OCEAN HYPOXIA – 'DEAD ZONES'

Its Impacts on Ecosystems and Economies

During the last few decades, anthropogenic inputs of excess nutrients into the coastal environment, from agricultural activities and wastewater, have dramatically increased the occurrence of coastal eutrophication and hypoxia. Worldwide there are now more than 500 'dead zones' covering 250,000 km^2 with the number doubling every ten years since the 1960s. The economic costs to fisheries, tourism and other coastal livelihoods are already in the many tens of billions of dollars annually and will only continue to increase in the 'business as usual' scenario.

Satellite Photograph of Hypoxia Zone in the Baltic Sea choked by harmful, noxious algal blooms. (Nasa Earth Observatory 2006)

OCEAN HYPOXIA

Definition:

- Reduced oxygen in the ocean, detrimental to living organisms.

Causes:

- Excess anthropogenic nutrients, especially fertilisers such as nitrogen and phosphorus, fuels phytoplankton growth. As it dies, phytoplankton sinks to the bottom where it is decomposed by bacteria that use up oxygen.
- Stratification of water with the warmer less salty estuarine water forms a lens above the denser, more salty, colder water on the bottom layers of the ocean, reducing the circulation of oxygen-rich surface water to lower levels.

Effects:

Hypoxia Has Caused Major Changes in Structure and Functions of Ecosystems

- Mass mortality of fish and benthos
- Changes in species composition
- Changes in trophic relationships
- Decrease in biodiversity and species richness
- Decrease in fisheries production
- Increase in harmful and noxious algal blooms

UNDP Response to Hypoxia – Project Examples

The UNDP-GEF Danube/Black Sea Basin programme: For nearly 20 years, UNDP supported countries of the Danube/Black Sea basin to identify and implement policies and legislation to address both point (wastewater, manure storage, certain industries) and non-point (agricultural run-off of fertiliser and manure) sources of nutrient pollution. UNDP-GEF identified nearly 500 projects totalling $5 bn. in nutrient reduction investments with over 60% of those investments completed or underway leading to sizeable reduction in pollution and improvements in the Danube ecosystem and a reversal of major hypoxic zones in the Black Sea.

Reducing Environmental Stress in the Yellow Sea Large Marine Ecosystem: The UNDP-GEF Strategic Action Programme committed China and the Republic of Korea to reduce nutrient discharges to the Yellow Sea by 10% every 5 years through 2020, to reduce fishing pressure by 25-30% through reduction of fisheries overcapitalization, to scale up sustainable mariculture, and to establish a regional network of Marine Protected Areas.

Implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA): The Laguna de Bay-Pasig River-Manila Bay Watershed IRBCAM project has provided decision-makers with forecasts of total biochemical oxygen demand (BOD), nitrogen and phosphorus loadings in 58 sub-basins up to 2020. The project aims to strengthen investments in pollution reduction to eliminate hypoxia towards achieving the target of a 'swimmable' Manila Bay.

Reducing Hypoxia and Eutrophication in Havana Bay, Cuba through Innovative Approaches: UNDP-GEF assessment of levels and sources of pollution in Havana Bay found excess burdens of the nutrients nitrogen and phosphorus, primarily from untreated or insufficiently treated wastewater, leading to local eutrophication and hypoxic conditions. UNDP-GEF interventions led to the creation of: the 'State Working Group (SWG) for Sanitation, Conservation and Development of Havana Bay'; and the Port Authority for Havana Bay to achieve efficient port administration; plus the Luyano River wastewater treatment facility, to reduce nitrogen and phosphorus loads by 50-70%, with corresponding improvements in Havana Bay water quality, contributing substantially to the overall ecosystem recovery effort.

For further information, and other UNDP-GEF programmes, see resources listed in green box, right.

GESAMP-UNDP SIDE EVENT 2012

Ocean Hypoxia and its impacts on ecosystems and economies reviewed the scientific understanding of hypoxia's causes, its environmental and socioeconomic impacts, and introduced approaches to reverse hypoxia and restore degraded marine ecosystems. Moderated by Manmohan Sarin, Vice Chairman of GESAMP, the seminar included presentations with power points by:

- Dr. Rudolf Wu, Director and Chair Professor, School of Biological Sciences, The University of Hong Kong *'Hypoxia: Problems and Scientific Challenges'*
- Dr. Robert W. Howarth, David R. Atkinson Professor of Ecology and Environmental Biology, Cornell University *'Nutrient Pollution of Coastal Waters: Trends, Drivers, and Potential Solutions'*
- Dr. Peter Thomas, HEB Endowed Professor in Marine Science, University of Texas Marine Science Institute *'Disruption of fish reproduction in hypoxic coastal waters: potential impacts on coastal fisheries worldwide'*
- Dr. Nancy N. Rabalais, Executive Director and Professor, Louisiana Universities Marine Consortium *'Ocean Deoxygenation and Coastal Hypoxia in a Changing World'*
- Dr. Andrew Hudson, Head, Water and Ocean Governance, UNDP *'Reversing Ocean Hypoxia through Application and Scaling up of Innovative Policy, Economic and Financial Tools'*

To view a video of the seminar, click on link in above box, or go to: http://www.ustream.tv/recorded/21944007

RESOURCES AND PUBLICATIONS

Ocean Hypoxia and its Impacts on Ecosystems and Economies, Side Event at GESAMP's 39th Session held at UNDP, NY, April 2012 - Link to Seminar Video

Recent Water and Ocean Governance Documents available at www.undp.org/water

- Catalysing Ocean Finance, Volume I: Transforming Markets to Restore and Protect the Global Ocean. UNDP-GEF (2012)
- Catalysing Ocean Finance Volume II: Methodologies and Case Studies. UNDP-GEF (2012)
- Frontline Observations on Climate Change and Sustainability of Large Marine Ecosystems. Editors K. Sherman and G. McGovern. UNDP-GEF (2012)
- International Waters - Delivering Results. UNDP-GEF (2012)

Contact Information: Andrew Hudson,
Head, Water & Ocean Governance.
Andrew.hudson@undp.org
Tel +1 212 906 6228; Fax +1 212 906 6998
UNDP, 304 East 45th St. FF9100
New York, NY 10017, USA