></td>
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<tr>
<td>Mean</td>
<td>0.909</td>
<td>1.422</td>
<td>10.501</td>
<td>12.832</td>
<td></td>
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</tr>
</tbody>
</table>


National Capacities

- Laboratories with analytical capacity:
- Laboratorio Nacional de Salud (Control de Calidad)
- Universidad del Valle de Guatemala y Universidad Mariano Gálvez (Capacity for limited number of samples)
- Universidad de San Carlos de Guatemala, Escuela de Química (posgraduated and trained researchers for environmental analyses). Trying to get chromatographic equipment for studies of POPs in aquatic ecosystems.

- International cooperation: Federal University of Rio de Janeiro (PAHs and organochlorine pesticides in fish and sediment samples).

Thank you for your attention.
Esfuerzos de la Rep. Dominicana para reducir los Contaminantes Orgánicos Persistentes

- Se adhirió al Convenio de Marpol 73/78 de 1998 por medio de la resolución No. 258 de ese año.
- Firmó y ratificó la Convención de Base en el día 10 de junio del 2000.
- Bajo la resolución 506-2005 de noviembre del 2005 ratificó la Convención de Rotterdam.
- Regulación del uso de Productos Químicos (POPs)

Esfuerzos de la Rep. Dominicana para reducir los Contaminantes Orgánicos Persistentes

- Inicio en el 2006 un Plan Nacional de Implementación de la Convención de Estocolmo:
  - Inventarios de los Contaminantes Orgánicos Persistentes (COPS). Plaguicidas, PCBs y Dioxinas y Furanos.
  - Se ha establecido una coordinación con EDE-SUR y EDE-NORTE como institución responsable de las líneas de transmisión, por tanto de los transformadores, para el manejo y eliminación de PCBs.
  - Muchas Generadoras han eliminado los transformadores contaminados, utilizando los servicios de empresas extranjeras.

Sustancias Orgánicas Persistentes

- Convenio de Estocolmo
  - ALDRÍN
  - CLORDANO
  - MIREX
  - DIETRÍN
  - DETOX
  - DDT (diclorobifeniletacilano): Bifenilos policlorados (PCB), Trifenilos policlorados (PCT), Crocódilo, Fosfato de trios, Actinolita, Amosita, Tremolita, Tetraetilo de plomo, Tetrametilo de plomo

Productos Químicos Regulados

- 2,4,5-T
- Aldrina
- Allopapad
- Captan
- Captafol
- Chlordano
- Chloroduform
- Chlorobenceno
- Compoundes de mercuro
- DDT
- Dieldrina de etiolo
- Dioxina
- Diclorobenzofenol
- Metilparátón
- Propionatos de ivermectin con combinación de concentraciones igual o mayores al 7% de benomilo, 10% de carbamato y 25% de tricloro
d- Tetraciclina
- Tiametómida
- Tetrametilo de plomo

Proyectos para Sostenibilidad de las zonas Costeras de la República Dominicana


Objetivo:
Identificar los medios para apoyar las capacidades de República Dominicana para cumplir con sus obligaciones en el contexto de la Convención de Estocolmo sobre Contaminantes Orgánicos Persistentes (COPs), incluyendo la preparación de un Plan Nacional de Implementación focalizado en los contaminantes orgánicos persistentes que cubran ampliamente aspectos de la gestión segura y ambientalmente sana de químicos y desechos.
**Use de Técnicas Nucleares en el Manejo Integrado de los Problemas de las Zonas Costeras en la Región del Caribe. (Proyecto Regional RLA/7/012 OIEA) 2007-2010. Este se implementará a nivel Nacional (2008-2012).**

**Objetivos:**
Desarrollar y mejorar las capacidades para reducir la degradación, debido a impactos antropogénicos y naturales, del ecosistema costero de la Región del Gran Caribe, usando técnicas nucleares como apoyo en el manejo integrado de la zona costera.

ramondelanoy@yahoo.com

**Actividades RLA/7/012:**
Muestreos de los sedimentos (núcleo) de todas las zonas de bahía y desembocadura de los principales ríos de la República Dominicana para determinar, cuantificar y datar los diferentes contaminantes de origen natural y antropogénicos que han sido arrastrados durante los últimos años a las zonas costeras. Los análisis a realizar son: metales pesados, materias orgánicas, plaguicidas, hidrocarburos, biodiversidad y datación por Plomo 210.

---

**Capacidades**
La República Dominicana cuenta con varias instituciones que poseen:
- Cromatografía de Gases
- Secretaría de Estado de Agricultura y Ganadería
- Instituto de Química –UASD–
- Instituto de Investigación y Biotecnología
- Otras

Técnicas Analíticas Nucleares (Fluorescencia de Rayos X, Espectroscopía Alfa, Beta y Gamma)
- Instituto de Física
- Espectrofotometría por Absorción Atómica
- Varias Instituciones

---

**Gracias**

---

**Efforts to reduce Persistent the Organic Polluting agents in the Dominican Republic**

- One adhered to the Agreement of Marpol 73/78 of 1998 by means of resolution no. 258 of that year.
- It signed and ratified the Convention of Basel day 10 of June of the 2000.
- Under resolution 506-2005 of November of the 2005 it ratified the Convention of Rotterdam.
- Regulation of the Chemical agent use (POPs)
Beginning in the 2006 of a National Plan of Implementation of the Convention of Stockholm:

- Inventories of Organic Polluting agents Persistent COPS (Killing of Plagues, PCBs and Dioxinas and Furanos).

- A coordination with EDE-SUR and EDE-NORTE like institution responsible for the lines of communication has settled down, therefore of the transforming, for the handling and elimination of PCBs.

- Many Generating ones have eliminated the contaminated transforming, using the services of foreign companies.

Efforts to reduce Persistent the Organic Polluting agents in the Dominican Republic

Regulated chemical agents

- Use of Nuclear Techniques to Address the Management Problems of Coastal Zones in the Caribbean Region (Regional Project RLA/7/012 OIEA) 2007-2010. This it will be implemented in the National scope (2008-2012).

Projects for the Sustainability of the Coastal zones of the Dominican Republic

- Qualifying activities on Persistent Organic Polluting agents (POPs) in Dominican Republic (2006 – 2008)

  Objective:

  To identify the average ones to support the capacities of Dominican Republic perform one's duty in the context of the Convention of Stockholm on Persistent Organic Polluting agents (POPs), including the preparation of a National Plan of Implementation focused in persistent the organic polluting agents that will widely cover aspects with the safe and environmentally healthy management of chemistries and remainders.

Activities RLA7012:

- Samplings of sediments (Cores) of all the bays and mouth of the main Dominican rivers of the Republic to determine, to quantify and to date the different polluting due to anthropogenic and natural impacts agents that have been dragged at the last years to the coastal zones. The analyses to make are: heavy metals, organics matters, killing of plagues POPs, hydrocarbons, biodiversity and dating by Lead 210.
Capacities

The Dominican Republic account with several institutions that they have:

Gas chromatography

★ Secretariat of State of Agriculture and Cattle ranch
★ Institute of Chemistry - UASD-
★ Instituto de Investigación and Biotecnología
★ Other

Nuclear Analytical Techniques (X-rays Fluorescence, Spectroscopy Alpha, Beta and Gamma)

★ Institute of Physics

Spectrophotometer by Atomic Absorption

★ Several Institutions
Belize Scenario

- National Framework
- Various Line Ministries have mandate over POPS and PTS
  - Ministry of Natural Resources, Geology and Environment (DOE)
  - Ministry of Health (PHD)
  - Ministry of Agriculture and Fisheries (FisD, Pest.Ctrl Brd, BAHA)

Plans

- Belize’s obligations under the Stockholm Convention are
  - a) to restrict and eventually prohibit the production, use, emissions and import and export of POPS and
  - b) obligated to develop and implement a National Implementation Plan (NIP).

Plans cont.

- GEF Funding
  - The project seeks to strengthen and support Belize's own sustained capacity in addressing the management and accounting of persistent organic pollutants in Belize. The Project proposes the development of various mechanisms and strategies aimed at mainstreaming POPS management into national development planning for sustainable development. As Belize's experts in this area are diffused, the project aims to coordinate management efforts across sectors, involving the relevant stakeholders in the participation of POPS activities. The Project will help in the determination of a national profile resulting in the preparation of a National Implementation Plan (NIP), based on the establishment of national inventories, situational assessments and national priority setting. The NIP is expected to comprehensively cover important aspects of the safety and management of chemicals, as provided for in Chapter 19 of Agenda 21.

Achievements

- Phase 1: Establishment of a coordinating mechanism and a process organization.
- Phase 2: Establishment of POPS inventories and assessment of national infrastructure and capacity.
- Phase 3: Priority assessment and objective setting;
- Phase 4: Formulation of the NIP;
- Phase 5: Endorsement & submission of the NIP.

Major Groupings

- DDT
- PCB’s
- Dioxins and Furans
Persistent Organic Pollutants:

**List of Chemicals**
- DDT, Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, Hexachlorobenzene, Mirex, Toxaphene, Polychlorinated Biphenyls, Dioxins, and Furans
- Currently stored – DDT
- Belize Electricity Ltd used transformers with PCBs – have stopped using since 1970 and started to get rid of them. 4,560 transformers.
- Several tonnes of DDT stockpiled since the ‘80s that need to be destroyed.

**Marine Environment**
- Little has been done
- Mesoamerican Barrier Reef System Project Synoptic Monitoring Project, Pollution Component
- WWF did a Sapodilla Cayes Baseline Research project on white grunt, mutton snapper. Will be replicated in 2008 throughout Belize.
- Independent Researcher is doing a mercury, lead presence in marine fish
- Work done in Placencia Lagoon to determine anthropogenic sources of nitrogen using stable isotope

**Capacity**
- Lack of analysis centres (Cinvestav)
- Bowen and Bowen, BAHA but have limited capabilities
- costly to monitor and no funding presently available outside of the GEF funded project
- Low number of trained individuals
- Overburden government agencies and lack of capable staff
Ways Forward

- Fisheries Department is willing to continue assisting in the monitoring implementation
- Seek training
- Individual NGOs doing some work
- Resources
- Encourage the University of Belize to meet the demands in the analysis (Lab planned to come online in 2008)
- There is the need to streamline and harmonize legislation
- Closer inter-agency cooperation

Thank you
Stockholm Convention on POPs
Country Obligations

Hanneke Van Lavieren
UNU-INWEH

Objective: To protect human health and the environment from persistent organic pollutants

Signed in 2001 and entry into force: 2004

In implementing the Convention, Governments will take measures to:

- eliminate or restrict the production & use of all intentionally produced POPs (i.e. industrial chemicals and pesticides)
- minimize & where feasible, ultimate elimination of releases of unintentionally produced POPs such as dioxins & furans
- manage stockpiles and dispose of in a safe, efficient and environmentally sound manner

As of August 1, 2007

Signatories in green and Parties in red

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<thead>
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<th>Signature</th>
<th>Ratification</th>
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Project links to Stockholm Convention (SC) Articles

This project can assist countries in fulfilling some of the obligations under the SC:

Articles:
- 7 - implementation plans
- 9 - information exchange
- 10 - public information
- 11 - research, development & monitoring
- 12 - technical assistance

Stockholm Convention

Objective: To protect human health and the environment from persistent organic pollutants

Signed in 2001 and entry into force: 2004

In implementing the Convention, Governments will take measures to:

- eliminate or restrict the production & use of all intentionally produced POPs (i.e. industrial chemicals and pesticides)
- minimize & where feasible, ultimate elimination of releases of unintentionally produced POPs such as dioxins & furans
- manage stockpiles and dispose of in a safe, efficient and environmentally sound manner

Stockholm Convention

Article 7 - National Implementation Plans (NIPs)

Parties shall:
- develop & implement a plan for fulfilling obligations under Convention
- cooperate with global & regional organizations to facilitate implementation & updating

Article 9 - Information Exchange

Parties shall:
- facilitate/undertake exchange of POPs information on:
  (a) Reduction/elimination of production, use & release
  (b) Alternatives to POPs
Parties shall promote:

- provision of POPs information to public & decision makers
- education & training programs
- public participation

**Article 10 - Public information, awareness & education**

Parties shall:

- Encourage and/or carry out adequate research, development, surveillance & cooperation activities

**Article 11 - Research, Development & Monitoring**

- support programs, networks & international organizations – on research, data and surveillance
- support national & international efforts to build on national scientific and technical research capacity to foster access & exchange of data

**Article 11 - Research, Development & Monitoring**

**Article 12 - Technical Assistance**

- provide timely & appropriate technical assistance
  & promoting the transfer of technology to developing country Parties & Parties with economies in transition

---

**This Project**

*Will further obligations of participating countries under the Stockholm Convention (SC) by:*

- attaining new data on occurrence of POPs in coastal & possible upstream waters
- improved monitoring of POPs
- better understanding transport & interconnection
- greater lab capacity to analyse POPs
- better public support for implementation of SC
- greater capacity to develop and implement NIPS

**Through networking the countries with greater existing capacity will be able to assist their neighbours to achieve their particular SC obligations**

*Working together on a common pollution problem with often trans-boundary nature*

---

**Project also links with other relevant agreements**

- **Rotterdam Convention** on prior consent
- **Basel Convention** on Hazardous Wastes
- **Cartagena Convention (1983)** - Promoting regional cooperation for the protection and development of the marine environment of the Wider Caribbean Region
- **Protocol on Land Based Sources of Pollution** (Dominican rep. Signed in 2000 and Trinidad and Tobago-ratified in 2003)
- **Global Programme of Action:** protection of the marine environment from land-based activities (Washington Declaration 1995): action plan for curbing & controlling pollution & other land-based activities affecting coastal & marine ecosystems
Tracing Persistent Toxic Substances and their Impacts in Aquatic Ecosystems

Ken Drouillard,
Great Lakes Institute for Environmental Research (GLIER),
University of Windsor, Windsor, ON, Canada

Case Study
Detroit River Area of Concern

- Detroit River Designated a Great Lakes Area of Concern in 1987 by IJC
- Assessment Report Identified Use Impairments:
  - Restrictions on fish and wildlife consumption
  - Tainting of fish and wildlife flavor
  - Restrictions on drinking water consumption, or taste and odor
  - Degradation of fish and wildlife populations
  - Beach closings
  - Fish tumors or other deformities
  - Degradation of aesthetics
  - Bird or animal deformities or reproduction problems
  - Degradation of benthos
  - Restriction on dredging activities
  - Loss of fish and wildlife habitat
  - Exceedance of Water Quality Criteria

Great Lakes Population Distribution & AOC's

Coordination and Communication Challenges

- International River
- U.S. Federal, State (Michigan) and Municipal Programs
- CDN Federal, Provincial (Ontario) and Municipal Programs
  - Environment Canada, Health Canada, OMDE, OMNR, City of Windsor, ERCA
- Academic Institutions & Researchers
  - University of Windsor (GLIER), Wayne State, U. Michigan
- Public Stakeholders
  - Industry users (automotive & steel), Environmental Groups (CEA), public at large

Toxicity Issues

- Human Health Concerns
  - Presence of Fish Advisories
  - Air & Water Quality
- Degraded Fish and Wildlife
  - Loss of sensitive species (Eagles, whitefish)
  - Deformities and Reproductive Impairments
  - Fish Tumors & Skeletal Anomalies
- Degraded Benthos
  - Altered Community Structure
  - Mouthpart deformities – chironomids
  - Failed toxicity bioassays
- Degraded Plankton
  - Failed toxicity tests (Trenton Channel)
Chemicals of Concern
- Heavy metals
- Mercury
- POPs
  - PCBs, DDTs, chlorinated benzenes, OCS, Dioxins
- PAHs
- Chlorinated Naphthalenes
- Pharmaceuticals
- Current Use Pesticides
- Bacteriological
- Nutrients

Detroit River Modelling and Management Project 1999 - 2002
- GLIER-Led Initiative Sponsored by Canadian Implementation Committee & Environment Canada
- Update status of Detroit River
- Develop bioaccumulation models to perform hazard assessments
- Link bioaccumulation models to hydraulic models to assist management of remedial activities

Need for Models in Management
- Calibrated models provide scientifically defensible interpretation of integrated datasets
  - Can indicate knowledge/data gaps and provide guidance on the types of monitoring programs necessary to fill gaps
- Multi-stakeholder investment into single model framework ensures agreement on approaches taken
  Weight-of-evidence assessments used in absence of management model framework
  - Can lead to biased conclusions if available studies are not representative of the entire system
  - Not very good at cause-effect linkages or establishing effective remediation strategies

Integrated Modelling and Monitoring Programs
- Management Models Implemented
  - Hydraulic and Sediment Transport
  - Food web bioaccumulation
- Enhanced Monitoring Programs
  - Water and Sediment Chemistry
  - Benthic Community Structure
  - Sediment Toxicity Bioassays
  - Food web sampling

Project Design

Water Quality Assessment POPs
- Large Volume Water Extractions (LVWE)
  - Standard method
  - Distinguishes between particulate and dissolved fractions
  - Time consuming and Expensive limits spatial and temporal resolution of measurements
  - Provides an instantaneous snapshot of concentrations at time of measurement – is this useful for rivers?
- Passive Samplers & Biomonitor
  - Less expensive allowing high resolution sampling & replication of measurements
  - Time integrated measures over deployment
  - Bioavailable fraction identified, but not inter-phase partitioning within water
  - Contaminant/sampler kinetics need to be accounted for
Steady State Correction of Biomonitoring

Contaminant Bioaccumulation Kinetics In Deployed Mussels

\[ \frac{dC_m}{dt} = C_m k_1 + C_{ss} - C_m k_2 \]

Steady State Correction

\[ C_{ss} = C_m \left(1 - e^{-k_2 t} \right) \]

* Elliptio size selective filter, < 20 um, we assume it is less influenced by suspended solids
* \( C_{ss} \) provides a time integrated \( C_m \) estimate over period of mussel deployment
* Steady state correction assumes \( k_2 \) is constant in different deployment environments

**Environment Canada Large Volume Water Extractions**

Mean Total PCB Concentration (pg.L⁻¹)

- Lake Huron Outlet
- Roberts Landing
- Port Lambton
- Lake St Clair
- Fleming Ch.
- Trenton Ch.

**Cross Technique Comparisons Mussel Biomonitor and LVWE's**

Mussel Estimated Water at MSI 1998 (Gewurtz 2000)


Mean Technique Bias: 3.6+- 0.3

**Liquid-Liquid vs. Mussel Estimated C_w for PCBs in western Lake Erie**

LI Extraction at MSI 1994 - 1995 (Morrison 1996; Couillard et al. unpublished)

Mussel Estimated Water at MSI 1998 (Gewurtz 2000)


Mean Technique Bias: 3.6+- 0.3

**2002 Biomonitoring Survey**

U.S. Seasonal Geomean \( C_{ss} \) PCBs: 5.5 Fold higher than CDN

* Muscles deployed for 30, 60 and 90 d

**Detroit River Sediment Assessment**

Stratified Random Design
- 150 stations
- \textit{a priori} selection of sample sites
- 3 longitudinal zones
- Canada/US 50:50 (= 6 zones)
- interspersion (~300 m)
Contaminated Particle and Biomonitoring PCB Hotspots

OCS Concentration (ng/g OC wt.)

Octachlorostyrene as a Tracer of PCB Point Sources

- Main OCS source from upstream St. Clair River
- Hydrophobic chemical with similar env. fate as PCBs
- No differences in sediment OCS concentrations between CND and US Sites
- Enrichment of OCS likely reflects sediment focusing
- Dilution (shoreline erosion or tributary inputs)

PCB Mass Balance in Detroit River Sediments

<table>
<thead>
<tr>
<th>Zone</th>
<th>Area (m²)</th>
<th>Depth (m)</th>
<th>PCB mass (kg)</th>
<th>% PCB mass</th>
<th>% Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.4 x 10⁶</td>
<td>0.10</td>
<td>1.1</td>
<td>0.25</td>
<td>3.0</td>
</tr>
<tr>
<td>2</td>
<td>3.4 x 10⁶</td>
<td>0.10</td>
<td>0.4</td>
<td>0.09</td>
<td>3.62</td>
</tr>
<tr>
<td>3</td>
<td>3.7 x 10⁶</td>
<td>0.10</td>
<td>2.4</td>
<td>0.52</td>
<td>3.29</td>
</tr>
<tr>
<td>4</td>
<td>7.0 x 10⁵</td>
<td>0.10</td>
<td>5.9</td>
<td>1.31</td>
<td>6.21</td>
</tr>
<tr>
<td>5</td>
<td>7.1 x 10⁵</td>
<td>0.10</td>
<td>7.2</td>
<td>1.60</td>
<td>6.32</td>
</tr>
<tr>
<td>6</td>
<td>8.5 x 10⁵</td>
<td>0.10</td>
<td>20.5</td>
<td>4.55</td>
<td>7.56</td>
</tr>
<tr>
<td>7</td>
<td>14.7 x 10⁵</td>
<td>0.10</td>
<td>27.4</td>
<td>6.09</td>
<td>12.72</td>
</tr>
<tr>
<td>8</td>
<td>7.4 x 10⁵</td>
<td>0.10</td>
<td>10.8</td>
<td>2.40</td>
<td>6.56</td>
</tr>
<tr>
<td>9</td>
<td>4.8 x 10⁵</td>
<td>0.10</td>
<td>39.8</td>
<td>8.84</td>
<td>4.27</td>
</tr>
<tr>
<td>10</td>
<td>3.6 x 10⁵</td>
<td>0.10</td>
<td>55.8</td>
<td>12.41</td>
<td>28.94</td>
</tr>
<tr>
<td>11</td>
<td>18.7 x 10⁵</td>
<td>0.10</td>
<td>278.7</td>
<td>61.95</td>
<td>16.64</td>
</tr>
</tbody>
</table>

Total: 112.4 x 10⁵, 0.10 449.9

Monitoring Conclusions

- Coordinated water and sediment assessments demonstrate elevated contamination along U.S. side of river
- Use of tracer chemicals such as OCS useful for removing hot spots related to sediment focussing
- Water + sediment contamination provides evidence for current loads not legacy contamination
Hydraulic Model (CH3-D)

U.S. Army Corps of Engineer’s Code
- Grid: 7,696 horizontal cells (~100x100 m)
- 5 vertical layers
- Bathymetry: 2000 NOAA Data Set
- Flow Calibration: ADCP Current Profiles

MODEL APPLICATION
- Predict flow velocities in each cell of grid
- Determine shear stress at sediments
- Track water and particle dispersion when loaded at multiple source locations
- Dispersion of Concentrations
- Time Integrated Lake Erie Loads

Potential Applications:
- Toxic Contaminants
- Suspended Solids
- Nutrients
- Bacteria

2002 Application: Impact of Storm Events
- Storms generate wind build-ups that can cause water levels in the lower Detroit River to drop by 0.75-1 m.
- Hydraulic model demonstrated increased flow and loss of sediment deposits in the river during these events. The sediments most susceptible to resuspension are also the most contaminated with respect to total Hg and PCBs.

Temporal Trends of PCBs in Biota
- PCB Concentrations in Biota Have Not Changed Over the Last Ten Years

Food web Sampling – PCBs and Hg
- 5 Food Web Sites Sampled 2000-2002
- Objective: Provide Validation Data Set for Bioaccumulation Model
- Sample Collections:
  - Benthos, Forage Fish, Pelagic Fish, Piscivores, Benthic Fish

Both trophic status and elimination rate are size dependent.
- Slope = particle size conversion efficiency (Borgman and Whittle)
- Trophic relationship with PCBs falls for animals > 100 g
- Slope is highly variable among sites (movement vs size?)

PCBs in Biota vs. Sediment
- Large Organisms Integrate Large Spatial Areas
- Smaller Organisms More Representative of Local Environments
- Ecological Information on Species specific Time Budgets in Contaminated Regions Often Lacking!
Steady-State Bioaccumulation Model

• Morrison et al. Model Describes Trophodynamics of PCBs

\[ C_{bio} = \frac{C_{org}}{Z_{org}} + \left( \sum_{p} \frac{G_{geo}}{Z_{geo}} \right) \times G_{geo} \]

• Model Uses:
  - Perform hazard assessment to determine concentrations that would be achieved in sport fish given 100% residence at defined areas of the system
  - Characterize importance of water & sediment sources
  - Define areas of poor water/sediment quality that could contribute to fish consumption advisories
• Model Constraints
  - Cannot predict time course of recovery after cleanup
  - Cannot establish risk of local environmental quality

Model Validation at Food Web Sample Sites

Hazard Assessment: Fish Advisories

• 11 Food Web Zones Defined for Bioaccumulation Model Simulations

• Species used in Hazard Assessment:
  1) Yellow Perch
  2) Walleye
  3) White Bass
  4) Rock Bass
  5) Smallmouth Bass
  6) White Perch
  7) Stonecat
  8) Bluegill Sunfish
  9) Largemouth Bass
  10) Black Crappie
  11) Northern Pike
  12) Brown Bullhead
  13) Freshwater Drum
  14) Muskellunge
  15) Carp
  16) White Sucker

Bioaccumulation Model Inputs

• Sediment Data based on 150 sample sites (1999 Survey)
• Water Data derived from mussel biomonitoring program

Hazard Assessment Model Output

• Hazard Assessment: Fish Consumption Advisories

MI: 0.050 µg/g total PCBs
ON: 0.153 µg/g total PCBs

No spp.
2-4 spp
5-10 spp
> spp

>10 spp above min trigger
No spp.
2-4 spp
5-10 spp
> spp

Hazard Assessment: Fish Consumption Advisories

MI: 0.050 µg/g total PCBs women/children
ON: 0.153 µg/g total PCBs W&C, General Public
Hazard Assessment: Fish Consumption Advisories

MI: 2 µg/g total PCBs
No Consumption

ON: 1.22 µg/g total PCBs
No Consumption

5 Sportfish Spp.

> musky & carp above trigger

No spp.
2-4 spp
5-10 spp
> spp

Hazard Assessment Conclusions

• PCB Bioaccumulation model indicates Upstream C_w will generate fish advisories for most stringent advisory trigger of 0.05 ug/g. Advisories associated with this trigger are due to regional contamination effects.

• Only two areas shown to have sufficiently high C_w to cause more stringent fish advisories

• PCB Bioaccumulation model can be used to establish target sediment concentrations for reduction of fish consumption advisories (Protective of OMOE):
  - 2 ug/g OC wt. (protect 10 most consumed spp)
  - 0.58 ug/g OC wt. (protect top predators)

Project Conclusions

• Identified continued point source inputs of POPs within system as opposed to legacy inputs
• Equivalence of biomonitor & Sediment PCB Contamination
• Hydraulic models documenting instability of sediment deposits
• Established cause-effect linkages between water & sediment contamination and fish consumption advisories
• Hazard model discriminated against regional level contamination and local contributors to chemical bioaccumulation
• Model used to estimate sediment contamination that is protective of stringent fish advisories
• New delisting criteria being established to consider philopatric indicator bioaccumulation as monitoring tool
• Sediment mass balance identified priority regions for sediment clean-up actions

Conclusions

• DRMMF provides a case study for model-based management framework for pollutant mass balance and fish exposure assessment
• Created through multi-stakeholder investment
• Implementing DRMMF required
  - Coordination of monitoring programs to meet minimum data requirements & ensure data compatibility
  - Database development and accessibility
  - Develop appropriate validation data sets
  - Frequent feedback between model developers and monitoring program implementers
  - Modeler support to develop simulations
Assessment of Pollution in Coastal Marine and Estuarine Habitats of the Mesoamerican Barrier Reef Region. Using South-South Partnerships to Monitor PTSs.

Dr. Gerardo Gold-Bouchot
Cinvestav Merida
POPs Planning Workshop
Hamilton, Canada
26-28 November, 2007

Mesoamerican Barrier Reef Project
• Background
• It is the second longest barrier reef in the world
• It started with the Tulum Declaration in 1997
  – Signed by the governments of Mexico, Belize, Guatemala and Honduras
• Project development 1998-2000
• Submitted to GEF in 2000
• Project started in 2001
• First phase finished in 2007
• Second phase is being planned

Mesoamerican Barrier Reef Project
• It is a project to build on existing institutions and cooperation
• To promote new ways for collaboration
• Main areas:
  – Sustainable tourism
  – Sustainable fisheries
  – Public education and awareness
  – Distributed database
  – Monitoring program
  • Coral
  • Fish
  • Mangroves
  • Sea grass beds
  • Water quality
  • Toxic pollutants

Monitoring manual
Available from:
www.mbrs.org.bz

Pollution Monitoring
• Chemical analysis of:
  – Chlorinated pesticides (including PCBs)
  – Petroleum hydrocarbons
  – PAHs
    • in sediments and fish
• Biomarkers (in fish):
  – Cholinesterase inhibition
  – PAH metabolites in bile
  – We are doing more
• Sampling design:
  – Stratified random
    • 3 sediment replicates/site
    • 5 individual fish/site
Pollution Monitoring

- Characteristics of selected fish species:
  - Present in the whole MBRS region
  - Abundant
  - Easy to capture
  - Big enough to divide
  - Easy to identify in the field (even for non-biologists!)
  - Bottom feeder
  - Not protected (endangered, threatened, etc.)

- Two sampling seasons:
  - 2005 (pilot sampling)
    - 14 sites for sediments and 4 sites for fish
    - Finished (report available online; a few printed copies are available here)
  - 2006
    - 27 sites for sediments and 14 for fish
  - Analyses were done in one laboratory
  - Sampling was done by a crew from the analytical lab and MBRS
    - With strong participation and guidance from local institutions

Training

- Three training courses on analytical techniques:
  - Biomarkers, in Belize
  - POPs analyses in Merida
- Field methods:
  - Itinerant course in the four countries

Results
Contaminants in fish liver

Hydrocarbons in sediments

PAHs in sediments

Hydrocarbons in sediments by country

Organochlorine Compounds

Organochlorine Compounds
Organochlorine Compounds

PAH Metabolites in bile

Cholinesterase Inhibition

Lessons Learnt

• Time and money was saved by using a single analytical laboratory
  – There is no need for an intercalibration program
  – Data are comparable
  – . . . but it has not been possible to set up other laboratories
• Most sampling sites are marine protected areas
  – As you move (conceptually) away from corals, there is less effort by local people
• A very fast turn over of trained personnel
• Very little is known of the basic biology of the White Grunt (*Haemulon plumieri*)
  – We are characterizing its toxicological responses

Relation to this project

Way forward

• There are many possible linkages
  – 50% of the participant countries are in the MBRS project
  – Both projects include POPs
  – Information and experience exchange
• Etc.

• The MBRS Project is being redesigned for its second phase
• A strong component on watershed management will be included
• Species for monitoring pollutants in sea grass beds, mangroves and estuaries (rivers?) need to be selected
• Include metals?
Thanks!

Comments, complaints, etc. to:

ggold@mda.cinvestav.mx
gerardo.gold@gmail.com
Potential for PTS Contamination from Tourism and Agriculture in the Western Caribbean Basin

Chris Metcalfe
Trent University
Peterborough, Ontario

Overview

- Introduction to Trent University
  - Institutional strengths
  - Capacity for training and research
- Case histories with relevance to PTS in the western Caribbean
  - Tourism and recreation in the Yucatan, Mexico
  - Pesticide transport in the citrus growing region

Institutional Strengths

- Strong research record

Programs

- Watershed Ecosystems Graduate Program
  - 90 MSc students
  - 30 PhD students
- Environmental and Resource Studies Program
  - BS
  - BA
- Indigenous Environmental Studies Program
- Ecological Restoration Program
  - joint with Fleming College
- GIS Program
  - joint with Fleming College

The Geological History of the Caribbean

North American Plate
Cocos Plate
Caribbean Plate

Trent University
• A small liberal arts & science university in central Ontario
• 7,500 full time undergraduates
• 400 graduate students
• Strong research record

Institutional Strengths

- Worsfold Water Quality Centre
- Canadian Environmental Modeling Centre
- Institute for Watershed Science; Partnership with:
  - Ontario Ministry of Natural Resources
  - Fleming College

Research Organizations

- Centre for Environmental Modeling
- Centre for Water Quality and Environmental Health
- Centre for Environmental Science and Policy
- Centre for Sustainability and Research
Geological Zones

- Complex geology
- Northern region (Mexico and northern Belize): Karst geology
- Southern region (Southern Belize, Guatemala and Honduras): Mesozoic limestone (fault block mountains) with alluvial soils in valleys, and with volcanic formations to the west and south

Potential for Environmental Impacts in Southern Region

- Urban pollution
  - Domestic wastewater
  - Hydrocarbons
  - Metals
- Forestry
- Industry
  - Food processing
- Agriculture
  - Citrus; Banana
  - Palm oil; Pineapple
- Potential para Impactos Ambientales
  - Contaminación urbana
  - Aguas servidas domésticas
  - Hidrocarburos
  - Metales
  - Explotación forestal
  - Industria
  - Procesamiento de alimentos
  - Agricultura
  - Cítricos; Bananas; Palma; Piña
Aldicarb:
- Carbamate insecticide
- High toxicity
- Granular formulation applied to soil as a nematicide (Temik®)
- Oxidation relatively rapidly to aldicarb sulfoxide – toxic and persistent
- High potential for transport of degradation product through acidic, silty soils
- Evidence of groundwater contamination

Aldicarb:
- Insecticida de carbamato: Alta toxicidad
- Formulación granular aplicada al suelo como nematicida (Temik®)
- Oxidación relativamente rápida a sulfóxido de aldicarb - tóxico y persistente
- Alto potencial para transporte del producto de degradación a través de suelos
- Evidencia de contaminación de aguas subterráneas
Desemboca de agua dulce cerca la costa en la Península de Yucatán

Subterranean Flows in the Yucatán Peninsula

Flujos Subterráneos en la Península de Yucatán

Potential for Environmental Impacts in Northern Region

- Urban pollution
  - Domestic wastewater
  - Hydrocarbons
  - Metals
  - Tourism and recreation

Impacts of Recreational Activities

- Wastewater discharges or septic leakage
  - Hotels and resorts
  - Recreational homes
  - Hydrocarbons from boats, vehicles
  - Maintenance of lawn and turf
    - Homes
    - Hotels and resorts
    - Golf courses

Exacerbated by reduced “ecological integrity” (e.g. removal of mangrove, wetlands)

 campo de golf proponeda cerca de cancún

Precambrian Shield Region

- Recreational homes
- Hotels and resorts
- Golf courses

Fastest growing sport in NA
Modern methods of golf course construction:
• Remove overburden
• Fill in wetlands
• Lay down porous (sand) substrate
• Seed or lay turf

Porous substrate
Susceptible to overland flow (runoff) or vertical transport (leaching)

Potential for toxic impacts of chemicals applied to golf courses

Quintozene (Pentachloronitrobenzene)
- Fungicide
- Relatively persistent (wk to mo)
- Degradation products are persistent
- Used heavily on golf course greens and fairways
- Potential for transport to streams and lakes draining golf courses
- Highly toxic to early life stages of fish

Monitoring Organic Contaminants Using Passive Sampling Technologies
• Problems with techniques currently used to monitor contaminants in water:
  • High spatial and temporal variability for "grab" samples
  • Monitoring with biota or sediments is problematic
  • Many classes of "legacy" and "emerging" contaminants
• Passive sampling methods may be a solution:
  • Non-polar (hydrophobic) compounds using semi-permeable membrane devices (SPMDs)
  • Polar (hydrophilic) compounds using new technologies (POCIS)

Passive Samplers

POCIS
SPMD

Sampling Characteristics of POCIS and SPMDs

Alvarez et al. 2007, Passive Sampling Techniques
Comprehensive Analytical Chemistry Vol.48, Elsevier.
Field deployment of SPMD and POCIS samplers in Great Lakes

Years:
2006 (L. Ontario)
2007 (L. Erie)
2008 (L. Ontario)

Analytical Methods

SPMD Extracts
- PCBs: GC-MS or GC-ECD
- OC pesticides: GC-MS or GC-ECD
- PAHs: GC-MS
- Polycyclic musks: GC-MS
- Alkylphenols (NP, OP): Acetylation & GC-MS or LC-MS/MS
- PBDEs – GC-MS (R. Letcher)
- Anti-microbials (triclosan, triclocarban)- LC-MS/MS
- Perfluorinated organic substances – LC-MS/MS (D. Ellis)

Monitoring of persistent contaminants released from the carcasses of Chinook salmon that spawn in the Credit River watershed of L. Ontario

O'Toole and Metcalfe, 2005

SPMDs deployed every month from Sept, 2001 to Nov, 2002

Worsfold Water Quality Centre

Analysis of Organic Contaminants

Analytical Instruments
- Micromass Quattro LC-MS/MS
- Sciex API 4000 LC-MS/MS
- Sciex Q-Trap LC-MS/MS
- Micromass LC-QToF
- Varian Saturn GC-MS (ion trap)
- Varian Inova LC-NMR (500 mHz)

Preparative Instruments
- Varian preparative HPLC
- Dionex ASE 300 accelerated solvent extraction system

Centro Worsfold de Calidad del Agua
Analisis de contaminantes organicos
Instrumentos analiticos y de preparacion
Monitoring for POPs and PTS:
How do we interpret the data?
- Spatial analysis
- Temporal analysis
What are the risks to human health?
What are the risks to the ecosystem?
Are we managing the risks?

Analytical chemist

Analytical standards?
Certified Reference materials?
Available Instrumentation?
Extraction/isolation?
Assessment, Monitoring and Management of Persistent Organic Pollutants (POP) and Persistent Toxic Substances (PTS) in the Coastal Ecosystems of the Wider Caribbean Region

- What pollutants are where in our coastal waters?
- How can we trace back to find their sources?
- How can we restore polluted coastal ecosystems to health?

Goals of the Project

- Pollution by PTS is widespread and poorly monitored in many countries
- PTS include chemicals with serious health effects, and with serious ecological impacts
- Coastal waters are economically and culturally important in Caribbean countries, and are important sources of protein food
- PTS get into coastal ecosystems from upland sources, and can be traced back to their sources for remediation
- Monitoring is only the first step
Goals of the Project

- Build partnerships among coastal managers and analytical labs to monitor pollution by PTS
- Extend data on PTS in coastal ecosystems
- Improve capacity for laboratory analysis of PTS pollution
- Trace selected cases of pollution back to their sources
- Educate about, and reduce incidence of PTS pollution

Goals of this Workshop

- Learn about existing POP/PTS remediation activities in the Caribbean
- Explore prevalence of POP/PTS in coastal waters
- Learn about POP/PTS impacts on ecosystem function and on health
- Assess capacity to monitor and remediate
- Decide extent, nature of participation in the project
- Decide on the activities during the first two years, and possible extension to a larger project

Agenda

1. Other POP/PTS projects in the region and elsewhere
   Monday morning
2. Current status/capacity in each country
   Early afternoon
3. Stockholm Convention Obligations
   Late afternoon
4. POP/PTS in the coastal marine environment
   Late afternoon and Tuesday morning
5. Committing to and planning details of this project
   Mid-morning Tuesday to close