IUCN
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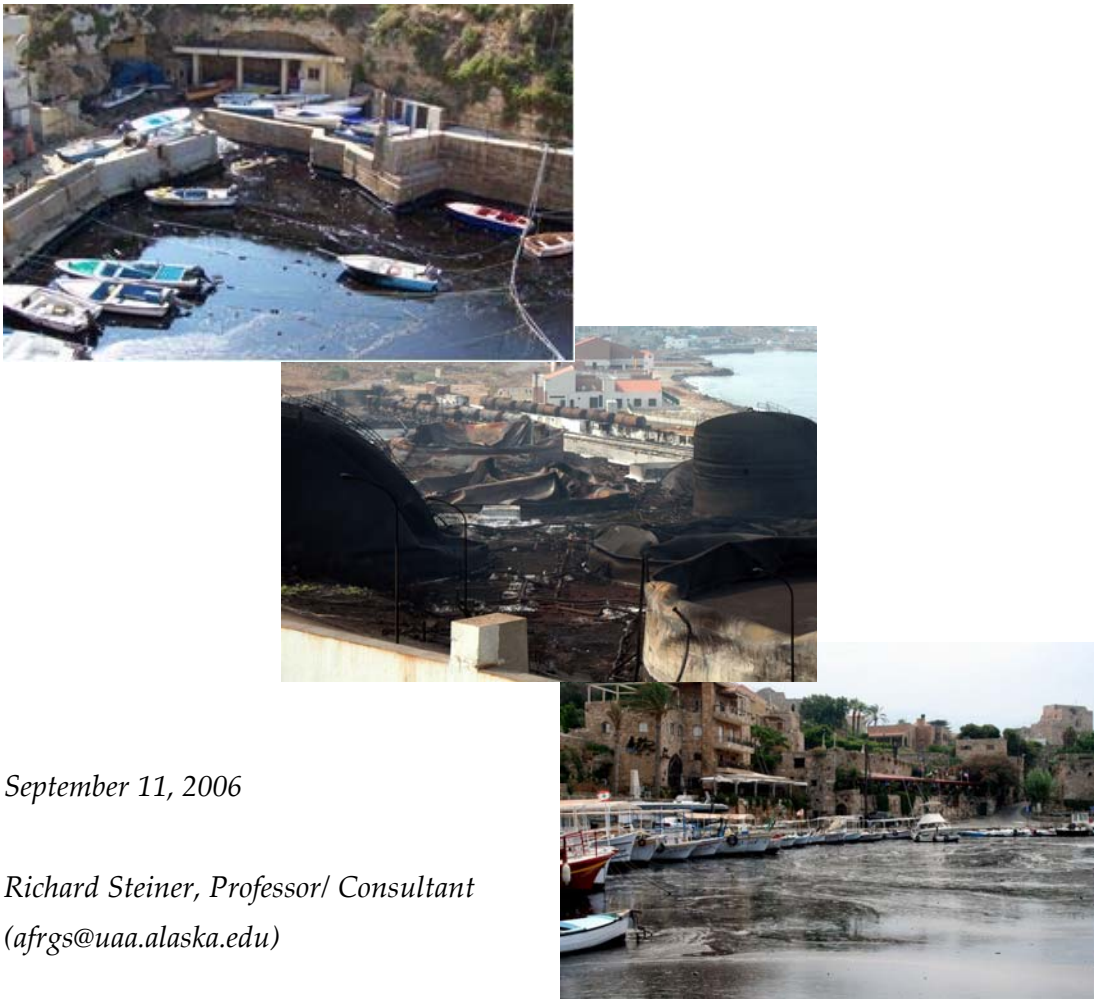
Green Line

Lebanon Oil Spill Rapid Assessment and Response Mission

Final Report



September 11, 2006

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Photos: Green Line, August 15, 2006

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IUCN Secretariat (Office of the Director General and WESCANA Regional Office)

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Planet2025 Network, Washington DC, USA

Green Line Association, Lebanon (IUCN member)

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EXECUTIVE SUMMARY/RECOMMENDATIONS

Based on the Mission the following are recommendations to IUCN for priorities post the immediate response and assessment initiatives currently underway in Lebanon and suggestions for wider global oil spill response and assessment priorities:

1. Develop and approve a robust National Contingency Plan for Lebanon;
2. Develop an in-region oil spill response capability, with a response base, trained personnel, and equipment in Lebanon;
3. Conduct a Risk Assessment for future spills in eastern Mediterranean;
4. Implement a Phase II NRDA progamme for 2007, with a public symposium toward the end of 2007 to present scientific results of the NRDA programme, and to conduct a scoping process for Restoration
5. Lebanon sign and ratify the tier-two and tier-three international spill compensation protocols – the International Oil Pollution Compensation (IOPC) Fund, and the Supplementary Fund, bringing spill liability coverage up to about $1.1 billion (USD);
6. Continue a comprehensive marine environmental monitoring programme / strategic environmental assessment (SEA) for the eastern Mediterranean;
7. Establishment of a Lebanon National Oil Spill Fund (based on a nominal tax on imported petroleum products) to be used to support all government activities with regard to spill prevention and response preparedness, etc. in the future. Many other nations have such funds, and it would greatly ease the financial burden of reprogramming funds in emergency response situations in the future.
8. Survey other coastal states globally to ascertain which still do not have a National Contingency Plan, which may be vulnerable to oil pollution disasters, and then assist those coastal states in the formulation of a NCP as soon as possible.
9. Consider amendments to the international pollution compensation regime that would allow the three-tiered funds to be available to cover wartime related spills or otherwise establish a $100 million USD fund to be made available on an emergency basis for other wartime related spills. As well, the international compensation regimes must be amended to cover *all environmental injury* in spills, not simply those limited injuries that may be amenable to direct Restoration initiatives as is currently the case.

Introduction

At the request of the Lebanese Ministry of Environment (MoE), the Secretariat of the World Conservation Union (IUCN), IUCN Commission on Environmental, Economic, and Social Policy (CEESP), and Green Line (Beirut), I travelled to Lebanon from Aug. 11-25, 2006 to conduct a rapid assessment of the oil spill and provide response assistance based on the following Terms of Reference.

General

IUCN in coordinates with other organisations (UNEP-OCHA-REMPEC-UNDP-EU) and the Ministry of Environment Lebanon is engaged in efforts and missions to assess and mitigate the environment impacts of the conflict. As part of this wider effort, IUCN is retaining a consultant to conduct a study in Lebanon to support the assessment of the environmental impacts of the recent oil spill and inputs will be focused around a Natural Resource Damage Assessment (NRDA) including any estimate of social and economic impact.

Specific

1. conduct a *preliminary assessment* of oil spill extent / severity;
2. advise Ministry of Environment (MoE) and others re: *spill response*;
3. develop and implement a *Natural Resource Damage Assessment* (NRDA) programme
4. develop conceptual approach to *claims / compensation*

I. Preliminary Assessment

Assessment

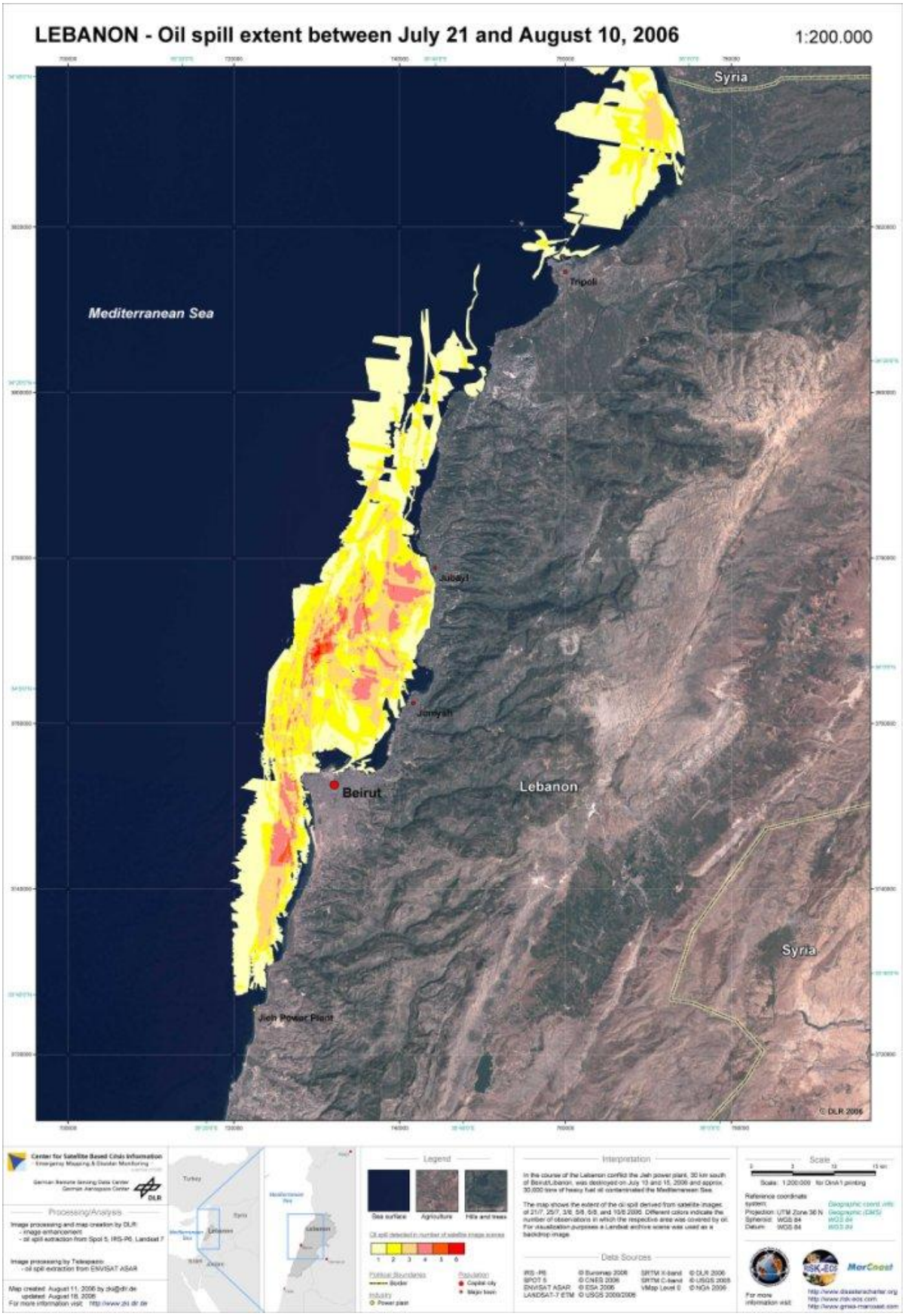
Along with members of Green Line and/or IUCN WESCANA, I travelled to many of the oiled shoreline segments, from south of Jiyyeh to Palm Island in the north although travel was slowed significantly due to bombed bridges and roads, but still possible and necessary.

The estimated volume of 15,000 tons of heavy IFO 150 (number 6 fuel) spilled seems reasonable, but impossible to independently verify with existing information. Additionally, the other 55,000 tons in storage at the Jiyyeh tank farm

are thought to have burned, causing extensive atmospheric contamination in a plume reportedly reaching 60 km. In interviews we conducted in the vicinity of Jiyyeh, this atmospheric plume caused some short-term respiratory symptoms among those people that were exposed. It was also evident that it rained small droplets of oil from the plume in a 5 km radius around the fire at Jiyyeh, further exposing residents to contamination. These splatters are still evident on the ground and property around Jiyyeh.

In the beach surveys conducted, I found shoreline oiling to be quite extensive – perhaps 120 km or so - and in places oil can be found up to 50 cm deep. Oiled sand beaches and rocky shorelines were surveyed, and some found to be extremely contaminated, others only moderately, and some only very lightly oiled or not at all.

Photos: Green Line, July 19, 2006


LEBANON - Oil spill extent between July 21 and August 10, 2006
1:200.000
Syria
Tripoli
Mediterranean Sea
Jbeil
Jonyah
Beirut
Lebanon
Syria
Jieh Power Plant
© DLR 2006
Center for Satellite Based Crisis Information
German Remote Sensing Data Center
German Aerospace Center
DLR
Processing/Analysis
Image processing and map creation by DLR:
- image enhancement
- oil spill extraction from Spot 5, IRS-P6, Landsat 7
Image processing by Telespazio:
- oil spill extraction from ENVISAT ASAR
Map created: August 11, 2006 by dsi@dlr.de
updated: August 16, 2006
For more information visit: http://www.zki.dlr.de
Turkey
Syria
Lebanon
Legend
Sea surface
Agriculture
Hills and trees
Oil spill detected in number of satellite image scenes
1 2 3 4 5 6
Political Boundaries
Border
Population
Capital city
Major town
Industry
Power plant
Interpretation
In the course of the Lebanon conflict the Jieh power plant, 30 km south of Beirut/Lebanon, was destroyed on July 13 and 15, 2006 and approx. 30.000 tons of heavy fuel oil contaminated the Mediterranean Sea.
The map shows the extent of the oil spill derived from satellite images of 21.07, 25/7, 3/8, 5/8, 9/8, and 10/8 2006. Different colors indicate the number of observations in which the respective area was covered by oil. For visualization purposes a Landsat archive scene was used as a backdrop image.
Data Sources
IRS -P6 © Eurimage 2006
SPOT 5 © CNES 2006
ENVISAT ASAR © ESA 2006
LANDSAT-7 ETM © USGS 2000/2006
SRTM X-band © DLR 2006
SRTM C-band © USGS 2005
VMap Level 0 © NGA 2006
Scale
Scale: 1:200.000 for DinA1 printing
Reference coordinate system:
Projection: UTM Zone 36 N
Spheroid: WGS 84
Datum: WGS 84
Geographic coord. unit: Geographic (GMS) WGS 84 WGS 84
For more information visit:
http://www.disasterscharter.org
http://www.risk-eos.com
http://www.gmes-marcoast.com
RISK-EOS
MarCoast

Note: the entire 70,000 tons of fuel at Jiyyeh did not spill into the sea. It is estimated that 15,000 tons spilled and 55,000 burned.

Further, on-water observations together with observations from shore and on approach to Beirut airport on arrival showed that there was at that time considerable amounts of oil still floating offshore. Some slicks were extensive, but the thickness seemed limited.

It was also predictable that some oil would transport to the subsurface seabed, and we confirmed such upon examination in surf zones off sandy beaches where oil had combined with sand and sunk. Underwater video / still photography sponsored by Greenpeace clearly showed extensive sea bed oiling due to other transport mechanisms – evaporative weathering of surface slicks, with slicks then sinking in the warm, low-density sea water. Such slicks remain on the seabed, but it is unclear just how extensive is this component. These seabed slicks will likely re-surface at some point, and travel as large tar balls or slicks to contaminate other shorelines in the eastern Mediterranean basin.

On August15, I asked the French Embassy in Beirut for support to conduct an aerial survey with their relief helicopters along the coast, to ascertain extent of remaining offshore oil, and to better guide what response options might be necessary. After several attempts by the French Ambassador as well as European Union to secure clearance from Israel for this flight, Israel refused to grant clearance at that time. Thus, I requested of the international support group to take up this issue at the Athens meeting on August 17.

Overview of Lebanon's coastal and marine ecosystem

In order to assess potential impact of the spill, one needs at least a general understanding of the coastal and marine ecosystem in which the spill occurred. Available scientific literature on Lebanon's coastal and marine ecosystem is sparse, and this overview does not constitute a comprehensive summary.

Lebanon's coastal and marine ecosystem is characterized as Mediterranean with sub-tropical components. The shoreline extends 220 km, and is interspersed with 3 bays, 12 prominent headlands, limestone sea cliffs, and several small river deltas. Unusual coastal habitat types include rocky terraces covered with the mollusk Vermetes and calcareous algae (Vermetid terraces), coastal springs, and coastal dunes. The Vermetid terraces / coralline reefs are an important and unique feature

of the eastern Mediterranean. These wave-resistant terraces host a diverse ecosystem consisting of brown algae, calcareous algae, encrusting sponges, barnacles, scleractinian corals, bryozoans, bristle worms, nudibranchs, anemones, sea urchins, sea cucumbers, crabs, cuttlefish, various fish species, and sea turtles. The shoreline habitat of Lebanon is approximately 20% sandy beach, with the remainder being rock or gravel. The continental shelf is quite narrow, with the widest part at only 12 km in the north, and is intersected by several submarine canyons. Sea surface temperature varies between 16 C in winter and 30 C in summer. Tidal range is slight, averaging from 15 cm – 30 cm, with a maximum up to 50 cm.

The marine ecosystem is not particularly high in productivity, as it is nutrient-poor, has a narrow continental shelf, and summer wind patterns inhibit nutrient replenishment through upwelling. However, the marine system exhibits high biodiversity. One recent marine conservation assessment (AMWAJ 2003) concluded the following:

> *The Mediterranean is one of the richest seas for biodiversity in the world since it hosts 7.5 % of the marine animal taxa and 18% of the world marine flora for an area covering only 0.7% of the world oceans. The Mediterranean infralittoral and deep flora and fauna are characterized by a high ratio of endemism*

Although Lebanon's marine ecosystem is not particularly well studied, it is reported to host at least 1685 species of fauna, of which 50 are commercially important. Much of the marine biodiversity - 1250 species - is found in the plankton community (small plants and invertebrate organisms drifting in the water column). There are reportedly more than 300 Indo-Pacific marine species that have invaded the Mediterranean from the Red Sea subsequent to the opening of the Suez Canal in 1869. These invasive species now compete with Atlantic and Mediterranean species, and are believed to have significantly altered marine communities in the region.

The phytoplankton community off Lebanon is comprised of 227 species of dinoflagellates and some 151 species of diatoms. Benthic macroalgae (sea bed algae) include some 191 species, 29 of which are endemic to the Mediterranean. But again, overall productivity as measured by chlorophyll concentration is very low relative to other coastal seas. The zooplankton community consists of at least 747 species, and both the phytoplankton and zooplankton communities exhibit significant seasonal variation in species composition, distribution, and abundance. The benthic meiofauna community is dominated by calanoid copepods, and is

thought to be important to overall marine productivity. Benthic decapods (crab, shrimp, etc.) comprise important communities on rocky bottoms at 30- 50 meters depth.

The cephalopod community (octopus, cuttlefish, squid, etc.) off Lebanon is not well studied, but the Eastern Mediterranean has at least 21 species, of which the most common off Lebanon are cuttlefish (sepia), Octopus vulgaris and Octopus macropus.

There are 357 known fish species in Lebanese waters, 59 of which are exotic to the region. Fish diversity is highly correlated with rocky bottom substrate and habitats with greater substrate complexity. Commercial fisheries land only about 6,000 tons / year, and are still mostly artesanal, using small boats near shore. Much is caught at night using lamplights. Although small in comparison to other coastal fisheries, Lebanon's marine fisheries support some 30,000 fishermen and their dependents, and thus have socioeconomic importance to the nation.

Lebanon is not an area of high bird nesting abundance, due at least in part to over hunting and habitat degradation. But lying along a north-south migration corridor, some 300 bird species are known to migrate through the coastal zone.

Two sea turtle species – Loggerhead and Green – are known to nest on Lebanon's beaches, and feed in coastal waters. There are perhaps 19 sandy beach segments along the coast that may be suitable for sea turtle nesting. Marine mammals found in Lebanese waters include common dolphin (the most common), striped dolphin, and bottlenose dolphin. Sperm whales have been sighted offshore on rare occasions, and the critically endangered Mediterranean monk seal has been seen on rare occasions, most recently at Palm Island Nature Reserve.

Environmental Impact of spill

The extent of ecological impact of the spill remains speculative at this point. The Lebanon offshore and coastal ecosystem may indeed not be one of the most productive marine systems by global standards – e.g. total annual fishery production is only about 6,000 tons (rather than hundreds of thousand of tons in some marine systems), etc. As well, it is widely recognized that the coastal environment of Lebanon was significantly degraded prior to the spill from chronic pollutant inputs, coastal development, sand removal, un-sustainable fishing, debris, etc.

As far as I could determine, there were few large dead organisms washed up on beaches due to the spill. It could be that spill mortalities washed away offshore and/or sunk, or alternatively that there has not been a massive mortality of large animals. There was no need in this spill to field an animal rescue effort, as very few oiled and living animals were recovered. Another aspect that may limit ecological impact is the exposed nature of the coastline along which the spill traveled, making it more susceptible to physical breakdown due to turbulent mixing, as well as the warm temperatures of both water and air.

However, all this should not be taken to mean that ecological impact has been negligible. Whenever 15,000 tons of a highly toxic fluid is spilled into a coastal or marine ecosystem we should expect the damage to be extensive. That the ecosystem is known to have a high degree of endemism as well as high species diversity gives rise to concern that the relative impacts on individual populations / species may be higher than normal. That is, population-level impacts may have resulted. Much of the short-term, acute mortality may have gone undetected offshore due to the war and air/sea blockade. Further, spill ecological injury can often take time to manifest as sub-lethal, chronic effects. For instance, in the Exxon Valdez Oil Spill in Alaska, some fish population collapses did not occur until 3 years after the initial spill.

It is clear that much of the shoreline ecosystem that was contaminated was heavily impacted. The impact has clearly included significant mortality and impairment of the structure / function of the shoreline ecosystem. Of particular concern with shoreline oiling is the impact to Vermetid terraces / coralline reef communities. As well, there is a southward migration of birds expected along the coastal zone of Lebanon in September / October, and some of these can be expected to be exposed to the large amounts of oil remaining on the shoreline.

Sea turtles that are just now hatching may be exposed to residual oil on beaches as well as offshore waters. Such exposure may result in acute mortality and/or sub-lethal effects including such things as carcinogenesis, physiological and reproductive impairment, and so on.

Additionally, the seabed impact is significant, but also indeterminate as yet. All such impacts will be investigated in the NRDA programme (see below). It is a good sign that no large-scale mortality of large, "charismatic megafauna" (birds, dolphins, sea turtles, large fish, etc.) has yet been reported, but it is too early to draw too many conclusions about ecological impact until the Phase I NRDA programme is completed.

II. Spill Response Guidance

Limitations of response

Before traveling from Alaska to Beirut, I contacted the *Oil Spill Response Limited* (OSRL) base in Southampton, UK regarding potential response assets available from them. OSRL is one of the largest spill response organizations in the world. Their manager and staff discussed my request, and they informed me at the time that, while interested in helping in Lebanon, they were unable to assist for several reasons, primarily due to the hostilities still existing in-region, as well as no contract being offered.

Response to this spill was *severely limited* due to three unique and overwhelming factors:

1. No Responsible Party ("RP") response – It is normal procedure in oil spills that the spiller or "responsible party" (oil company, ship owner, shore facility, pipeline owner, etc.) is required to mount an immediate response, including limiting additional oil outflow, at-sea containment, shoreline booming of sensitive habitats, oil recovery, beach cleanup, etc. In the LOS case however, the RP did not mount any response at all.

2. Lack of Government Capacity – again, in normal situations, if a RP does not mount a sufficient emergency spill response, the coastal state government will take on the response itself. The Government of Lebanon, with no National (oil spill) Contingency Plan, was almost entirely unprepared for this challenge. The government had apparently attempted several years ago to draft and approve a National Contingency Plan, but for reasons still unclear to me, this was never finalized. Thus, the government lacked an effective emergency response organizational structure, finances, equipment, and personnel to mount an effective spill response.

3. Limited Access due to War and Blockade – an obvious overarching reason for the lack of effective response to this spill was the 34-day war and continuing air and sea blockade off Lebanon's coast. Even with the cessation of hostilities, the ongoing blockade prevents easy deployment of any significant response.

Thus, while it is generally not advisable to have a distant bureaucracy (U.N. or other) involved in emergency spill response, in this case it certainly provided significant support and filled a large gap and provided useful international resources.

However, it should be pointed out that even if Lebanon had the equipment, personnel, finances, command structure, and clear access to the water in place in July, it is highly likely that this spill could not have been contained or recovered effectively anyway. Experience with large marine oil spills shows that once oil is in the water, response efforts seldom collect over 10% of the spill volume. Thus, efforts by Lebanese officials to prevent additional outflow were paramount.

Initial spill response

An initial response was fielded at Chekka (near Tripoli) on private beaches through privately contracted resources (MOIG / Navy Group International in Beirut), and we were told that about 100 tons of contaminated material were removed from these areas over a 2-week period. Another response effort began August 15 in the Byblos (Jbeil) Harbor, by the Lebanese Army and MoE, which wrapped up about 1-week later with over 100 tons removed from the harbour (using booms and the Norwegian drum skimmer). Another beach cleanup began at Ramlet el-Baidal (in Beirut) and another on August 20 at Jbeil both by NGOs, but both were terminated initially due to waste storage and administrative issues with the government.

In one of my first meetings at the MoE, I recommended that the MoE consider contracting the spill response to a trained spill response contractor (such as OSRL in Southampton), utilizing local labor, etc., but the MoE seemed interested in coordinating the effort locally.

As a result of the many response difficulties referenced above, the Minister of Environment asked on August 21 that I prepare a preliminary emergency cleanup plan, which I developed and presented to the Minister later that same day. While there had been several plans presented before, including one by myself prior to the August 17 Athens meeting, the Minister needed an immediately operational plan for emergency cleanup. The hastily developed plan consisted of two phases, giving the Minister sufficient guidance with which he could order an immediate, expedited response.

The two-phase plan was immediately approved by the Minister and it is summarized below.

Rapid Response – August 2006

Shoreline Response:

Response teams – 10 teams of 30 workers each, deployed to priority beaches to conduct pilot projects: 1. Jbeil; 2. Ramlet el Baidal; 3. Jiyyeh; 4. Mobile team (Palm Island, etc.). These teams were to include hired workers, civil society volunteers, municipalities, etc…As well, we suggested that the Lebanese Army response team under the command of Colonel Hashem be redeployed as soon as possible from Byblos to Delieh fishing harbor in Beirut (which has now occurred) for additional near shore, on-water recovery.

Equipment - recommended included shovels and rakes, PPE (gloves, raingear, masks, etc.), absorbent booms (20 x 500 m x 20 inch diameter per team); absorbent pads (2000 x 17 x 19 inch / team); buckets; heavy earthmoving equipment.

Waste transfer – truck / bobcat for each shoreline team, containers, polyethylene sheeting (for interim storage higher on beaches for later transfer); all other garbage to be removed as well.

It was also recommended that all locally available response assets be contracted and deployed as soon as possible. For instance, Navy Group International -Mediterranean Oil Industry Group (MOIG) contractor whom I met with on August 22, seems to be a competent, locally trained and equipped response contractor (who was employed at Chekka), and it is my recommendation that they be contracted to conduct aspects of the response as appropriate.

Mid-term / Long-term response – remainder of 2006 / 2007

Shoreline / Offshore / Seabed Response:

Spill response should be expanded as soon as practicable to include rocky shoreline washing, additional sandy beach response, any offshore response still necessary, and seabed oil recovery (to the extent practicable). *Response teams* – expanded to 500 personnel total – 15 shoreline teams of 20 each, 5 offshore teams of 20 each (as necessary and to be determined by offshore aerial and vessel surveys yet to be conducted.).

Equipment – 30 high-pressure hot water jet washing units; 4,000 meters of containment boom; 30 skimmers (of various kinds); landing craft / work boats for offshore teams; 20 onshore beach skimmers / rock cleaners; transfer pumps / power packs; storage bladders / containers for waste transfer.

Long-term disposal – contaminated product to be disposed of / reused in various industrial processes – cement factories, refineries, road construction, etc.; and otherwise incinerated with sufficient emission controls.

Seabed recovery – this would be a unique aspect of the spill response, but as the seabed oil appears largely congealed in large seabed surface mats rather than mixed with sediment, it seems possible to recover various amounts of this contamination. I recommend a full underwater survey of seabed oiling using Remotely Operated Vehicles (ROVs) towed from vessels and divers, and then testing of various recovery techniques for this contamination, including grappling systems dragged by boats, bottom trawls / dredges, diver assist / manual collection and placing into buoyed net bags for retrieval by surface vessels, etc.

As well, I recommended an Incident Command System (ICS) structure be established for the government's spill response. This includes an Incident Commander, and four sub groups – Operations, Finance, Logistics, and Communications. This organizational recommendation was provided to the UNEP/OCHA/IMO and Danish experts coordination group on evening of August 21, reiterated the following day in their recommendation to the

Minister, and thereby approved. The Rapid Response now seems to be following according to plan.

Note on offshore oil

Upon approach to Beirut airport on August 14 it was clear that a significant amount of oil was still floating offshore in patchy surface slicks. These tended to disperse over the time I spent on-site, and I discussed this with the Minister and others. Our limited observations indicated that much of this floating oil may now be too dispersed / thin to lend to itself to effective containment / recovery, an observation I discussed with the Minister. More recent aerial observations by others concluded that there are now no recoverable concentrations of oil floating offshore. Thus, these observers felt that an offshore response may not be necessary.

It is still possible though that there are or will be surface concentrations of oil that could be recovered. There is a general tendency in the spill response community to wait for offshore oil to come ashore and collect it there. While this may be logistically easier, it is not always the best environmental protection strategy. Therefore, I recommend that any offshore slicks be assessed, and that an offshore containment / collection effort be mounted when oil can be corralled sufficiently to remove it from the environment. As well, some of the seabed oil patches can be expected to resurface as they weather and emulsify, and water temperature decreases (water density increases relative to the oil) over the winter. Thus, I feel the possibility of an offshore response effort should not be ruled out at this point. Further, there are still large amounts (+ 100 tons) of oil concentrated in several protected locations up the coast, e.g. Tabarja, Dahleih, etc. that require removal from the near shore sea surface before spreading again.

III. *Natural Resource Damage Assessment* (NRDA) programme:

Proposed organization of Lebanon Oil Spill NRDA

In response to the oil spill, it is essential to immediately implement an initial *Natural Resource Damage Assessment* (NRDA) program. This is a major spill (+15,000 tons), the potential for environmental injury is significant, and the environmental injury needs clear, credible documentation. An NRDA is essential for the following reasons:

1. to determine the extent and severity of ecological injury;
2. to fully inform the citizens of Lebanon and others, particularly those in affected areas, in a transparent and accurate manner, about the extent of ecological injury;
3. develop a basis for claims (to the extent that these become available); and
4. to guide a Restoration programme.

We convened an initial NRDA organizational meeting with in-region scientific community at the National Center for Marine Sciences (NCMS) in Batroun on August 14. Several copies of the NRDA&R manual I drafted for UNEP in 2004 were distributed broadly throughout Lebanon, and gave background and guidance with which to formulate the programme. We then organized a meeting the next day with NCMS, MoE, and other scientists to discuss the overall NRDA programme at the Ministry. I then visited the American University of Beirut (AUB) campus that afternoon, touring their analytical laboratory facilities – *Environmental Core Laboratory* and the *Central Research Science Laboratory*. Between AUB labs and the NCSR labs, there seems to be sufficient in-country analytical capability to do the laboratory analysis for total hydrocarbons / Polynuclear Aromatic Hydrocarbons (PAHs), etc.

On August 16, 2006, I proposed that the ***Phase I LOS NRDA*** be implemented with close coordination with MoE as follows:

National Center for Marine Sciences / National Council for Scientific Research (NCMS / NCSR): Overall Responsibility for NRDA programme

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NCMS / NCSR should function as overall coordination of the Phase 1 NRDA program, that NCMS Director Gaby Khalaf be designated Chief Scientist, and that NCMS organize and contract with all Principal Investigators (P.I.s), both in-house and externally, for all Phase I NRDA scientific studies.

A *Memorandum of Agreement* (MOA) should be developed between Lebanon's Ministry of Environment (LMoE) and NCMS / NCSR stipulating the arrangements for conduct of the Phase I *LOS NRDA* program. Phase I *LOS NRDA* will commence as soon as possible (August 2006) and terminate by December 31, 2006 (thus, about 3 months). As Scientific Coordinator for the program, NCMS / NCSR will coordinate proposal solicitation and organization.

Proposed Phase I NRDA Studies

Studies proposed for the Phase I *LOS NRDA* program will include the following:

1. **spill trajectory monitoring** – physical oceanographic modeling combined with satellite imagery and on-ground / sea observations.
2. **water and sediment contamination** – sampling of on-shore and offshore habitats for hydrocarbon contamination from the Jiyyeh spill
3. **inter-tidal / shoreline ecology** – impacts on inter tidal flora / fauna – patella, periwinkles, mussels, oysters, algae, terrace environments, meiofauna, etc
4. **plankton** – phytoplankton and zooplankton impacts, including fish eggs and larvae (Bluefin tuna, etc.)
5. **subtidal benthic community** – sea urchins, sponges, etc..
6. **fisheries** – fish and cephalopod (octopus, cuttlefish, etc.) impacts
7. **birds** – potential impacts on shore and sea birds, direct oiling, nesting, etc.
8. **sea turtles** – potential impacts on turtles, including nesting success, hatchling survival, contamination of eggs / hatchlings, etc.
9. **marine mammals** – surveys of distribution and abundance of marine mammals - dolphins, etc..
10. **carcass collection and analysis** – all animal carcasses collected during the beach cleanup operations analyzed

I recommended that the MOA between the LMoE and NCMS/NCSR specify that funding be routed directly to NCMS/NCSR for the conduct of Phase I LOS NRDA, and that a report of all Phase I LOS NRDA results be provided on or before December 31, 2006. As part of the MOA, the NCMS shall develop a *Phase II* LOS NRDA plan / proposal for funding and implementation in 2007. An omnibus proposal for Phase I NRDA is in preparation by NCMS, and sampling began (for the fish study) on Aug. 22.

With regard to initial funding, I drafted an initial proposal from IUCN WESCANA RO for use of $100,000 from OPEC via UNEP/OCHA, half for emergency response, and half for the Phase I NRDA programme. Also, I participated in a meeting with UNDP staff, discussing the need for additional response and damage assessment funding.

After meeting with NCSR Secretary General Dr. Mouin Hamze on August 23, I recommended to the Minister of Environment that NCSR be designated overall authority of the NRDA programme for the following reasons:

1. NCSR is the statutorily designated government department for scientific research and coordination in Lebanon;
2. NCSR has very straightforward budgetary authority to expedite the scientific programme;
3. assigning this responsibility to NCSR will ease the burden on MoE so that MoE can focus on their top priority – spill response; and
4. the NCSR would dedicate one of their facilities (Juneih) specifically to the NRDA programme.

I then met with MoE Minister Sarraf about this, and he offered his conceptual support to this structural proposal.

Lebanon Oil Spill Coordination Council (LOSCC)

As well, I proposed on August 23 to the Minister of Environment and NCSR Secretary General that the Government of Lebanon form an intergovernmental Lebanon Oil Spill Coordination Council composed of 5 ministers, as follow:

Minister of Environment

Minister of Transport and Public Works

Minister of Agriculture (Department of Fisheries)

Minister of Health

Secretary General of National Council of Scientific Research (NCSR)

As each of these governmental departments has authority and responsibility for certain aspects of this spill, this coordinating council was proposed as an information sharing body, meeting regularly. As envisioned, the LOSCC would be separate from, and not have authority over the spill response ICS structure managed directly by the MoE.

IV. Media Outreach

Though it was not part of the initial plan and in response to numerous requests by information hungry media, I conducted many media interviews during and after the mission to Lebanon, arranged either by Green Line and at direct media request with several Lebanese / local media interviews; many other interviews of opportunity with international media (French, German, Russian, U.K., U.S., Reuters, AP, etc.); an IUCN video documentary; and an Islam Online interview arranged by WESCANA communications liaison.

It is to my confidence that this part brought great attention to the catastrophe and this will surely reflect on the support for the cleanup efforts

IV. Claims / Compensation

The issue of claims / compensation is very problematic with this spill, as the international compensation regime (to which Lebanon is a party only to the tier-one Civil Liability Convention) does not cover spills caused by acts of war.

There are other options available however. One is legal, through the International Criminal Court at The Hague, and the other is to seek a negotiated settlement for damages caused by the spill between parties. This would be accomplished via political and diplomatic channels, and would likely be the most expeditious and effective approach to just resolution of claims.

To substantiate claims, economic, public health, and environmental damages should be methodically assessed and valued. This should include such things as lost income to fishermen including lost catch, gear damage, vessel damage; damage to tourism businesses, and others. As well, all costs imposed on government response, cleanup, and damage assessment should be collected by government ministries. An assessment of public health impacts of the spill, including respiratory effects of the atmospheric plume, health impacts from direct contact with oil, and social / psychological impacts of the spill is also important. Environmental damages should be assessed by the NRDA programme recommended above. To the extent possible, the claims assessment should segregate oil spill impacts from war impacts.

Thus, on August 29, 2006, I sent a letter to Israeli Prime Minister Ehud Olmert (on my own behalf), requesting that the Israeli government establish a $1 billion (USD) Eastern Mediterranean Oil Spill (EMOS) Restoration Fund.

This Fund is proposed for use as follows to:

1. Reimburse costs of response, cleanup, damage assessment, etc.
2. Compensate businesses (fishing, tourism, etc,) for economic losses due to the spill
3. Develop and implement a comprehensive environmental Restoration programme for the eastern Mediterranean Sea.

VI. Restoration

One of the primary purposes of conducting a *Natural Resource Damage Assessment* is to develop and implement an environmental *Restoration* program [see NRDA&R Draft Manual, UNEP 2004]. Restoration is generally defined as any action that endeavors to restore to their pre-spill condition (or to the condition that would have existed had the pollution incident not occurred) any population injured, lost or injured as a result of the spill, or that replaces or substitutes for the injured resources, or that provides another positive environmental offset to the damage suffered. An ecosystem can be considered *recovered* when the populations of organisms are again present, healthy, productive, and at numbers and distributions that would have existed had the spill not occurred; there is a full complement of age classes; they are behaving normally; and people have the same opportunities for the use and enjoyment of natural resources as they would have had the spill not occurred.

Thus, the overall goal of a Restoration program is to return a damaged ecosystem to the same ecological state that would have existed had the pollution incident not occurred.

In general, Restoration measures should satisfy the following criteria:

- measures should be likely to accelerate significantly the natural process of recovery
- measures should seek to prevent further damage as a result of the incident
- measures should, as far as possible, not result in the degradation of other habitats or in adverse consequences for other natural or economic resources
- measures should be technically feasible
- costs of the measures should not be out of proportion to the extent and duration of the damage and the benefits likely to be achieved (that is, be cost-effective)

Based on the results of the NRDA program, potential options should be developed with which to restore, replace, or provide other environmental benefit to offset / mitigate the damage from the pollution event. The primary focus of a Restoration program is to assist in and enhance the full recovery of an injured ecosystem.

Except for the reimbursement of actual government expenses (including the costs of a NRDA program), it is generally accepted that governments should apply any and all monies recovered in pollution events toward the Restoration and recovery of the injured ecosystem.

Direct vs. Indirect Restoration

Under the general scientific approach to ecological restoration, there are two principal categories of activities, as follow:

Direct Restoration / Reinstatement – projects that aim to improve the rate of natural recovery through direct manipulation of the environment, e.g., replanting of mangroves or seaweed in injured areas, restocking injured fish populations, fish habitat improvement, removal of contaminated sediments, captive breeding programs to enhance wildlife populations, etc; and

Indirect Restoration – projects that protect natural recovery processes, e.g. redirecting hunting and fishing effort away from injured populations to aid recovery, reducing human disturbance around sensitive habitat areas, enhancing sustainable fishery management regimes, increased enforcement of laws and regulations, protected areas designation, reduction of pollution, acquisition of habitat, etc.

Direct Restoration of impacted populations and environments is often difficult, particularly in aquatic ecosystems, but any opportunity to do such should be explored and implemented as appropriate. Beyond such direct restoration opportunities as may be available, often the greatest Restoration opportunity in significant pollution events is from *Indirect Restoration* - the implementation of other environmental protections and enhancements as offsets and mitigation. The general concept with Indirect Restoration is to provide a *net environmental benefit* to the impacted ecosystem.

If for instance a coastal environment in which a pollution incident occurs was already significantly degraded prior to the spill, then an effective Restoration program must take these pre-existing sources of degradation into account. In this case, reducing the chronic, point-source input of pollutants into a degraded coastal area would offer broad ecological and economic benefit, and perhaps be a cost-effective option for Restoration. Additional Indirect Restoration options include the designation and management of protected areas, implementing Coastal Zone Management Plans, habitat protection, acquisition of resources equivalent to those injured, and/or other efforts that enhance the sustainability of the coastal environment.

In general, all Restoration projects should contribute to a healthy, productive, and biologically diverse ecosystem. The Restoration program should assess what limitations may exist to the sustainability of the injured ecosystem and develop options to mitigate such limitations.

Restoration decisions should take into account the extent to which natural recovery is occurring, the priority of the resource both ecologically and economically, and the technical feasibility of the option. The Restoration program should be subjected to independent scientific review (as the NRDA program), government acceptance, and be responsive to the concerns and ideas of citizens.

Restoration Plan

Using results of the Phase I and II NRDA program, all Principal Investigators and the public should begin a Restoration planning effort as soon as possible (perhaps as part of a NRDA&R symposium at the end of 2007). This is essentially the "who, what, when, where, and why" of Restoration. The Restoration planning process generally requires broader input than the scientific input necessary for the NRDA program. The Restoration Plan should provide a reasonable balance between costs and potential benefits, be appropriately scaled, holistic and comprehensive, and employ an ecosystem approach. As such, the plan must take into account all ecological stressors in an injured ecosystem, not just those caused directly by the pollution incident. The Restoration Plan should monitor natural recovery, and seek to minimize further disturbance from human activity.

The Restoration Plan should be the principal document providing long-term guidance for restoring resources and services, and it may or may not list specific restoration projects.

If the plan is general in scope, then it should be implemented through annual work plans that describe in detail the projects to be supported for Restoration. The development of annual work plans should be competitive and subjected to thorough scientific review and deliberation by government authorities. Using the NRDA results, the Restoration Plan should identify each injured resource and resource service (human uses of natural resources), and then establish *recovery objectives* and *strategies* for each. These recovery objectives should state a clear, measurable, and achievable endpoint specific to each injured resource. An example might be: "populations of species 'x' will have recovered when they are again healthy and productive, exist at pre-spill abundances and distribution, and have pre-spill age / sex ratios." In other injured resources, the best that can be hoped for may be "population stability or increase." Restoration strategies to reach these specific objectives will provide the guidance for solicitation of project proposals.

Government Trustees of the Restoration program should publish an annual report of their program (available to the public), including a status of injured species / resources which categorize all resources in one of four categories as follow: *not-recovering, recovering, recovered,* or *recovery-unknown*,. The status of injured species / resources list should be updated as new information becomes available. The annual report should also update the public on all Restoration projects and activities. Additional methods of disseminating information on the NRDA&R program to the public should be employed as appropriate - web site, regular public meetings with opportunity for public comment, etc.

Potential Restoration Options for Lebanon

Without presupposing what sort of Restoration options should be selected in Lebanon, some potential examples include the following:

Direct Restoration:

Restocking of fisheries through aquaculture and enhancement techniques to supply additional food resources for natural predators and additional resources for fishermen.

Additional cleanup of contaminated sites in the ecosystem, using bioremediation, mechanical removal, etc., of contaminants not otherwise removed during the spill response, and whose presence may impair the recovery of injured resources.

Enhancing sea turtle nesting success, via predator deterrence, nest site protection, etc.

Indirect Restoration:

Improved / intensified management of harvested fish and shellfish populations to prevent over fishing: existing fisheries could be restricted or redirected to other areas / stocks to enhance injured fish populations and the predators dependent upon them. Various restrictive management tools could be considered, including more restrictive catch limits, additional gear restrictions, time / area closures to fishing, fish size restrictions, fleet capacity reduction (vessel buyback) etc.

Intensified management and protection of sensitive species such as sea turtles, birds, marine mammals, etc. -- reducing human disturbance of sensitive habitats for priority species by restricting human access to sensitive habitats, implementing measures to reduce the incidental take of such species in fish nets, expanded buffers around sensitive habitats, etc.

Increased enforcement of fish & wildlife and environmental laws and regulations – the provision of funds for additional enforcement officers, vessels, aircraft, etc, to reduce illegal harvests, apprehend violators, increase awareness of fish and wildlife protection laws, etc.

Reduce or eliminate introduced species from the ecosystem, e.g. removal of rats and rabbits through trapping, establishing ballast water treatment systems, invasive species management programs, etc.

Pollution abatement- develop an initiative to reduce or eliminate point-source pollution into a spill impacted region. This should include a comprehensive analysis of point-source effluent discharge (e.g. from mills, power plants, refineries, sewage outfalls, fishing vessels, large ships, port facilities, etc.) in the region, as well as non point-source inputs.

On the basis of the comprehensive analysis and mapping of all pollutant inputs into the ecosystem, a detailed plan for the reduction of such deleterious inputs should be prepared with a necessary budget, timetables, and measurable outcomes. This project would be large, and thus may need funds outside the framework of the compensation conventions. It should be contracted to a credible environmental engineering firm, with a proven track record on such large

pollution abatement projects, and would likely take many years to fully implement.

Implementing sustainable management initiatives - in many cases, nations have already developed plans to enhance the sustainability of ecosystems, but have yet to implement these plans due to inadequate funding and/or governance structures. For example, Lebanon has a 2002 *National Report of the Country of Lebanon for the Strategic Action Plan for the Conservation of Biological Diversity in the Mediterranean Region*. This action plan identifies threats to marine biodiversity, and recommends possible interventions to mitigate such threats. There are other such efforts already on the shelf as well, such as the 2003 *Thematic Activity for Marine Conservation Areas: Lebanon*; and the 2001 *Marine Turtle Nesting Activity Assessment on the Lebanon Coast*. However, many of these national and regional management plans have yet to be implemented, and they provide an excellent general framework for the development of a long-term Restoration programme that would enhance the recovery and sustainability of an environment injured by a pollution event. In this way, a significant pollution event can become a catalyst for the implementation of such plans in the context of Restoration.

Habitat protection - protecting ecological habitat from other sources of degradation can be an extremely useful Restoration tool. Additional protections can be enacted for habitats injured by the pollution incident, or those uninjured but threatened by other injury, such as quarrying, mining, industrial development, etc. In nations with significant private or corporate ownership of resources, these resources or resource harvesting rights (logging rights, mineral rights, etc.) can be purchased and protected by a government in the context of a comprehensive Restoration program - coastal forests, wetlands, beaches, etc. Such publicly acquired protections are intended to assist overall recovery by minimizing further injury to habitats already injured, and/or to preventing additional injury within the general ecosystem. Such protections may protect water quality and reduce disturbance in particularly sensitive areas.

Designation of Protected Areas - on lands and waters already in public / government ownership, to be managed accordingly. This can include the designation of new marine protected areas, wildlife refuges / sanctuaries, no-take reserves, parks, etc., and/or the improvement of management in protected areas already in existence.

Debris cleanup and control – plastic and other persistent and harmful debris in an ecosystem should be cleaned up to the extent practicable. Such debris is well known to effect many organisms, including birds, fish, mammals, and sea turtles.

Also, a program to eliminate or reduce this source of degradation should be implemented – improved solid waste management, better collection facilities, an education program, etc.

Economic alternatives for local fishermen – if fishery resources are injured or contaminated by a pollution event, it may be possible to develop alternative resources which fishermen can harvest. For instance, if an offshore fishery is dominated by foreign vessels, a program to award a portion of the offshore fishery catch / quota to domestic fishermen could gradually phase out foreign fishing and contribute to the development and sustainability of a nation's domestic fishery. Also, a fishery observer program for offshore foreign fisheries could be implemented (or expanded if it already exists) to provide additional enforcement of fishery regulations as well as to train coastal fishermen in offshore fishing technologies.

Develop tourism / recreational alternatives - to substitute for the loss in tourism and recreational opportunities – development of new parks and other tourist amenities along the beaches, etc.

Develop an environmental education program for children and adults to increase awareness of the importance of conservation and sustainable management, with particular emphasis on the injured ecosystem. This can include consideration for the construction of additional educational facilities and/or expanded funding for existing facilities / programs. It can also include specific educational objectives such as how boaters can reduce disturbance of sensitive species (marine mammals, sea turtles, seabirds, etc.).

Recovery Monitoring and Restoration Science - to the extent that effective management actions in an ecosystem are limited by lack of information, research is a legitimate exercise of the Restoration process. It is critical that such research projects be targeted specifically to gather information necessary for more effective management, and then applied in the improvement of management. An example of such research may be to better understand environmental pressures on fish populations so that harvest levels can be regulated more effectively. In addition to this sort of management research, there is also a need to monitor recovery and the effects of the restoration program. Governments should carefully consider the scale of their research and monitoring program post-settlement. In this regard, it is important to recognize that research and monitoring do not contribute to environmental recovery *per se*, but rather through the management *application* of research results.

In a sense, the Jiyyeh spill should provide an opportunity to remedy many other problems that compromise the environmental integrity of the eastern Mediterranean Sea over and above pollution from the Jiyyeh spill. High on a restoration agenda should be the aggressive implementation of a comprehensive coastal pollution reduction initiative, including effective shore side solid waste management protocols, industrial outflow management, sewage treatment, etc. such that the overall health of the coastal ecosystem off Lebanon will be restored to a condition better than that which existed just prior to the spill. As well, and effective Coastal Zone Management (CZM) programme should be initiated. This would better site tourism facilities, shoreline protection, and urban development to protect ecologically important assets of Lebanon.

VII. Other war / environmental issues

In considering the environmental impact of the war, it is necessary to keep the oil spill in context with all environmental issues in the region as a result of the war. Many of these are being identified / evaluated by the UNEP post conflict process. These include *potential (*yet to be confirmed) releases such as the following: hazardous material (ammonia) spills from bombing of the Liban milk plant in Baalbek; HFl spills from the bombed Maliban glass factory in Zahleh; petroleum product spills from the bombing of the Zahrani refinery in Al Junub; potential PCB spills (37 tons) from transformers at the Jiyyeh power plant; the 40,000 tons of kerosene that burned in the bombing of the tank farm at Beirut International Airport, the Safi El-Deen plastics factory bombing potentially releasing hazardous materials including ethylene glycol, vinyl chloride, chlorine, etc.; the bombing of the Army base at Rayak with unexploded ordinance and kerosene; bombed Sinno wood Industries potentially releasing formaldehyde; drinking water air contamination; some 22 bombed petrol stations releasing petrol, diesel, propane; household hazmat released in the bombed south Beirut suburbs and towns in the south; etc.

VIII. Overall Recommendations

In addition to the recommendations in the above interim report, other long-term recommendations will include the following:

- develop and approve a robust National Contingency Plan for Lebanon;
- develop an in-region oil spill response capability, with a response base, trained personnel, and equipment in Lebanon;
- conduct a Risk Assessment for future spills in eastern Mediterranean;
- implement a Phase II NRDA progamme for 2007, with a public symposium toward the end of 2007 to present scientific results of the NRDA programme, and to conduct a scoping process for Restoration
- Lebanon sign and ratify the tier-two and tier-three international spill compensation protocols – the International Oil Pollution Compensation (IOPC) Fund, and the Supplementary Fund, bringing spill liability coverage up to about $1.1 billion (USD);
- continue a comprehensive marine environmental monitoring programme / strategic environmental assessment (SEA) for the eastern Mediterranean;
- establishment of a Lebanon National Oil Spill Fund (based on a nominal tax on imported petroleum products) to be used to support all government activities with regard to spill prevention and response preparedness, etc. in the future. Many other nations have such funds, and it would greatly ease the financial burden of reprogramming funds in emergency response situations in the future.
- survey other coastal states globally to ascertain which still do not have a National Contingency Plan, which may be vulnerable to oil pollution disasters, and then assist those coastal states in the formulation of a NCP as soon as possible.
- consider amendments to the international pollution compensation regime that would allow the three-tiered funds to be available to cover wartime related spills or otherwise establish a $100 million USD fund to be made available on an emergency basis for other wartime related spills. As well, the international compensation regimes must be amended to cover *all environmental injury* in spills, not simply those limited injuries that may be amenable to direct Restoration initiatives as is currently the case.

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