

Agenda item 9.6

Background information on the Indian Ocean tsunami and the mitigation of natural disasters

Note by the Ramsar Secretariat

1. This paper contains four background materials concerning issues and assessments of the impact of the disastrous Indian Ocean tsunami of 26 December 2004, in support of the draft COP9 Resolution on natural disasters (DOC. SC31-23).
2. These materials are:
 - i) the Declaration of Principles (“Beyond the tsunamis; a way forward ...”) from the participants of the World Wetlands Day 2005 Forum on Natural Mitigation of Natural Disasters, held in Gland on 2 February 2005 in association with the 12th meeting of the Scientific and Technical Review Panel (STRP);
 - ii) the Recommendations for Action from the Special Session on Tsunami and Coastal Wetlands, held as part of the Asian Wetland Symposium (Bhubaneswar, India, 9 February 2005);
 - iii) the Draft Recommendation on Tsunami and Coastal Wetlands prepared by the Asian Ramsar regional meeting (Beijing, 13-16 May 2005); and
 - iv) an updated report on assessment of tsunami impacts on coastal ecosystems in the Indian Ocean, prepared by Wetlands International on behalf of the Ramsar Tsunami Reference Group.
3. The Ramsar Tsunami Reference Group was established by Wetlands International in collaboration with the Convention’s other International Organization Partners and other relevant agencies and organizations at the invitation of the Secretary General, with the objective of coordinating efforts to bring together scientifically sound advice on wetlands in the region in order to assist governments in choosing the most effective response measures, including through the provision of advice to the Standing Committee and COP9.

Beyond the tsunamis; a way forward...

*Declaration of Principles from the Participants
at the World Wetlands Day Forum on Natural Mitigation
of Natural Disasters*

We, the participants at the World Wetlands Day Forum on Natural Mitigation of Natural Disasters, recognize that:

In extreme events we cannot count only on natural systems to mitigate the effects, but, with the increasing frequency of unusual climatic events, healthy natural systems have key roles to play.

For natural disasters in general we must develop multipurpose strategies which incorporate the resilience of natural systems. Part of the multipurpose strategy must include rational land use planning which incorporates communities' views, sensitivity and livelihoods.

This planning must be based on an ecosystem approach which incorporates conservation and wise use of natural resources. An ecosystem approach includes adaptive management.

In order to implement such a strategy, more data, knowledge and understanding are needed and efforts must be made to obtain knowledge on dynamics and ecosystem functions and services. Such data must be made freely available.

Education, training and capitalization on past experiences and a comprehensive outreach programme must be part of the strategy.

There is a clear need to utilize existing legislation through better enforcement and, where necessary, strengthen the legislation.

All participating organizations agreed that continued inter-institutional cooperation, particularly in the recovery phase, will be critical. The Ramsar Convention will promulgate its existing knowledge and management advice through its Contracting Parties and more widely through the international system.

Participants agreed that networks established following the tsunamis should be strengthened and maintained during and beyond the restoration and rehabilitation phase.

Gland (Switzerland), 2nd February 2005

Participating organizations: The Ramsar Convention, Swiss Federal Office for the Environment, Forests and Landscape, United Nations Environment Programme (UNEP), United National High Commissioner for Refugees (UNHCR), World Health Organization (WHO), World Meteorological Organization/Global Water Partnership (WMO/GWP) Associated Programme on Flood Management, Food and Agriculture Organization (FAO), Convention on Migratory Species (CMS), Convention on International Trade of Endangered Species (CITES), International Association of Hydrologists, IUCN - The World Conservation Union, World Wide Fund for Nature (WWF), BirdLife International, Wetlands International, International Water Management Institute (IWMI), European Space Agency.

The Tsunami and Coastal Wetlands – Recommendations for Action

Special Session on Tsunami and Coastal Wetlands, Asian Wetland Symposium 9 February 2005

A **Special Session on the Tsunami and Coastal Wetlands** was organized on 9th February 2005 as part of the Asian Wetland Symposium in Bhubaneswar, Orissa. It was co-organized by the Ministry of Environment and Forests of the Government of India, Ramsar Centre Japan, Chilika Development Authority, Wetlands International, Global Environment Centre and the Ramsar Convention Secretariat. It was chaired by Ms Meena Gupta, Additional Secretary of the Ministry of Environment and Forests and attended by over 250 experts on wetlands, natural resource management and tsunami issues from many countries in the region as well as international organizations. Presentations were made by 15 experts on different aspects of impacts and response options. Key findings from the session were as follows:

Impacts of the Tsunami

Major human impacts include massive loss of life, destruction of coastal settlements and infrastructure, loss of fishing boats and facilities, loss and degradation of agricultural lands and forests and salinisation and contamination of water sources.

According to rapid assessment, the main impacts of the tsunami on coastal wetlands varied according to the location and distance from the epicenter/fault line. Impacts include:

- ◆ Loss or degradation of mangroves and seagrass beds
- ◆ Silting and degrading of coral reefs
- ◆ Sedimentation/turbidity of coastal waters leading to algal blooms
- ◆ Major changes in intertidal flats and coastal lagoons

Certain wetland types played a role in reducing the tsunami impact, especially in locations further from the epicenter, including coral reefs and mangroves which broke the impact of the waves and absorbed some of the energy and protected areas further inland. Mangroves stopped people being washed out to sea and trapped debris, reducing further damage.

The main response to the tsunami by the affected countries in relation to coastal wetlands has been focused initially in rescue and survival of local communities, followed by rapid assessment of impacts which are leading to the development of action plans.

Future directions

Providing new, sustainable livelihoods in affected communities linked to wetlands

- ◆ Top priority to identify feasible options to provide sustainable livelihood
- ◆ Need to have new solutions rather than business as usual (such as over-fishing inappropriate use of resources etc)
- ◆ Look at incentive and grant schemes to help the villagers rebuild their livelihoods and environment
- ◆ Impacted communities should play a key role in setting priorities in their areas.

Role of wetlands in recovery, securing water supply, fisheries, protection of storms

- ◆ 70% of coastal fish species are dependent on coastal mangroves or coral reefs
- ◆ Restoration and protection of remaining wetlands will secure future food resources
- ◆ Freshwater wetlands will be important source of freshwater
- ◆ An integrated multi-focal approach is needed

Protecting remaining coastal ecosystems and rezoning development

- ◆ Urgent to map remaining intact coastal systems in the region and identify areas for protection and sustainable management
- ◆ Establish or enforce zoning requirements
- ◆ Restrict sand mining, fishing and other activities in impacted areas according to capacity
- ◆ Develop further the concept of “No construction zones” taking into consideration ecological and equity issues.
- ◆ Allocating adequate freshwater resources to support the maintenance of estuarine mangroves as well as development of coastal shelterbelts.
- ◆ Need to be effective management and enforcement
- ◆ Communities should be empowered take a leading role in protecting and managing the coastal ecosystems

Use of soft engineering versus hard structures

- ◆ It is reported that in some countries without proper assessment, 70% of hard solutions to coastal protection and erosion fail due to poor siting and design
- ◆ Hard structures may transfer problems to adjacent areas
- ◆ In selected circumstances (particularly where infrastructure cannot be moved back from the sea) there may be a role for hard protection structures or eco-engineering structures.
- ◆ Eco-engineering practices combine hard and natural structures, can be cost effective and appropriate and methodologies need to be explored further.

Rehabilitation of degraded coastal wetlands

- ◆ Detailed assessments needed to guide rehabilitation
- ◆ Need to support natural regeneration and supplement as necessary

Coastal greenbelt (mangroves and coastal forests) for tsunami and storm damage protection

- ◆ Develop guidelines (dos and don'ts) for immediate and medium term measures for greenbelt development
- ◆ Need to assess the correct balance of potential species based on ecological zones and protection requirements
- ◆ Use local communities in development of greenbelts
- ◆ Combine mangrove protection with beach forests and dune protection
- ◆ Set up proper management of greenbelts with communities and other stakeholders to ensure long term maintenance
- ◆ Communities need to be involved at early stage

Standardising assessment methodologies

- ◆ Need to have common methodology to enable comparison between assessments
- ◆ Cautious approach - don't make conclusions on limited information
- ◆ Approach needs to vary according to situation
- ◆ Assessments need to generate predictions of future recovery/constraint scenarios
- ◆ Need regular monitoring to assess changes and recovery

Joint assessments and sharing of information

- ◆ Avoid duplication
- ◆ National and regional database

Early warning and preparedness, communication

- ◆ Overall regional approach is needed involving all affected countries
- ◆ Warning needs to be rapidly communicated and local communities need to be aware of avoidance options.
- ◆ Draw on indigenous warning systems and traditional knowledge
- ◆ Develop options for evacuation of people in vulnerable zones – such as through storm shelters

Resources, generating and sharing

- ◆ Coordination is needed to avoid wasteful duplication of work
- ◆ Allocation of resources for coastal ecosystem rehabilitation and use should be part of national recovery plans

Climate change implications and coastal zone management

- ◆ Protection for tsunami can be linked to protection from climate change impacts
- ◆ Climate change scenarios should advise zoning and rehabilitation plans
- ◆ Tsunami as example and stimulus for measures to adapt to climate change

Partnership framework and the way forward as a group

- ◆ Need to have a network to involve all interested people/experts
- ◆ Support and expand the Tsunami and Wetland Group to involve all interested organizations and experts
- ◆ Make all relevant materials openly available on linked websites
- ◆ Organize meetings of stakeholders at country/regional level
- ◆ Combine resources to develop an international institution/mechanisms to look at the issues of tsunami/storms etc in relation to coastal wetlands to provide advice for countries involved

RECOMMENDATIONS

Recognising the role of coastal wetlands (including coral reef, seagrass, mangroves, intertidal flats and lagoons etc) in protecting coastal communities and assisting in the recovery of peoples livelihoods.

Noting that tsunami is an extreme natural event of relatively low frequency, but that as a result of climate change it is predicted that there will be an increasing frequency and intensity of storm and other extreme weather events;

Further recognizing that the tsunami creates an opportunity to demonstrate best practices in integrated coastal management and to make a paradigm shift from earlier unsustainable practices.

The AWS Special Session on the Tsunami and Coastal Ecosystems, RECOMMENDS:

1. There is an urgent need for coordinated and harmonised assessments in priority stretches of affected coastline in order to identify areas where ecological restoration would be most effective
2. Develop predictive guidelines on the value and appropriate positioning, structure and composition of natural greenbelts to provide protection to coastal communities from severe storms/tsunamis
3. Integrate wetland restoration and management options with the immediate response to the humanitarian needs and the short and medium term Action and recovery plans in tsunami affected countries
4. Develop community led approaches for protection and restoration of affected and other wetlands, drawing on traditional knowledge and practices and with provision of incentives for sustainable livelihood development.
5. Prioritise the enhancement of natural coastal defenses through greenbelt/coastal “bioshield” development and only consider hard engineering solutions in combination with natural measures and in areas where there are no alternatives to safeguard human life.
6. Establish and enforce “no construction zones” in vulnerable areas and manage them to enable sustainable use by local communities as well as ecosystem recovery.
7. Build on and strengthen the regional/international cooperation mechanisms to connect governments, agencies, institutions, communities and individuals. Combine their competencies in assessment and in developing and implementing action plans, related to the tsunami response and coastal wetlands.

The organizers of the Special session will circulate and promote the results of this meeting to appropriate fora and mechanisms.

Draft Recommendation on Tsunami and Coastal Wetlands

Asia Regional Ramsar Meeting (Beijing, China, 13-16 May 2005)

Recognising that the Asian Tsunami of 26th December 2004 brought immense impact and suffering to the coastal communities of six affected Asian countries and severely affected both coastal wetlands including mangroves, mud flats, sea grasses and coral ecosystems and adjacent inland freshwater wetlands, which are important for biodiversity conservation as well as provision of livelihood to local communities through coastal fishery and other activities.

The Asian Ramsar Meeting:

1. **Welcomes:**

- a) the unprecedented level of international support for the rescue and recovery of coastal communities;
- b) the recognition given by a number of affected countries to the protection and restoration of coastal wetlands to act as barriers against tsunamis, storms and other extreme events;
- c) the work undertaken by the Ramsar Tsunami and Wetlands Group, the organizers of the special session on Tsunami and Coastal Wetlands at the Asian Wetland Symposium 2005, as well as others, to assess the impacts on coastal wetlands, biodiversity and livelihoods, increase access to information and expertise to affected countries and mitigation functions of coastal wetlands in relation to the tsunami and develop strategies for the future; and
- d) the contributions by a range of agencies including the government of Japan, Novib, Netherlands, Sunstice Foundation/Nordeco Denmark and the affected countries to support a range of activities responding to the effects of the tsunami on wetlands, livelihoods and biodiversity restoration.

2. **Calls on** Ramsar Contracting Parties and others to urgently work together to support the process of recovery of coastal wetlands and associated community livelihoods in tsunami affected countries as well as reducing the vulnerabilities of coastal communities and wetlands through enhanced integrated coastal zone management throughout the region to mitigate against future tsunami and storm damage as well as sea level rise.

3. **Recognises** the urgent need to:

- a) provide practical guidance and to build local capacity for detailed assessment, mapping, identification of mangroves, coral reefs and other coastal wetlands of high biodiversity value for conservation and provide the most effective responses for their restoration through implementation of integrated coastal zone management including zoning through the work of the Ramsar Tsunami and Wetlands Group and others,
- b) initiate ecologically sustainable management and redevelopment approaches for multiple purposes including coastal protection, biodiversity conservation and

livelihood support and supports the proposal to develop a coastal greenbelt initiative including development of practical guidelines and establishment of pilot restoration sites,

- c) develop a platform to share experiences and expertise through development of a regional initiative on coastal wetland management involving affected countries, international agencies, NGOs and other interested bodies,
- d) support development of a comprehensive early warning system of future tsunamis, and
- e) highlight action needed by affected countries through strengthening of DR10.

4. Requests the Ramsar Tsunami and Wetlands Group together with the affected countries and other interested bodies to prepare a report for the Ramsar COP9 on the progress and constraints in restoration of wetlands and associated livelihoods along tsunami impacted coastlines.

Ramsar Tsunami Reference Group: Assessment Report, June 2005

1. Introduction

The Ramsar Convention established the Ramsar Tsunami and Wetlands Group, led by Wetlands International, to coordinate efforts to bring together scientifically sound advice on wetlands in the region in order to assist governments in choosing the most effective response measures. The Ramsar IOPs, Wetlands International, WWF International, IUCN and BirdLife International, alongside IWMI, agreed to collaborate within this Group. Later it was joined by the Global Environment Center, Malaysia.

On World Wetlands Day, 2nd February 2005, at a meeting of the Scientific and Technical Review Panel (STRP12) and invited observers, the first report of the Group was presented (see http://www.wetlands.org/Tsunami/data/STRP12_Asian_Tsunami.doc).

Since the major tsunami event on 26th December 2004, there have been many aftershocks and earthquakes that have increased loss of life and contributed to the earlier damage, however, the situation remains that the tsunami had the most significant impact on the coastal peoples and ecosystems of the region. The present report to Standing Committee updates the facts known to the Ramsar Wetlands and Tsunami Group as at 11th May 2005.

After a review of current thematic and country-based status based on assessments, the current and future plans of the Group members are summarised. It should be noted that the present report has been written by Wetlands International with text input received solely from IWMI. Wetlands International has attempted to fairly represent the views and competencies of its partners within the Group.

2. What we do know

This section updates information on “natural mitigation of natural disasters”: How were mangroves and other elements of coastal ecosystems affected during the tsunami and did they mitigate the effects of the tsunami? Through rapid and site-based assessments, this section also reports on the post-tsunami status of coastal wetlands, as far as it is presently known to the Group.

Since producing the first report in February 2005, the members of the Ramsar Tsunami and Wetlands Group have continued to collaborate and share information about our activities and roles, including assessments, guidance and actions, this information is summarised in section 4.

Although there has been significant progress regarding rehabilitation of infrastructure, transport and formal economic sectors of forestry, agriculture and fisheries by the development community, there have been few results achieved so far for coastal ecosystems and livelihoods. This is probably due to the dispersed nature of the problems to be solved and timescale required to rehabilitate the coastal ecosystem, and also due to the urgency of humanitarian aid and livelihood redevelopment, including resettlement. There is also an absence of appreciation of the role of ecosystem health and the importance of ecosystem services in supporting livelihoods – *sensu* the MA concepts and findings.

In addition to the factual approach taken within this section, the Ramsar Tsunami and Wetlands Group is trying to present its best available analysis and advice, intended to provide governments and regional agencies with well-informed choices about restoration actions and their location.

The Group strongly recommends that these choices be considered only within an integrated coastal zone management (ICZM) approach, and are not selected in isolation. The Ramsar *Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management* (Ramsar handbooks for the wise use of wetlands, 2nd edition, 2004) provide a sound baseline, and the Group proposes that extensions to the guidance be developed, based on the special needs of post-tsunami rehabilitation.

2.1 Information available on the Internet

2.1.1 Factual and support materials available

At the outset, the availability of information about the gross impact had been widely publicised, with many websites serving “before and after” images of affected areas, most notably in Sri Lanka and Aceh Province of Indonesia. Most tsunami-related websites provide links to the network of maps and images processed and the Tsunami and Wetlands Group now maintains a series of web pages accessed through a common portal, see: www.wetlands.org/tsunami (see Figure 1).

Satellite imagery is especially detailed and widely available under the UN-sponsored Disasters Charter partnership (see: <http://www.disasterscharter.org>). UNOSAT maps provide good overall access to affected areas at varying scales (<http://unosat.web.cern.ch/unosat/asp/charter.asp?id=55>), and much of this imagery has been geo-indexed through intensive effort by the UNEP-WCMC (see: <http://tsunami.unep-wcmc.org/imaps/tsunami>). Most of the links collated by UNEP-WCMC access free imagery; there are also, however, a large number of commercial sources of satellite imagery, some of which are subsidising costs or are negotiating special arrangements.

IWMI's imagery data sources are also being made available directly through their website, but agencies such as FAO are also using IWMI's imagery (see: <http://www.iwmi.cgiar.org/TSUNAMI/Index.asp>).

Several institutes have presented simulations of the tsunami wave (see e.g. UNEP's website at <http://www.unep.org/tsunami/images/image001.png>). The force of the tsunami waves appears to be very uneven across the region, and only field assessment can reveal the actual impact. For further information about the hydro-dynamics and geology, please follow the satellite and data links available at <http://www.wetlands.org/Tsunami/Tsunamidata.htm>.

The FAO (<http://www.fao.org/tsunami/environment/maps.html>) has provided a complementary mapping service on two downloadable CDs containing high resolution scans of topographical maps for Aceh Province, Indonesia, and Sri Lanka, plus a selection of the UNOSAT maps, as well as extensive data on agricultural land, etc.

There are also useful thematic sources for coastal ecosystem components; for example, mangroves are quite well covered by the FAO under the forestry section of their tsunami pages and for corals by ICRI (<http://www.icriforum.org/router.cfm?show=secretariat/tsunami.html>).

Within the Ramsar Convention Wise Use Handbook series, Handbook 13 *Principles and guidelines for incorporating wetland issues into Integrated Coastal Zone Management (ICZM)* is recommended as the principal sourcebook for guiding rehabilitation actions, see http://www.ramsar.org/lib_handbooks_e13pre.doc. The Ramsar Tsunami and Wetlands Group proposes to provide supplemental guidance, which may be read alongside the Handbook.

Figure 1. Ramsar Tsunami and Wetlands Group web portal – assessments page (see: <http://www.wetlands.org/Tsunami/Tsunamidata.htm>)

The screenshot shows a web browser window displaying the 'Wetlands and the Tsunami - assessments' page. The page has a green header with the title and a navigation menu on the left. The main content area contains a table of assessments, categorized by country and region. The table lists various assessments, including those by the UNDP, World Bank, and various international organizations, with dates ranging from January to February 2005.

Assessments - coastal environment and livelihoods		
Country	Assessment Title	Date
India	MS. Swaminathan Research Foundation (three area assessments)	Jan
Indonesia	Wetlands International Aceh rapid field assessment 29 Jan-13 Feb	Feb 15
Indonesia	Wetlands International Indonesia Rapid country level assessment	Jan 20
Malaysia	Wetlands International Malaysia Preliminary sites	Jan 7
Sri Lanka	International Water Management Institute (IWMI) Notes on preliminary tsunami damage rapid assessment for coastal wetlands in Sri Lanka (south coast)	Jan 28
Thailand	UNDP / World Bank / FAO Joint Tsunami Disaster Assessment Mission Link	Jan 10
	Wetlands International Thailand Rapid country level assessment	Jan 7
Regional		
	Post - Tsunami Conservation Issues and Challenges for Co-ordinated Action Brief meeting report	April
	Wetlands International Assessment report to Ramsar STRP	Feb 2
	Asian Development Bank has carried out preliminary assessments in Indonesia, Maldives, and Sri Lanka, the three countries that have requested ADB assistance	Jan 13
	Coral Reef Degradation in the Indian Ocean (CORDIO & IUCN) Assessment. The attached report is a compilation of observations made by experts in Sri Lanka, India, Maldives, Seychelles and Kenya during the first 10 days following the tsunami. Web Site: www.cordio.org	Jan 19
	UNEP After the Tsunami: Rapid Environmental Assessment (from the Asian Tsunami Task Force)	Feb 22
	UNEP Asian Tsunami Disaster Task Force Situation Report 2, News Report 6	Feb 6
	FAO: Impacts of the Tsunami on Fisheries, Aquaculture and Coastal Livelihoods	Jan 7
	Early observations: Statement from the IUCN Wetlands & Water Resources Programme	Jan 12
	Early observations: Statement from the IUCN Forest Conservation Programme	Jan 7

2.1.2 Strategic environmental assessments available

Assessments of the impacts have obviously been led by the need to immediately target humanitarian relief, but while these actions were often in the news, several international agencies rapidly assessed coastal livelihood issues, for example:

- the UNDP/World Bank/FAO reported on a joint assessment for Thailand conducted in the period 4-8 January;
- FAO issued its first regional report on fisheries, aquaculture and coastal livelihoods on 7 January, followed by reports from each of its country agencies.

Many later assessments are broad scale and often contain little reference to the environment itself, especially coastal ecosystems. However, the Asian Development Bank, World Bank and UNDP issued country assessments for rehabilitation of infrastructure and the wider economy, and these are extremely useful in providing a development context for the work of more specialised experts groups such as the Ramsar Tsunami and Wetlands Group. FAO's reports on fisheries are especially helpful because they mention community needs within coastal zones across the region.

The UNEP Asian Tsunami Task Force, has issued its first main assessment report on 22 February, and this collates many of the observations reported in the first Ramsar Tsunami and Wetlands Group Report, and extends it by including many maps and collated input from UN agencies and NGO partners. See: “*After the Tsunami: Rapid Environmental Assessment*” (http://www.unep.org/tsunami/tsunami_rpt.asp).

The report covers Maldives, Seychelles, Somalia and Yemen (countries that the Ramsar Tsunami and Wetlands Group have not considered before), UNEP did not, however, conduct its own assessments in India, Malaysia and Myanmar. These countries chose instead to perform their own assessments.

2.1.3 Sites of high conservation importance

This section summarises the distribution of Ramsar Sites and Important Bird Areas (IBA) likely to have been impacted by the tsunami. Further reference should be made to the web sites of the members of the Ramsar Tsunami and Wetlands Group, which update the status of these sites and species as information is collected.

In addition to Ramsar Sites and IBAs, several reports mention assessments of other national parks or reserves. These can be found via the Ramsar Tsunami and Wetlands Group web portal at www.wetlands.org/tsunami

Ramsar Sites.

Ramsar Sites potentially exposed to the tsunami are located, these are named in Figure 2 below. Those thought to be tsunami-affected are in the southern part of the region shown, however, little is known about their current status, with the exception of the following reports which are referred to from the country assessment sections (see Section 2.3).

Bundala, Sri Lanka, conducted by IUCN, Sri Lanka
Point Calimere, India, report by UNDP

Figure 2. Ramsar Sites potentially affected by the tsunami



Important Bird Areas

Important Bird Areas (IBAs) are distributed throughout the affected area (see Figure 3), and those in the Andaman and Nicobar Islands may be most severely affected. Little specific post-tsunami assessment information is available for IBAs, however, BirdLife has published a review of IBAs and their key species to use to target rapid assessment, and this extensive data set has been collected together and posted in the Library for the **“Impacts of the tsunami on species and priority sites”** discussion forum reached via www.wetlands.org/tsunami.

Figure 3. Important Bird Areas potentially affected (source BirdLife International)



2.2 The protective effect of coastal ecosystems

Evidence so far collected only weakly supports the assertion that coastal wetlands can act as a “green barrier” to protect the coastline and its communities from storms, including waves, reducing erosion from wind and wave energy and mitigating damage. The specific evidence for each ecosystem component remains non-quantitative and very incomplete. With relatively few resources available, the members of the Group have not been able to conduct widespread assessments, and instead have focused on relatively small areas.

In Aceh province, Sumatra, complete loss of beaches, mangroves and severe localised damage to coral has occurred, indicating that in extreme events very little mitigation may be possible in those areas most exposed to the higher wave energies. Measurements of wave energy and height of inundation would have been useful to calibrate the observed impacts – in most places little is known, but for example in the Maldives, the USGS has provided estimates (see: <http://soundwaves.usgs.gov/2005/04/fieldwork3.html>).

Away from the epicentre of the earthquake and tsunami, there are localised anecdotal reports of reduction of damage behind mangrove stands, and coral reefs, but little quantitative data is yet available. None of the members of the Ramsar Tsunami Reference Group appear to have obtained firm evidence, but there is a reasonable knowledge of coastal areas worth investigating in further detail.

According to the UNEP report, “Sri Lanka offers some of the best evidence that intact coastal ecosystems, such as coral reefs and healthy sand dunes, helped buffer aggressive waves. For example, most of Yala and Bundala National Parks (southeast coast) were spared because vegetated coastal sand dunes completely stopped the tsunami, which was only able to enter where the dune line was broken by river outlets. Some of the severest damage to Sri Lanka’s coast was where mining and damage of coral reefs had been heavy in the past. Similar observations were found in the province of Phang Nga in Thailand, where mangrove forests and sea grass beds significantly mitigated the affect of tsunami.” These observations need to be independently confirmed by local scientists.

In presenting this summary, the information provided by members of the Group is organized by country, rather than by individual components, with one exception - mangroves. Mangroves have often been cited as having a special protective effect and these are considered first on their own.

Mangroves

FAO has recently reviewed the factual basis for mangroves providing coastal protection (see: <http://www.fao.org/forestry/site/27285/en>). Overall, FAO stated that “As widely reported, extensive areas of mangroves can reduce the loss of life and damage caused by tsunamis by taking the first brunt of the impact and by dissipating the energy of the wave as it passes through the mangrove area. On the other hand, narrow strips of mangroves, when uprooted or snapped off at mid-trunk and swept inland, can cause extensive property damage and loss of life.” FAO are now seeking objective evidence to improve their knowledgebase, and also offer a range of references to best practices guidance for integrated fish and shrimp pond aquaculture within mangrove areas.

In addition, on 7-8 March 2005, FAO convened a Workshop: Rehabilitation of Tsunami-Affected Forest Ecosystems: Strategies and New Directions, Bangkok, Thailand, in which mangrove and other forest species were considered (see: summary report, <http://www.fao.org/forestry/foris/webview/common/media.jsp?mediaId=8122&langId=1>). The protective effects of mangroves and other coastal forests were acknowledged, but no firm conclusions were reported. Much more information needs to be collected.

Indonesia: *Efrizal Adil* (partner of WT-IP) In Bakongan, Aceh Selatan, approximately 160km from the epicentre of the earthquake, there are mangroves (*Rhizophora*), sea pine (*cemara*), seagrass, and many coconut trees. The impact of the tsunami was less in this area than in areas that did not have this vegetation. However, in the coastal area of Banda Aceh (approximately 220km from the epicentre of the earthquake) mangroves were carried inland by the waves and were found in residential areas up to two to three kilometres inland; this included mangroves that were in relatively good condition in the area of Ulee Lhee. In contrast, species of sea pine (*cemara laut*) and coconuts were not carried away by the tsunami. *Munthadar* (Master's student in Coastal Management, Bogor Agricultural Institute).

Sri Lanka: IUCN followed up with targeted assessments and for example in two eastern provinces reported that “Extensive stands of mangrove appear to have played a positive role in buffering the inland landscapes from the tsunami in some areas by reducing the energy of the incoming waves and absorbing the tsunami waters into a network of mangrove creeks and channels.”

India: Reports from Tamil Nadu's Point Calimere Wildlife and Bird Sanctuary - a Ramsar site - indicates that the natural configuration of the bay and mangroves may have helped to reduce the impact on the site, although the area was inundated. M S Swaminathan Research Foundation reports that in the Pichavaram mangrove wetland, occupying an area of about 1400 ha, located about 280 km south of Chennai, in the Cuddalore District, there was no damage to six hamlets that are physically protected by the mangroves, but hamlets located on or near to the beach have been totally devastated.

Malaysia: National Hydraulics Research Institute Malaysia (NAHRIM) reports that at a project site at Kuala Sala, Kedah and thanks to the mangroves, damage to surrounding areas including Kampung Burma, was minimal. However, unprotected coastal areas about 2 km southwards from the research station, were severely eroded.

FAO reported that the Penang Inshore Fishermen Welfare Association in Malaysia claimed that in areas where the mangrove forests were intact, there was reduced damage.

2.2.1 Guidance on rehabilitation of coastal ecosystems

For some components, especially coral, there is new guidance available (see IUCN websites), and for mangrove, FAO guidance already exists for mangrove planting and shrimp/fish pond construction. Members of the Ramsar Tsunami and Wetlands Group also have considerable experience in mangrove rehabilitation (but see also FAO's tsunami website). For coral, which requires specialist advice and skilled divers, the following section summarises IUCN's advice.

Coral – damage and best practice for restoration

Based on dive evidence, many authoritative sources are reporting that most coral damage is in fact due to being covered by silt, sand, and other debris. Damage was highly variable, but was mostly within shallow waters less than 5 metres depth.

For example, IUCN Sri Lanka in its report “Coral Reef Areas in South Western Sri Lanka: Status after the Tsunami and Recommendations on Management Action” recommends, amongst a range of key actions, reducing the existing stress on coral communities (stress relief) as being the most cost-effective and practical strategy, rather than attempting restoration or large-scale cleaning operations. However, the report also emphasizes the urgency of getting the land systems stabilised to reduce the risk of further deposition of debris onto coral. (reference: <http://www.iucn.org/tsunami/docs/mpa-recommendations-ccd.pdf>). In special situations, e.g. at Hikkaduwa National Park on the Southern coast of Sri Lanka, IUCN has reported that clean up operations to remove dangerous debris such as nets from corals is desirable.

Similarly, the UNEP report of 22 February summarised the same situation for corals: “and the damage to coral reefs is mostly due to the impact of debris from the land. Coastlines have been eroded, with much of the sediment deposited on healthy reefs, agricultural land, in rivers, or even creating new islands. Shallow soils were stripped from some low-lying atolls.”

The general advice provided by some authorities therefore is that further coral damage can be reduced by paying attention to land-based conservation actions to prevent further soil erosion run-off or inappropriate waste disposal. Report by CSIRO on Maldives corals is also available. (see: <http://www.csiro.au/>)

2.3 Assessments of tsunami impacts on coastal ecosystems by country

For each country reported on, a summary of available information is provided and then for each zone of the coastal ecosystem – shallow sea, through the intertidal, beach and inland zones – a brief description is given of the impacts with the source of information.

India (including Nicobar and Andaman Islands)

Areas impacted

UNDMT Situation Report: The hardest hit areas were the Nicobar and Andaman Islands and the southern provinces of mainland India (Kerala, Tamil Nadu, Pondicherry, Andhra Pradesh), with Tamil Nadu by far the worst affected. About 2,260km of coastline was affected, but very little information is available about the status of wetlands.

FAO reported extensive damage to fish and shrimp hatcheries in all provinces.

Andaman & Nicobar Islands Environmental Team reported that most of west coast of South Andaman, entire Middle & North Andamans including Little Andaman, North & South Sentinel islands is raised by an average of 1 m which has led to extensive exposure of reef flats.

Shallow waters (corals and seagrass)

CORDIO/IUCN: a rapid assessment has been initiated by the Suganthi Devadason Marine Research Institute - Reef Research Team (SDMRI-RRT) a week after the tsunami to assess the

status of corals and associated shallow water habitats. One site each near the islands of Kariyachalli and Vaan in the Tuticorin group and one patch reef site near the mainland were assessed. The results of surveys conducted at the island sites revealed that there was very little damage to coral reefs and associated habitats caused by the recent tsunami. The rapid assessment is continuing for other island areas (Vembar, Kilakarai and Mandapam groups) in Gulf of Mannar

Reef Watch Marine Conservation reported that the coral reefs in the Andaman and Nicobar Islands have been deeply impacted by the tsunami. They have recorded mechanical uprooting of coral colonies, sand deposition on the corals, habitat change due to increase/ decrease in the depth and exposure of reefs due to upliftment.

Intertidal (mangroves, fish & shrimp ponds)

WWF is collecting data on the role of mangroves in lessening the impact in certain areas, and is calling for an immediate moratorium on any further mangrove destruction and the immediate restoration of lost mangroves. It is also calling for the strengthening of laws on regulating development in coastal zones.

M S Swaminathan Research Foundation reports that in the Pichavaram mangrove wetland, occupying an area of about 1400 ha located about 280 km south of Chennai in the Cuddalore District, there was no damage to six hamlets that are physically protected by the mangroves, but hamlets located on or near to the beach have been totally devastated.

Andaman & Nicobar Islands Environmental Team recorded that due to the upliftment of the west coast of South Andaman, entire Middle & North Andamans, the mangroves remain 1 m above the high tide line in creeks, leading to mangroves strands drying and sliding into creeks.

Upper beach and tree zone (turtles, shelter belt trees)

WWF reports that turtles have been sighted on several beaches on the Andaman and Nicobar Islands.

Andaman & Nicobar Islands Environmental Team carried out a rapid assessment on the status of the marine turtle nesting habitat in the Andaman and Nicobar Islands. They reported that the tsunami occurred during the peak nesting period of *D. coriacea* & *L. olivacea* and highly impacted their nesting. The upliftment of the reefs have also impacted their habitat.

Inland (fisheries, rice)

No specific information collected

Thailand

Areas impacted

Six provinces were affected: Phuket; Ranong, Phang-Nga, Krabi, Trang, Satun. Of these Phang-Nga was most seriously affected [source: WI]. With the exception of Phuket - which has long been heavily developed for tourism - the remaining five provinces represent the most heavily mangrove forested provinces in Thailand and contain almost 175,000 hectares, or 70% of the

nation's mangrove resources. The Natural Resources and Environment Ministry has said it will declare the provinces of Krabi and Phang-Nga as "environmentally protected areas" in order to give it more power to regulate rebuilding, redevelopment and planning. The Forest Department wants to re-zone the coastal parks to become more tsunami-resistant.

Regarding Ramsar sites and others, BirdLife reported that Krabi River Mouth was to some extent sheltered or the impact of the tsunami dissipated by the many coastal inlets.

Shallow waters (corals and seagrass)

FAO states that at least 5.9 sq km of coral reef and 3.9 sq km of mangroves have been damaged. Damage to aquaculture floating cages has been estimated as probably less than US\$ 32.7 million, with a total of about 1.1 million square metres (or 41,439 cages) for marine fish culture, 179 rai (approximately 30 ha) of shrimp farms and 434 rai (approximately 70 ha) of shellfish area being damaged. The damage is expected to drive Thai shrimp exports down by 75 000 – 80 000 MT this year.

UNDP/World Bank/FAO reports that only 5% of coral along the Andaman coast has been damaged, much less than originally thought. However, substantial to severe damage is located at South Patong Beach, Koh Pai (Phi Phi), Rana Bay and Similan Island.

WI's overall assessment is that:

- Coral at depths in excess of 5m is unlikely to have been significantly damaged.
- Reports estimate about 5 – 10 percent coral destruction from areas surveyed in Phuket, Krabi and Phang-Nga Provinces.
- Coral damage in the Similan Island group and Surin Island group is thought to be significant. Photos show coral "boulders", in excess of 1m in diameter, thrown up onto the beaches, and some reefs are reported as suffering 70% damage or more.
- Localised coral damage, dependant on location, is estimated at up to 90 percent.

There are further serious risks of indirect impacts to coral and there are concerns that more losses will be suffered through the following mechanisms:

- The serious disturbance of the seabed, combined with the volume of organic and non-organic materials, debris, sand and silt that has settled on coral as the tsunami receded has, will cause longer term damage.

Trang Province, and in particular the Chao Mai Ramsar site, which lies within the tsunami zone, have the most extensive seagrass beds in Thailand. As a result, Chao Mai is also a location of rich marine biodiversity, including significantly Dugongs (*Dugong dugon*) and critically endangered Hawksbill turtles.

Preliminary reports on seagrass at Hat Chao Mai suggest that it is not extensively damaged or lost, but in many places has been damaged, torn out, and seagrass has been found washed up on the beach.

Intertidal (mangroves, fish & shrimp ponds)

WI states that Phang-Nga Province, which recorded the most serious human casualties, is also the province with the highest amount of mangrove in Thailand. This suggests that if there is indeed damage to mangrove forest it is most likely to be in Phang-Nga.

Upper beach and tree zone (turtles, shelter belt trees)

UNDP/World Bank/FAO reports that at Haad Thaymuang, urgent recovery of the beach nesting site is required for Leatherback and Olive Ridley turtles

Inland (fisheries, rice)

No specific assessment reported

Indonesia

Areas impacted

WI: The areas that were closest to the epicentre of the earthquake and therefore most seriously affected by the tsunami include the coast from Meulaboh to Banda Aceh, Aceh Besar and Aceh Jaya, including Simeuleu Island. There are many reports that one of the reasons that damage on the island was minimized was because of the formation of the coastal wetland ecosystem, which was complete and in relatively good condition, including coral reefs, seagrass and (on the east coast of the island) mangroves. To date information is only available on the mangrove ecosystem. In contrast to the situation on Simeuleu Island, reports from residents in Pulo Aceh group of islands state that coconut trees that stretched along the beach were uprooted by the tsunami. This situation leads to strong speculation that the entire coral reef ecosystem, the turtle breeding beach, and seagrass beds (habitat for dugong) were completely destroyed.

Shallow waters (corals and seagrass)

WI: It is estimated that the most serious damage occurred to coral around the Pulo Aceh Islands, and that damage to Weh and Simeuleu Islands was moderate. It is thought that the coral around the Banyak Islands is still in good condition.

Based on the location of the islands and the damage caused by the tsunami on land, it is estimated that the damage to seagrass beds in the Pulo Aceh islands is 100%, while damage is 50% in the Simeuleu and Weh Islands.

UNEP: There were an estimated 100,000 hectares of coral reefs in the affected area providing critical ecosystem functions. According to Wetlands International, coral reef ecosystems are found mainly in the waters of northern Aceh, including Weh Island, Pulo Aceh Islands and the western waters of the Simeuleu and Banyak Islands.

Intertidal (mangroves, fish & shrimp ponds)

WI: In 2000 the remaining area of mangrove forest in Aceh that could be considered in good condition was only 30,000 ha, including the mangrove that is found on Simeuleu Island. Damaged mangrove covered 25,000 ha, and mangrove in moderate condition was distributed over 286,000 ha. The table below shows the length of the coastline and the estimated area of mangrove on the east and west coasts of Aceh.

Location	Length of coastline (km)	Total area of mangrove (ha)
North coast to east	761	296,078
West coast to south	706	49,760
Simeuleu islands	1.000	1,000

The above data shows that while the length of the coastline is almost the same on both coasts, the area of mangrove on the east coast is six times more than on the west coast.

To date there is no accurate quantitative data on the level of mangrove destruction caused by the tsunami. Available information consists of reports from local residents and humanitarian volunteers who have seen the situation in the field and also from photographs of the coast taken by volunteers. Based on this information, it is possible to estimate mangrove damage as follows:

1. Aceh Besar, 100%, 26,823 ha
2. Banda Aceh, 100%, <500 ha
3. Pidie, 75%, 17,000 ha
4. Aceh Utara and Bireun, 30%, 26,000 ha
5. Aceh Barat, 50%, 14,000 ha

The above data might overestimate the damage caused by the tsunami, as it could include damage that took place before the tsunami struck. This possible discrepancy is caused by the fact that it is not clear what criteria were used by the Department of Forestry in preparing the report on mangrove coverage.

Upper beach and tree zone (turtles, shelter belt trees)

WI: The tsunami damaged approximately 50% of the sandy beaches of Aceh. This damages includes changes to the sandy coastline and also refuse and substrate that were carried as the tsunami waters receded.

FAO: surveys of damages to coastal aquaculture ponds along the coast indicate serious damages, ranging from 40 – 60 percent of the ponds in the various districts (worst hit is Bireuen).

Inland (fisheries, rice)

WI: The damage to rice fields is difficult to estimate because they are spread from low to high land. From a satellite photo it was determined that all of the rice fields in Aceh Besar, covering 30,000 ha, were damaged by being submerged in tsunami waters.

The damage to aquaculture ponds on the west coast was most extreme in Banda Aceh, Aceh Besar and Pidie, where the level of destruction was 100%. Damage in Bireun and Aceh Utara was approximately 50%. The level of damage of coastal aquaculture ponds could be as high as 27,000 ha, more than half the total area of ponds in Banda Aceh.

FAO: 30,981 ha of the rice production is reported to be damaged. In the districts of Aceh Utara, Bireun, Pidie, Aceh Besar, Aceh Java, Aceh Barat and Nagan Raya a total of 90,350 ha have been destroyed (47,955 ha fish ponds and 30,981 ha paddy fields).

Malaysia

Areas impacted

FAO: The northern states of west coast of Peninsular Malaysia have been badly affected – these include Kedah, Penang Perlis and Perak. Penang and Kedah suffered the most damage.

Shallow waters (corals and seagrass)

FAO: Key issues of concern are the destruction of floating cage farms in Kedah, which grow various marine fish species located at the river mouth, a fishing ground for bivalves and floating cage farms.

Intertidal (mangroves, fish & shrimp ponds)

WI reports uprooting and complete loss of coastal mangrove belts in some areas of impacts.

National Hydraulics Research Institute Malaysia (NAHRIM) reports that at a project site at Kuala Sala, Kedah and thanks to the mangroves, damage to surrounding areas, including Kampung Burma, was minimal. However, unprotected coastal areas about 2 km southwards from the research station were severely eroded.

Upper beach and tree zone (turtles, shelter belt trees)

No specific information collected

Inland (fisheries, rice)

No specific information collected

Mauritius

The Mauritian Wildlife Foundation (BirdLife) reported that the wave had no or very little impact on the island thanks to the coral reef barrier

Sri Lanka

Areas impacted

The tsunami affected the coastline most severely from the southwest coast to the northeast coast though with varying degrees of impact. A rapid preliminary assessment carried out by IWMI on coastal wetlands three weeks after the event focused mainly on the southwest coast, between Hambantota and Colombo, with the primary focus being in Hambantota District. IWMI's assessment looked at physical impact on where, why and how certain areas were more impacted than others.

IUCN's rapid assessment in two eastern coast provinces (see: <http://www.iucn.org/tsunami/docs/rapid-ass-easte-sri-lanka.pdf>) showed that damage was “far more severe” than in the southern provinces. However, broad and mature sand dunes also

functioned as effective barriers against the tsunami waves in some areas. The many coastal lagoons in the area appear to have played an important role by absorbing the tsunami waters. However, in some cases lagoons with narrow outlets resulted in the funnelling of sea water which damaged infrastructure and human settlements.

A Ministry of Environment and Natural Resources (MENR) report based on transects spaced 1 km apart along 700 km of affected coast is due soon. This is accompanied by an atlas.

FAO in its country agency report states that the mangroves, coastal lagoons and coral reefs acted as protection/buffer zones, lessening tsunami impacts.

Ramsar Sites: available assessments

Bundala: IUCN-Sri Lanka has surveyed Bundala National Park (<http://www.iucn.org/tsunami/docs/tsunami-impact-bundala-np.pdf>) and in general, the BNP and the adjoining Bundala village have been well protected by a broad, mature and stabilized sand dune running parallel to the coastline.

Shallow waters (corals and seagrass)

IWMI: Assessments on coral reefs have already started with preliminary surveys by the Global Coral Reef Monitoring Network (GCRMN) contributing to the International Coral Reef Initiative (ICRI) of the International Society for Reef Studies (ISRS). Jerker Tamelander, coordinator of the Marine Program of IUCN, said that preliminary surveys have been carried out in Hikkaduwa, Weligama, Unawatuna and Trincomalee and indicated that the coral reefs of Trincomalee (north east) have been devastated compared to the reefs on the south coast, though there was a fair amount of damage there, too. Local observations at the Hikkaduwa Nature Reserve displayed limited damage to the existing reef structure other than for a few toppled boulder corals and a few lesions.

NARA has surveyed reefs and harbour bathymetry, and some fishery issues (see: <http://www.nara.ac.lk/RAP/>)

UNEP reports a case study for the reef at Dutch Bay, Trincomalee, showing that about 50% of the coral area had been destroyed, but in its report it also states that the damage across other areas is extremely variable.

Intertidal (mangroves, fish & shrimp ponds)

IWMI: It would be expected that mangrove would have been minimally affected due to their root systems making them very resistant to water surges, and this seems to go along with reports from various sources around the country. Our personal observations at Kalametiya showed large mangrove trees of *Sonneratia* sp. uprooted /collapsed at a distance of about 200 m away from the beach area.

IUCN: Extensive stands of mangrove appear to have played a positive role in buffering the inland landscapes from the tsunami in some areas by reducing the energy of the incoming waves and absorbing the tsunami waters into a network of mangrove creeks and channels

Upper beach and tree zone (turtles, shelter belt trees)

IWMI: Sand dunes - Observations made on the sand dunes on the Hambantota coast, which are vegetated with *Casurina* trees and invasive shrub species, suggest that they seem to have protected the immediately adjacent areas inland. However, planting of the introduced casuarinas is controversial.

IUCN: Casuarina plantations were observed only in the Nawaladi area of Batticaloa Town, where they did not succeed in protecting the heavily-populated inland areas from the tsunami waves and were themselves badly damaged by it.

Inland (fisheries, rice)

Work has been undertaken by the International Rice Research Institute (IRRI, see: www.irri.org) and will shortly be reported.

3. Current and planned actions by the Group members

Each of the Ramsar Tsunami Reference Group members is participating in assessments. These will cover the full range of wetlands and livelihoods issues. Moving beyond rapid assessments is now essential, because some reputable science is now needed, as well as inventory and establishment of reference or baseline conditions through effective inventory which adheres to previous Ramsar advice/guidance.

BirdLife International continues to systematically assess the post-tsunami status. Their preliminary analysis shows that 27 globally threatened birds species regularly occur in the regions and habitats of Asia potentially affected by the tsunami. There are three Endemic Bird Areas and two Secondary Areas in this part of Asia, and up to 88 Important Bird Areas that might have been affected.

Despite the wealth of biodiversity in the region affected by the tsunami, this preliminary assessment indicates that few (if any) threatened species are likely to have been seriously affected by its direct effects, and no extinctions are predicted as a result of the tsunami. However, surveys are needed to confirm the situation, particularly in the Nicobar Islands.

Wetlands International has worked with the Ministry of Forestry in Indonesia to perform joint rapid assessments, with a strong emphasis on livelihoods and the priorities for wetland restoration – where feasible. A national workshop was convened on 8th February in Jakarta to set priorities and integrate efforts further. Other ministries are also involved in joint environmental assessments, and it is intended that WI staff will be embedded in these field assessment teams. In Thailand, Wetlands International mounted field rapid assessments of specific sites, including Krabi, where an existing project is located, and will try to obtain more specific information about coral damage and mangrove mitigation. In Malaysia, Wetlands International staff will target efforts at Penang and Kedah state, to assess the fisheries/wetlands status and evidence for mangrove mitigation. In India, a relationship with the Bombay Natural History Society and others will provide more systematic investigation along the southwest coast, but there are still large gaps in knowledge for the southeast provinces.

IUCN is continuing to concentrate its efforts in Thailand and Sri Lanka and is currently undertaking assessments regarding biodiversity loss, impacts on fisheries and tourism, and land use planning, and will continue to do this over the coming months with key partners. Globally, the Marine, Forestry and Water and Wetlands Programmes are coordinating efforts to follow up assessments across the region.

WWF Indonesia is working in Indonesia with the Aceh Forum, a coalition of local NGOs, which is helping with the management of refugee camps and aid distribution. It is also working closely with the Ministry of Environment (with WI), which is due to carry out assessments of the environmental impact. WWF in India is collecting data on the role of mangroves in lessening the impact in certain areas, and is calling for an immediate moratorium on any further mangrove destruction and the immediate restoration of lost mangroves. WWF India is also investigating the strengthening of laws on regulating development in coastal zones. WWF is part of the UNEP tsunami task force and is engaged in dialogue and meetings. UNEP is helping to coordinate various environmental assessments in the region.

IWMI will continue to support assessment and rehabilitation efforts in Sri Lanka. In collaboration with IUCN, IWMI has undertaken to map the Sri Lankan coastal wetlands on the basis of remotely sensed imagery and focused biomonitoring, including the creation of a national database. Digital GIS and SRS maps of wetland sites are to be produced by the GIS / RS Group at IWMI, in consultation with IUCN and CEA. IWMI is also doing literature collation and analysis of existing info and outcomes of rapid assessments covering livelihood and ecological issues as a basis for a structured vulnerability assessment (using draft Ramsar guidance on VA) of ecological change and its interrelationship with livelihood issues and capacity of governance to implement strategic management. Linked with local humanitarian and restoration efforts by environment and humanitarian groups and within context of wetlands within ICZM. Will utilise where possible imagery-based change analysis techniques.

Collaboration with IUCN to produce guidance notes on various elements of ecosystem restoration.

Additionally, IWMI is also involved in Analysis of well cleaning efforts; Support for IRRI rice field analyses, and WorldFish Centre cooperation. Finally IWMI will input to the IUCN-CEM workshop on responses to natural disasters in June 2005, Colombo.

Many other partners including FAO, UNEP, country UNDP offices, are also aiming to increase assessments, and a great deal more environmental information was reported to the UNEP Governing Council meeting held on February 15.

4. Who's who in coastal wetland assessments and restoration

The international Ramsar Tsunami Reference Group of partners (IWMI, WWF International, IUCN, BirdLife International, Wetlands International, and the Global Environment Centre, Malaysia) represent wetlands expertise, but other international and national organizations have complementary and substantial capacity to assess coastal wetlands and livelihoods and also assist restoration. It is not possible to include a comprehensive listing here – instead the Ramsar Tsunami and Wetlands Group website should be consulted (www.wetlands.org/tsunami), for further links

4.1 Role and capacity of the Ramsar Tsunami Reference Group

Each organization outlined their role and focus in dealing with the tsunami (**updated** as at 10 May 2005).

BirdLife International	<ul style="list-style-type: none"> ○ Rapid assessment of impact of tsunami on globally important IBAs/ key biodiversity areas and their communities. ○ Technical assistance to IBAs and communities in tsunami affected areas, initially in Sri Lanka. ○ Provide information, advice and support to those responsible for redevelopment/ resettlement to avoid longer term damage to the natural habitats and the people depending on these resources for their livelihoods. ○ Support for students in natural resource management who have lost their means of education, with a focus, initially in Aceh.
IUCN	<ul style="list-style-type: none"> ○ Assists governments of Sri Lanka and Thailand in humanitarian relief efforts in the immediate term and technical advice for rehabilitation effort. ○ Creation of an IUCN Tsunami Information Hub and Clearing House in Sri Lanka and Thailand offices. ○ Formulation of guidelines & methodology for rapid field assessment of terrestrial coastal ecosystem. ○ Formulation of guidelines for ecosystem rehabilitation incorporating livelihoods concerns. ○ IUCN is member of the UNEP Task Force. ○ Impact assessment of Tsunami on: <ul style="list-style-type: none"> ○ coastal wetlands of Bundala National Park (Ramsar site), Lunama- Kalametiya sanctuary and Rekawa ○ marine ecosystems of Seychelles and Indian Ocean coral reefs ○ Agreement signed with Swiss Agency for Development and Cooperation for “greening” the reconstruction of three fishing villages in Thailand
IWMI	<ul style="list-style-type: none"> ○ Involved extensively in Sri Lanka in immediate relief work by sending out emergency supply. ○ Launched IWMI and CGIAR system –wide appeal to raise funds to support the rehabilitation and recovery process. ○ ‘IWMI – Tsunami Relief Group’ formed to facilitate coordination and ensure fast and meaningful responses (iwmi-tsunami-relief@cgiar.org). ○ Prepared Tsunami Disaster Relief Maps in collaboration with government of Sri Lanka (http://www.iwmi.cgiar.org/TSUNAMI/IWMI_Tsunami_maps.asp). ○ Kalametiya Rehabilitation and Development Trust (KRDT) Fund set-up for rehabilitation and rebuilding of villages in Kalametiya area. ○ Involved in hydrological assessment on Kalametiya lagoon and Walawe estuaries. ○ Provide technical assistance to IPGRI’s work in Dodanduwa village (South Sri Lanka) on salinization of freshwater sources.
WI	<ul style="list-style-type: none"> ○ Indonesia, Thailand, Malaysia and India – preliminary assessments undertaken/underway. Indonesia team working very closely with central and district, organizing a workshop with government to bring the parties together to id. info needs and link it to decision making and spatial planning. ○ WI role is to lead collaboration with others in the further development of

	<p>these wetland assessments, in order that we can bring information together at the regional level and make it available to decision-makers</p> <ul style="list-style-type: none"> ○ Partnership with ITC Netherlands developed to manage remote sensing data on behalf of the Ramsar Reference Group. ITC has many students from the region who are willing and able to do assessments using baseline info pre and post tsunami. WI needs information from partners on wetland assessment information that is available and priority areas for case studies. The capacity for ground-truthing in each country also needs to be established ○ Our website presents analyses of the Ramsar Tsunami Reference Group to external audiences. See www.wetlands.org/tsunami ○ The moderated discussion forum is available to enable information and ideas to come together, under specific topic headings. Others are invited to participate in it – information will feed into the Ramsar processes. ○ WI has some links to donors and re-construction programmes and is keen to work with other partners to coordinate on this.
Ramsar Convention	<ul style="list-style-type: none"> ○ The Convention is the user of the work of the Group and can provide it to the Contracting Parties. ○ Information being generated was provided as initial advice to the Ramsar STRP in early February, then in early March to the Ramsar Standing Committee Subgroups and then in June to the full Standing Committee. ○ The Convention organized a special forum on “natural mitigation of natural disasters”, in conjunction with the World Wetlands Day (2nd February) during the STRP meeting in Gland.
WWF	<ul style="list-style-type: none"> ○ Involved in the relief efforts in Malaysia and Indonesia. ○ WWF International had called upon governments to support communities in the tsunami affected areas to rebuilt their livelihoods integrating the environmental aspects. ○ Developed media releases dealing with issues of ‘green construction’ and mangrove protection. ○ Post-tsunami coral reef assessment carried out in Thailand. ○ WWF India has carried out preliminary assessment and mapping in southern coast of India and Andaman. ○ WWF India has been working closely with WI India office and other NGOs for formulation of an collaborated/ integrated action plan for rehabilitation and restoration of tsunami destructed areas in India taking into consideration the ecological aspects. ○ Produced a web page on tsunami issues. (http://www.panda.org/about_wwf/where_we_work/asia_pacific/news/news.cfm?uNewsID=17950)

5. Key References

For a more complete reference list, please refer to the website of the Ramsar Tsunami and Wetlands Group.

Ramsar Tsunami and Wetlands Group	http://www.wetlands.org/tsunami
BirdLife International:	http://www.birdlife.org/
IUCN-World Conservation Union	http://www.iucn.org/
WWF International	http://www.panda.org/
IWMI (International Water Management Institute):	http://www.iwmi.cgiar.org
Wetlands International	http://www.wetlands.org/
Ramsar Convention on Wetlands	http://www.ramsar.org
CSIRO (Australia)	http://www.csiro.au/
NARA (National Aquatic Resources Research and Development Agency Sri Lanka)	http://www.nara.ac.lk