

# **Assessment of the Environmental Impact of Military Activities During the Yugoslavia Conflict**

**Preliminary Findings, June 1999**

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**[Executive Summary](#)**

**[Introduction](#)**

**[Background](#)**

**[Environmental Effects](#)**

**[Anticipated Future Risks or Threats](#)**

**[Conclusion](#)**

**[Appendices](#)**

# ENVIRONMENTAL IMPACT OF THE YUGOSLAVIA CONFLICT

## 1. Executive Summary

### **Assessment Method:**

The study was carried out over a period of ten days by a team of expert staff from the Regional Environment Center for Central and Eastern Europe (REC) and other contracted country experts. A framework was prepared by REC headquarters and the REC's country offices in the five selected countries gathered information and data. Additional experts were hired to give some analysis of certain specialised subjects in Yugoslavia, FYR Macedonia and Albania. The information was compiled in REC's Szentendre offices and edited for consistency. The report represents a compilation of the existing information on the environmental impacts from the conflict.

### **Main Findings:**

The environment in the whole territory of Yugoslavia was affected as a result of the military conflict in Yugoslavia. Given the available information, it can be stated that so far there is no evidence of a large-scale ecological catastrophe, but pollution is very severe in the vicinity of targeted industrial complexes, such as Pancevo, Prahovo or Novi Sad, and many valuable ecosystems were disturbed.

With respect to the human/built environment, the conflict has had a strong impact, in particular in Kosovo, as a result of Yugoslav Army activities. All over Yugoslavia, the infrastructure suffered heavy damage. Just because there have been no acute large-scale effects (e.g. visible impact on flora and fauna, health impacts) at the moment does not mean that there will be no long-term effects. Based on the given information, the following main types of environmental damage occurred or may occur:

- High levels of pollution around main military targets, in particular chemical industry.
- Ecosystems threatened, in particular river ecosystems.
- Food contamination resulting from soil pollution (also as a secondary effect of air pollution).
- Drinking water contamination.
- Human health (long term effects of toxic/carcinogenic substances, radiation).
- Environmental disturbances resulting from the refugee situation in Kosovo, Albania and FYR Macedonia, but also from refugees coming home (e.g. use of wood for heating etc.) and refugees in Serbia and Montenegro.
- Institutional threats: At the same time, it can be estimated that the position of Yugoslav authorities who seek to deal with environmental issues is even weaker than it was prior to the conflict. This means that even existing environmental legislation can not be implemented or enforced. Additionally the position of NGOs and other civil society builders is weakened.
- Low priority of the environment in the reconstruction process: As the Bosnian experience has shown, environment tends to have a low priority in reconstruction processes. Especially under time pressures this can lead to decisions where the environmental impact of an activity is not taken into consideration.

Furthermore, to be able to define the dimensions of these long-term effects, it is necessary to conduct additional research. This should consist of two main elements:

1. A detailed assessment of the actual situation.
2. Long-term monitoring of the effects mentioned, in order to be able to determine the size of the problems and to be able to start remedial action.

For the neighbouring countries selected for this assessment, it can be stated that there is no evidence of an acute environmental impact from the conflict. Here it has been taken into consideration, that the monitoring of environmental parameters in particular in Macedonia, Albania and Romania has been very limited. The major impact in neighbouring countries has been caused by the refugee situation.

## **1.1. Summary of Environmental Effects**

### **1.1.1. Water**

Surface waters have suffered largely as a result of leakage from damaged industrial plants or pollution from poorly planned refugee centres. Specific impacts include the following:

- PCBs have been released from damaged transformer stations.
- Oil products have leaked into the Danube River from the Pancevo industrial centre and the refinery at Novi Sad.
- More than one hundred tonnes of ammonia leaked into the Danube.
- More than one thousand tonnes of ethylene dichloride spilled from the Pancevo petrochemical complex into the Danube.
- Over a thousand tonnes of sodium hydroxide were spilled from the Pancevo petrochemical complex.
- Nearly 1,000 tonnes of hydrogen chloride spilled from Pancevo into the Danube River. Stretched water supplies in Albania due to the huge numbers of refugees.
- Lack of sewage treatment in Albania's refugee camps has resulted in uncontrolled discharges of sewage into water channels.
- In FYR Macedonia, there is a possible threat to underground water supplied through poor sewage management in refugee camps.
- Oil discovered in the Danube River in Romania (below the maximum allowed concentration).
- Heavy metals: copper, cadmium, chromium and lead, at rates double the maximum allowed concentration, have been registered in Romania's Danube.

It has to be noted that, so far, the measurable impacts are limited. However, this does not guarantee that they are not present.

### **1.1.2. Air**

Air pollution, in the case of the one-off strikes, tends to be a short-term phenomena. However, the following have been registered:

- Radioactive pollution from depleted uranium weapons (claimed in Yugoslavia).

Vinyl chloride monomers (VCMs): Yugoslav reports state that VCMs have reached concentrations of 10,600 times more than permitted levels near the Pancevo petrochemical plant. Polluted clouds carried the products of combusted VCMs: phosgene, chlorine, chlorine oxides and nitrogen oxides.

- Products from incomplete hydrocarbon combustion were released as a result of strikes on oil refineries.
- During the Pancevo and Novi Sad attacks, large oil depots were burned. This resulted in the production of soot and other particulates. Following the Pancevo incidents, a cloud of smoke some 15 kilometres in length lasted for 10 days. Concentrations of soot, SO<sub>2</sub> and chlorocarbons increased by four-to-eight times the allowable limits. Nitrogen oxides have been released from jet aircraft and through burning industrial installations.
- Hydrofluoric acid was released when the chemical plant in Baric was destroyed. Destruction of metal industry plants released heavy metals into the atmosphere: mercury, cadmium, chromium, copper and zinc.
- Acid rain was measured in a number of areas, including Romania (Berliste, pH 5.4, May 12, 1999; Gradinari, pH 4.7, May 15, 1999; Timis County, pH 5.1, May 21 1999, Arad County pH 5.7, June 1, 1999) and Bulgaria (Rozhen, pH 4.23 from May 23-26, 1999). The Environmental Protection Agency in Oradea, Romania, reported an increased amount of acid rain in comparison to the same period before the conflict. The timing of much of this acid rain and the prevailing wind directions tends to link the acid rain with attacks on Yugoslavian industries.
- In Timis County, Romania (north east of Belgrade), from April 18-26, 1999, the maximum allowed concentration for sulphur dioxide, nitrogen oxide and ammonia was exceeded between 5-10 times.

Actual impacts on the environment and public from these sources have yet to be ascertained.

### **1.1.3. Soil**

Much of the air and water pollution will eventually settle into the surrounding soil. This will be through rainfall or leaching. These effects, however, have yet to be measured. Other identified threats to the regions' soil are:

- Locally damaged soil structure from bombing and shelling.
- Degraded agricultural land in Albania and FYR Macedonia from the siting of refugee camps.

### **1.1.4. Biodiversity/Nature**

The direct consequences on biodiversity and nature can be summarised as follows:

- Locally the physical destruction of habitats and plant and animal populations by air and land attacks.
- Degradation of habitats and plant and animal populations from chemical contaminants (borne in air, water and in soil).
- Disturbance of fauna in their habitats and along migration routes. In FYR Macedonia, there has been a measurable increase in the presence of some species, presumably

from Kosovo.

Protected areas have been directly affected by the conflict:

- In Yugoslavia, these include: Kopaonik Mt. National Park, Fruška Gora Mt. National Park, Tara Mt. National Park, Sarplanina Mts. National Park, Vrsacke Planine Mts. Natural Reserve.
- In Albania a number of protected areas either had refugee camps built within them (Rrushkull, Divjaka), or refugees are impacting on nearby areas by felling trees or polluting water sources.

### **1.1.5. Human Environment/Health**

Great damage has been caused to the human-made environment as a result of the fighting. This has centered on villages in Kosovo and town centres across Yugoslavia. Naturally there are casualties from these actions. In Yugoslavia, more than 1,400 civilians are reportedly killed in air strikes. There are no complete figures for those killed in Kosovo or military casualties to date, but these numbers are expected to be higher, by at least an order of magnitude.

Negative health impacts are expected from damaged infrastructure (water and sewage systems) in Yugoslavia and from the poor conditions that prevail in some refugee camps.

### **1.1.6. Transboundary**

At the moment, it is not possible to obtain real facts on the quantity and level of transboundary contamination. These effects are more likely to be revealed later. However, the main areas for review will be the transboundary impact of leakage and burning of the industrial complexes at Novi Sad, Prahovo and Pancevo, which produced acid rain and Danube River pollution, notably in the Iron Gates Reservoirs; the destruction of transformers (Kragujevac and near Belgrade); and the possible release of radioactive aerosols from depleted uranium weapons.

### **1.1.7. Other**

The unique nature of such military activity also produces unique waste and pollution. These require specialised treatment and procedures for their removal. Unexploded munitions and land mines in their own way pollute the environment.

## **1.2. Summary of Future Threats and Risks**

### **1.2.1. Environmental**

The longer-term environmental impacts (threats and risks) still need further definition owing to lack of concrete data and study. However, there are a number of more obvious areas of concern:

The greatest chronic risk to the environment is to the water, which is threatened by considerable amounts of chemicals. The bio-accumulation of these pollutants in rivers and groundwater resources (well, springs and aquifers) is considered a likely risk. The build up of pollutants in the Danube River reservoirs (Iron Gates) are a likely consequent of the conflict. For Albania and FYR Macedonia the danger to precious water resources is a continuing concern.

The impact of air pollution has decreased with the cessation of hostilities. However, the use

of depleted uranium is another issue, the full dimensions of which will be revealed with time. This material's possible effects will surely be a topic of controversy and research. This controversy in itself represents a risk, because resources might be unevenly distributed between measurements of the future environmental risks emanating from the conflict.

There is a risk of long-term health effects from pollutants. This will require research and monitoring of "at risk" populations. The possible contamination of food stuffs is a considerable threat. This is especially pertinent in those countries that have shown an inability or unwillingness to present results of general pollution. Therefore there is reason to be concerned about how they will be able to monitor the toxins in foodstuffs as well.

The slow reconstruction of infrastructure (particularly sewers and water treatment) represents a further risk to health – notably in Kosovo itself. Additionally, there are health dangers from the large numbers of people living in tented refugee camps with inadequate sanitation. In Yugoslavia itself the breakdown of the power system could leave tens of thousands without adequate power and water throughout the winter.

### **1.2.2. Institutional**

The institutional threats can be summarised as threats to the environmental management authorities (ministries, inspectorates) and the wider environmental community (citizens groups or NGOs). For Yugoslavia itself, the main threat is that environmental management systems may be so disrupted that the task of addressing the environmental problems cannot be properly addressed. Under the current political situation, the resources required are not likely to materialize. This can only contribute further to the environmental "aftershocks" following the conflict.

The current crisis has revealed that, in most of the countries, there are very inadequate monitoring facilities and resources (Albania, FYR Macedonia and Romania). The threat revealed is that these countries cannot adequately measure the environmental consequences of the war and so cannot adequately prepare plans and provisions to address them.

NGOs constitute a vital component in bringing the wider community to the environmental debate. This is necessary to allow adequate public involvement in environmental decision-making and planning (public participation). Additionally, NGOs can help solve and manage environmental problems where the official authorities cannot reach. The threat is that the conflict has reduced both of these functions.

NGOs in Yugoslavia have had their activities curtailed, due to a lack of resources and political realities. NGOs in transboundary countries had their cross-border activities halted by the conflict. As is known environmental problems do not stop at national boundaries. Additionally in those countries where the largest proportion of refugees were housed there is a risk that aid priorities will concentrate solely on humanitarian or development issues, at the expense of the environmental dimension. International donors should consider this in developing their list of priorities.

The involvement of local knowledge is crucial at both the governmental and public level. Too often, previous aid programmes have been rushed and unfocused, and have relied too heavily on foreign "expertise" without involving informed local specialists. If mishandled in this way, the remedial measures can become as much a threat as a solution.

## 2. Introduction

This assessment was prepared by the Regional Environmental Center for Central and Eastern Europe (REC) for the European Commission Directorate General XI. Its purpose is to make an initial "snapshot" of the environmental consequences and impacts of the recent North Atlantic Treaty Organisation (NATO) military action on the territory of Yugoslavia and on selected neighbouring countries. Though, until now it has been largely impossible to assess the impacts of the Yugoslav Army (VJ) in Kosovo. The assessment's authors have attempted to show those actual impacts on the environment and also highlight the possible or future ones.

The objectives of this assessment are to:

- prepare an analysis on the possible environmental impacts on the region due to military activity;
- estimate possible further threats to the environment from the conflict;
- gauge the facts available on the environmental and health impacts in the affected countries;
- highlight the key environmental threats to each country, so that remedial action may be prepared.

The report looks at five Balkan countries: Yugoslavia ñ where the fighting took place; Albania and FYR Macedonia ñ the "refugee" countries; and Bulgaria and Romania ñ the selected "transboundary" countries. The report is split into two main parts: environmental impacts and anticipated or future risks. The case of each country is assessed separately, to enable ease of comparison and to define specific national priorities. At the end of the report conclusions are made. In the Conclusion and in the Executive Summary, a number of priorities for assistance are suggested.

The authors have tried to present the situation as clearly as possible and with as much precise and verifiable information as was available ñ given the time constraints and the on-going military activity. Readers should realise that to gather information in the short time-frame available presents some difficulties. Where information has not been accurately verified, the authors have made this clear in the text. However, it is the opinion of the authors that the situation described in the report is generally representative.

The study was carried out using the REC's expertise and resources in the five target countries ñ Yugoslavia, Albania, FYR Macedonia, Romania and Bulgaria ñ and through independent experts. Information from in-country environmental experts on specific topics was gathered, along with details from key pollution monitoring stations, to give specialists' analyses. Final compilation was carried out using REC Headquarters staff (environmental experts and editors).

Credits for the work and specific methods used in the included countries are:

- **Yugoslavia:** Dragana Tar, the REC's Country Office Director in Belgrade, devised the study. She contracted a number of independent experts to compile the list of damaged sites and their associated impacts. Asst. Prof. Dr. Radoje Lausevic, Ing. Chem. Miroslav Spasojevic and M. Sci. D Mitar Lakusic prepared various sections of the Yugoslavia report.

- **Albania:** Mihallaq Qirjo, REC Country Office Director for Albania, prepared the Albanian report. This included site visits to a number of refugee camps in the country.
- **Bulgaria:** Mihail Staynov, Project Manager in the REC Bulgaria Office, compiled the report. He utilised information available from Bulgaria's National System for Environmental Monitoring (NASEM) and associated inspectorates of the Ministry of Environment and Waters (MEW).
- **FYR Macedonia:** Katarina Stojkovska, the REC's Local Representative, prepared the Macedonian portion of the report, with the support of the entire local REC staff and with very helpful cooperation from the National Agency for Environment and Ministry of Environment of the Republic of Macedonia. Dr Eftim Dimitrev prepared the section on environmental effects in the refugee camps.
- **Romania:** Catalin Gheorghe, the REC's Local Representative, compiled the report. All environmental protection agencies in the potentially affected area (the south western section of Romania) were utilised, along with the Ministry of Environment, Monitoring Department.
- **Editorial Team:** Compilation and editing was performed by a number of staff at the REC Headquarters in Szentendre, Hungary. Project management was carried out by Robert Atkinson, Head of Country Office Support Department; project director was Alexander Juras, Deputy Executive Director; Editing and proofing was carried out by Tom Popper, Project Officer. Further input and comment was given by Jernej Stritih, Executive Director of the REC and Oreola Ivanova, Head of the Executive Director's Office.

[HOME PAGE](#)[PHANTOM](#)[SEARCH](#)[GUEST BOOK](#)

### 3. Background

The military action in Yugoslavia started before the NATO commenced its air strikes on March 24, 1999. Prior to these strikes, the deployment of forces in and around Kosovo had already taken place. Also, a number of refugees had been moving within the province itself. However, the air strikes by NATO's air forces on industrial and military targets has attracted the most attention. The possible negative impact on the environment from damage to these installations is the subject of this paper.

The environmental outcomes of the conflict, however, are not confined to the territory of Yugoslavia itself. Neighbouring countries may also have been negatively affected by the military actions. Albania and Macedonia have both been swamped with hundreds of thousands of refugees. The camps associated with these present not only a humanitarian management task, but also an environmental management task. For Romania and Bulgaria, who hold common borders with Yugoslavia and share water and air resources, the possibility of transboundary pollution passing along the Danube is the most obvious concern.

In the following sections, the background to these threats is highlighted country-by-country. The reason for the geographical division is to define the most pressing problems for each nation, so that the possible causes are not simplified and grouped inaccurately. The effects of these threats are covered in Part 4 and future risks in Part 5.

#### 3.1. Yugoslavia

The Federal Republic of Yugoslavia covers an area of 102,173 square kilometres, with a diverse landscape, high biodiversity (for details see Stevanović, V., Vasić, V. eds. 1995) and a developed legal framework of environmental protection (Milićević, G. 1995). Although Yugoslavia represents only 0.07 percent of the Earth's land area, or 2.1 percent of Europe's, it encompasses all European biomes, or 5 of the total of 12 terrestrial biomes on Earth. According to IUCN-WMC criteria, the territory of Yugoslavia, together with mountainous part of Bulgaria, represents a European centre of biodiversity – one of six in Europe and 153 world-wide. Yugoslavia is home to 38.93 percent of the total number of vascular plant species in Europe, 51.16 percent of European fish species, 74.03 percent of European bird species and 67.61 percent of European mammal species. Protected natural features in Yugoslavia, which cover 4 percent of state territory (see appendix), represent localities of highest concentration of plant, animal and all other species.

Montenegro (the southern Republic of Yugoslavia) has declared itself to be the world's first "environmental state," pledging to live more harmoniously with nature. The

#### ***Bomb-damaged Sites that Pose an Environmental Threat***

**Pancevo industrial complex:** The industrial complex at Pancevo (population approximately 150,000) is located 15 kilometres north-east of Belgrade. It includes the Pancevo Nitrogen Processing Plant (a factory manufacturing nitrogen fertilisers), the Pancevo Refinery and the Pancevo Petrochemical Plant. All three bombed plants are within the eight-kilometre-square industrial zone. The nearest residential buildings are less than 150 metres away from the nitrogen processing plant.

Present in the plants are ethylene-dichloride, ethylene, chlorine, chlorine-hydrogen, propylene and vinyl chloride monomers. These fluids have been released into the atmosphere, water and soil due to bomb damage and now pose a serious threat to human health in general and to ecological systems locally and in the broader Balkan region. The soil at the Petrochemical Complex was soaked with ethylene-dichloride.

All chemicals that had been released in water were found to be present in the surface waters, as well as the compounds resulting from their reactions. A large number of people have been poisoned, injured and/or evacuated. According to Yugoslav estimates, some 70,000 people have been endangered locally.

challenge it has set itself is a difficult one, with tourist developments along the coast threatening saltwater estuaries and industry causing pollution of the air, soil and water (Microsoft Encarta World Atlas 1998 Edition).

This environment has been exposed to bombing by NATO forces since March 24, 1999. At the time this assessment was prepared, the shooting part of the conflict appeared to have ceased, but the bombing lasted for 78 days. It is estimated that more than 1,200 aircraft made about 25,000 flights from the onset of the bombing in Yugoslavia. During these flights, about 17,000 attacks (with 700 in one night alone, May 14, 1999) were made against designated targets all around Yugoslavia ñ notably the industrial areas of Serbia and its province Kosovo and Metohia. Among them, a large number of industrial facilities were attacked ñ more than 80 before June 5 (see appendix).

**Novi Sad Oil Refinery:** Damage to the oil refinery in Novi Sad, because of its location at the very bank of the Danube River in the open Pannonian plain, poses a particular threat to the environment. Yugoslav reports state that hundreds of tonnes of oil and petroleum products have leaked into the Danube as a result of air strikes. Considerable pollution has been, and is being, detected in the air and in other media of the environment (water, soil and biota), and the inhabitants from the nearby area have been evacuated. More serious environmental damage is expected when the Danube reaches a higher level.

**Transformer stations:** Several badly damaged transformer stations have released toxic pyralene transformer oils (PCBs in the case of the town of Kragujevac). Following the attack on a large transformer station in Belgrade, 150 tonnes of the special transformer-oil leaked through a canal system 3 kilometres from Belgrade. The oil reached the Rakovica Stream and the Topcider River, tributaries of the Sava River. Yugoslav authorities tried for seven days to collect the oil from the surface of the river and to prevent the contamination of the Sava River. Success was only partial.

### 3.2. Albania

The crisis in Kosovo affected Albania mostly through the refugee flow into country; military troops, operating in Albania as aid distributors and camp managers; and, only slightly, by the military incidents in villages on the Kosovo-Albania border. Monitoring of transboundary pollution threats is nearly non-existent. As a result, it is difficult to assess the possible impacts.

The flow of refugees started on the third week of March, reaching its peak by the end of March and beginning of April. By the end of April, the flow of refugees was reduced to groups of hundreds. The Albanian government and NATO troops helped to move the refugees in camps and collective centres inside Albania. By May 21, 1999, the following figures were presented for the number of refugees and camps in Albania:

ACCOMMODATION TYPE	NO. OF OCCUPANTS	PROJECT CAPACITY	NO. OF SITES
Tented camps	68,909	200,360	49
Collective centres	91,323	151,818	257
Host Families	305,592	Unknown	N/A
<b>Totals</b>	<b>465,824</b>	<b>323,978</b>	<b>306</b>

Source of data on refugees: the Emergency Management Group figures for May 21, 1999 (established by the Albanian Government, international and local NGOs operating in this field).

The environmental effects expressed in this material are related mostly to the refugees' impact on the environment, rather than to the other interventions, for which the data is either missing or not public. Initially, of course, environmental problems were not considered as a priority of the first moment. Food, shelter and medical care were the main concerns of all government agencies and non-governmental organisations (NGOs) involved in helping refugees. As weeks pass, and the summer weather proves to be unusually hot and dry, environmental concerns are taking a higher rank in the priority list. These concerns include health problems in camps, destruction of soil fertility and structure, damage to national parks and protected areas and waste water and sewage problems.

### 3.3. Bulgaria

As far as threats posed to Bulgaria's environment, transboundary pollution is the main concern caused by the conflict in Yugoslavia. Bulgaria has a border with Yugoslavia - but not Kosovo so the refugee problem was limited - sits down-stream from that country on the Danube River and is on the downwind side of prevailing winds. As such, the monitoring system provides the best indication of actual environmental impacts or threats.

In Bulgaria, all components of the environment are monitored by the National System for Environmental Monitoring (NASEM), which is managed by the National Center for Environment and Sustainable Development (NCESD) of the Ministry of Environment and Waters (MEW). There are some other sources of information related to environment, such as Hygienic-Epidemiological Inspectorates of the Ministry of Health and the National Hydrological and Meteorological Institute (NHMI). But the data provided by them are included in the information which is processed and published by NASEM.

The data on air quality, water quality and radiation are published by the NCESD in quarterly and annual bulletins, which are distributed to the authorities and are available to the public on a fee basis. This data was used to make the assessment of the environmental impact that the Yugoslav conflict had on Bulgaria.

### 3.4. FYR Macedonia

Since the start of the conflict in Yugoslavia, many ethnic Albanians from Kosovo entered FYR Macedonia as refugees. The most visible environmental impact of the conflict for FYR Macedonia has been this influx of refugees and the need to accommodate them. From the middle of March 1999 until now, almost 270,000 refugees have entered the country. So far, eight refugee camps have been established. The active camps, and some pertinent specifications, are as follows:

- **Radusa Refugee Camp**, located in the community of Kondovo, northwest of Skopje, is 1.33 hectares, with a capacity of 2,000 refugees, who would have an annual water consumption of 35,879,500 litres and produce approximately 220 tonnes of garbage per year.
- **Senokos Refugee Camp**, located in the community of Nagotino, southwest of Skopje, with an area of 1.2 hectares and a capacity for 1,500 refugees in 252 tents, has water and waste disposal needs similar to Radusa.
- **Bojane Refugee Camp**, located in the community of Saraj, west of Skopje, is situated on 4.5 hectares and has a capacity of 4,000 refugees in 600 tents, with potential annual water needs of 71,759,000 litres and potential garbage production of approximately 500 tonnes per year.

- **Neprosteno Refugee Camp**, located in the community of Tearce, west of Skopje, is situated on 5.6 hectares, and has a capacity of 5,000 refugees in 833 tents, with potential annual water needs of 71,759,200 litres and garbage production of approximately 500 tonnes per year.
- **Cegrane Refugee Camp**, located in the community of Cegrane, southwest of Skopje, has a total area of 17.2 hectares, a capacity for 50,000 refugees in 8,334 tents, potential annual water consumption of 119,603,200 and potential garbage production of approximately 520 tonnes per year.
- **Stenkovec I Refugee Camp** and **Stenkovec II Refugee Camp** are located northeast of Skopje, with a territory of 20 hectares and capacity for over 50,000 refugees. Other data on these two camps are not available.

Aside from the above-mentioned camps, there was also a camp at Blace, north of Skopje near the border with Yugoslavia, which acted as a reception centre, but it is now closed. When assessing negative environmental impact of the conflict in Yugoslavia, these camps remain the focus of attention. As with Albania the amount of monitoring of transboundary pollution is limited, though there appear to be some measurable contaminants.

### **3.5. Romania**

In Romania, much like Bulgaria, the threat of transboundary pollution appears to be the area of greatest concern when assessing the Yugoslav conflict's potential to impact the environment. Romania has a contiguous border with Yugoslavia. The two countries share the Danube River for part of its course, and the river continues downstream into Romania for a further part of its course. When looking for environmental impacts, therefore, it is important to assess transboundary air or water pollution.

Information regarding the environmental impact of the war, and specifically quantitative data that makes comparisons with previous years, was requested from the environmental protection agencies in the potentially affected areas (southwestern Romania). The same was also requested of the Ministry of Environment, Monitoring Department. Most agencies responded to the request; however, the data quality they provided is poor in most cases. The agencies acknowledge that they do not have either the required equipment or the needed reagents to test for many pollutants. This situation made it difficult for them to provide good quality data. Quite often, in their desire to provide some data, agencies in Romania have used expired reagents or old equipment. In comparison with the Bulgarian results therefore the reliability of data should be questioned.

## 4. Environmental effects

### 4.1. Yugoslavia

#### 4.1.1. Water

Initially, water pollution was estimated to be a potentially chronic problem, but also less acute than that of air-borne pollutants. However, it would be a mistake to underestimate the potential damage caused by the oil and oil derivative pollution in the rivers ñ as well as potential river pollution from acids, alkalis and phenols. Usually, oil flows away, acids and alkalis are quickly diluted and phenols hydrolyse. But the pollution of ground water is more serious, because ground water has a limited capacity for self-purification. According to the Yugoslav Federal MOE, reservoirs on large rivers (like the Danube) are in special danger, because the process of sedimentation is increased due to the slower flow of the river. This especially holds true for the Iron Gateís reservoirs (Djerdap I and Djerdap II at the Yugoslavia/Romania border).

#### **Surface waters:**

The Danube River was undoubtedly polluted with oil, oil derivatives and various other harmful chemicals due to attacks on river-side facilities. After the bombing of the vinyl chloride monomers plant in Pancevo on the night of April 18, 1999, more than 1,000 tonnes of ethylene dichloride and almost 1,000 tonnes of a solution containing 33 percent hydrogen chloride were released directly into the Danube River. Furthermore, about 3,000 tonnes of sodium hydroxide, and tens of tonnes of liquid chlorine (Cl<sub>2</sub>) were released (Glas Javnosti, May 19, 1999). It seems highly likely that some quantity of mercury was released into the environment after destruction of the chlorine-alkaline electrolysis plant in Pancevo, where about 100 tonnes of mercury is stored during the plantís normal operation process. As a consequence of toxins released after repeated bombings, the Yugoslav authorities have prohibited fishing on the Danube downstream from Pancevo (TiM, May 14, 1999).

#### *Details on chemicals that have been released due to damage to industrial plants*

- **Polychlorinated biphenyls (PCBs):** Because PCBs are still used in many transformers, these substances may be spilled by the destruction of any transformer station ñ whether it is part of an energy-producing section in an oil refinery or industrial plant, or part of the transmitting tower at Mt. Avala. It is estimated that one litre of the PCB Pyralene pollutes one billion litres of water. Even in those facilities where Pyralene was replaced by permitted liquids, the PCB was, in most cases, not destroyed or neutralised but only stored somewhere in the factory yard, so that the barrels were exposed to potential damage by bombing. (P. Poli?, 1999)
- **Oil Spills:** As the result of strikes on Pancevo, a large quantity of oil leaked into the Danube (about 50 tonnes of emulsion), through common equipment for the treatment of wastewater (which was not working). A few hundred tonnes of oil and petroleum products leaked into the Danube from the destroyed oil refinery in Novi Sad, when 18 oil tanks were simultaneously hit. Fishing is now forbidden in the vicinity of these areas and a large quantity of dead fish was observed in an area 30-40 km downstream from Pancevo.
- **Ammonia (NH<sub>3</sub>):** More than 100 tonnes of liquid ammonia leaked directly into Danube from the "Azotara" Nitrogen Processing Plant at Pancevo.
- **Ethylene Dichloride (EDC):** During air strikes, more than 1,000 tonnes of EDC leaked into the Danube, through a connection channel from the Pancevo petrochemical complex. According to the Yugoslav Federal

Although a flowing river eventually cleanses itself by bottom sediments, toxic substances accumulate in the sediment and can remain there. If toxins are not degraded, they can be released again by a change in the physical and chemical properties of the water, such as alterations engendered by ionic forces, a change in pH, oxidation reduction or the presence of complexing agents. (P. Poli?, 1999).

#### **Groundwater:**

It is estimated that groundwater supplies 90 percent of Serbia's domestic and industrial needs. The long-term pollution of underground waters is therefore very serious. This problem is compounded by the limited self-purification capacity of groundwater. There is concern that "Makiö", Belgrade's main aquifer, and many other wells, are in great danger of eventual pollution from spills created by the bombing in Yugoslavia. Pollutants can reach underground waters from the surface or by soaking through the bank sediments of polluted rivers. (P. Poli?, 1999).

#### **4.1.2. Air**

One of the dangers of air pollution is the speed with which it can affect large populations. Belgrade, with roughly 2 million inhabitants, was faced with a potentially serious health emergency on April 18, 1999, after the bombing of the petrochemical complex in Pancevo. If the wind had been blowing from the east-northeast, all the air-borne toxic substances from the Pancevo industrial zone (such as phosgene and vinyl-chloride) and poisonous by-products of burning fuel would have blown into Belgrade. However, the wind was westerly, and at times strong. This wind, coupled with rain, helped in the reduction of air pollution (phosgene hydrolysis, yielding carbon dioxide and hydrochloric acid). (P. Poli?, 1999) To date it is almost impossible to evaluate the qualitative and quantitative effects of downwind pollution and pollution of soil, water and plant life and those indirect influences caused by chlorination and other chemical reactions.

MOE, concentrations of several grams per litre of ethylene-dichloride were found in the river. EDC was also released after bombing of the vinyl chloride monomers plant in Pancevo on the night of April 18, 1999. It is estimated that 1,400 tonnes of EDC have been released directly into the Danube watercourse.

- **Sodium hydroxide (NaOH):** A few thousand tonnes of a 40 percent solution of NaOH leaked into the Danube through a connection channel from the Pancevo petrochemical complex.
- **Hydrogen chloride (HCl):** Nearly a thousand tonnes of a 33 percent solution of HCl leaked into the Danube during attacks on Pancevo.

#### ***Details of pollutants that are reported to have been released into the atmosphere***

- **Radioactive pollutants:** This is one area of controversy related to NATO actions. Reports indicate that NATO has used depleted uranium (DU) ammunition in the conflict. The Institute of Nuclear Sciences in Vinca, Belgrade, has surveyed the remnants of exploded bombs and claims to have established the presence of uranium. NATO representatives have confirmed the use of depleted uranium ammunition in shells carried by A-10 planes. (Tanjug, Belgrade, May 17) According to reports, each A-10 Thunderbolt 30mm cannon anti-tank shell contains 275 grams of DU (10.1 MBq) (CRL, 1999). The depleted uranium is radioactive, and upon impact, the material may turn into a mobile aerosol. Aside from emitting alpha radiation, uranium is chemically toxic.
- **Vinyl chloride monomer (VCM):**

The Pancevo VCM plant ("Petrohemija") was completely destroyed and more than 1,000 tonnes of VCM was released. The Times of London quoted the Serbian Environment Minister as saying that the amount of carcinogenic matter in the air over Pancevo was 7,200 times above the permitted level.

(Environment News Service, April 19, 1999) According to a press release from Belgrade's Institute of Public Health, a VCM concentration of 10,600 times above the permitted level was recorded a few kilometres away from the bombed plant in Pancevo. (Glas Javnosti, May 19, 1999, pg. 5) This measurement has been confirmed by the Yugoslav Federal MOE. The polluted clouds created by the bombing at Pancevo carried the products of combustion of VCMs (phosgene, chlorine, chlorine oxides and nitrogen oxides), as well as ammonia, petroleum and petroleum products. The VCM storage facility burned for hours, creating a whitish smoke and clouds that were moving westwards, toward the outskirts of Belgrade (Borča, Ovca and Padinska Skela). The cloud was carried by low air currents and merged with another cloud that had been formed when a storehouse full of fertilizer was hit. Increased concentrations of nitrogen oxides (10 milligrams per cubic metre) and phosgene (2 parts per million) were also registered. Secondary chemical reactions caused by released VCM represents an extra concern.

- **Chlorine (Cl<sub>2</sub>):** The toxic gas chlorine was released after bombing of the petrochemical complex in Pancevo on the night of April 18, 1999.
- **Products from incomplete combustion:** Pollution resulting from the burning of oil, petrol, crude oil, motor oil, tires, asphalt and other materials at extremely high temperatures ñ as well as pollution caused by the explosive charges of different missiles ñ can include the products of incomplete combustion. Some of the products of incomplete combustion are: carbon monoxide; aldehydes, which take part in photochemical reactions; and soot, which absorbs polycyclic aromatic hydrocarbons. According to V.

Janji?, 1999, quantities of those products have reached over 1,000 million cubic metres in the atmosphere. Modern buildings incorporate many synthetic materials in their structure, furnishings and fittings. Consequently, a modern building produces many pyrotoxins when burning. One night of bombing in the centre of Belgrade produced a cloud that did not disperse until the late morning hours.

- **Soot and particulates:** Soot was released in enormous quantities during the burning of oil refineries in Novi Sad and Pancevo and the burning of large oil depots, such as Smederevo. According to the Yugoslav Federal MOE, during the Pancevo bombing a huge cloud of thick smoke was formed. It was about 1.5 kilometres wide, three kilometres high and 20 kilometres long and left a sediment of soot, ash and dust. The latter part of this cloud was blown westward, where it came down to the ground about 15 km from the burning factory. This cloud changed direction in the following 10-day period. In the first five days, concentrations of SO<sub>2</sub>, soot and total chlorocarbons increased by four-to-eight times in relation to the limit values. This was especially the case with unburned contents of oil: benzene, toluene, xylenes, carbon monoxide, mercaptanes and formaldehyde.
- **Nitrogen oxides (NO<sub>x</sub>):** Nitrogen oxides are released by jet aircraft, as well as by burning oil. Since the beginning of the air campaign, NATO jets put in more than 150,000 flight hours. At the same time, large quantities of nitrogen oxides were produced by the destruction of oil refineries and fuel depots all around Yugoslavia. (SES, April 15, 1999)
- **Hydrofluoric acid (HF):** According to unconfirmed data, hydrofluoric acid had been released during destruction of the production line of the "Prva Iskra" chemical plant in Baric on April 19, 1999. Fortunately, most of the HF was controlled and eliminated before the strikes.
- **Heavy metals:** Heavy metals are also extremely dangerous and

potentially difficult to contain. For example, mercury, in its methylated form, can be transported for thousands of kilometres. Other heavy metals, including cadmium, chromium, copper and zinc, were released after the destruction of industrial facilities, where these metals were used in normal operating processes (e.g. electroplating shops in Kragujevac, Valjevo and Cacak).

- **Acid rain:** Large quantities of released carbon dioxide, sulphurdioxide, nitrogen oxides and ammonia, have caused the appearance of acid rain. The smoke cloud that appeared following the main Pancevo strike was rinsed by heavy rain for several hours after it was formed.

### 4.1.3. Soil

Due to precipitation, much of the air pollution described above will eventually reach the soil and become a part of the further bio-chemical cycle. Bombing has also created deep craters in the humus layer, which will take years to recuperate. According to estimates a 240 kilogram bomb makes a crater that is 4 metres deep and 8 metres in diameter ñ or 50 square metres in surface area. The total surface of the craters created by the three-month bombing campaign has yet to be estimated. Not only are the craters unusable, but so is the land around the craters. The destruction of the upper layers of the soil means the destruction of its flora and fauna. The natural regeneration of this layer could last thousands of years. It takes from 1,500 to 7,400 years for nature to produce a 20 centimetre thick upper layer of soil. Within 100 years, the surface layer of soil naturally grows only 0.5-2 centimetres. (V. Janji?, 1999)

### 4.1.4. Biodiversity/Nature

Direct consequences of the conflict on biodiversity and the natural areas of Yugoslavia include:

- Physical destruction of habitats and plant and animal populations due to bombing all over Yugoslavia and land war activities in the region near the border between Albania and Yugoslavia.
- Physical destruction of habitats and populations of flora and fauna because of chemical contamination, particularly of water ecosystems, that occurred as a result of the destruction of chemical, oil and electric-power installations. Pollution in the Danube River has already caused a marked increase in

#### *Important areas threatened by the bombing*

Natural areas affected by bombing, and some of the rare species in these areas, include:

- **Kopaonik Mt. National Park**, which includes the localities of Panci?ev Vrh, top Suvo Rudiöte top, Duboka and Velika Gobelja top, was hit by at least nine bombings. Among the most endangered and most significant species are plants: cardamine pancicii, sempervivum kopaonikense and viola kopaonikense as well as the insect otiorinchus kopaonikensis, whose sparse populations inhabit exclusively the peaks of Kopaonik.
- **Fruöka Gora Mt. National Park**, which includes Cot, Iriöki Venac, Beocin, Rakovac, Vrdnik, etc.,

fish mortality. Fishing is officially forbidden in one section of the Danube beneath Pancevo. The lower course of the Danube is inhabited by fish registered in Yugoslavia as either endangered or vulnerable species. Water contamination may increase the risk that certain species such as *acipenser nudiiventris*, *acipenser sturio*, *zingele streber streber*, *zingel zingel*, *ubmra krameri* will become extinct in the region of Yugoslavia.

- Disturbance of populations caused by the physical impact of explosions, as well as the accompanying noise, along migratory routes. Detonations along migratory routes have already caused a decrease in the populations of many animal species, especially among large mammals and birds. The high quantity of plane flights in the air space above Yugoslavia, and all of south and south-eastern Europe, where there are many significant migratory corridors, may have negative consequences for a this years reproductive season of many migratory bird species.

#### **Protected areas:**

In Yugoslavia, approximately 1,800 especially valuable natural sites enjoy various degrees of protection. The total area of protected and valuable natural areas amounts to over 400,000 hectares or approximately 4 percent of Yugoslavia's territory. Especially valuable are nine national parks located in all of the three geographic macro-regions: the Pannonian plains, the mountainous regions and the coast. These parks include Fruska Gora, Djerdap (the Iron Gates), Kopaonik, Tara, Mt. Sara, Biogradska Gora, Durmitor, Lovcen and Lake Skadar. (Mandić, R. 1999)

Under UNESCO's criteria, Yugoslav sites included in the List of World Natural Heritage are: the Tara River Canyon, the Kotor-Risan Bay and the Durmitor National Park. (Stevanović, V., Vasić, V. eds. 1995)

sustained at least 20 bombings. The most significant species are Pannonian endemites *crepis pannonica*, *epipactis borbasii*, *paeonia banatica* and *suaeda pannonica*.

- **Tara Mt. National Park**, which includes Crveni Potok, Mitrovac and Perućac, sustained bombing that endangered the strict reservation of *picea omorica* at Crveni potok, which represents the unique habitat of this rare, and endorelict Balkan species. Apart from *picea omorica* in the region of Tara there are also: *cladium mariscus*, *dryopteris cristata*, and *waldesteinia trifolia*.
- **Sarplanina Mts. National Park**, which includes Brezovica, Dragaö and Gornje Selo, sustained at least four bombings. It is particularly important to single out the species *achillea alexandri regis*, *cerastium neoscardicum*, *colchicum macedonicum*, *crepis macedonica*, *fritillaria macedonica*, *sideritis scardica*, *silene nikolicii*, *tulipa scardica*, whose sparse populations inhabit the region of Tara Mt. Exclusively.
- **Vröacke Planine Mts. Natural Reserve** includes a TV transmitter that was destroyed by bombing. On the rocks under the destroyed transmitter is the only habitat of the species *minuartia frutescens* in Serbia, which has a population of 20. Also in this reserve is Vröacke Breg hill, the only known habitat of the endemic species *Barbarea lepuznica* in Yugoslavia.
- **Wetland habitats**, are found in Koviljsko-Petrovaradinski Rit marsh, Palić Lake Reserve and along the Sava river at Makiö, Baric and Obrenovac. These are inhabited by many endangered plants. The rarest and most significant ones are: *hottonia palustris*, *achillea ptarmica*, *aldrovanda vesiculosa*, *asparagus pseudoscaber* and *eryngium planum*. Apart from water plants, numerous endangered or vulnerable bird species live here, including: *plegadis falcinellus*, *platalea leucorodia*, *milvus milvus*, *burhinus oedipnemus*, *hippobolus pallida*, *hippobolus olivetorum*, *gavia stellata*, *gavia*

Numerous sites of national and international significance, as well as areas inhabited by rare, endangered species and protected plant and animal species, have been bombed. The habitats of the highest concentration of rare and endangered species in Serbia (Stevanovi?, V. (Ed.), in press) were heavily impacted by the war, according to the Serbian Ecological Society (SES 1999b). It is impossible to make an exact evaluation of the present consequences for ecosystems and biodiversity, but it is clear that military actions have increased the risk of extinction of numerous species.

#### **Other Endangered Areas:**

- **The border regions near Albania and FYR Macedonia** (Mora Morina, Goroûp, Djeneral Jankovi?-Kacanik, Preöevo-Bujanovac, Slavujevac-Rujen Planina Mt.) are inhabited by some 20 plant species whose risk of extinction has been increased by NATO, VJ and KLA activities. Particularly endangered are the species *crocus rujanensis*, *dianthus behriorum*, *genista nyssana*, *gentiana nopscae*, *solenanthus krasniqii* and *tulipa scardica* whose sparse populations inhabit these regions exclusively.
- **The area around the town of Nis** is one of the regions that has been exposed to the heaviest destruction. Particularly endangered are the species: *hypercymum pseudograndiflorum*, *nonea pallens* and *stachys milanii* whose sparse populations inhabit these regions exclusively.
- **The area around the city of Novi Sad** is another region exposed to some of the worst destruction. This region is inhabited by some 15 species whose risk of extinction has increased.

In the above mentioned areas, which represent only a part of the territory exposed to bombing, there are approximately 100

*arctica*, *botaurus stellaris*, *ixobrychus minutus*, *anas querquedula*, *aythya nyroca*, *mergam albella*, *milvua migrans*, *pandion haliaetus*, *rallua aquaticua*, *himantopus himantopus*, *recurvirostra avosetta*, *limicola falcinellua*, *numenius arquata*, *gelochelidon nilotica*, *chlidoniaa hybridua*, *acrocephalua paludicola*, *haliaetua albicilla*, *crex crex*, etc. In these habitats the following amphibians are listed in Yugoslavia as endangered or vulnerable species: *trituru cristatua*, *trituru dobrogicu*, *rana arvalia wolterstorffi* and *emys orbicularia*. There are also, many local endemic invertebrates, such as: *ophiogomphua serpentinu*, *lycaena dispar*, *graphoderua bilineatua*, *chelusia griseifacia*, *colaropyxidua stankovicii*, *lecania apatinenaa*, *lepadella mica*, *testudinella pannonica*, *chirocephalua brevialpua*, *imnadia banatica*, *imnadia cristata*, *imnadia panonica*, *eoleptetheria spinosa*, *eoleptetheria spinosa magna*, *eoleptetheria spinosa minor* and *leptetheria saetosa*.

critically endangered and rarest plant species and approximately 70 animal species that are equally at risk.



#### 4.1.5. Human Environment/Health

##### **Human environment:**

Great damage has occurred through the destruction of villages in Kosovo by the VJ and paramilitaries. This is likely to require major reconstruction before areas can become habitable again. Residential areas in all major cities around Yugoslavia have been struck by military action from the VJ and NATO. The downtown area of Priština has been destroyed; central-downtown Belgrade has been hit several times, and the damage includes government buildings. Residential areas in towns of Novi Sad, Pancevo, Niš, Zuprija, Aleksinac, Kragujevac, Valjevo, Surdulica, Kraljevo, Jagodina all sustained damage.

##### **Health effects:**

Generally, the state of health of the Yugoslav population in 1996, 1997 and 1998 was relatively satisfactory compared to the period of 1992-1995, when international sanctions were in effect. However, since the beginning of the conflict the general state of health has deteriorated. The problem is especially pronounced in the following areas:

- **Civilian casualties:** It is estimated that more than 1,400 civilians have been killed in Yugoslavia by air strikes. There are no definite figures for those killed by Yugoslavian forces in Kosovo, and no figures on military personnel killed, but from early indications the total of these figures will be several times more than the number of reported air strike victims.
- **Impact of pollutants:** The release of the above-described toxic compounds poses a threat to the civilian population. For example, more than 100,000 citizens of the Pancevo region (Belgrade's northern suburb) were endangered after the bombing of the neighbouring petrochemical complex on April 15 and 18. However, there are no reports about the number of people affected, or the long-term impact of this pollution. These numbers can only be ascertained by long-term monitoring of the population.
- **Loss of basic services:** Graphite bombs caused short circuits on power lines and the collapse of the electric power system of Yugoslavia. The result was severe problems in obtaining elementary needs (health, hygiene, etc) of the entire population. The problems have enlarged since main transformer stations and main long-distance power lines were destroyed. Those most severely affected are patients in hospitals and residents who live in the high-rise buildings.
- **Damage to food supply:** Agricultural products can be contaminated by pollution in rivers, groundwater and precipitation from all the toxic substances mentioned above. (P. Polić, 1999) There is a risk that these products will reach consumers. Dr. Luka Radoja, agronomist, notes that the conflict happened during the planting season for many crops: corn, sunflower, soy, sugar beet and other vegetables. The planting of 2.5 million hectares of land was halted. The lack of fuel for agricultural machines will also have catastrophic results on food production.

#### 4.1.6. Transboundary

It is obvious that the environmental consequences of war activities in Yugoslavia are not confined to state boundaries. The pollution of rivers in Yugoslavia will almost certainly affect the neighbouring downstream countries in the coming weeks, months or years, and the wind will disperse toxic clouds over the entire region. At the moment it is not possible to

obtain real facts on the quantity and level of contamination in Yugoslavia. However, from experience, it can be anticipated that the following areas are the most likely to transboundary environmental effects:

- **Pancevo incident:** Toxic clouds released after the bombing of combined petrochemicals, fertilizer and oil plants in the Belgrade suburb of Pancevo contain vinyl chloride monomers, chlorine, hydrochloric acid and phosgene. These toxins are expected to be carried into Romania and Bulgaria and down the Danube River into the Black Sea (Environment News Service, April 19, 1999. According to BBC News (April 19, 1999), workers at the petrochemical complex also decided to release tons of carcinogenic ethylene dichloride into the Danube to avoid the risk of an explosion.
- **Prahovo incident:** After the May 15, 1999, bombing of the oil depots in Prahovo, in the vicinity of the Yugoslavia/Bulgaria border, heavy rain in Bulgaria the next night was black and tainted by soot and hydrocarbons, according M. Sci Milivoje Ili?, head of district. (Politika, May 18, 1999).
- **Products of fuel combustion:** Fuel used by aircraft contains a large number of highly-toxic substances (ammonium-perchlorat, nitroglycerine, nitro-cellulose, polybutadien, polyurethane, polyvinyl-chloride, polystyrene, polyacrylate, lead-salicylate, lead-ethylhexoat, lead-stearate, metal nitrates, metal perchlorate and fluorine compounds) whose combustion is toxic and carcinogenic. Combustion of these substances produces, nitrogenous oxides, chloric compounds and other harmful substances that can destroy forests and vegetation and have a direct effect on human health as well. Harmful fluorine radicals are formed as a result of combustion of fuel stabilisers together with lead.
- **Damage to the ozone layer:** Numerous flights by jet aircraft over a period of more than eight weeks will have negative effects on the already depleted ozone layer.
- **Radioactivity:** When armaments with depleted uranium are used, they produce uranium oxides ( $U_3O_8$   $UO_2$ ) as well as the gases radium and radon, among others. Oxide particles are from 0.5 to 5 microns in size and can be carried by the wind over several hundred kilometers. Depending on the wind direction, these particles can be spread to neighbouring countries.
- **Water:** Surface waters that were polluted as a consequence of the bombing belong to the catchment area of the Black Sea, as well as the Aegean and Adriatic seas, which means that all the above-described water pollution could have transboundary effects. However, the most conspicuous effects can be expected in Bulgaria and Romania, the countries that are downstream from Yugoslavia on the Danube River. Floating oil slicks released from bombed refineries cause an obvious threat to these countries.
- **Iron Gates reservoirs:** Reservoirs on large rivers, such as Iron Gate I and II on the Danube, are in special danger because the process of sedimentation is increased due to the slowing down of the river's flow. Iron Gate's reservoirs therefore act as collectors of all upstream pollution. Dramatic pollution of most rivers in Yugoslavia by heavy metals, pyralene (PCB), oil, etc., will almost certainly affect the neighboring "downstream" countries of Romania, Bulgaria and Ukraine in the coming days, months or years. (P. Poli?, 1999)

#### **4.1.7. Others**

##### **Military waste:**

Due to military operations there are unique forms and categories of waste in Yugoslavia. These include live munitions, graphite bombs, land mines, destroyed military vehicles and aircraft, damaged and contaminated military equipment and infrastructure. Finding, characterising, and safely removing these wastes requires a highly specialised type of work. Unexploded bombs, munitions and land mines still litter the landscape of the war zones. These pose a special threat to the environment and citizens.

#### **4.2. Albania**

##### **4.2.1. Water**

The water supply for the refugee camps mainly comes from the drinking water system of nearby towns. This has reduced the available quantity of water per capita. One example of how serious the problem can be is the district of Lezhe (Shengjin), where the refugees equal 46.6 percent of the population.

Drinking water sometimes comes from artesian wells, which can only reach potable water standards after a careful treatment process. In Durres, the Spitalle camps use artesian wells for 1,400 tents, which house some 6,000 people. In some other areas, the drinking water is very polluted by oil. In Fier District, wells of up to 7 metres in depth are contaminated by oil field infiltration. This is an old problem that is being exacerbated by the increased population. Camps constructed in the seaside zone are facing the presence of E.coli ñ an indicator of faecal pollution.

In all of the camps there is no sewage water treatment. There have been several cases when requests have been made to local authorities to be able to discharge sewage collection vehicles in drainage canals (Durres, Spitalle area) or in the fish hatchery ponds (Saranda: Vrina area), instead of in the main sewage collection facility. A situation that is this serious has direct implications for public health.

Lack of sewage water treatment and discharge into inappropriate areas, especially for tented camps, is a major problem. It will remain an important environmental and health related problem in the whole country. In most of the sites, sewage water is disposed in septic holes (not tanks), most of which have reached their maximum capacity and are causing other environmental and health problems, such as a high risk of epidemics, bad smell, soil pollution or infiltration of polluted water into the underground water table. In most cases, it is not possible to adequately connect the camps to nearby town sewage systems ñ where these systems exist.

Due to the lack of sewage and household water collection systems, there are canals near the camps with very polluted water. The number of camps in such conditions is considerable, and they can be seen all over the country. One specific example is the Islamic Relief Camp in Shkodra.

The general policy has been to construct tented camps along rivers beds or near fresh water lakes. This policy has proven to be a mistake in the case of vulnerable ecosystems or water systems without large water inputs and outputs. For example, in Tirana, Pishina camp, with 2,000 refugees, is located near Tirana park, on the western side of a small artificial lake. The selection of this site is now widely considered to be a mistake. Other camps are built downstream from badly polluting factories. One case is in Elbasan Mjeksi camp, with a population of 3,500, administered by the Turkish army. The military industry upstream pollutes the river and has direct effects on the refugees' health. Local authorities are looking

for ways to bring water into the camp from another irrigation canal.

#### **4.2.2. Air**

There are no data available on the effect of air pollution.

#### **4.2.3. Soil**

##### **Physical damage:**

Considering the small percentage of agricultural land in Albania, one of the main environmental impacts of the construction of refugee tent camps is agricultural soil damage. Some hundreds of hectares of soil have lost their function as arable land because of the concrete and gravel layer used for camp surfacing.

This problem is more pronounced in the districts where massive tent camps have been constructed. In Durres (in the Hamallajt area) camps occupy approximately 100 hectares of agricultural land, which has been covered by concrete and gravel to a depth of 60 centimetres. In Elbasan, a 6 hectare area could require 10-15 years to recover. At the camp in Lezhe (Shengjin), 2,000 cubic metres of gravel have been used to cover 1.3 hectares, an area with a capacity of 612 people.

##### **Organic and chemical soil pollution:**

The use of poorly constructed septic holes has led to the soil pollution, especially over time, when the holes overflow and the sewage water runs into drainage canals (Lezhe, Kavaja, Vlore).

#### **4.1.4. Biodiversity/Nature**

The impact of the incoming Kosovo refugees on protected areas has been quite visible, especially in the western part of Albania along the Adriatic coast. Some of these areas ñ such as the Divjaka-Karavasta complex, the only Ramsar site in Albania, Kune Vain Lagoon, Rrushkull reserve and Patok Reserve ñ are quite vulnerable due to increased human pressure in recent years.

In the first weeks of April, several camps were built within the protected areas (Rrushkull, Divjaka). The international organisations managing these camps did not seek prior permission, or even consider suggestions of local authorities. This has led to a situation where the Rrushkull camp (Durres), covering a surface of 14.5 hectares and administered by the UNHCR, was built within a hunting reserve, where it causes considerable damage to fauna. Some other sites are close to wetlands, within protected areas. One such example is the Kune-Vain reserve, 62 metres above sea level, where construction work on 0.5 hectares was cancelled only because of flooding risks and mosquitoes.

After the initial emergency situation in the early part of the conflict, international agencies sought permission to build camps within protected areas like Dajti National Park, 25 kilometres from Tirana, and Patok. But the Albanian General Directorate of Forestry remained firm about protecting these areas. The doubling of the capacity in some collective centres near the protected zones ñ like Sh?ngjin, which went from 400 to 820 residents ñ has also increased the pressure on the natural values and biodiversity of the surrounding area.

#### **4.2.5. Human Environment/Health**

Along with the above-mentioned problem of poor sewage treatment one of the biggest human environment problems is solid waste disposal. The camps and collective centres that are located within town boundaries have their waste disposed in landfills. However, there are districts that do not have landfill facilities (Shijak, Sukth, Manz?, Kruje). In these cases, the

disposal is done along the rivers.

The quantity of waste produced by a camp depends not only on the number of refugees, but also on the type of food and other aid distributed to them. In composition, the most significant percentages of waste consist of paper, plastics, and cans. An example of the waste produced in only one district (Shkoder, North Albania) are:

Refugee Facility	Amount of waste	number of refugees
Austrian camp	2,700 kilograms/day	3,000
Caritas	3,280 kg/day	1000
Cigar Enterprise Collective Center	3,300 kg/day	370
DI MODENA camp	400kg/day	435
Islamic Relief Service	720 kg/day	800
L.V.I.A camp	550 kg/ day	620

The situation of camps constructed in village areas are the worst. In districts like Lezhe, Fier and Lushnje, even small camps can produce 250-500 kilograms of waste per day. This waste is disposed just outside of the camps in open fields and is quite often burned. Medical wastes are usually collected together with other urban waste without a preliminary treatment or special packaging. In some cases, as in a camp managed by the foreign military, hospital waste has reportedly been burned in special incinerators.

### 4.3. Bulgaria

**4.3.1. Water** There are three reference water monitoring stations, and several representative stations, in the regions where the impact of the military strikes on industrial targets can be expected. Routinely, the results of water quality tests are presented at the Ministry of Environment and Waters (MEW) 45-60 days after sampling. But the MEW has arranged that one of the most representative stations on the Danube River begins sampling every day at 10 a.m. and submits data to the National Center for Environment and Sustainable Development of MEW on the same day at 5 p.m. Sampling at this station has not shown any deviation in the values of the measured: pH, dissolved oxygen, electric conductivity, permanent oxygenation, BOD5, ammonia, nitrate, nitrite, phosphate, soluble and non-soluble matter, Mn and Fe. Figures to date have therefore shown no measurable effects on the river from the war.

#### 4.3.2. Air

Starting April 6, 1999, the MEW began to implement an extra programme for air quality monitoring to ensure that any changes in the concentration of air pollutants will be registered and the necessary measures to protect human health will be enacted. Three mobile air monitoring stations were moved to areas along the border with Yugoslavia where pollution from military action could be expected. These places had not been monitored in the past, so the data was compared with data from existing stations in Vidin, Montana and Blagoevgrad. The measured parameters are: non-toxic dust, sulphur dioxide, nitrogen oxide, carbon dioxide, hydrogen sulphide, ozone, ammonia, methane and non-methane hydrocarbons. The highest (peak) daily mean

values are:

<b>Pollutant</b>	<b>Measured value, milligrams/cubic metre</b>	<b>Limit value, milligrams/cubic metre</b>
<b>Dust (particulate matters)</b>	<b>0.375-0.65</b>	<b>0.25</b>
<b>Lead</b>	<b>&lt;0.001</b>	<b>0.001</b>
<b>Sulphur dioxide SO<sub>2</sub></b>	<b>&lt;0.15-0.405</b>	<b>0.15</b>
<b>Nitrogen oxide NO<sub>x</sub></b>	<b>&lt;0.1</b>	<b>0.1</b>
<b>Hydrogen sulphide H<sub>2</sub>S</b>	<b>&lt;0.008-0.0136</b>	<b>0.008</b>

The exceeding of certain parameters is not unusual for these sites, measurements therefore record an ordinary situation from before the military actions began. Only particulates are higher.

Starting from May 13, 1999, measurements were taken for volatile organic compounds  $\bar{n}$  benzene, toluene, xylene, dichlormethane, dichlorethane, tetrachlormethane and tetrachlorethylene. There have not been any reported cases of these substances exceeding the usual limits. For methane and non-methane hydrocarbons, where the limit values are not established, the levels of concentration have been in the ordinary range. The results are reported every day by the regional environmental inspectorates and announced for the media and public in weekly briefings.

Acid rain (pH 4.23) was recorded in the period of May 23-26, 1999, at the reference monitoring station Rozhen. The nature of acid rain makes it difficult to properly identify the source of pollution. But the direction of the wind (north-northwest) indicates the rain was related to the industrial damage in Yugoslavia. Because figures tend to indicate that in Bulgaria there has been no measurable effect on the air quality since the conflict began, the period of acid rain would seem to be a one-off event, possibly caused by attacks on industrial plants.

#### 4.3.3. Soil

The agricultural land along the border with Yugoslavia were already very heavily polluted during the last decades by the operation of the Bor non-ferrous mines in the basin of the border River Timok in Yugoslavia. The samples taken from these places do not point at any excessive pollution, when compared with the samples taken from before the fighting. However, the government took a decision to start an ambitious programme to investigate the soil pollution in 40 sampling sites along a 50 kilometre zone of the border. This investigation should reveal the level of pollution by heavy metals, polyaromatic hydrocarbons (PAHs) and PCBs in order to develop and implement a land reclamation programme.

#### 4.3.4. Biodiversity/Nature

As shown above, the pollution entering into Danube River (toxic chemicals and oil products) from NATO activities did not yet show up in measurements because of the

very high level of dilution. Nevertheless, some pollution is likely (see Yugoslavian section), and it will settle down in the sediments on the river bed and accumulate in the water flora and fauna. In order to investigate these processes, the MEW held an ecological assessment of the Danube River. Starting from the border with Yugoslavia and covering 167 kilometres of the river in the period of May 25-29, 1999, some 14 points were sampled.

The physical and chemical analysis of the water sampling does not exceed the limits for surface waters. Additionally, the gas-chromatography analyses show that the level of concentration of polyaromatic hydrocarbons, polychlorinated biphenyls (PCBs) and volatile organic compounds is less than the norms. The total microbe index, E.coli index, chlorophyll A and biotic index also came up within the norms. The concentration of toxic metals and metalloids in the water did not exceed the limits. Sediments, soil and plants were analysed for the specific radio-nuclides: uranium-238, radium-226, thorium-232, potassium-40, cesium-137, beryllium-7, lead-210, etc. No activity of the radio-nuclides over the ordinary level for this region were found.

The level of toxic metals and metalloids in the sediments near the border exceeded the average long-standing levels as follows:

- lead, three times;
- copper, 1,400 times;
- cadmium, 30 times.

Along the investigated route, the concentration falls and at the end of the route the levels are equal to the levels from previous periods. It seems that the main pollution source is the discharges of mines Bor in Yugoslavia and not as a result of the conflict.

Soil sampling from the Kutovo Island (near the border) showed that only copper exceeded the norm  $\bar{n}$  by six times. An excess of nickel content in the fishes was found. However, no dead fish, nor birds were found. There was no other visual damage on the water flora and fauna. It seems apparent that there has been no real impact (short or long-term) on the biodiversity of the country.

#### **4.3.5. Human Environment/Health**

Bulgaria did not participate in the military action and received fewer refugees than other countries. Nevertheless, on seven occasions, missiles used in the war in Yugoslavia came down near villages, and once in a residential suburb of Sofia. Sofia has 1.2 million inhabitants. There was no loss of life and only limited damage to buildings.

#### **4.3.6. Others**

Starting from May 13, 1999, 17 additional points in the region next to the border with Yugoslavia were added to the National System for Environmental Monitoring. Results have shown that the natural gamma activity was not exceeded. All samples display figures between 0.12-0.19 mSv/h as before the war. The same results (uranium and radio-nuclides) were displayed by the samplers of soil (for radio-nuclides), surface water, drinking water, rain water, lakes and dams, plants and ambient air.

### **4.4. FYR Macedonia**

#### **4.4.1. Water**

According to the Ministry of Environment, there is no identified increase in water pollution with chemicals, toxins or radiation during the period of March-June, 1999. The total alpha-radioactivity in water samples from the river Lepenec (Northern FYR Macedonia) during May 24-28, 1999, was 0.083 Bq/l which is 1.5 times lower than the maximum allowed concentration according to the FYR Macedonia standards for drinking water. There are no comparative figures from previous periods, because this is not a regular monitoring point.

Due to the refugee camps, however, there is a high potential and danger for contamination of the biggest drinking water spring in FYR Macedonia, Rasce, which supplies Skopje. The ministerial committee visited two camps, Radusa and Bojane, both located in the first protected zone of the Rasce Spring, which is a karst region. The commitment between the FYR Macedonia Government and the UNHCR was to collect the sewage waters and to transport them to the sewage treatment station near Struga. However, this commitment was only enforced between May 10-17, 1999, with a total of 90 cubic metres of wastewater. After that, the treatment station did not receive any water for treatment, while it was obvious that sewage water from the Bojane camp was taken away every three days. Since then, on June 7, 1999, the state environmental inspectorate found private individuals dumping wastewater into the Vardar River, near the camp. The Ministry of Environment prepared immediate recommendations to the government, such as dislocation of both refugee camps, in order to protect anticipated long-term pollution of the Rasce spring and to build sewage treatment stations for both villages Radusa and Bojane. The costs of these treatment stations are estimated at USD 1.8-2 million.

Water taken from Bojane and Radusa camps, which is used for the needs of the refugees, was analysed for the presence of micro-biological agents. According to the medical teams who work in the camps, this water should only be used for washing or bathing, not drinking water. The results of the analyses show no presence of any group of bacteria or any kind of micro-biological contamination, so that the water sampled from the Bojane and Radusa camps actually met the requirements for drinking water. Water taken from Skopje water pipes also showed negative results on micro-biological contamination. The presence of chlorine is 0.1 milligrams per litre, which is within the frame of the maximum allowed levels (0.2-0.5 mg/l).

However, taking into consideration the fact that the camps are very near to the Rasce spring, there is still reason to be concerned about the possibility of contamination of underground water in the future. Negative results on micro-biological testing does not necessarily mean that the water is clean and drinkable. If there are septic holes nearby, contamination of underground water can occur, even if chlorine is applied. This would be indicated by the presence of ammonia and nitrites in the water. It is still too early to notice any kind of contamination. One possible remedy to the situation might be to require obligatory monitoring of underground waters in the area of Rasce.

#### **4.4.2. Air**

The National Institute for Health Protection (NIHP) performed analyses of the alpha-radioactivity in the air in FYR Macedonia, during the month of April, 1999. Samples were analyzed in Bulgaria, as FYR Macedonia does not have sophisticated equipment for this type of measurement. The director of the NIHP announced that the analyses discovered up to eight times higher concentration of alpha-radioactivity in the air in FYR Macedonia, than the usual concentration. This increased level is still within the maximum allowed concentration, and the NIHP director said the measurement simply means that this parameter needs to be continually monitored.

The measurements of other types of radioactivity were conducted by several Macedonian institutes. The intensity of the absorbed dose of outreach gamma radiation during April 20-June 3, 1999, was between 0.08 ñ 0.17 mG/h, which is 3-6 times lower than the maximum allowed concentration. The specific beta-radioactivity in the air during April-May 1999 average 4.1 mBq/m<sup>3</sup> in Skopje and 3.23 mBq/m in Gevgelija, which is 50 times lower than the maximum allowable concentration. The maximum allowable concentration standards for air radiation used those of the European Union, because FYR Macedonia has not developed its own standards yet. The state environmental inspector has not provided more detailed information regarding the alpha-radiation, which is possibly the most important, because that is the radiation that comes from depleted uranium weapons. Furthermore, it is hard to fully appreciate the results of the measures that were announced, because FYR Macedonia does not have permanent monitoring of the radioactivity, so the above-mentioned results cannot be compared with previous years. The results of radioactivity tests mentioned above are available to the public.

FYR Macedonia does not have sophisticated equipment in any of its institutes for measuring the concentration of chemical pollutants in the air. Competent experts from the monitoring institutes in FYR Macedonia, chemists and physicians are concerned that potential air pollution, with highly toxic and dangerous pollutants, released from the chemical and petroleum industrial complexes in Yugoslavia, could easily come towards the country. There is major concern about the potential concentrations of dioxins, furans and polychlorinated biphenyls, whose allowable air concentration should be 0 according to EU standards.

On June 2, the Ministry of Environment recommended to the government that the state budget include funding of Dinar 3,000,000 (DM 94,000), for the measurements conducted during April and May, and Dinar 1,000,000 (DM 32,000) for monthly needs. The ministry also recommended that these types of measurements should continue for 12 months after the day of cessation of military activities in Yugoslavia.

#### 4.4.3. Soil

At this point, there are no signs of any kind of pollution of the soil. State monitoring institutions have not announced any measurements, nor findings of pollution, as a result of the military conflict in Yugoslavia.

#### 4.4.4. Biodiversity/Nature

The Agency for Environment of FYR Macedonia has researched the changes in the populations of biological species in the natural reserves in FYR Macedonia. The last report from March 31, 1999, states that there are increased numbers of some population of rare birds in the regions of Mariovo, Tikves, Demir Kapija and Pelagonija Valley. The following findings were identified:

- 64 specimens of the bird neophron pernopterus, a 100 percent increase from the previous years;
- four specimens of aquila heliaca;
- 68 specimens of gips fulvus, a 30 percent increase;
- two nests of milvus migrans, which is a sign of a new population;
- one pair of ciconia nigra, which is in process of nesting;

- three specimens of *buteo buteo*;
- and two specimens of *circaetus gallicus*.

There are also findings of an increased number of boars and three bears.

The assumption is that these species have moved from Kosovo as a result of disturbances from the military activities.

The Fund for Environment of FYR Macedonia has immediately transferred Dinar 20,000 to the local ecological association from Kavadarci to gather food and bring it to the preserve. The Agency for Environment of FYR Macedonia has also developed a feasibility study for complete management of the natural preserve "Tikves," where most of the new inhabitants arrived, including monitoring, watching, protection, feeding, etc. The implementation of this study will cost approximately DM 60,000 DEM.

#### 4.4.5. Human Environment/Health

There is an increased number of patients in the medical centres and hospitals in Skopje, Kumanovo, Tetovo, Kichevo, Debar and Struga, as a result of the increased population in FYR Macedonia. No one from the Health Institutions was able to give the precise numbers of increased need for medical assistance. However, it is known that capacities are almost fully utilised. Most of the health problems that appear in the refugee camps are solved in the camps' own medical centres and only serious cases are transferred to hospitals. The latest data says that 152,340 refugees are located in households, and they receive the basic health control in existing medical centres/hospitals.

##### Environmental Effects from Refugee Camps:

The REC conducted a study in two refugee camps, Radusa and Bojane, to assess their possible environmental impacts. Both camps are located in rural areas and were prepared immediately after the first refugees came from Kosovo to Macedonia.

The camps were visited on June 10, 1999. They are located very close to the Macedonian capital of Skopje. The number of refugees at Radusa is 1,800 and in Bojane is 3,500. The Albanian refugees stay in textile tents (usually one family per tent). The organisational logistic of the camps is very good. According to medical teams at both camps, the human health status is good and epidemiological status is normal. A 24-hour-a-day human health control system is in operation at both camps and they are staffed by Macedonian and international medical teams who can handle more than the capacity of the camps.

The drinking water supply system is well organised. Sanitary inspectors and the Republic Health Institute of Skopje, regularly conduct the water quality analyses. According to their reports the drinking water quality is good. The researchers also took samples from the drinking water for analysis.

Sewage waters (effluents) are connected to the sewage system of the Radusa village (at Radusa camp) and collected by pumps in Bojane, by a public company called Komunalec, for treatment. At both camps there is no visible discharge to the River Vardar or possible influence of sewage to the underground waters. Komunalec organises solid waste management and after collection from the refuse bins, solid waste is disposed on Drisla landfill, near Skopje. Komunalec does not collect the waste out of properly located cans. Researchers saw many places with a lot of litter and waste in Bojane Camp and around its perimeter. Refugees were also apparently burning waste paper in cooking fires.

**Other observations include alterations to the natural landscape, which may have an effect on the local environment. Forests in the surrounding area are being cut for fuel, but there is no official information about this activity.**

#### **4.4.6. Others**

**Citizens' complaints mostly concern the increased noise coming from NATO vehicles, which mostly drive in night-time hours. Also, military airplanes are producing very high levels of noise, and the utilisation of Skopje Airport increased by 10 times. There are no official measurements of the increased decibel levels in Macedonia.**

### **4.5. Romania**

#### **4.5.1. Water**

**Measurements from the Romanian stretch of the Danube River yielded the following results:**

- From 31-64 organic micro-pollutants are present, but they do not exceed the maximum allowable concentration.**
- Oil was found in the Danube (aromatic hydrocarbons), but amounts did not exceed the maximum allowable concentration.**
- Phenols have frequently exceeded the maximum allowable concentration.**
- Heavy metals, such as copper, chromium, cadmium and lead have twice exceeded the maximum allowable concentration.**

**No massive mortalities of aquatic organisms have been reported yet, but it is possible that, due to chronic toxicity and bio-accumulation, the effects will only show much later.**

#### **4.5.2. Air**

**For air the following measurements were made:**

- In the period between April 18-26, 1999, in Timis county, the maximum allowable concentrations for sulphur dioxide, nitrogen oxides and ammonia were exceeded 5-10 times.**
- As a consequence of the bombing of the Prahovo oil terminal on the Danube, on May 15, 1999, a cloud of smoke was generated that covered about 10-15 square kilometres of Romania's territory.**
- On the May 12, 1999, in Caras Severin County, near the village of Berliste, acid rains were reported (pH=5.4), and on the May 15, 1999, acid rains were reported near the village of Gradinari (pH= 4.7). The acid rains in this area appear to be a direct consequence of the atmospheric pollution generated by the fires caused by bombing.**
- The Environmental Protection Agency in Oradea reported an increased level of acid rain compared to the same period before the war.**
- Rains with a pH of 5.7 ñ a slight decrease ñ was registered on the June 1, 1999 by the Arad County Environmental Protection Agency.**

- **The Timis County Environmental Protection Agency reported acid rains of pH=5.1 in Moravita on May 21, 1999. In this county there have also been reports from the population that vegetation is severely affected, but these reports were not confirmed by the local EPA. The EPA considers that these effects are due to the general level of pollution combined with excessive heat during this period.**

#### **4.5.3. Soil**

**There were no reports of impact on soil that could be confirmed by reliable sources.**

#### **4.5.4. Biodiversity/Nature**

**No reports of impact on biodiversity/nature were reported.**

#### **4.5.5. Human Environment/Health**

**There is only one report regarding effects on human health: the inhabitants of one of the border police checkpoints have reported respiratory problems (cough, suffocation, irritation) apparently due to air pollution.**

## 5. Anticipated Future Risks or Threats

### 5.1. Environmental

#### 5.1.1. Yugoslavia

##### **Internal Threats:**

Future negative consequences of the military activities on the environment and nature of Yugoslavia are difficult to perceive at the moment. Even more difficult is to make any prediction regarding the intensity of future ecological damage. Nevertheless, some elementary prognosis and estimations can be made even now:

- Present negative effects on reproduction of flora and fauna, caused by physical damage to habitats and populations as well as chemical and other types of contamination, can result in the decrease of populations of the rarest and most endangered species in Yugoslavia, as well as in migratory species in the broader region.
- Accumulation of toxic and cancerous material in the soil and plants, in the future might result in decrease in number of populations of the most endangered species provoked by the disturbance of their reproductive cycles.
- Accumulation of toxic and cancerous material in the soil and plants may cause food contamination and therefore have consequences for human health.
- Because of the destruction of the electric-power system and oil industry of Yugoslavia, and destruction of the most significant heating plants in the biggest towns, one of the consequences will be insufficient heating in the coming winter season. Therefore, especially in rural areas, it is realistic to expect an enormous increase in tree felling, both controlled and uncontrolled. Apart from devastation of the forest ecosystems, the felling will provoke an increased risk of extinction of many rare and endangered forest species.
- Also, in the places of intensive tree felling, there will certainly occur an increased erosion of the soil.

##### **Chronic effects on human health:**

- **Pollution:** Several of the above-described toxic compounds released after bombing can cause chronic health problems. Perhaps the most dangerous is depleted uranium, but there are also other carcinogenic and toxic substances, such as vinyl chloride monomers, which have been released. Many of the compounds released can cause miscarriages and birth defects. Others are associated with fatal nerve and liver diseases. The effects of the bombing of Yugoslavia's industrial facilities are a serious threat both locally and regionally to human health in the long-term.
- **Water supply:** The whole population of Yugoslavia faces shortages in elementary supplies: power, water and food. Use of graphite bombs caused short circuits on high-voltage power lines and the collapse of the electric power system of Yugoslavia. About one million households and other local facilities are short of water supply due to the adverse effects on the water supply system. Water pipelines have been destroyed in Novi Sad, Belgrade, Sjenica and other cities.
- **Food:** Shortages should be expected because the conflict took place in the phase of

planting of many crops, including corn, sunflower, soy, sugar beet and other vegetables. The lack of protective substances, as well as fertilisers, could totally endanger the survival of certain crops. The lack of fuel for agricultural machines will curtail work.

- **Infrastructure:** The Yugoslav population is also threatened by destruction of infrastructure (central heating stations, the road and railway networks) which could lead to humanitarian problems during the coming winter.

### **5.1.2. Albania**

The following are considered as the main future threats or risks:

- Autumn and winter are rainy seasons in Albania. Some of the camps, constructed on flatlands near hills, are threatened by flooding (Elbasan: Shushica camp), even when the precipitation amount is within its normal levels.
- The free run-off of sewage water is a permanent threat, not only for the refugee communities in camps or collective centres but also for the Albanian residents near them.
- The reduced amount of drinking water during summertime, and bad quality of chlorinating (Shengjin) might be a source of infectious diseases. Supplying water to camps and collective centres will decrease the water supply for urban areas and, due to poor links in pipelines, the quality of the water is expected to decrease too.
- Protected areas are under threat from construction of tented camps or other sheltering buildings. Fire might cause considerable damages during the hot and dry summer.
- The potential threat of pollution to the underground water table has not been adequately considered. In Korca, the most important city in south-east Albania, three large camps, with a maximum capacity of 20,000 places, have built above the area from which the whole region obtains its drinking water.

### **5.1.3. Bulgaria**

As was mentioned above, data from environmental monitoring did not present concrete figures for pollution. It is quite obvious that risks to the environment can be expected, but they cannot yet be assessed. Monitoring should continue.

### **5.1.4. FYR Macedonia**

- It is anticipated that long-term pollution of the drinking water may appear at the Rasce spring. Water pollution from all camps poses a serious risk.
- There is still a risk of radioactive and chemical pollution of the air. This could result in pollution to the soil, and consequently, food products. The situation requires further monitoring to ascertain the possible risks.
- Due to temperatures of up to 40 degrees centigrade and more during the months of June, July and August, epidemic diseases may appear, though there is very good medical coverage in the camps. Larger than normal instances of mental illness can also be anticipated as a result of social, economic and political conditions, both among Macedonians and in the refugee camps.

### **5.1.5. Romania**

As in Bulgaria, the data of the environmental monitoring did not present concrete figures for pollution, but it is quite obvious that risks to the environment might be expected. Because these cannot yet be assessed, monitoring should continue.

## **5.2. Institutional**

### **5.2.1. Yugoslavia**

#### **Governmental and professional:**

Due to damage caused by the war and a lack of resources, it can be anticipated that the governmental structure will be unable to deal with the nation's environmental problems. This incapacity will be exacerbated by Yugoslavia's years of isolation.

Future reconstruction should take place with the support and full participation of relevant Yugoslav governmental institutions and bodies. Otherwise the proper process of restoration and reconstruction of Yugoslavia, including its environment, will not be possible. If existing government structures are completely by-passed or left out of efforts to restore the country, reconstruction could take place without the proper information and institutional memory required for good planning. The result could be that reconstruction might actually compound environmental threats.

#### **NGOs:**

The whole Yugoslav NGO community was seriously affected by the war. This is especially evident within environmental NGOs. The dynamic process of forming new organisations, which had been increasing in recent years, has come to a halt. In most cases, the programmes of existing NGOs have been cancelled as well. On one hand the constant bombing prevented field activities. On the other, shortages in available subsidies, problems in power supply and reduction in communications kept NGOs capacity to a minimum. Existing or planned networks did not have the opportunity to organise any kind of meeting or workshop.

Without outside help, it is hard to believe that the majority of Yugoslavia's environmental NGOs, especially grass-root organisations, will survive the following period. The repercussions on the wider process of democratisation of the whole society will be much slower without well developed NGOs or citizens groups.

### **5.2.2. Albania**

Notwithstanding the good efforts and extreme preoccupation of the Albanian government, there was poor co-operation between the emergency structures of central and local government and the responsible environmental institutions. The National Agency for Environment was not a party to the decisions on camp building or other interventions into the environment. Also, the international organisations and military in charge of specific camps provided little data and showed little willingness to co-operate with the local structures for environment. In most districts, environmental specialists are not local emergency committee members. If this state of affairs persists, then the environmental dimension will be totally lost in the reconstruction efforts of Albania.

The work of NGOs has supported many protected areas and environmental campaigns. There is a danger that funds will move to the humanitarian NGO sector, leaving a dearth of funds for environmental work.

### **5.2.3. Bulgaria**

In Bulgaria, the monitoring systems were able to cope with the new challenges of the conflict. It is important, however, that the government act on any threats that appear on the longer-term once the initial crisis has passed.

For environmental NGOs, the threat might be that the conflict has complicated the environmental issue in the country by focusing attention away from other areas. Additionally, the chances of transboundary co-operation with neighbouring countries may be curtailed.

### **5.2.4. FYR Macedonian**

In general, no institutions in FYR Macedonia were able to anticipate precisely future risks either in quantity, quality or financial causes. This reinforces the position that the infrastructure of the authorities to deal with possible problems is weak.

Additionally, environmental NGOs do not appear to have reacted completely to the environmental challenges posed by the conflict. Most probably this is because the humanitarian issues were the main priority.

### **5.2.5. Romania**

The general conclusion is that the conflict has offered no extra threat to an already weak institutional framework. The Romanian monitoring system appeared to be so seriously under-developed and under-funded, and despite the best work of the staff the results are questionable.

NGOs have also failed to take any great stand on the possible environmental consequences of the conflict. The transboundary work with colleagues in Yugoslavia and Bulgaria will require encouragement to bring the level of cooperation up.

## 6. Conclusions

### 6.1. Yugoslavia

Yugoslavia's environment has experienced very real impacts from the war's activities. In regard to ecological consequences, the effects of the bombing of Yugoslavia's industrial facilities have uncontrollably released tonnes of toxic chemicals into the environment.

#### **Air:**

Air pollutants, caused by high concentration of toxic substances (soot, phosgene) - even carcinogenic compounds (VCMs, PCBs, DU) - were released from destroyed industrial facilities, produced in reactions of incomplete combustion of different materials, or produced as a direct effect of military action, were the most acute (short-term) problems.

#### **Water:**

The water pollution from oil and its derivatives, as well as pollution from a variety of harmful chemicals (PCBs, VCM, EDC, HCl, HF, heavy metals, etc.), is evident and will last for a longer period of time. All released substances will undoubtedly become part of further bio-chemical cycles - possibly with unpredictable transformations, which enlarge future risks. Quantities of war waste have increased the country's soil pollution problems.

#### **Biodiversity:**

Biodiversity was threatened by: physical destruction (bombing and land war activities) of habitats and their associated plant and animal populations; by chemical contamination and by physical and noise disturbance of animals in their habitats and migratory paths. The exact evaluation of the present consequences for the ecosystems and diversity is still impossible to make, but it is probable that military activities have increased the threats to scarce populations.

#### **Transboundary:**

Regarding transboundary effects, the most affected are neighbouring countries, especially those on the River Danube downstream from FRY. However, the contribution to endangering the ozone layer and therefore of climate change also should be recorded.

#### **Future Threats:**

The main anticipated future risks include biodiversity reduction, decrease in efficiency in combating pests (insects, fungi) both in natural (forests) and agricultural (food industry) during the present crop season, harmful consequences for human health and an enormous increase of tree felling during next winter for providing wood for heating.

Polluting substances endanger the population directly through air, water and food, but also accumulate, most often in geological formations or in the biosphere. These can represent a long-term health risk. The argument over the DU issue is bound to be revealed by time. However, the controversy around this issue may distract attention from other issues. More pressing to the Yugoslav population is the destruction of infrastructure (power and water supply systems, central heating stations, the road and railway networks) which could lead to human suffering during the following winter.

### 6.2. Albania

In Albania, many decisions were taken under time pressures in helping deal with the influx of refugees. As a result, many mistakes are now visible after three months. The environmental impact of this conflict is therefore most evident in the camp locations. This environmental impact might have been much less if consultations with environment

specialists had occurred. Poor siting of camps ñ health problems caused by the pollution where the camp is located ñ is forcing the government and international organisations to move camps to other safer places.

There has been a positive tendency in cooperation with environmental authorities in the last few weeks, which has resulted in a minimisation of further environmental impact. For example, there are cases where construction of camps within protected areas and reserves has now been avoided.

In general, the environmental impact of the first month was much greater in scale compared to the last weeks of April and May. The more massive camps have caused large environmental impacts in soil fertility, sewage waters, waste and pollution of different kinds. However, the camps and collective centres constructed and managed by NATO's military forces have caused less environmental impacts in the long run compared with those managed by some international organisations.

Collective centres have also had less environmental impact compared to tented camps due to their smaller number of refugees and because they are permanent constructions and consist of a minimum of facilities and infrastructure.

Other anticipated environmental impacts are related to engineering works for building military bases (Rinas airport, 25km from Tirana), Kukes (In Yugoslavia/Albania border). There is no data available for their environmental impact as yet.

### **6.3. Bulgaria**

So far there have been no measurable effects of the conflict on the Bulgarian environment. Bulgaria's monitoring system has reacted swiftly to the concerns raised by the population. However, there is still a concern for transboundary pollutants along the Danube River. Monitoring should continue over a period to assess any possible long-term trends. The government could then define any new priorities from this.

During the investigation for the project it was pointed out by the relevant environmental experts that the idea to collect, compare and incorporate the data from all potentially affected parts of the country is very pertinent. This approach should be implemented in the years ahead. It will assist the country in the cases of industrial accidents and other environmental disasters.

### **6.4. FYR Macedonia**

For FYR Macedonia, some calculation of the urgent needs are mentioned in this report, but these are only the most pressing needs. During this short three month period, there is obvious and visible damage in nature, the human environment and the urban environment, as well as an overloading of capacities that cause environmentally negative impacts. The main threats identified are sewage, water and health impacts from the camps. However, it has not yet been possible to reflect on potential transboundary impacts. Measures to address these, and any underlying trends, should be developed by all parties. That work will include not only government and international help, but also the commitment to involve NGOs and local communities.

This preliminary research only shows that more detailed further analyses and studies are needed to get the true picture of the actual situation of environmental damage. This is to enable the preparation of steps for remediation of the damage caused. This further study should also identify the solutions and financial costs for remediation of the damage. In the beginning of the military conflict, the government of FYR Macedonia offered to host a

maximum capacity of 20,000 refugees in the country. The refugee population of 273,770, as of June 9, is more than 10 times higher than the offered capacity. This has caused a misbalance in the whole community, including an environmental one. This environmental misbalance will probably be visible for some time after the conflict is over.

## **6.5. Romania**

The environmental impacts measured in Romania so far include a number of days of acid rain. This is to be expected, as the Romanian border with Yugoslavia is the closest among all the neighbouring countries to the main industrial targets. What is still missing, however, is evidence of effects on the transboundary waters and an analysis of what this could mean in the long-term.

Priorities for Romania would seem to be:

- Improved monitoring system, and a period of monitoring to assess the long-term risks.
- Using the results of monitoring to design plans on ameliorating the pollution impacts on the environment and the public.
- International support for assisting in any environmental clean-up.

## 7. Appendices

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## **7.2. Protected Areas in Yugoslavia**

An overview of protected areas and areas planned for protection in Yugoslavia until 2010.

1. Gornje Podunavlje (Upper Danube) area
2. Suboticke forests
3. Selevenj-Palic-Ludas complex:
  - 3a) Selevenj steppe
  - 3b) Ludas lake
  - 3c) Palic lake
4. Zobnatica forest and stud farm
5. Karadjordjevo complex
  - 5a) Bukinski Rit swamp
  - 5b) Karadjordjevo forest and hunting area
6. Fruska Gora Mt.
7. Bosut-Zasavica complex
  - 7a) Bosutske forests
  - 7b) Zasavica channel
8. Obedska Bara pool
9. Titelski Breg hill
10. Ponjavica
11. Deliblatka Pescara sends
12. Vrsacke Planine Mts
13. Uzdinska Suma forest
14. Carska Bara pool - Stari Begej channel
15. Hajducica park
16. Rusanda pool
17. Slano Kopovo marshes
18. Sokolac park near Becej
19. Pastures of Large Bustard near Mokrin
20. Koviljsko - Petrovaradinski Rit swampy area
21. Cer Mt.
22. Trsic village
23. Orlaca pool
24. Avala Mt.
25. Djerdap (Iron Gate, Danube)
26. Bukulja hill
27. Gradac river and gorge
28. Valjevske Planine Mts
29. Rudnik Mt.
30. Deli Jovan Mt.
31. Kucajske Planine Mts.
32. Tara Mt.
33. Ovcarsko - Kablarska gorge
34. Rtanj Mt.
35. Ozren Mt.
36. Djetinja river and gorge

37. Zlatibor Mt.
38. Mucanj Mt.
39. Goc Mt.
40. Jastrebac Mt.
41. Sicevacka gorge
42. Suva Planina Mt.
43. Stara Planina - Vidlic Mt.
44. Jerma river and gorge
45. Zlatar Mt.
46. Uvac river, gorge and reservoir
47. Pester plateau
48. Golija Mt.
49. Kopaonik Mts.
50. Southern Kopaonik Mt.
51. Radan Mt.
52. Kukavica Mt.
53. Grdelicka Klisura gorge
54. Vlasina reservoir and plateau
55. Lipovica Mt.
56. Gazimestan monument
57. Grmija hill
58. Presevo region
59. Tikvara pool
60. Ratna Ostrva islands
61. Radujevac section of Danube river
62. Prokletije Mts.
63. Begecka Jama pool
64. Trešnjica hill
65. Jegricka swamp
66. Durmitro Mt.
67. Tara river watershed
68. Biogradska Gora Mt. and Biogradsko lake
69. River Piva gorge
70. Djalovica Klisura gorge
71. Lovcen Mt.
72. Mirusa river and gorge
73. Pcinja river valley

### **7.3. Industrial Targets in Yugoslavia, before June 5, 1999**

1. Fertilizer plant (Nitrogen Processing plant DP HIP AZOTARA), Pancevo
2. "Zastava" car factory in Kragujevac
3. Petrochemical industry "DP HIP PETROHEMIJA" Pancevo
4. Oil Refinery in Pancevo
5. Oil Refinery in Novi Sad
6. "Krusik" holding corporation in Valjevo
7. Fuel storage in Lipovica, which caused extensive fire in the Lipovica forest
8. "Beopetrol" fuel storage in Belgrade
9. "Beopetrol" fuel storage in Bogutovac
10. Fuel storage of the boiler plant in Novi Beograd
11. Chemical industry plant "Prva Iskra" in Baric
12. "Sartid" still works, Smederevo
13. Fuel storage plant in Prahovo

14. RTB Bor ñ mining and metallurgical complex
15. "Jugopetrol" fuel installations in Smederevo
16. Thermo-electric power station/boiler plant in Novi Sad
17. "Jugopetrol" storage in Sombor
18. Fuel storage "Naftagas promet", located 10 km from Sombor
19. Naftagas" fuel storage between Conoplja and Kljaicevo (Sombor)
20. "Beopetrol" fuel storage in Pristina
21. Jugopetrol fuel storage in Pristina
22. Jugopetrol petrol station in Pristina
23. Fuel storage in Gruza, near Kragujevac
24. PIK "Kopaonik" in Kursumlija - agroindustrial complex;
25. PIK "Mladost" in Gnjilane-agroindustrial complex
26. Agricultural Complex "Malizgan" in Dolac;
27. Agricultural Complex "Djuro Strugar" in Kula;
28. Agricultural and food-processing plant and a cow-breeding farm with 220 milk cows "Pester", in Sjenica, have been destroyed
29. Power supply system Kolubara,
30. Power supply system Kostolac
31. Power supply system TENT-Obrenovac
32. Water supply lines (Novi Sad, Zemun,Sjenica etc.)
33. "Zdravlje" pharmaceuticals in Leskovac
34. Pharmaceutical company "Velafarm" in Nis
35. "Sloboda" household appliances factory in Cacak
36. "Din" tobacco industry in Nis
37. "Div" cigarette factory in Vranje
38. Production line of the tobacco factory "Nis" in Nis
39. "Elektrotehna" warehouse in Nis
40. Food storage facility "Fidelinka" in Nis
41. "14 Oktobar" machine factory in Krusevac
42. Metal factory "Metalac" in Kursumlija
43. "Ciklonizacija" in Novi Sad
44. "Tehnogas" in Novi Sad-production of technical gases
45. "Novograp" in Novi Sad-construction company
46. "Gumins" in Novi Sad
47. "Albus" in Novi Sad ñ chemical plant
48. "Petar Drapsin" in Novi Sad
49. "Motins" in Novi Sad
50. "Izolacija" in Novi Sad-civil engineering company
51. "Novokabel" in Novi Sad-cabel factory
52. "Istra" fittings factory in Kula
53. The river port of Bogojevo
54. "Nova Jugoslavija" printers in Vranje
55. "Furniture factory "Simpo" in Vranje
56. Textile industry "Jumko" in Vranje
57. Wood-processing complex "27. November" in Raska
58. Plastic tubes factory in Urosevac
59. "Milan Blagojevic" chemical plant in Lucani
60. Plastics factory in Pristina
61. Cotton yarn factory in Pristina
62. Shock-absorber factory in Pristina
63. Surface coal mine "Belacevac"
64. "Binacka Morava" hydro construction company in Gnjilane

65. Cigarette factory in Gnjilane
66. Battery factory in Gnjilane
67. Industrial complex "Dvadeset Prvi Maj" in Rakovica
68. "Dijana" shoe factory in Sremska Mitrovica
69. Machine building plant "Industrija Motora Rakovica" in Rakovica
70. Factory "Jugostroj" in Rakovica-industrial refrigerators
71. Factory "Frigostroj" in Rakovica-industrial refrigerators
72. "Lola Utva" agricultural aircraft factory in Pan?evo
73. "Elektronska industrija" factory in Nis
74. "Jastrebac" machine industry in Nis
75. Facilities of the "Beograd" rail company in Nis
76. Construction material depot "Ogrev Invest" in Nis
77. General merchandise depot "Kopaonik" in Nis
78. Industrial facilities in Vrbas
79. Machine industry in Nis
80. Office building of the company "So Produkt" in Nis
81. Factory of dyes and lacquers "Pomoravlje" in Nis
82. A plant of Factory of dyes and lacquers "Limit Duga" in Prizren
83. Warehouse "Energogas", Nis
84. Plant "Naftagas", Cacak
85. "Energogas" energy plant near Jagodina
86. Fuel depot in Gruza near Kragujevac
87. Agricultural Complex "Majevica" near Sombor
88. Agricultural Complex "Progres" in Prizren;
89. Comercial Orchard "Vocnjak plantaza" in Urosevac
90. Repair-technical Company in Cacak
91. Factory for termotechnical equipment "Cep" in Cacak
92. Factory "Radioton" in Lipljan
93. Rubber industry "Rekord" in Belgrade
94. Group "Zastava" in Kragujevac
95. Factory for sutting tools in Cacak
96. Textile factory "Kosovka" in Kosovo Polje
97. Textile factory "Titek" in Murino near Plav
98. Textile factory "Trikortaza" in Raska
99. Metalworks "Feronikl" in Glogovac
100. Korporation "Trajal" in Krusevac
101. Enerprise "Jugotehnika" in Nis
102. Factory "Betonjerka" in Nis
103. Meat industry "Juhor" in Jagodina
104. Section of "Hidrotehnika" company in Cacak
105. "Ramiz Sadiku" company in Prizren