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1 General Considerations

Biodiversity is the very foundation of human life. Biological diversity is therefore the total variability of life on Earth and essentially refers to the variability of plants, animals, micro-organisms and ecosystems in which they occur. Starting from ecology (the study of relationships between organisms and their biotic and abiotic environment) ecological diversity study refers to the number of species in a given area, the ecological roles such the species will play, how the species composition will change and move within the region, and how species are grouped (ecosystems) in a certain area, together with the processes and interactions that occur within and between such systems.

Biodiversity is variability of living organisms from any source or ecological system, including intra-species diversity and ecosystem diversity. Biodiversity may be sub-divided, so as to refer to the biodiversity of a country, a region, an ecosystem, or a group of organisms, and even of a single species.

Biodiversity may be quantified, so that species extinction, loss of ecological associations, or loss of genetic variability in the depleted species may be recorded as loss of biodiversity.

New elements of life – obtained through mutation, natural or artificial selection, speciation, biotechnology or ecological multiplication – may be seen, on the other hand, as biodiversity gains.

1.1 National Setting

Due to the particularities and exceptional diversity of relief, Romania’s flora and fauna are of exceptional value. The number of identified species is very large, in relation to the area of its territory and compared to the situation of other European countries.

Most of the national territory is still unknown from the point of view of flora and/or fauna composition. Very few areas are relatively well-known in regard to some groups, and these generally include sites placed under an early protection status: The Danube Delta, the Retezat Mountains, or places that have always attracted nature scientists due to their eco-climatic characteristics, such as Cerna Valley, or sites in southern Dobrudja.

However, whole regions are still to be included in systematic taxa research studies, where only sporadic observations have been recorded.

Based on the existing data, more than 3800 plant species, more than 35,000 invertebrate species, and about 700 vertebrate species have been identified to date.

For some groups, proposals have been made to include them on Red Lists, but such an internationally recognized document is still not available, in spite of recent publications on vertebrate species (The Red List of Vertebrates in Romania) or the many Red Lists of Plants in Romania, etc.

According to the legislation, more than 700 species of flora and fauna are under some protection regime, strict for some, but rather theoretical for others.

1.2 Regional Setting

Romania is an area of overlap for many specific areas of distribution of plant and animal species of high bio-indicator value. Thus, Romania is at the crossing point of important biogeographical areas, with evident regionalization in which the Carpathian Mountains play a key role.

Regional climate aspects overlap with bio-geographical particularities to make the Western Carpathians a unique zone.

The main European bio-geographical areas encountered in the country include: The Pannonian area (in the west, the Western Plain), the Continental area, descending along the Carpathian arch, from higher elevations, an important route of Siberian elements into Europe, the Ukrainian Steppe area, in the north/east and east of the country, and the Pontic...
Because of the peculiar configuration of Aries Valley, from a bio-geographical perspective, the central part of the Western Carpathians, or Apuseni, acts like a closed corridor, where southern elements that penetrated the southern sectors of the Carpathian arch, in their north-western migration, became “trapped”. The existence of patches of steppe, around some of the chalky massifs, allowed the preservation of warm and dry habitat loving insects. Such areas act as catalysts of the speciation processes. Population isolation and the effect of specific ecological factors have determined the appearance of distinct forms, even subspecies and species of flora and fauna, different from the panmictic populations. Thus, the whole of Aries Rive Basin is a natural asset of particular scientific value.

**Figure 1.1. Bio-Geographical Areas of Europe**

![Map of Bio-Geographical Areas of Europe](image-url)
2 Approach

In order to provide sufficient information for an environmental impact assessment, and biodiversity impact in particular, a complex approach was adopted, involving both traditional investigation practices and the more modern technologies, including RSII – aerial photograph (Remote Sensing Imagery Interpretation) and satellite images interpretation, GIS, respectively.

Traditional biodiversity investigation practices include:

- vegetation transect analysis;
- vegetation cover assessment based on the Braun-Blanquet method;
- UTR vegetation bioform analysis;
- free (acoustic and visual) observation for flora and fauna inventories in randomly selected areas;
- inventories of natant and bentos aquatic fauna using trawls, drags, sieves, filters, nets, etc.
- use of (light, Malaysian, Barber, etc.) traps and nets for the assessment of fauna (especially invertebrate) species
- use of non-lethal (light) traps and nets for the assessment of vertebrate fauna (especially small species)
- footprint assessment and monitoring (especially for large vertebrates);
- interviews and questionnaires for the local population for the assessment of common species, including for historic data;
- review of literature focusing on the study area, etc.

Figure 2.1. Multi-spectral analysis of a perimeter within the study area to identify forest vegetation

Modern biodiversity investigation practices include:
multi-spectrum interpretation of satellite imagery (Fig. 2.1);
overlay of topographical references on a Stereo '70 grid;
reambulation and detailing of satellite imagery using aerial photograms;
habitat analysis based on satellite imagery and high resolution aerial photograms (1 px. = 0.112 m); = 0.112 m);
project development in GIS.

2.1 Hydro-biological Approach (aquatic flora and fauna and biotic indicators of water quality)

2.1.1 Sampling methods

Both qualitative and quantitative sampling approaches were used. Three quantitative replicate samples and one qualitative sample were collected at each station. The objective of the qualitative sample is to make site comparisons to determine the presence or absence of benthic invertebrates having varying degrees of tolerance to pollution and to obtain information on the richness of taxa, at family level. Quantitative methods essentially provide an estimation of the abundance of the various components of the invertebrate community per unit area.

A Surber sampler with a mesh size of 0.25 mm was used for sample collection in flowing water systems. A stovepipe-type device was used for sampling in lakes. This is the only quantitative device suitable for sampling shallow-water habitats (Klemm, 1990). After collection, all samples were fixed in the field with 4% formalin. Samples were sorted in the laboratory and invertebrates were stored in 70-80% ethanol.

Several lake and pond sampling stations were also established at locations accessible from shore. At each sampling station the following physico-chemical parameters were recorded: substrate type, current velocity, depth, water temperature, alkalinity, pH, hardness, and dissolved oxygen.

Fish were reported in several of the lakes near the towns of Roșia Montană and Corna, but no formal surveys (seine nets, fishing, or electroshocking) were performed during the baseline investigation.

2.1.2 Data analysis

Biological impairment may be caused by several major factors such as organic enrichment, habitat degradation, or toxicological effects and may be manifested in several aspects of the benthic macroinvertebrate community. There are numerous methods of data analysis and interpretation that have been developed based on biotic communities to indicate water quality, however, the following indices have been selected and calculated to provide a wide range of baseline information necessary for this survey.

Taxa Richness is simply the total number of taxa (total number of families) present. In general the diversity of macro-invertebrates decreases as water quality worsens. However, variability, in natural habitat also affects this number.

The EPT Family Richness is the total number of distinct taxa within the general pollution – intolerant orders Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddis...
flies) collectively known as EPT. These organisms are more sensitive to low concentrations of dissolved oxygen and high concentrations of metals or natural organic compounds than many other types of benthic invertebrates. Thus a high EPT Richness represents a healthy community balance and favourable biotic conditions.

As a guideline, EPT Richness numbers should be greater than 10 in good quality water and habitat.

The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups (Ephemeroptera, Plecoptera, Trichoptera, and Chironomidae) as a measure of community balance. Good biotic conditions are reflected in communities with even distribution among all four major groups and with substantial representation in the groups Ephemeroptera, Plecoptera and Trichoptera which are considered sensitive to pollution.

Inbalanced populations, with a disproportionate number of Chironomidae in relation to more sensitive insect groups indicate an environmental stress (Ferrington 1987, Shackleford 1988, and Plafkin 1989). Chironomidae tend to become more dominant as a percentage of taxa composition and relative abundance on an increasing gradient of heavy metal enrichment (Ferrington 1987 and Plafkin 1989).

Hilsenhoff Biotic Index (HBI) uses the number of benthic invertebrates in the Phylum Arthropoda at a sampling location and their tolerance to pollution to evaluate the degree to which organic compounds are likely to be present. Each benthic invertebrate is assigned a tolerance value of 0 to 10, with 0 assigned to invertebrates least tolerant of organic pollution and 10 assigned to invertebrates most tolerant to organic pollution.

The HBI is divided into seven categories, ranging from excellent to very poor. A low HBI value indicates excellent water quality with little or no organic pollution and a high value indicates a poor water quality and higher organic pollution.

The formula for calculating the Biotic Index is:

\[
HBI = \sum \left( \frac{x_i \times t_i}{n} \right)
\]

where:
- \(x_i\) = number of families
- \(t_i\) = tolerance value of family (0–10)
- \(n\) = total number of arthropods in a sample.

The Index of Similarity (S) between two samples has been used to determine whether shifts in community assemblages have occurred along a stream gradient or above and below a pollution impact. The Index of Similarity can also be used as a quality assurance tool when evaluating variance in community assemblages between two control or reference sites and is expressed as follows:

\[
S = 2 \frac{C}{A+B}
\]

where:
- \(A\) = number of species in sample 1
- \(B\) = number of species in sample 2
- \(C\) = number of species common to both samples.

### 2.2 Forest Stock Study Approaches

The ICAS database was used for location, environmental and vegetation conditions, the current state and evolution of tree stands over more than 30 years, the game resource dynamics, economically viable species, etc. for the national forestry stock on the Project site and in the...
area surrounding it. Information was collected from forestry management units in the study area (Alba Forestry Directorate, state and private forestry units), hunting ground administrators (AJPS Alba, AJPS Campeni) and the local government units (Alba County Council, Mayors’ Offices) Romanian and international literature was consulted on the regional ecosystem biodiversity, studies of flora and fauna specific to Rosia Montana area, with the relevant national and international legislation in force.

To provide transparency and facilitate decision making by the stakeholders, and to provide a totally objective assessment of both impact during implementation and of efficiency of the measures included in the Biodiversity Management Plan, special emphasis will be placed on establishing a biodiversity database on GIS support, to be linked to the national Biodiversity Information Management System (BIMS), which was developed under specific programs initiated by the Ministry of the Environment and Water Management and developed by the “Danube Delta” National Research and Development Institute in cooperation with a number of national specialist institutions.

2.3 Foliar Diagnostic Analysis Approaches

The method used in determining micro-elements (Zn, Cu, Fe, Mn, Mg) is the “European Standard Method – dry digestion, hydrochloric acid dilution and identification by means of Atomic Absorption Spectrophotometry” The method was applied to conifer leaves (growth of 2005), harvested in February 2006 from the Rosia Montana site.

2.4 Terrestrial Flora Study Approaches

The project area was initially evaluated using information collected in 2001 as part of a preliminary survey. That information included a general overview of ecosystems and vegetation communities, the results of a floristic survey, as well as the fauna and aquatic ecosystems assessment.

The background document contained maps of vegetation patches in the project area. The maps were generated through an interpretation of the available air photo coverage, and were supported by limited field sampling. Because of the preliminary nature of the survey, limited areal scope, and late-season timing of the sampling, an additional field program supplemented this preliminary survey. This program was based on the following principles: carry out a complete three season (spring, summer, fall) inventory of the flora and vegetation; identify and delineate the vegetation patches at the highest possible level of detail; spatially, cover the entire project area through groundtruthing of as many patches as possible; and support the vegetation descriptions and map by plot sampling in representative locations. The vegetation and land use polygons were initially delineated through an airphoto interpretation of the low-level orthographically-corrected colour photos. This resulted in the preparation of a preliminary map showing the major cover types, such as forest (deciduous, mixed, coniferous), meadow, sparsely vegetated areas, and various complexes incorporating mixtures units, impossible to define on an individual basis. At that stage, the more precise differentiation of patches, based on dominance of individual species (e.g. beech vs. hornbeam, fir versus spruce) was not possible.

The preliminary vegetation map was subsequently used as planning tool to develop a field sampling program. The project area was subdivided into more or less homogeneous landscape sections to be surveyed on the ground. Examples of such landscape units include: Corna
Valley (eastern and western slopes) Rosia Valley (southern and northern flanks), severely impacted areas, etc. The stratification was then used to establish transects of the sections on dominant directions. The overall goal was to identify and sample as many vegetation patches and types as possible, that would represent the observed spectrum of ecological variability within the project area. Plots were therefore sampled in a range of conditions, such as various topographic situations (e.g. upper, middle, lower slopes, level areas; valleys, lakesides, etc.), moisture types (e.g. dry, mesic, wet), microclimate types (normal, cooler than normal, warmer than normal), soil types (e.g. mineral, organic), and land use types (e.g. heavily grazed, ungrazed). Emphasis was placed on sampling, describing and analyzing those areas that will be the most affected by mining operations, however, in their geographical distribution an attempt was also made to spread plot locations so that the entire project area received coverage.

Fieldwork was carried out during three sessions: Spring (June 11–17, 2003), Summer (July 21–29, 2003), and Fall (September 24–29, 2003). Representative patches were initially visually assessed for their site and vegetation characteristics. Following this, a plot site was selected based on homogeneity of topography, soil, vegetation structure and species composition. The plot size depended on the type of communities, varying from 5-10 m² for herbaceous types, to 200-400 m² for forests. Photographs of representative community types were taken.

The sampling protocol followed the generally accepted standards, which consisted of:

- plot successive number;
- date;
- general location;
- detailed location, including GPS reading;
- vegetation type;
- site characteristics (soil, moisture, drainage, slope, exposure, etc.)
- vegetation structure (layering, height, dominance, tree dbh);
- presence and size of woody debris;
- complete floristic list with cover-abundance values for species, using the Braun-Blanquet scale;
- current land use and disturbance factors (e.g. grazing, mowing, access, logging); and,
- overall assessment of the vegetation.

During sampling, the draft vegetation map was being continuously updated, based on the observed vegetational patterns and characteristics of specific areas. Polygon labels were finalized and polygon boundaries were corrected and/or defined. Wherever possible, patches were identified at the vegetation type level to ensure accuracy. However, in many instances, current land use and disturbance history have resulted in communities that could not be described and labelled consistently.

A floristic list of the study area was initiated based on the existing reports. The list was being continually updated based on new findings, both during plot sampling and during traversing between the plots as additional species were observed. Species that could not be keyed out in the field were collected as voucher specimens for identification.
2.5 Terrestrial Fauna Study Approaches

Bird and other terrestrial vertebrate surveys were undertaken in May, June, July and August of 2003. The bird survey made use of the transect method. Each transect contained at least one habitat type. Ten transects were studied in all. The ten transects are described as follows:

1. Mixed forest dominated by fir (*Abies alba*) a few deciduous trees and shrubs, such as sycamore maple (*Acer pseudoplatanus*), European mountain-ash (*Sorbus aucuparia*), hazel (*Corylus avellana*), birch (*Betula pendula*), honeysuckle (*Lonicera nigra*), rose (*Rosa canina*) and hawthorn (*Crataegus monogyna*). At the forest boundary, a small lake of approximately 0.25 ha is present. The transect encompasses both the margin and interior of the forest.

2. pasture with small tree clumps (maximum 0.25 ha), of mainly black alder (*Alnus glutinosa*), aspen (*Populus tremula*), European elderberry (*Sambucus nigra*) and goat willow (*Salix caprea*). In some places the saturated soil favoured wetland vegetation. Mixed forest edge on the Ghergheleu hill base.

3. Corna Valley: pasture with small coniferous and deciduous tree patches of maximum 1 ha, alternating with field crops. Beech Forest (*Fagus silvatica*)

4. From Roșia Montană to Taul Mare: orchards alternating with deciduous woodlots.

5. Jig-Vaidoaia Pasture to Tarina – Roșia: overgrazed pastures and clumped shrubs of hawthorn (*Crataegus monogyna*, rose (*Rosa canina*), and black thorn (*Prunus spinosa*). 

6. overgrazed pastures and clumped shrubs of hawthorn (*Crataegus monogyna*, rose (*Rosa canina*), and black thorn (*Prunus spinosa*). 

7. Orlea area: pastures and tree rows, natural regenerated forest with young birch (*Betula pendula*) and heath (*Calluna vulgaris*) and shrub patches.

8. Taul Tapului – Roșia Montană area: ungrazed secondary meadows, small forest patches; small lake with small bur-reed (*Typha sp.*) patches.

9. Vârtop Valley: interface between spruce and deciduous forests and pasture areas.

10. Localities: backyards, gardens, and several empty houses.

All birds observed within an approximately 100 metre wide strip of a transect line were recorded. Transects were censused between 7 and 12 a.m. and again between 6 and 9 p.m., at slow uniform speed. Birds were identified acoustically (by songs or calls) or visually (through binoculars), using the Svensson field guide (Mullarney, Svensson et al., 1999). For each observed individual, additional information concerning the breeding status (i.e. territorial behaviour and song, juvenile presence) was recorded.

Mammals surveys were carried out concurrently with the bird surveys. Direct and indirect observations, such as scats or footprints were used. For small mammals, traps were used to collect live specimens. Overnight captures were recorded, then the animals were set free. In addition, records of mammal presence were provided by the Campeni Hunting Department. Chiropters were surveyed by the specialists in direct observations, inspections of the roosting places (crevices, holes in the rocks, tunnels) and nighttime research, using the transect method for various habitats, and sonar detectors.

Amphibians and reptiles were likewise surveyed during the bird field work. Direct (by sight and song) observations of adults were carried out early morning and late evening. Tadpoles and larvae present in lakes and amphibian breeding pools were collected using nets.
3 Baseline Conditions

3.1 Information on the Study Area Biotopes; Overview of the Vegetation

The two types of existing vegetation types appear well differentiated: nemoral and eremial formations, respectively, which, according to Cristea (1993) belong in three major vegetation tiers from a phytocoenologic point of view:

The most wide-spread sub-tier (more than 60%) is that of beech and mix forests, followed by the spruce sub-tier (more than 35%). To a lesser extent, on isolated areas, no more than 5% of the total, around the highest peaks, vegetation of the sub-alpine tier has developed (Fig. 3.1).

According to earlier botanical studies [St. Csuros, 1972], the primary vegetation of the Aries River Basin, along the watercourse was predominantly water-loving tree species, grouped into specific associations, e.g.: Salicetum purpurae or Salicetum triandrae which, depending on the size of the floodplain, would cover more or less extensive areas. The species growing in such riverside forests included: Salix alba, S. fragilis, Populus alba, P. nigra, P. tremula, Alnus glutinosa, A. imcana.

Grasses (alliances of Nanocyperion and Polygonochenopodion developed in areas of gravel, sand, or loamy sand, only exposed during minimum flow periods (July-September). Where conditions allowed it, especially on the lower reaches of the Aries, reed- (Scirpo-Phragmitetum) dominated associations would develop, interspersed or bordered by water loving bushes.

On the sites of floodplain forests, secondary grass associations developed, in care, with characteristic species including Carex (C. acutiformis, C. riparia, C. gracilis, C. inflata etc.) and graminaea (Molinia coerulea, Deschampsia cespitosa, Poa trivialis, Agrostis alba, A. tenuis, Alopecurus pratensis, Festuca pratensis, F. rubra, Poa pratensis, Trisetum flavescens, Agropyrum repens, Arrhenaterum elatius etc.).

3.1.1 Nemoral formations:

In the sub-tier of the beech forest (lower and middle mountain tier) zonal wood associations may be distinguished, such as beech woods with black burr (Symphyto cordato-Fagetum Vida 1959), developing on moist, slightly acidic-neutrophyle soils. On slopes, with acidic, leached soils, the so called “Dacian beech stands” (Hieracio transsilvanico - Luzulo-Fagetum Soo (1951, 1962) have developed the distinct species of Transylvanian hawkweed (Hieracium transsilvanicum).

Under similar aedaphic conditions, but more moist and with more “moder”-type humus, beech and fescue stands (Festuco drymeiae-Fagetum Morariu et All. 1968) develop. On narrow, shady and moist valleys, grasses are dominated by hart’s tongue and other mesohygrophyle species, and beech stands are are found in associations of Phyllitidi-Fagetum Vida (1959, 1963).

Dominant bushes include hazel (Coryletum avellanae Soo 1927), and aedificated ones are dominated by meadow sweet (Spiraeetum ulmifoliae Zolyomi 1939).
The middle mountain or mix forest tier include a veritable ecotone belt of passage to conifer forests may have natural (primary) or anthropogene origins, if resinous species (spruce, fir) infiltrated beech cuttings. In stations of high relative humidity, nemoral associations are of the Pulmonario rubro - Abieti-Fagetum (Knapp, 1942) Soo, 1964 type, and relatively warmer and shady locations, they are of the Chrysanthemo rotundifolio-Piceo-Fagetum Soo 1964 type. Grass associations in the lower and mid-mountain tier frequently include bentgrass (Agrostis tenuis) and vernal grass (Anthoxantum odoratum) or red fescue (Festuca rubra), rye grass (Lolium perene), crested dog’s tail (Cynosurus cristatus) etc. The upper mountain sub-tier, also known as “spruce”, considered as a separate (boreal) tier, is characterized by pure spruce stands (Hieracio transsilvanicae-Piceetum Pawl et Br. – Bl. 1939 em. Borhidi 1957), developed especially on moderately moist soils.

Toward the upper limit, spruce stands acquire a distinctive look in the gradual assertion of juniper (Juniperus communis). Associations with Oxalo-Piceetum abietis (Brezina et Hadac 1962), develop in stations of shallow and dryer soil, and along the valleys, in conditions of higher moisture, associations of the Chrysanthemo rotundifoliae-Piceetum type (Krajina 1933). Where excess water is retained, a rich bryophytic layer develops, dominated by peat moss, in associations of the type Sphagno-Piceetum abietis Brezina et Hadac 1969). Thickets occur mainly along the valleys, in aedificated associations of red elder (Sambucetum racemosi (Noirf. 1939, Oberd. 1973) or raspberry (Rubo-Epilobietum Hadac et all 1969), but also in forest clearings and cuttings (Fragario-Rubetum (Pfeiffer, 1936, Siss., 1946 sau Campanulo-Vaccinietum myrtilli (Boșcaiu, 1971)
Grass vegetation is dominated by aedificated associations of red fescue (*Festuca rubra*) fescue (*Nardus stricta*), and in overgrezed areas species including *Calluna vulgaris* or *Carex sp.*

Important areas of rock outcrop in this sub-tier host a number of micro-habitats preserving some of the ice-age elements (Fig. 5). The alpine sub-tier is only sporadic in the Apuseni Mountains, near peaks over 1700 m high. The lower limit overlaps with spruce clearings.

![Figure 3.3. Detail of a cliff synusy.](image)

Common juniper is encountered in such areas in associations of Vaccinio-Pinetum mugi Hadac 1956, Jenik 1961.

Of special interest in the Apuseni Mountain area are thermal inversion events that determine the "reversal" of certain vegetation tiers; spruce stands appear on the valley bottoms (moister), and while pure beech and beech association stands are maintained on the slopes. Such situations have been frequently encountered in the study area.

### 3.1.2 Eremial formations:

The lower and middle mountain tier are dominated by grass formations of the hay meadow and meadow variety in traditional use (Fig. 3.4 - 3.5).

This tier is interspersed with "islands" of azonal vegetation of the xero-thermophile type. Typical in this respect are the meadows on the southern slope of the Turda Canyon ("Emil Pop Slope), those at the foot of Piatra Secuiulu (Rimetea), or those in the Runcu Canyon area.

Meadow structure is characterized by high specific diversity, with sometimes spectacular specimens that, on the whole, in point of color, may be considered the most beautiful in the country [Cristea, 1993].

Typical associations include: Hypochoerio radicatae – Agrostietum tenuis Pop et all. 1989, and Scorzonero rosae – Festucetum rubrae nigrantis (Pușcariu et all. 1956, Coldea 1987). In their regressive evolution, these meadows may evolve toward broom weed (Agrostio – Genistelletum Boșcaiu 1970), xero-nardets (Hieracio posellae – Nardetum strictae Pop et all. 1989), hygro-nardets (Carici – Nardetum strictae Resm., 1984, et Pop 1986) or toward strongly acidophile phytocoenoses, dominated by heath and bilberry (Vaccinio – Callunetum vulgaris Bük, 1942, with the sub-association bruckenthalietosum Coldea 1991, considered to be specific to the Romanian Carpathians).
4.6 Biodiversity


Outside these zones, particular conditions at odds with the general sub-tier features determine the occurrence of aedificated meadows of tall oat grass, hair grass, bluegrass, fescue, etc. The dominant meadows in the upper mountain tier are red fescue (Scorzonero rosae – Festucetum rubrae nigricantis (Pușcariu et al. 1956, Coldea 1987), but also associations such as Nardo – Festucetum rubrae Maloch 1933, that become degraded by overgrazing and evolve toward associations of Violo declinatae – Nardetum strictae Simon 1966, toward Vaccinio – Callunetum vulgaris Bük 1942, or Carici-Nardetum strictae Resm., 1984, et Pop 1986.

In the outcrop areas, associations are similar to those encountered in the lower and middle mountain tier. However, typical to this sub-tier are associations such as: Eriophoro vaginato – Sphagnetum recurvi – Magellanici (Weber, 1902) Soo, 1927, 1954, Sphagnetum acutifolii Pușcariu et al. 1956, especially in swamps or bogs.

The vegetation of the sub-alpine sub-tier appears in scattered islands in Apuseni Mountains, where grass vegetation is dominated by aedificated associations of hair grass, strongly infiltrated by fescue and red fescue meadows.

### 3.1.3 Local Setting

The study area site is located in an area of no major interest area for biodiversity.

This is due to multiple and very long term interaction between environmental and anthropogenic factors. If, for the whole of Romania, factors that impacted biodiversity were mostly related to agricultural activities, with industrial impacts only felt in the later half of the 20th century, in the Rosia Montana area, there is ambivalence of these two types of impacts.
In the Rosia Montana area, impacts on biodiversity were due to both agricultural and historic industrial activities. Note the ambivalence of this impact generating combination. The existence of valuable gold, silver, and copper ore in the Rosa Montana area determined important human concentrations, of unusual density for the elevation – see Fig. 3.6.

Figure 3.6. Population density in Apuseni Mountains compared to other mountain areas in Romania

A significant population increase of population density is noted in Aries Valley, including Rosia Montana.

The industrial importance of the area triggered the need to develop remarkable logistic infrastructure, based on everyday needs (agricultural development an especially livestock breeding to provide protein and energy for the social category of the workers) and industries related to ore processing, with special emphasis on forestry to provide the materials (supporting beams, traditional mining installations, firewood, etc.). It is worth mentioning that selective harvesting of valuable species such as oak *Quercus robur* (that provides better strength to mining support infrastructure), beech *Fagus sylvatica* (providing high calorific firewood), and some resinous species, especially fir *Abies alba*, but also spruce *Picea abies* (providing timber for a variety of above-ground structures for industrial or related uses as well as agriculture, transport, etc.).

This led to a gradual invasion of hornbeam and less important pioneer species in forested areas, such as birch (*Betula pendula*) or hazel (*Corylus avellana*).

Following the unprecedented development of industrial branches in parallel with agriculture, it may be safely said that this is one of the most impacted areas of Romania, with severely affected biodiversity.

Due to anthropic activities involving natural resource use ever since ancient times, even before the Roman conquest, it is extremely difficult to identify zones that may have preserved some natural integrity, or any functional natural balance.
The discontinuities of the vegetation cover describe eco-geographic directions of evolution taken part from the continental, regional or local plane, like “slices” of the content represented by the primary vegetal producers. These “slices” are known as ecoclines (as defined by Stugren). Vegetal ecoclines are faithfully followed by the plant eaters, by direct action, and ultimately reflect the respective discontinuity wave over the whole biocenotic architecture.

In the study area, the vegetation cover is the result of interaction of natural and anthropogenic factors, bearing obvious effects of the multiple and strong impacts of the anthropogenic factor (see Fig. 3.7).

The natural factors that influence vegetation include abiotic and biotic influences. Among abiotic influences, the geological underlay plays the predominant role. However, in this area, the geological strata have been heavily disturbed by dislocation and exposure, sorting and disposal of geological material in the form of waste and tailings, further weathered and impacted by human factors and scattered on areas ranging from a few hundred square meters to several hectares. Thus, bio-indicator species can no longer be considered without including the disturbing effect of waste dispersal.

Apart from the geological underlay, a determining role is played by slope exposure and inclination (see Fig. 3.8). Following GIS interpretation of the slopes in the Project area, we noted the dominance of northern and north-western exposures, which are favorable to the development of particular ecological conditions for shade loving species.

Flat areas are almost totally absent, but there are some gentle slopes, of gradients up to 0.5 degrees, suitable for some crops, but they are limited to tiny areas, no larger than 0.1-0.2 ha. It may be said that, in this area, due to the orographic particulars, and considering the elevation tier in the primary layer, the typical vegetation used to be forest massifs of beech *Fagus sylatica*, mixed with resinous species, with more sparse oak stands. Also, among abiotic factors, an essential role is played by the environmental medium water. This medium plays a primordial role in the ecological dynamics.

Thus, for each of the catchments included in the Project area, a GIS model was developed for the Maximum Flow Accumulation areas in order to establish the strategic the potential...
wetland areas of the compensatory ecological network and potential protective structures against impact (especially by siltation) of valuable riparian or wetland habitats.

An analysis of the Maximum Flow Accumulation, overlain on the 3D model of the area will reveal the existence of a profoundly disturbed area at the centre of the Project site, exposing the discharge cones of torrential streams that have carried tailings from mining operations.
An overlay of satellite images reveals the existence of a site area with very poor, pioneer vegetation, that can withstand extreme ecological conditions (very good drainage encouraging xeric, oligo-trophic habitat types, considerable acidity of around pH5) of extreme scarcity in nature, limited to arid and semi-arid zones.

The very poor vegetation cover is limited to ruderal and adventive species, plus some introduced species, especially pine (*Pinus sylvestris*), resistant to the existing conditions and planted in an attempt to stabilize the waste piles and tailings ponds.

Another abiotic factor of major importance is temperature, which is closely related to slope insolation, and with the geological underlay, that may have an important buffering role. Slope exposure and valley orientation determine thermal inversion phenomena, evinced by the nemoral formations occurring surprisingly, with resinous species at the valley bottom and deciduous toward the tops of the slopes.

Such phenomena occur naturally in the Apuseni Mountains area, and have been identified in the study area, near the Rosia Montana Project site, in the Vartop forest body (u.a. 64 – 66, Table 1).

The existence of micro-climate islands is limited to the rock outcrop area near Taul Corna, where the vegetation has a mountain aspect with sporadic sub-alpine elements (Sedum album).

Of the biotic factors, the most important are inter-specific. Interaction between species shapes the natural habitats, normally following a rather clear succession, with the ultimate climax is a forest massif.
However, since natural relations between species in the area are extremely limited by permanent anthropogenic intervention, there is little point in referring to preservation of habitats in their natural state.

Extensive agriculture has determined total elimination of the open natural ecosystems, mostly preserved as agro-ecosystems, among which secondary meadows are the only valuable items in point of biodiversity.

Thus, the Project area may represent a classic example of interaction between natural and anthropogenic factors, that have placed a strong, long term impact, of a unique character at the national level, that has been ongoing for centuries and continues to be extremely aggressive in combining agricultural and industrial practices.
Figure 3.10. Influence of the anthropic factor on the ecosystems in Rosia Montana area – note the agro-system model, dominated by secondary meadows and the limitations of the forest matrix. The margin effect is dominant, conferring increased instability to the natural systems.

Figure 3.11. Percentage distribution of land use before the Rosia Montana Project

From the point of view of land use, the best represented categories are meadows and hay meadows, accounting for 60% of the land area (Fig. 3.11). The forest stock only accounts for 18% of the area, but forest vegetation of low productive value due to human intervention also exists elsewhere. They for the so called forested meadows of re-growth from stumps or bush aspect. Arable land covers a very limited area (1%) and the long industrial history made non-productive land account for 5 times the arable areas (5%). Therefore, for the present stage, we have chosen to identify major vegetal formations, for better overall
characterization, and especially for a good understanding of the issues related to future impacts on the site. The major vegetal formations identified are described in the following.

3.1.4 Agro-ecosystems

Agro-ecosystems are ecosystems that human intervention modified in an irreversible manner (in most cases) in order to practice agriculture, to satisfy human need for food, but also for economic reasons.

Gradually, the more complex ecosystems, such as forests, then primary and even secondary meadows, were irreversibly replaced by agro-ecosystems, the so-called artificial ecosystems, characterized, among others, by the fact that they involve extremely simplified food chains.

By replacing natural with artificial habitats (either agricultural or other), the biochemical cycle and the energy flow will sometimes undergo major negative changes, leading to serious imbalance in nature. Natural habitats, with more complexity, are much more resistant to degradation agents than artificial ones. Therefore, prudence is needed in changing natural ecosystems, and habitat change should be gradual, so that the biotic environment may adjust to the new conditions and respect the rights to existence of marginal areas within the anthropogenised regions, even be they merely samples or corridors.

It may be concluded that such agro-ecosystems, or natural systems impacted by human intervention may perfectly fit into the natural ecological balance, provided that, on some of the land, natural systems should be preserved, as they are the only means of maintaining regional dynamics.

3.1.5 Meadows

Meadows are extensive areas of land covered in greases, characterized by a large complex of species of plants from different families, typically dominated by perennial graminæa. Apart from the superior plant species, a meadow will also be characterized by inferior plants, micro-organisms and fauna. Specific inter-relations develop between the populations of diverse species, between the bioocoenosis and the physical and chemical factors of the environment, creating an overall functional unit, a characteristic ecosystem. Then types of meadows include:

Natural meadows where vegetation developed spontaneously, without human intervention. In their turn, they may be of two types: primary natural meadows, developed in regions where the climatic factors allowed the installation of forests on black, fertile, chernozyom soils, and secondary natural meadows only called natural because the vegetation developed spontaneously, in areas resulting from wood and thicket clearing.

Permanent meadows covering all the meadows, irrespective of origin or state of evolution at which vegetation developed spontaneously, and characterized by the permanence of vegetation.

Temporary (sown) meadows are meadows sown with perennial grass species or mix of species for variable periods of time, of usually 2-5 years.

Pastures and hay meadows, which are meadows used for either grazing or feed production, or both. In Apuseni Mountains, grazing alternates with haymaking; in spring meadows are used for grazing, while in summer, when the animals ar taken up the mountains, they provide a hay harvest, and in autumn, after the animals come back to the villages, they are grazed until the first snow.
3.1.5.1 **The Importance of Meadows**

The economic and ecological importance of meadows for humankind is significant, as:

- they are a source of food for the livestock;
- they provide habitats and a source of food for the wildlife;
- well developed meadow vegetation is a good means of soil erosion prevention and control;
- well balanced and diverse meadow vegetation will maintain good soil structure and fertility.

3.1.5.2 **Multi-functionality of the meadows**

Meadows are a fundamental biome of the biosphere. Their important capacity of storing atmospheric carbon is relevant for the process of climate change. Land covered by meadows has a major role in containing storm water, and they become veritable reserves of water which, together with the water contained by forest systems, is gradually returned to the environment in springs.

Another important aspect relates to the role of meadows in the great bio-geo-chemical cycles of the biosphere. In the case of the great nitrogen cycle, natural meadows used for grazing and haymaking, with a normal load per hectare, largely reduce nitrogen leachate and thus contribute to the maintenance of good quality groundwater.

From an ecological perspective, the main role of meadows is to maintain biodiversity. The use of natural meadows for grazing or haymaking is, paradoxically, a source of biodiversity, the land use enhancing the vegetation heterogeneity. In times like these, when human aggression on natural ecosystems is so intense, meadows play an essential role in maintaining the landscape.

3.1.5.3 **Meadows – a characteristic ecosystem**

Alongside forests and bush, meadows create characteristic biomes. One of these – primary natural meadows – is pioneer vegetation developing spontaneously, in parallel with the soil generation process. With the development of agriculture, new categories of meadows have been developing, with human intervention becoming ever more energetic, so that now they are rather a product of humans and the animals they breed. For all their diversity, meadow ecosystems have many features in common, which allows them to be treated consistently, based on the main characteristics.

3.1.6 **Aquatic Ecosystems (Water Bodies, Wetlands)**

The flowing and standing water systems, including the man-made lakes in the Project area are described below:

The source of the Roșia stream is Taul Mare to the northeast of Roșia Montană. Most of the existing mining operation is within the Roșia stream watershed. Four sampling stations were established on the Roșia stream including impacted and non-impacted areas: Roșia 1- upstream of the town of Roșia Montană, Roșia 2- the point where river enters the town, Roșia 3- in the middle of the Roșia Montană town, Roșia 4 – before flowing into Abrud River.

Tributaries feed the Abrud River from the Roșia Montană Valley, Corna Valley, Bucium Valley, and Vârtop Valley. The Abrud River flows north and joins the Aries River approximately 6 km north of the Roșia Valley confluence. One station for qualitative sampling was established on the Abrud River, downstream of its junction with Roșia stream.

Corna Valley is located south of Roșia Montană on the south side of the current mining operation. The Corna stream flows to the south-southwest into the Abrud River upstream of
the town of Abrud. Two stations were established on the Corna stream: one in Corna village and the other downstream of the village.

Saliste stream is a small stream to the west of the current mining operation. The upper portions of the watershed are relatively undisturbed. A tailing storage facility is located at the bottom of the watershed just upstream of the confluence with the Abrud River. One location upstream of the tailings facility was sampled for aquatic life and physico-chemical parameters were measured at one downstream location.

Vârtop Valley is located to the north of Roşia Valley and is relatively undisturbed except for logging activity along several sections. Two sampling locations were selected for use as a comparison to the disturbed valleys. Land covered by meadows has a major role in containing storm water, and they become veritable reserves of water which, together with the water contained by forest systems, is gradually returned to the environment in springs.

The Aries River is the receiving water for the Abrud River, into which all the sampled valleys flow. It flows to the east approximately 6 km north of the Roşia Valley. Two sampling stations were established on the Aries River, one upstream and one downstream of the confluence with Abrud River.

By analyzing the topographic maps the following types of aquatic ecosystems were identified as being possibly present in the general assessment area:

- streams;
- lakes;
- riparian wetlands; and,
- non riparian wetlands.

Most of the riparian wetlands were limited to the stream and lake ecotones. One riparian wetland in the Saliste Valley (upstream of the current tailing lake) is the result of a small-scale dam built in the past.

3.1.6.1 Mineral Shallow Marsh with Equisetum – Carex

SITE CHARACTERISTICS: In shallow water marsh habitats, on soft mineral substrates.

STRUCTURE AND COMPOSITION: Simply structured communities, dominated by *Equisetum fluviatile* and *Carex riparia*. Microtopography is hummocky, with open water between sedge tussocks.

DISTRIBUTION: Found only in a small, partially dug-out pond/depression south of Taul Mare.

SUCCESSIONAL STATUS: Closely related to either horsetail or sedge dominated marsh types into which it grades. A relatively stable community, provided water regime remains constant.

3.1.6.2 Mineral Shallow Marsh with Carex

SITE CHARACTERISTICS: At sheltered locations along the shorelines of lakes and ponds, in waters up to 40 cm deep, on soft mineral substrates, such as fine sand and silt. Often exposed to trampling by cattle. Cover small areas, 20 to 40 m² in size.

STRUCTURE AND COMPOSITION: Simply structured communities composed of a single herbaceous herb layer dominated by sedges (e.g. *Carex riparia*).
DISTRIBUTION: Pure sedge marshes are found at the southern shore of Taul Mare, while sedge-rush associations were observed in dug-out depressions located to the south of the lake. Often associated with other aquatic and marsh types.

SUCCESSIONAL STATUS: Community appears stable with water levels varying within the ecological range.

3.1.6.3 Mineral Shallow Marsh with Carex
SITE CHARACTERISTICS: Found along shallow water or exposed mineral substrates around lakes and ponds, with water depths up to 20 cm. Forms small patches, 10 to 30 m² in size.

STRUCTURE AND COMPOSITION: *Equisetum fluviatile* is the dominant plant in this simply structured community. Minor species may include *Polygonum amphibium* either floating on the water or trailing on exposed bottom, or scattered clusters of *Typha angustifolia* that overtops the main herb layer.

DISTRIBUTION: Observed along the south shoreline of Taul Mare.

SUCCESSIONAL STATUS: An amphibian type of community, between the purely aquatic types and terrestrial vegetation. Its composition varies in response to changes in water levels.

3.1.6.4 Mineral Shallow Marsh with Typha
SITE CHARACTERISTICS: Typically forms the first, emergent vegetation zone along lakes and ponds. Occurs in waters 30 to 60 cm deep, on fine mineral substrates. May cover larger areas (100-200m²) than the other marsh types.

STRUCTURE AND COMPOSITION: Composed of either narrow-leaved cattail (*Typha angustifolia*) or wide-leaved cattail (*Typha latifolia*) or their combinations. The main herb layer reaches 1.5-2.0 metres in height and few if any other species compose the community.

DISTRIBUTION: Best-developed associations are found along the south shore of Taul Mare, but smaller patches may occur as very narrow fringe communities along other lakes.

SUCCESSIONAL STATUS: The communities appear to be successionally stable as long as water levels remain within the ecological range of variability.

3.1.6.5 Sparganium ramosu) Organic Shalow Marsh
SITE CHARACTERISTICS: Along shorelines of lakes and in small depressions, in shallow water, on organic substrates.

STRUCTURE AND COMPOSITION: *Sparganium ramosum* is the dominant species, sometimes accompanied by small amounts of *Polygonum amphibium*, *Bidens cernuus* and *Alisma plantago-aquatica*.

DISTRIBUTION: Found only at Taul Tapului and, poorly developed, in a few wet depressions (cattle drinking holes) amongst meadows to the west of the lake.

SUCCESSIONAL STATUS: Probably stable communities if water levels remain within the ecological range of tolerance. Severely trampled by cattle.

3.1.6.6 Organic Shallow Marsh with Sedge (Carex)
SITE CHARACTERISTICS: Shallow shorelines of lakes, on deep organic substrates.

STRUCTURE AND COMPOSITION: Simply structured communities composed of *Carex spp.*, intermixed with *Juncus effusus* and *Lysimachia nummularia*, and a few other marsh species.
DISTRIBUTION: Found only at Taul Tapului.

SUCCESSIONAL STATUS: Community appears stable with water levels varying within the ecological range. Severely trampled by cattle.

**3.1.6.7 Organic Shallow Marsh with *Equisetum***

SITE CHARACTERISTICS: Found only in a dug-out pond on the south facing slopes of upper Roșia Creek valley. Water conditions are determined by seepage and surface runoff.

STRUCTURE AND COMPOSITION: Virtually entirely dominated by *Equisetum fluviatile*, with lesser *Lemna minor* floating on the water surface during the growing season.

DISTRIBUTION: Sampled only in the Taul Tarina valley.

SUCCESSIONAL STATUS: Stable community under current water regime.

**3.1.6.8 Mineral Shallow Marsh with *Carex***

SITE CHARACTERISTICS: Found in small, man-made depressions fed by surface runoff and seepage.

STRUCTURE AND COMPOSITION: Entirely dominated by *Carex spp*.

DISTRIBUTION: Observed only in the Taul Tarina valley.

SUCCESSIONAL STATUS: Stable community under current water regime.

**3.1.6.9 Submerged Shallow Aquatic with *Myriophyllum spicatum***

SITE CHARACTERISTICS: In relatively deep, up to 1.5 metres, water along shores of lakes and ponds, rooted in fine mineral substrates enriched with organic matter.

STRUCTURE AND COMPOSITION: *Myriophyllum spicatum* is usually the exclusive species forming underwater colonies, with inflorescences above the surface at flowering times.

DISTRIBUTION: Observed in Taul Corna.

SUCCESSIONAL STATUS: Stable community as long as enough water depth is available.

**3.1.6.10 Floating-Leaved Shallow Aquatic with *Polygonum amphibium***

SITE CHARACTERISTICS: Occurs along shallow shoreline areas around lakes and ponds, in waters 20-50 cm deep, on soft bottom substrates. Usually covers small areas from a few square metres to a few dozen of square metres in size.

STRUCTURE AND COMPOSITION: Typically very simply structured and dominated almost exclusively by the floating-leaved macrophyte - *Polygonum amphibium*. Only during the smartweed’s flowering time do its flowers emerge above the water surface.

DISTRIBUTION: Found only at Taul Mare’s south shore in association with other aquatic and shallow marsh types.

SUCCESSIONAL STATUS: Community stable as long as water levels and their fluctuation remain within ecological range.

**3.2 Information on the local flora**

**3.2.1 Forest Stock**
The size of the study area was selected so as to include all the potentially significantly impacted areas of the Rosia Montana Project and to establish the level of ecological balance in the area. The limits of the study area were:

- on the south-west and west side, national road Alba Iulia-Abrud-Campeni between Gura Corna (downstream) and Carpinis;
- in the north, the road connecting Carpinis, Varop, Garda Barbulesti-Rosia Montana;
- in the east and south-east Corna Hill, Bunta Hill, Orzana Mare Hill, the intersection of the village road to Bucium Sat and the national road, downstream of Gra Corna.

Characterisation of stational conditions and vegetation in the Rosia Montana Project study area is given in Annex 1.

The forest bodies at Vartop (u.a. 61-66), Seliste (u.a. 99-104), Rosia (u.a. 82-85), Abrud (u.a. 107—114, 372) and lots 129,149,150 are located outside the Project site and will be areas to include in the compensatory ecological network, with low exposure to potential secondary impacts.

Data presented in Table 4.6.1 and Figures 3.12 – show:

**The types of habitat** in the study area, classified according to Natura 2000, the distribution of which is shown in Figure 3.12, reflect that the most common is type **9130** – *Asperulo-Fagetum* beech forests, both for the study area and for the site. Two other types of habitat were identified **91VO** - Dacian beech forests (*Symphyto-Fagion*) and **9110** - *Luzulo-Fagetum* beech forests.

**Figure 3.12. Distribution by habitat types (Natura 2000) in the Rosia Montana Project study area**

<table>
<thead>
<tr>
<th>Types of habitat</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9130</td>
<td>600</td>
</tr>
<tr>
<td>9110</td>
<td>550</td>
</tr>
<tr>
<td>91VO</td>
<td>500</td>
</tr>
</tbody>
</table>

The proportions and characteristics of this type of habitats are as follows:
### Table 3-1. Habitat types in the Rosia Montana Project study area

<table>
<thead>
<tr>
<th>Natura 2000</th>
<th>Surface Area (%)</th>
<th>PAL. HAB</th>
<th>EUNIS</th>
<th>Romanian Habitats</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>9130 Asperulo-Fagetum beech forests</td>
<td>73.7</td>
<td>41.1 D 224</td>
<td>Dacian Dentaria bulbifera beech forest</td>
<td>-</td>
<td>Dacian beech (Fagus sylvatica) and hornbeam – (Carpinus betulus) with Dentaria bulbifera</td>
</tr>
<tr>
<td>9110 Luzulo-Fagetum beech forests</td>
<td>2.6</td>
<td>41.1 D 14</td>
<td>Dacian bilberry-beech forest</td>
<td>-</td>
<td>R4107 – South-eastern Carpathian beech (Fagus sylvatica) and fir (Abies alba) forests with Vaccinium myrtillus</td>
</tr>
<tr>
<td>91VO Dacian beech forest forests (Symphyto-Fagion)</td>
<td>23.7</td>
<td>41.1 D 212</td>
<td>Dacian Pulmonaria rubra fir- beech forest</td>
<td>G3.1 123</td>
<td>Dacian neutrophile montaine fir forest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41.1 D 211</td>
<td>Dacian Dentaria glandulosa beech forest</td>
<td>G1.6 D 21</td>
<td>Dacian Symphitum beech forest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41.1 D 221</td>
<td>Dacian Galium Schultesii beech-horn beam forest</td>
<td>G1.6 D 22</td>
<td>Dacian hairy sedge beech/ horn beam</td>
</tr>
</tbody>
</table>

### Table 3-2. Habitat types within the Rosia Montana Project site

<table>
<thead>
<tr>
<th>Natura 2000</th>
<th>Surface Area (%)</th>
<th>PAL. HAB</th>
<th>EUNIS</th>
<th>Romanian Habitats</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>9130 Asperulo-Fagetum beech forests</td>
<td>74.5</td>
<td>41.1 D 224</td>
<td>Dacian Dentaria bulbifera beech forest</td>
<td>-</td>
<td>Dacian beech (Fagus sylvatica) and hornbeam – (Carpinus betulus) with Dentaria bulbifera</td>
</tr>
<tr>
<td>9110 Luzulo-Fagetum beech forests</td>
<td>7.5</td>
<td>41.1 D 14</td>
<td>Dacian bilberry- beech forest</td>
<td>-</td>
<td>R4107 – South-eastern Carpathian beech (Fagus sylvatica) and fir (Abies alba) forests with Vaccinium myrtillus</td>
</tr>
<tr>
<td>91VO Dacian beech forest forests (Symphyto-Fagion)</td>
<td>18.0</td>
<td>41.1 D 212</td>
<td>Dacian Pulmonaria rubra fir- beech forest</td>
<td>G3.1 123</td>
<td>Dacian neutrophile mountain fir forest</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41.1 D 211</td>
<td>Dacian Dentaria glandulosa beech forest</td>
<td>G1.6 D 21</td>
<td>Dacian Symphitum beech forest</td>
</tr>
</tbody>
</table>
According to MO 1198/2005, Annex No. 1 – “Type of natural habitats the preservation of which requires special conservation areas” – none of the habitats identified in the Project area classifies as “priority habitat”.

The following is a description of these types of habitats, based on the current Romanian system, using reference Romanian Habitats, „Habitatele din România”, N. Doniță, A. Popescu, Mihaela Pauc-Comănescu, Simona Mihăilescu, I.A. Biriş, 2006:

3.2.1.1 R4109: South-eastern Carpathian beech (Fagus sylvatica) forests with Symphitum cordatum

Types of correspondent habitats:
- according to Natura 2000: 91VO Dacian beech forest forests (Symphyto-Fagion)
- according to EMERALD: 41.1 Beech forests
- according to PAL.HAB: 41.1 D 211 Dacian Dentaria glandulosa beech forest
- according to EUNIS: G1.6 D 21 Dacian Symphitum beech forest
- Plant associations: Symphito-Fagetum Vida, 1959

Types of ecosystems:
- 3316 Oxalis-Dentaria-Asperula beech forests
- 3327 Rubus hirtus beech forests

Coverage: 53.1 ha.
Stations:
- elevation: 770-1,038.93 yd.
- climate: mountain climate, medium mountain climate zone, slopes exposed to western winds; average annual temperature 6°C, average annual precipitation 830 mm, dominant wind direction, west.
- relief: corrugated or medium corrugated or disturbed lower slopes, inclination ranging between 28 and 45g, diverse exposure: S, SE, W, NW.
- rock: sandstone, quartzy conglomerates
- soils: lithic eu-mesobasic brunisol (eutri- cambisols)

Structure: aedificated plant coenoses of European meso-thermal, mesophyte, meso-eutrophic species. The tree tier consists of pure beech, or mix of beech and hornbeam, black alder or birch. The tree stands of the impact area are 15 to 85 years old, between 0.4 and 0.8 consistency and belong in the medium (3), but mostly low (4-5) yield classes.

The bush tier is absent or poorly developed, because of the shade; with rare specimens of hazel or hawthorn.

Grass and shrub tier: variably developed, depending on shade, may be absent in close canopy woods (pure beech stands); generally, however, rich in “mull flora” species, with typical elements including Carpathian species like Symphitum cordatum, Dentaria glandulosa, Pulmonaria rubra; shadier slopes, of a wetter micro-climate, may be dominated by Rubus hirtus.
Conservation value: high.
Floristic Composition:
- edifying species: Fagus sylvatica
4.6 Biodiversity

- typical species *Symphitum cordatum*, *Pulmonaria rubra*, *Dentaria glandulosa*
- other important species: *Actaea spicata*, *Anemone nemorosa*, *Galium odoratum*,
  *Athyrium filix-femina*, *Dentaria bulbifera*, *Dryopteris filix-mas*,
  *Epilobium montanum*, *Euphorbia amygdaloides*, *Lamium galeobdolon*,
  *Geranium robertianum*, *Hepatica nobilis*, *H. transsilvanica*,
  *Mercurialis perennis*, *Mycelis muralis*, *Oxalis acetosella*,
  *Sanicula europaea*, *Stellaria nemorum*.

3.2.1.2 R4118: Dacian beech (*Fagus sylvatica*) and hornbeam – (Carpinus betulus) with *Dentaria bulbifera*

Types of correspondent habitats:
- according to Natura 2000: 9130 *Asperulo-Fagetum* beech forests
- according to EMERALD: 41.1 Beech forests
- according to PAL.HAB: 41.1 D 224 Dacian *Dentaria bulbifera* beech forest
- Plant associations: *Carpino-Fagetum* Paucă, 1941

Types of ecosystems:
- 4116 *Asperula-Asarum-Stelaria* beech forests
- 4316 *Asperula-Asarum-Stelaria* beech forests

Coverage: 195.7 ha (79.4 to be deducted from total)

Stations:
- elevation: 610-1,093.61 yd
- climate: mountain climate, medium mountain climate zone, slopes exposed to
climates exposed to western winds; average annual temperature 6°C,
average annual precipitation 830
  mm, dominant wind direction, west.
- relief: generally medium corrugated slopes, but also medium disturbed or very or
  poorly corrugated, inclinations ranging between 15 and 40 degrees,
  and diverse
- rock: sandstone, quartzy conglomerates, dacites, andesites
- soils: lithic eu-mesobasic brunisol (eutri- cambisols)

Structure: aedificated plant coenoses of European nemoral, and Balkan meso-thermal,
mesophyle, meso-eutrophic species. The tree tier consists of pure beech, or mix of beech
and hornbeam, and scattered spruce, fir, cherry, ash, mountain ash, black alder and birch.
The tree stands of the impact area are 15 to 100 years old, between 0.4 and 0.9 consistency
and belong in the medium (3), or low (4-5) yield classes.

The bush tier, Of variable development, depending on the tree stand coverage, includes
hazel, black elderberry, dogwood, and hawthorn.

Grass and shrub tier: of variable development, contains species of the “mull flora” (*Galium
odoratum*, *Asarum europaeum*, *Stellaria holostea*, *Carex pilosa*, *Mercurialis perennis*,
*Dentaria bulbifera*).

Conservation value: low.

Floristic Composition:
- edifying species: *Fagus sylvatica*, *Carpinus betulus*
typical species none; possibly Erythronium dens-canis and species of the Lathyro-Carpinion alliance.

other important species: dominant in spring Dentaria bulbifera; with high frequency of occurrence: Anemone ranunculoides. A. nemorosa, Asarum europaeum, Galium odoratum, Carex sylvatica, Dactylis polygama, Lamium galeobdolon, Lathyrus vernus, Milium effusum, Mercurialis perennis, Primula vulgaris, Pulmonaria officinalis, Sanicula europaea, Viola reichenbachiana, and some South-European species (Melittis melissophyllum, Campanula peisicifolia, Lathyrus niger); in spring, in wet places, the soil is covered by Allium ursinum.

3.2.1.3 R4119: Dacian beech (Fagus sylvatica) and hornbeam –(Carpinus betulus) with Carex pilosa

Types of correspondent habitats:
- according to Natura 2000: 91VO Dacian beech forest forests (Symphyto-Fagion)
- according to EMERALD: 41.1 Beech forests
- according to PAL.HAB: 41.1 D 221 Dacian Galium Schultesii beech-horn beam forest
- according to EUNIS: G1.6 D 22 Dacian hairy sedge beech/ horn beam
- Plant associations: Carpino-Fagetum Paucă, 1941

Types of ecosystems:
- 4125 Carex pilosa beech forests
- 4225 Carex pilosa beech and hornbeam forests

Coverage: only on two lots, located outside the operational site; 2.8 ha.

Stations:
- elevation: 710-720m.
- climate: mountain climate, medium mountain climate zone, slopes exposed to western winds; average annual temperature 6°C, average annual precipitation 830 mm, dominant wind direction, west.
- relief: slopes of 24-25 degree inclination and SE and W exposure.
- rock: andesite, sandstone
- soils: lithic eu-mesobasic brunisol (eutri- cambisols)

Structure: aedificated plant coenoses of European nemoral, and Balkan meso-thermal, mesophyle, meso-eutrophic species. The tree tier consists of pure beech, or mix of beech and hornbeam, scattered alder. The stands are young (35-40 years), of full consistency (0.9) and low yield class (5).

The bush tier, Of variable development, depending on the tree stand coverage, includes hazel and black elderberry.

Grass and shrub tier: dominated by Carex pilosa, with elements of “mull flora”.

Conservation value: low.

Floristic Composition:
- edifying species: Fagus sylvatica, Carpinus betulus
- typical species Carex pilosa, Galium schultesii
- other important species: Anemone nemorosa, Asarum europaeum, Brachypodium sylvaticum, Campanula persicifolia, Carex digitata, Carex sylvatica, Dactylis polygama, Dentaria bulbifera, Euphorbia amygdaloides, Galium odoratum, Lamium galeobdolon, Lathurus vernus, Melica uniflora, Poa nemoralis, Primula vulgaris, Pulmonaria officinalis, Ranunculus auricomus, Stellaria holostea, Viola reichenbachiana.

3.2.1.4 **R4104: South-eastern Carpathian beech (Fagus sylvatica) and fir (Abies alba) forests with Pulmonaria rubra**

Types of correspondent habitats:
- according to Natura 2000: 91VO Dacian beech forest forests (*Symphyto-Fagion*)
- according to EMERALD: 41.1 Beech forests
- according to PAL.HAB: 41.1 D 212 Dacian *Pulmonaria rubra* fir- beech forest
- according to EUNIS: G3.1 123 Dacian neutrophile mountain fir forest
- Plant associations: *Pulmonario rubrae-Fagetum* (Soo, 1964) Tauber, 1987

Types of ecosystems:
- 2416 Oxalis-Dentaria-Asperula beech-fir forests
- 2116 Oxalis-Dentaria-Asperula fir forests
- 2427 Rubus hirtus beech-fir forests

Coverage: 6.92 acres

Stations:
- elevation: 910-1100m
- climate: mountain climate, medium mountain climate zone, slopes exposed to western winds; average annual temperature 6°C, average annual precipitation 830 mm, dominant wind direction, west.
- relief: disturbed upper slopes, of inclination ranging between 35 and 41 degrees, SW and S exposure
- rock: quartzy conglomerates
- soils: lithic eu-mesobasic brunisol (eutri- cambisols)

Structure: aedificated plant coenoses of European oligo-meso-thermal, mesophyte, meso-eutrophic species. The tree tier consists of pure beech, or mix of beech and fir, and scattered hornbeam, ash, birch, mountain ash. The tree stands of the impact area are 30 to 90 years old, between 0.6 and -0.8 consistency and belong in the medium (3), or low (5) yield classes.

The bush tier, Of variable development, depending on the tree stand coverage, includes hazel and black elderberry.
The grass and shrub tier is unevenly developed according to light availability and includes "mull flora" species. Moss tier: discontinuous and poorly developed, consisting of: *Hylocomium splendens*, *Thuidium abietinum*; *Dicranum scoparium*, *Catharinea undulata* etc.

Conservation value: moderate.

Floristic Composition:
- edifying species: *Fagus sylvatica*, *Abies alba*
- typical species: *Pulmonaria rubra*, *Symphytum cordatum*, *Dentaria glandulosai*
- other important species: *Adoxa moschaterrina*, *Actaea spicata*, *Asarum europaeum*, *Bromus benekeni*, *Carex sylvatica*, *Dentaria bulbifera*, *Euphorbia amygdaloides*, *Geranium phaeum*, *G. robertianum*, *Hordelymus europaeus* (roci calcaroase), *Lamium galeobdolon*, *Mercurialis perennis*, *Milium effusum*, *Oxalis acetosella*, *Paris quadrifolia*, *Polygonatum multiflorum*, *Rubus idaeus*, *Sanicula europaea*, *Salvia glutinosa*, *Senecio nemorensis*, *Stachys sylvatica*; in wet places: *Allium ursinum*, *Cardamine impatiens*, *Carex remota*, *Circaea lutetiana*, *Impatiens noli-tangere*; on shaded slopes, with high air humidity *Rubus hirtus* may be a dominant; locally on convex relief, specimens of *Luzula luzuloides*, *Veronica officinalis*, *Majanthemum bifolium* etc. may also appear.

3.2.1.5 **R4107: South-eastern Carpathian beech (Fagus sylvatica) and fir (Abies alba) forests with Vaccinium myrtillus**

Types of correspondent habitats:
- according to Natura 2000: 9110 Luzulo-Fagetum beech forests
- according to EMERALD: 41.1 Beech forests
- according to PAL.HAB: 41.1 D 14 Dacian bilberry- beech forest

Types of ecosystems:
- 3356 *Vaccinium* beech forests
- 2456 *Vaccinium* beech-fir forests

Coverage: 51.15 acres

Stations:
- elevation: 880-1000m
- climate:
- relief: very inclined medium and upper slopes (36-47g), disturbed, frequently shady exposure (N, NW, W)
- rock: acidic, shale, granite, siliceous sandstone
- soils: of the podzol type (typical and lithic podzol), medium-deep / shallow, very acidic, oligo-alkaline, hydrically balanced, oligotrophic

Structure: aedificated plant coenoses of European nemoral, and boreal meso-oligo-thermal, mesophyte, oligo-trophic species. The tree tier consists of pure beech, or mix of beech and fir, scattered spruce and pine. The tree stands are 30 to 105 years old, low (0.5 -0.7) consistency and belong in the medium (3), or low (5) yield classes.
The bush tier is generally absent, or consists of sparse specimens of *Sorbus aucuparia*. The grass and shrub tier dominated by *Vaccinium mirthyllus*, *Vitis idaea* and species of the *Calamagrostis-Luzula* type.

Conservation value: high.

Floristic Composition:
- edifying species: *Fagus sylvatica*, *Abies alba*
- typical species
- other important species: *Anthenaria dioica*, *Calamagrostis arundinacea*, *Dechampsia flexuosa*, *Luzula luzuloides*, *Lycopodium selago*, *Oxalis acerosella*, *Brukenthalia spiculifolia*, *Saxifraga cuneifolia*.

3.2.1.6 **R4205: South-eastern Carpathian spruce (Picea abies) forests with Oxalis acerosella**

Types of correspondent habitats:
- according to Natura 2000: 9410 Acidophylous Picea forests of the mountain to alpine levels (*Vaccinium-Picetea*)
- according to PAL.HAB: 42.21627 Carpathian Oxalis spruce forests

Types of ecosystems:
1226- spruce stands with Oxalis-Dentaria-Asperula

Coverage: 73.4 ha, an area located exclusively off site.

Stations:
- elevation: 580-907.70 yd.
- climate: mountain climate, medium mountain climate zone, slopes exposed to western winds; average annual temperature 6°C, average annual precipitation 830 mm, dominant wind direction, west.
- relief: corrugated or medium corrugated or disturbed inclination ranging between 14 and 31g, exposure: generally shaded N, NW, NE, W.
- rock: sandstone, quartzy conglomerates
- soils: typical eumesobasic brunisols (eutric cambisols) and lithic eu-mesobasic brunisol (distri-cambisols)

Structure: aedificated plant coenoses of boreal and Carpathian, oligothermal, mesophyte, meso-eutrophic species. The tree tier consists of pure spruce, or mix of spruce and fir, mountain ash, elm, beech. The tree stands of the impact area are 10 to 95 years old, full consistency (0.8 and 0.9) and high to medium (2-3), yield classes.

The bush tier is absent or poorly developed, because of the shade; with rare specimens of rowan, elder and raspberry.

Grass and shrub tier: uneven, patchily developed, with *Oxalis acerosella*, *Dentaria glandulosa*, locally with *Galium odoratum* or *Calamagrostis arundinacea*

Conservation value: moderate.
Floristic Composition:
- edifying species: *Picea abies*
- typical species *Hieracium rotundatum*
- other important species: *Athyrium filix-femina, Campanula abietina, Dryopteris filix-mas, Fragaria vesca, Lamium galeobdolon, Gentiana asclepiadea, Homogyne alpina, Luzula luzuloides, Mercurialis perennis, Rubus hirtus, Soldanella hungarica.*

Of the **natural basic forest types** currently existing in the Rosia Montana area, the most common, both in the study area and on the Project site, is **4312** – Beech-hornbeam forest with mull flora, of medium yield (Fig. 3.13). On the Project site, the dominant types of forest are mixes of beech and hornbeam, while spruce stands are all outside the site limits, while the fir forest with acidophile flora, near Carnic Hill (u.a. 74, 75A), although located on the site, near Carnic Pit, will be protected.

The basic natural character's only represented on 48% of the study area and 42% of the site.

Identified types include:
Most of these are medium yield types of forest (41% for the study area and 33% on the site). Derivated forests (naturally derivated, by hornbeam and birch invasion) account for 29% of the total study area and 46% of the site. Most of these are low yield types of forest (29% for the study area and 34% on the site).

Man-made forests are also present (plantations of spruce and pine), accounting for 23% of the study area and 12% of the site, almost all of them being high yield forests.
**Figure 3.13. Distribution of the tree stands in Rosia Montana Project study area by naturally fundamental types**

In regard to distribution by **functional groups** of forests (Fig. 3.14), for the entire study area production (2-1B) and protection (1—2A, etc.) functions are approximately equally represented. On the site, however, the dominant forests exercise protection, with more commonly: 1-2H- protection of sliding land and 1-2A, protection of soil on slopes steeper than 30-35 degrees. Off site, some forests classify for functions i-3J, protection against harmful industrial factors near tailings landfills and 1-4C, recreation. These forests will continue to stand, and discharge their assigned functions.

The importance of the protection function of forests is also reflected in their management. From this point of view, more than half of the forests are managed under a special conservation regime (only sanitation cuttings are planned, up to 5% of the wood mass volume)
In regard to the **age class** characterization of the forests of the study area, the situation is as follows:

- **age class I** (0 – 20 years) 7.8% overall and 0,... on the site;
- **age class II** (21 – 40 years) 19.7% overall and 24.7% on the site;
- **age class III** (41 – 60 years) 20.0% overall and 22.8% on the site;
- **age class IV** (61 – 80 years) 17.6% overall and 26.3% on the site;
- **age class V** (81 – 100 years) 24.8% overall and 20.3% on the site;
- **age class VI** (101 – 120 years) 10.1% overall and 5.9% on the site.

The situation is not well balanced, with predominance of aged forests, as a result of delayed final cutting and restrictions in the protected areas. Over the study area, all age classes are represented, while very young forests are absent and old forests only cover a limited area (Fig. 3.15).
Species Proportion is as follows:

- for the study area: 35,1Fa 22,0Mo 20,2Ca 7,4Ann 4,9Me 3,8Pis 3,0Pam 2,9Br 0,3Ci 0,3Fr 0,1Sr
- on the site: 31,8Fa 30,1Ca 11,8Me 8,9Pis 7,1Br 5,9Ann 2,1Mo 1,2Pam 0,6Fr 0,5Ci

Distribution by species of the forests in the study area shows that the dominant species belong in the types of habitats and ecosystems in the study area (beech, spruce and hornbeam). Other valuable deciduous and conifer species are also present (mountain ash, cherry, ash, fir).

On the site, the proportional contribution of spruce is more limited (10 times smaller).

From the point of view of forest biodiversity, it may be seen that there is a relatively large number of tree species, with pure stands (monoculture) only sparsely represented.
Figure 3.16. Distribution of tree stands in the Rosia Montana Project study area by species

3.2.1.7 Leaf Diagnosis Tests on Conifer Species on Rosia Montana Project Site
In order to establish the level of accumulation of components resulting from ling-standing mining activities in Rosia Montana area, in the winter of 2006, the first foliar diagnosis tests were conducted on conifer species on the future Project site. The same tests should be conducted for deciduous species (at the end of the vegetative season) to define the baseline. They should be continued by a monitoring program for each phase of the Project.

Bio-Assessment of Zinc Pollution
Within the optimum 15-60 ppm range (Bergmann, 1992), zinc is a component of enzymes regulating metabolic activities, especially of oxidizing enzymes. It is necessary in auxine formation – growth stimulating hormones (Raheja, 1966; Gaucher, 1968).

In forest ecosystems, zinc is fixed by the stable complexes of the upper, more humiferous horizon of the soil. Zinc solubility increases soil acidity and may be reduced by calcium improvement and phosphorus fertilization.

In the forest ecosystems in Romania (8 – analyzed in 1996, 11 in 1998 and 4 in 2005) the average zinc content in spruce leaves was:
- 74.28 ppm in 1996 – above the toxicity 60 ppm threshold (Bergmann, 1992), in 8 forest ecosystems;
- 53.1 ppm in 1998 – within the optimum range of 15-60 ppm, in 11 forest ecosystems (Bolea et al., 1998);
24.36 ppm in 2004 – in 4 forest ecosystems around Brasov (Postăvarul, Tâmâoaia, Poiana Brașov and Warthe);

At Rosia Montana, the average zinc content of 74.39 ppm in 1 year old spruce leaves (March 2006) was 24% above the toxicity threshold.

In 1996, the minimum 37.79 ppm and maximum 99.62 ppm levels were greater than those recorded in France (15.5 - 43.72 ppm in the RENECOFOR network – 1993).
In 1998, the absolute maximum level was 277.2 ppm, 362% above the toxicity threshold.

At Rosia Montana, the absolute maximum level was 82.05 ppm, 37% above the 60 ppm toxicity threshold.

Compared to spruce, (74.39ppm), the average zinc content in 1 year old fir leaves, as sampled and analyzed in February 2006 were 59.56 ppm, therefore lower, but very close to the 60ppm toxicity threshold.

At Rosia Montana, zinc pollution prevents the normal photosynthesis, breathing and transpiration processes.

Excess zinc may cause iron, manganese, and even phosphorus deficiencies, for a phosphorus/zinc ratio of less than 50 in the plant.

### Bio-Assessment of Copper Pollution

Copper is an oligo-element with a complex physiological role in trees:
- direct participation in the synthesis of chlorophyll;
- a constituent of several enzymes acting as an enzyme activator;
- contributes to the use of proteins in growth and oxido-reduction processes;
- intervenes in the use of ammoniacal nitrate in forming certain proteins.

In the spruce ecosystems of the country, copper is maintained within the optimum range of 4 to 10 ppm.

Thus, in 8 representative spruce ecosystems: Stâna de Vale (Apuseni Mountains), Călimănești, Pojorâta, Râșnov, Predeal, Romani, Rodna and Brașov, in 1996 and 1998:

- average levels were maintained between 3.78 and 7.74 ppm, decreasing in 1996 to 1.05 ppm in Călimănești, 2.63 ppm at Stâna de Vale and 2.84 ppm at Pojorâta;
- maximum levels were 10.1ppm at Stâna de Vale and 10.4 ppm at Pojorâta;
- absolute minimum levels were 0.38.ppm at Călimănești, 1.07 ppm at Stâna de Vale and 2.03 ppm at Pojorâta (Bolea, et al., 1998).

In the spruce forest ecosystems of Rosia Montana (located 52 km of Stâna de Vale), the average copper content (in 5 samples) of the 1 year old fir leaves (2005) was 12.65 ppm, with minimum content 7.41 ppm and maximum 28.64 ppm.

This indicates a high level of pollution with copper, considering that:
- the average level of copper at Roșia Montană (12.65 ppm) exceeds by 26.5% the 10 ppm toxicity threshold (Bergmann, 1992), by 207% the average 4.12 ppm level of 1996 and by 89.4% the average 6.68 ppm level of 1998, of the 8 – 11 representative ecosystems for Romania, by 144.2% the average 5.18 ppm level at Postăvaru – Tâmâoaia – Poiana Brașov – Warthe (2004) and by 11.8% the average content at Brașov;
4.6 Biodiversity

- The maximum 28.64 ppm level in Roșia Montană exceeds by 369.5% the maximum 6.1 mg level of 1996 and by 208% the maximum 9.3 ppm level in 1998 in spruce forest ecosystems, representative for Romania (Bolea, 1998) and by 842.1% the maximum 3.04 ppm level in France (Ulrich and Bonneau, 1994).

Fir, in the same forest ecosystems in Roșia Montană has a lesser average copper content (11.46 ppm) than spruce (12.65 ppm) but higher than fir in Predeal (in 1998 – 9.5 ppm – by 20.7%), Poiana Brașov (in 1998 – 7.1 ppm – 61.5%), Noua – Brașov (in 1998 – 8.24 ppm – by 39.1%), France – RENECOFOR network – 1993 (maximum value 3.86 ppm – by 197.0%).

According to Kabata-Pendios (1983), an increase of heavy metal concentrations, such as copper, will determine:

- changes in the permeability of cell membranes;
- reactions with the mercaptan group, triggering protein denaturizing;
- competition with essential metabolites, which it may replace;
- reactions with essential chemical compounds.

Some plant species protect themselves against the effects of excess micro-ions by:

- depositing them in the cell wall and
- affixing them to organic compounds (acids, phenols).

According to Parascan and Danciu (2001), tolerance of poligo-elements is genetically controlled and may lead to the appearance of new forms in plant species on polluted stations.

On soils with a limited content of manganese and iron, the massive contribution of copper may determine deficiencies of these elements.

For the prevention and control of such negative effects, it is recommended that:

- a humus layer as deep as possible should be maintained in the forest ecosystems around the pit areas, to provide copper fixation in organic complexes (acids and phenols);
- manganese fertilization should be applied on the soils (manganous oxide - 41%) if a deficiency thereof is identified.

Bio-Assessment of Iron Pollution

The average iron content of spruce leaves in Romania was:

- 100 ppm in 5 forest ecosystems (Călimănești, Romani, Rodna, Rășcov and Remeți) analyzed in 1996;
- 81 ppm in 11 forest ecosystems (Stâna de Vale, Călimănești, Pjojorâta, Rășnov, Predeal, Romani, Rodna, Brașov, Remeți, Sângeorz Băi și Pui) analyzed in 1998;
- 111 ppm in 4 forest ecosystems (Postăvaru, Tâmpa, Poiana Brașov and Warthe) analyzed in 2005;

Both the absolute minimum and maximum levels exceed the (30 to 90 ppm) levels determined in the RENECOFOR network in (Ulrich, Bonneau, 1994):

- 59 ppm and 171 ppm in 5 forest ecosystems analyzed in 1996;
- 36 ppm and 121 ppm in 11 forest ecosystems analyzed in 1996;
4.6 Biodiversity

- 64 ppm and 156 ppm in 4 forest ecosystems analyzed in 2005;

In this context, the average content in spruce leaves at Rosia Montana, of 96.87 ppm, analyzed in 2006 range within the general situation of forest ecosystems in Romania and reflect low variability, from a minimum 93.84 ppm to 98.91 ppm.

compared to spruce, fir in Rosia Montana accumulated a greater amount of iron in its leaves: 126.7 on average, on a slightly broader range, from 102.5 ppm to 166.9 ppm.

This capacity of fir to metabolize a higher amount on the same station was found in 1998 for:
- Predeal – (97 ppm for fir and 72 ppm for spruce) and in;
- Poiana Brașov (- 147 ppm for fir and 93 ppm for spruce).

In all the cases, the iron content of fir leaves ranged between the lower and higher European levels of 20 ppm and 200 ppm, respectively.

This leaf diagnosis shows that at Rosia Montana, neither copper nor zinc pollution has triggered an iron deficiency (below 30 ppm), so that iron can fulfill its physiological role of:
- chlorophyll formation;
- developing respiratory ferments;
- catalyzing oxido-reduction processes;
- tree nutrition and growth;
- enzymatic photo-synthesis reactions;
- reducing nitrates (Lemee, 1978).

Note that in industrialized towns, such as Brasov, the average content of spruce leaves amounts to 380.2 ppm, while absolute maximum values reach 1044.5 ppm (Bolea, Chira, 2005).

Bio-Assessment of Manganese Pollution
Foliar diagnosis of manganese in the spruce leaves of forest ecosystems in Romania shows:
- average content of 380 ppm in 8 forest ecosystems (Călimănești, Romani, Rodna, Râșnov, Predeal, Romani, Rodna, Brașov, Remetești, Sângeorz Băi și Pui) analyzed in 1996;
  - 401.9 ppm in 11 forest ecosystems (Stâna de Vale, Călimănești, Pojorâta, Râșnov, Predeal, Romani, Rodna, Brașov, Remetești, Sângeorz Băi și Pui) analyzed in 1998;
  - 164.56 ppm in 4 forest ecosystems (Postăvaru, Tâmpa, Poiana Brașov and Warthe) analyzed in 2005;
- minimum and maximum content of:
  - 81 ppm minimum and 775 ppm maximum in 8 forest ecosystems analyzed in 1996;
  - 34.3 ppm minimum and 537.3 ppm maximum in 11 forest ecosystems analyzed in 1998;
  - 21.9 ppm minimum and 365.8 ppm maximum in 4 forest ecosystems analyzed in 2005;

While all average manganese contents ranged within the optimum interval of 50–500 ppm (cf. Bergmann, 1993), the absolute minimum values at Pojorâta and Râșnov (1998) and Tâmpa (2005) indicate manganese deficiency on chalky soils, and the maxima at Poiana
Brașov (in 1996) and Stâna de Vale on acidic excess moisture soils, show an exceedance of the upper optimum limit (cf. Bergmann, 1993). As (according to Fielder and Hohne, 1985) the upper limit is 3200 ppm, it may be considered that in the Romanian forest ecosystems spruce are within the range of optimum conditions for manganese.

Spruce in Roșia Montană also ranges within this optimum interval (50 – 500 ppm), with 194.1 ppm average manganese content and a range of 115.5 ppm – 225.3 ppm

Compared to spruce, fir in Rosia Montana was characterized by:

- lower average manganese content - 192.32 ppm
- lower minimum manganese content - 155.1 ppm
- lower maximum manganese content - 223.9 ppm

In other forest ecosystems in the country, the average manganese content was in 1998 468 ppm, on ranges of 123 – 201 ppm at Predeal and 608 ppm – 888 ppm at Poiana Brașov, i.e. between the minimum and the upper European levels (20-2000 ppm).

Based on these leaf analyses, it may be stated that zinc and copper pollution at Rosia Montana has not caused manganese deficiency, and that this element may fulfill its physiological functions of:

- activating chlorophyll formation;
- ensuring the functioning of some oxido-reducer enzymes;
- fostering protein synthesis by reducing nitrates, which, in the absence of manganese will accumulate until toxic;
- participating in the transpiration process;
- contributing to normal root development.
- increasing spruce resistance to sporl salinity and draught

Bio-Assessment of Magnesium Pollution

Magnesium nutrition of the Romanian Carpathian spruce was characterized by an average magnesium content in 1 year old leaves of:

- 830 ppm in the 8 forest ecosystems analyzed in 1996;
- 1076.4 ppm in the 11 forest ecosystems analyzed in 1998;
- 910.8 ppm in the 4 forest ecosystems analyzed in 2005;

The range of magnesium content in the spruce leaves of the above ecosystems was:

- 340 – 1700 ppm in 1996;
- 107.6 – 2900 ppm in 1998;
- 794 – 1100 ppm in 2005;

These contents also ranked within the optimum interval of 1000 – 2500 ppm (Bergmann, 19930 for the 1998 average and the maxima in 1996 and 2005 and below the deficiency threshold for the average and minima in 1996 and 2005.

The toxicity threshold (2500 ppm) was exceeded by spruce at Pojorâta, growing on lithic eubasic rendzina.
In this context, the spruce at Rosia Montana shows an average magnesium content in of 1370 ppm, within the optimum interval (1000-2500 ppm) and ranges between 794 ppm (one case below the critical threshold) and 1835 ppm.

Compared to spruce, fir in Roșia Montană has a similar average magnesium content (1372 ppm) but for an optimum interval of 1500 ppm 4000 ppm it is found that it shows deficiency in magnesium nutrition, manifested in 4 out of 5 analyzed samples 1486 ppm, 1483 ppm, 1282 ppm, 1053 ppm.

This nutritional deficiency disturbs the physiological role of magnesium, which is:

- to participate in chlorophyll composition (2.7%), which is the basis of photosynthesis;
- to condition absorption and migration of phosphorus, with which it forms phytine and with which it is found in large quantities in the young and reproductive tissues.
- to activate a number of enzymes;
- to contribute, with potassium, in maintaining cell turgescence (Gaucher, 196800.

Due to this deficiency, fir is disfavored in comparison to spruce, which will lead to reduced biodiversity in the tree species.

Nutritional magnesium deficiency in fir is caused by:

- soil acidification by pollution;
- increased water content in the soil, leading to a decrease of bivalent cation exchange and an increase of monovalent ones;
- loss of magnesium by leaching with heavy precipitation and steep slopes.

### 3.2.2 Terrestrial and Aquatic Fauna

A total of 414 plant species were recorded during the field investigations, including 10 species of bryophyte (moss), 404 species of cormophyte. A systematic list of plant species identified in the Study Area is provided in Annex 2.

**Ecological Analysis of the Cormophyte Species in the Study Area:**

Floristic species identified on the site and those quoted in the references were reviewed based on the main ecological indicators (UTR), bioforms, and geoelements (floristic elements), and the resulting data were plotted on diagrams.

The ecological indicator chart (Fig. 3.17) shows that mesophyle (U3, humidity index 49.76%), meso-thermal (T3, temperature index 57.24 %) and neutrophyle (R3, soil reaction index 32.71 %) species are the best represented.
However, in reference to the humidity factor, species of lower requirements are also present, in considerable percentages. Thus, xeromesophyte species account for 22.19 percent, and xerophytes for 2.89, which suggests that the local meadows (the main habitat where the species are found), are rather dry, also due to overgrazing degrading the meadows from the point of view of floristic composition, with less valuable species unable to retail water in the soil, which causes the soils to degrade and become more arid. On the other hand, species with high humidity requirements are present in moist areas of the site, where meso – hydrophyte (U4 17.05%) and hydrophyte (U5 3.73%) species are well developed. These locations are near the streams, springs, or valleys with only temporary tiny watercourses. Ultra hydrophyte species, of maximum humidity index U6 are present as 1.63 %, including species identified in swamps.

In regard to the temperature factor, the following may be summarized: apart from the mesothermal species, accounting for the largest percentage, as above (57.24 %), only microthermal species, with low requirements in regard to temperature, account for a percentage worth considering (T2 17.28 %), which may be reasonable, considering that the studies were conducted in a predominantly mountain area, at elevations between 600 and 1100 m. However, in regard to temperature, it is worth mentioning that eurithermal species (indifferent to temperature) account for a large enough percentage (T0 22.89 %).

In regard to soil reaction, it is noted that the plant species of the study area prefer neutral soils, but acidophyle species are also present in considerabel percentages (T2 13.55 % and T1 2.8 %, respectively).

These species are found in resinous forests, where soil is known to be acidic. Species that prefer neutral to alkaline soils are also present, but we should first mention the eurionic species (R0 27.33 %), i.e. species with no pretension or preference to the chemical soil reaction on which they develop.
Figure 3.18. Chart of the bio forms in the study area

In an ecological and biological review of the cormophytes, bioforms are also a very important aspect to know in order to provide a better characterization of the sampled areas. By definition, bioforms are a form that the plant takes during the period of vegetative rest, in this case, how vegetative organs are preserved over winter, until optimum climate conditions return in spring for new vegetation.

As clearly seen on the diagram, hemicryptophytes account for an overwhelming majority (H 60.28 %), with annual terrophytes coming a distant second (Th 11.44 %), followed by geophytes (G 10.51 %). The other bioform categories are poorly represented, but megaphanerophytes, trees, deserve a mention, for the 3.97 % they represent, as well as chamephytes, bushes, accounting for 4.9 %.

Floristic elements indicating in fact the phyto-geographical origin of each species, also provide, after graphical processing, precious information on the phytogenetic character of the area. Thus, as expected, considering the geographical area of study, Euro-Asian elements are best represented (slightly over 40 percent), while European, circum-polar, and cosmopolitan elements account for good distribution percentages on the investigated site. The other geo-elements are poorly represented as percentages, but the Carpathian, Pontic, endemic and Dacian elements provide the highest floristic value to the region.
3.2.3 Mushroom resources

Forest ecosystems are dominated by arborescent species. However, these may not exercise their nutrition functions independently from mycorrhizal fungi (M- Annex 2). Thus mycorrhizes, these symbiotic associations, play an essential role in the functioning and productivity of forest ecosystems. A more efficient functioning of the forest tree- mycorrhizic fungus symbiosis will help develop both wood mass production and the mass of edible mushrooms, but especially increase the stability of the forest ecosystems.

On the other hand, saprophyte fungi (S, Ls – Annex 2) play an important role in the breakdown of organic substances.

Pathogen species for forest vegetation (Lp – Annex 2) are useful for their host ecosystems, but may cause important physical damage to forest economy.

The more spectacular species of fungi include:

- **Amanita** sp. Are the media queens of fungi – from the emperor’s mushroom, *A. cesarea* and *A. rubescens* sought by the gourmets, to the feared poisonous fungi *A. phalloides, A. pantherina* and the beautiful but dangerous *A. muscaria*, that annually account for casualties among the untrained pickers. Their role for the health of the forest is incontestable, as symbiotic (mycorrhitic) with the most important forest species (beech, oak, hornbeam, fir, spruce, etc.).

- **Boletus** sp., **Russula** sp., **Lactarius** sp. are the mycorrhizic genuses richest in species of deciduous and conifer forests, and important both to the forest ecosystems (all the three genuses include dozens of species in the mountain forests) and to the tourists of pickers.

- **Fomes fomentarius** is used by the craftsmen for the beauty and originality of (varnished) mushroom hats and for the (soft and light after processing) “core” used in crafting.

- **Hericium coralloides, Sparassis crispa, Polypilus** sp., **Ramaria** sp. are sought by nature treasure hunters, for the remarkable looks of the white, yellow, brown and grey tufts and branches.
- *Lepista nuda* attracts the eye, like autumn crocus, by their purple color, contrasting with the fresh September-October litter on the forest soil. The pleasant taste, odor and vivid colors make them an attraction to gourmets.

- *Polyporus squamosus* may grow to an impressive size, amusing the children, photographers and pickers.

### 3.2.4 Resources of Economically Important Plant Species

#### 3.2.4.1 Economic Analysis of the Cormophyte Species in the Study Area

As it is known that humans have capitalized the vegetal resources of the natural environment since ancient times, economically important species are well known. Such spontaneous or sub-spontaneous plants may be grouped into 7 main economic categories, with several sub-divisions in each: food, feed, melliferous, medicinal, toxic, industrial, and decorative.

The industrial plant category includes spontaneous wood in natural and some planted forests, and we have started with them because, in the study area, wood harvesting has been the main economic activity for decades. Economically important wood species are numerous, including *Fagus sylvatica*, *Quercus sp.*, *Abies alba*, etc. A considerable share of the industrially important species is held by tinctorial or tanning plants that contain certain natural chemicals used in coloring textiles. There are also tinctorial plants that may be used for tanning, i.e. contain astringent substances used in the tanning of hides. These include: *Pulmonaria officinalis*, *Genista tinctoria*, etc.

![Figure 3.20. Plant distribution by economic category](image)

As for meadows, apart from the animal feed economic value of the investigated meadows, other economic categories are also abundant. However, the economic potential of such meadows is primarily fodder producing, because of the floristic composition, dominated by fodder species (*Festuca pratensis*, *Briza media*, *Medicago falcata*, *Trifolium hybridum*, *Trifolium repens*, *Trifolium pratense*, *Lotus corniculatus*), although in point of quantity, melliferous species are found in a greater, dominant, proportion (most of the economically valuable species). These are more important for apiculture and well represented in the spontaneous flora of the investigated meadows, and even in forests. Thus, *Taraxacum officinale*, *Trifolium pratense*, *Trifolium repens*, *Fragaria vesca*, *Potentilla recta*, *Potentilla cynerea*, are some of the more widespread species.

Medicinal herbs are also worth considering as a cheap source of revenue. In their vegetal organs, blossoms, fruits or seeds, they contain active principles in the form of volatile oils,
alkaloids, glycosides, etheric oils, tannins, vitamins, that provide them with pharmaceutical properties. Therefore, they are used in traditional medicine or pharmaceutics, for the preparation of various herbal teas or drugs. Medicinal plants include: *Hypericum perforatum*, *Achillea millefolium*, *Cichorium intybus*, *Equisetum arvense*, *Veronica officinalis*, *Taraxacum officinale*, *Plantago major*.

Toxic plants in high enough percentages will negatively influence meadow quality, especially if they grow in large amounts. For humans, toxicity is dose-related. Some are used in medicine and pharmaceutics. Some of the toxic plants include: *Euphorbia cyparissias*, *Cynanchum vincetoxicum*, *Stellaria graminea*, *Hypericum perforatum*.

Another category includes important food species well capitalized by the local population, including:

- **Vaccinium myrtillus** L.- the bilberry bush is a member of the Ericaceae family. The bilberry is the most frequently found sub-bush in forest cuttings and mountain meadows between the upper beech tier ad the juniper tier, growing in bilberry “stands”. All the fruit found on the site may be collected, without endangering the species.

- **Rubus caesius** L.- the blackberry - is a member of the Rosaceae family. A frequent species in hilly areas, bushes and forest edges, on degraded slopes. Leaves and fruit may be collected, without endangering the species.

- **Fragaria vesca** (*F. viridis*) L.- the wild strawberry, is a member of the Rosaceae family. A frequent species in hilly areas, bushes and forest edges, on degraded slopes.

- **Crataegus monogyna** Jacq. - hawthorn - a member of the Rosaceae family. Fruit harvesting involves no ecological risk.

- **Rubus idaeus** L.- the raspberry - is a member of the *Rosaceae* family. All the fruit may be harvested, provided the bushes are not broken, as breakage determines lower yields in the following years.

- **Rubus canina** L.- the hip rose - is a member of the *Rosaceae* family. Dogwood grows in the hill tier, sometimes at higher elevations, at forest edges or in clearings, on sunny, exposed slopes.

- **Hippophaë rhamnoides** – of the *Elaeagnaceae* family. This is an introduced species, used in agro-forestry techniques of steep slope or degraded land stabilization.

- **Corylus avellana** – hazel – is a bush-tree species. It is found in mixed forests, especially in hill or sub-mountain areas.

Forest fruit are included in a number of food chains, for many species representing at least an alternative source of food. But or some species they are a key food source. As they are mostly available in the second part of the year, they provide for the cold season, when the food supply is reduced, in the best physiological state for many anumal species. Thus, they provide important sources of sugars, vitamins, etc., that are essential for animal survival until the following spring.

Given the key role of such organisms in the natural environment, balanced harvesting is strongly recommended.
3.2.5 **Protected Species of Flora**
A total of 414 species, one of the cormophytes is protected by MO1198/25/12.2005 (Annex 4”), namely *Galanthus nivalis*. This is a frequent species in the pre-vernal flora of Romania.

### 3.3 Terrestrial and Aquatic Fauna

#### 3.3.1 Invertebrates

##### 3.3.1.1 Insects in the Food Chain
Insects live in almost every habitat, with the exception of polar regions and the deep seas. The huge number of species and individuals, and the extraordinary diversity thereof, are elements that give them outstanding importance in most of the food chains on Earth.

A systematic list of potential invertebrates in Rosia Montana Area is provided in Annex 3. The role of insects in the energy cycles of various ecosystems translates into two major capacities: that of consumer (predator) and that of food (prey).

##### 3.3.1.2 Insects as consumers
Insects owe much of their evolutionary success to the capacity to use almost any type of natural organic substance in a wide range of feeding habits. Nutritional economy attempts to correlate the food “requirements” of a given species population with the available resources in its environment, considering seasonal changes and other variables.

As a general rule, insect growth, development and breeding are in direct correlation with the amount and quality of their food. The main categories of nutrients required by the insects include: minerals, vitamins, nucleic acids and nucleotides, sterols, essential fat acids, amino-acids and proteins, and water.

The food sources preferred by a large number of insect species include:

- floral and extra-floral nectar, pollen, aphid “manna”: an important source of carbohydrates and the natural food of many adult species of hymenoptera, Lepidoptera (diurnal and nocturnal), some Heteroptera and Coleoptera;
- the green parts of plants (leaves, shoots, buds, blossoms, etc.): eaten by many species of insects, such as Lepidoptera (in their larval state), coleopteran (larval or adult state), some hymenoptera, Ortoptera, etc.;
- various vegetal juices: the preferred food of most homoptera, and many heteroptera and diptera;
- the wooden parts of plants: although not a very efficient source of food, they are eaten by the larvae of some coleopteran, isopteran (including adults), Lepidoptera (e.g. *Cossus cossus*, *Zeuzera pyrina*, *Sesiidae*, etc.), etc.;
- detritus: the preferred food of whole orders including: *Diplura, Protura, Thysanura, Colembola*, etc.
- predators of other invertebrates and even small vertebrates: species of odonata (both adults and aquatic larvae that may even kill small fish), heteroptera, hymenoptera, neuroptera, coleoptera (weevils eating aphids, carabidae killing tha larvae of other insects, snails, etc.).
- parasites: e.g. fleas, some species of diptera (mosquitoes), etc. These species account for 1—20% of the total animal species on Earth, according to some authors.

Although the relative contribution of insects (as consumers) is not very well known, it would be prudent and realistic to assume that they may considerably alter the structure of the
upper food chain links (e.g. by excessive use of the vegetation stock, excessive parasitism, competition with other beings for the same food source, etc.).

3.3.1.3 Prey Insects
Considering the very important biomass of all the insects, they are one of the most important food sources on Earth. They are food to both other invertebrates and many species of vertebrates. For example, one bat will eat 1.8-3.6 kg of insects in a year, of which about 10 thousand are nocturnal moths (a living average size moth weighs about 0.1-0.2 g).

Insect larvae and adults are also an important source of food for insect eating birds that need a substantial amount of animal protein during breeding seasons. More precisely, the largest order of birds, Passeriforma, and the largest order of mammals (Insectivora and Chiroptera), are largely insect eaters.

Many insect species are also the preferred food of smaller vertebrates (lizards, frogs), spiders or other arthropods, including other insects.

Aquatic larva of the trichoptera, odonata, some diptera (chironomidae), ephemeropera, etc., are an excellent food base for the alevins of many fish species.

Considering the multiple and very complex roles played by the insects in most structures it is obvious that, due to their incredible diversity, insects are a major determinant in how animal and vegetal communities are structured at various food chain levels.

Some insects need tree species as hosts in their development cycle. These are forest pests, that may cause important damage. Others, i.e. predator insects, may destroy the caterpillars and pupae of the main forest defoliators, and are therefore useful insects.

3.3.1.4 Insect Pests
A list of the potential local pests, considering the host tree species, is given below, in Table 3-3.
### Table 3-3. List of Insect Pests

<table>
<thead>
<tr>
<th>Species</th>
<th>Order</th>
<th>Family</th>
<th>Tree host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buprestis rustica L.</td>
<td>Coleoptera</td>
<td>Buprestidae</td>
<td>fir, spruce, pine</td>
</tr>
<tr>
<td>Calaphora mariana L.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>Melanographa acuminata L.</td>
<td></td>
<td></td>
<td>pine, spruce</td>
</tr>
<tr>
<td>Anthaxia quadripunctata L.</td>
<td></td>
<td></td>
<td>spruce, larch</td>
</tr>
<tr>
<td>Anthaxia morio L.</td>
<td></td>
<td></td>
<td>pine, spruce</td>
</tr>
<tr>
<td>Dicerca berolinensis Hbst.</td>
<td></td>
<td></td>
<td>beech, hornbeam</td>
</tr>
<tr>
<td>Dicerca alni Fisch.</td>
<td></td>
<td></td>
<td>alder, beech</td>
</tr>
<tr>
<td>Agrilus viridis L.</td>
<td></td>
<td></td>
<td>willow, poplar, oak, beech</td>
</tr>
<tr>
<td>Tetropium castaneum L.</td>
<td></td>
<td>Cerambycidae</td>
<td>spruce, pine</td>
</tr>
<tr>
<td>Criocephalus rusticus L.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>Callidium violaceum L.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>Rhagim inquisitor L.</td>
<td></td>
<td></td>
<td>spruce, pine, fir</td>
</tr>
<tr>
<td>Anobium domesticum Geoffr.</td>
<td></td>
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<td>beech</td>
</tr>
<tr>
<td>Kestobium rufolivsum</td>
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<td></td>
<td>beech, oak</td>
</tr>
<tr>
<td>Ptilinus pectinicornis L.</td>
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<td></td>
<td>beech, oak</td>
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<tr>
<td>P. fuscus Geoffr.</td>
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<td></td>
<td>willow, poplar, oak, beech</td>
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<tr>
<td>C. scopoli Laich.</td>
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<td></td>
<td>beech, oak, hornbeam, elm</td>
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<tr>
<td>Rosalia alpina L.</td>
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<td></td>
<td>beech</td>
</tr>
<tr>
<td>Chlorophorus varius F.</td>
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<td>accacia</td>
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<td>Phagonotus arcuatus L.</td>
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<td>oak, beech, hornbeam, willow</td>
</tr>
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<td>Liopus nebulosus L.</td>
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<td></td>
<td>hornbeam, elm, beech, oak, sycamore maple</td>
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<td>Xylotrechus rusticus L.</td>
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<td></td>
<td>willow, poplar, birch</td>
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<tr>
<td>Saperda putulnea L.</td>
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<td>S. carcharias L.</td>
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<td>poplar, willow</td>
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<td>Pyrhidium sanquineum L.</td>
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<td>oak, beech</td>
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<td>Lamia textor L.</td>
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<td>willow, poplar, birch</td>
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<td>Hylobius abietis L.</td>
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<td>Curculionidae</td>
<td>spruce</td>
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<tr>
<td>Pisidodes notatus L.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>P. pin L.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>P. piniphilus Hbst.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>P. validirostris Hbst.</td>
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<td></td>
<td>pine</td>
</tr>
<tr>
<td>P. harcynae</td>
<td></td>
<td></td>
<td>spruce</td>
</tr>
<tr>
<td>P. piceae</td>
<td></td>
<td></td>
<td>fir</td>
</tr>
<tr>
<td>Rhyncolus culinaris Germ.</td>
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<td></td>
<td>spruce, fir, pine</td>
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<td>Apoderuscorvili L.</td>
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<td></td>
<td>hazel, alder</td>
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<td>Rhynchitesfrisits F.</td>
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<td></td>
<td>sycamore maple</td>
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<td>Rh. betulae L</td>
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<td>birch, beech, hornbeam</td>
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<td>Otiorynchus niger</td>
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<td>spruce</td>
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<td>O. ovatus L</td>
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<td>spruce, fir, pine</td>
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<td>O. singularis L</td>
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<td></td>
<td>spruce, fir, pine, ash</td>
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<td>Phyllobius arborator Hbst.</td>
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<td>Ph. argentatus L.</td>
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<td>Ph. glaucus Stol.</td>
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<td>alder</td>
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<td>Braicheres inicanus L.</td>
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<td>pine, spruce and deciduous</td>
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<tr>
<td>Cryptorhynchus lapathy L.</td>
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<td></td>
<td>alder, willow</td>
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<td>Magdalis violacea L.</td>
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<td>birch</td>
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<tr>
<td>M. frontalii Gyll.</td>
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<td></td>
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<tr>
<td>Lygnoides enucleator Panz.</td>
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<td></td>
<td>ash</td>
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<tr>
<td>Orchestes fagi L.</td>
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<td></td>
<td>beech</td>
</tr>
<tr>
<td>Rhynchaenus festuceum Müll.</td>
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<td></td>
<td>alder</td>
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<tr>
<td>Cionus fraxini L.</td>
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<td></td>
<td>ash</td>
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<tr>
<td>Hylastes ater Payk.</td>
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<td>spruce</td>
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<td>H. cunicularius Eich.</td>
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<td>Blastoglyphus piniperda L.</td>
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<tr>
<td>Blastoglyphus minor Hart.</td>
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</tr>
<tr>
<td>Cryptalus piceae Ritzb.</td>
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<td></td>
<td>fir</td>
</tr>
<tr>
<td>Trypodendron lineatum Oliv.</td>
<td></td>
<td></td>
<td>spruce, fir, pine</td>
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</tbody>
</table>
### 3.3.1.5 Useful Insects - Predators

Well known among the predator insects are carabid coleopteran of the Closoma genus (C. sycophanta L. and C. inquisitor L.), destroyers of caterpillars and pupae of the main forest defoliators. The eggs and pupae of these pests are often destroyed by the larvae of some Dermentidae (Dermestes erichsoni Gyll., Megatoma undata L.). Treebark bugs are eaten by the larvae and adults of Thanasimus formicarius L. și Tiltus unifasciatus F (Cleridae). In the galleries of trunk insects predator species of the Nitidulidae, Cucujidae și Histeridae families may also be found.

Coccinellidae have many representatives that feed on aphids, lice and plant eating acarides (genuses Coccinella, Pullus, Exochomus, Stethorus, etc.). A very important role in limiting pest populations is played by forest ants (Formica rufa L.), contributing to a great extent to the maintenance of biocoenotic balance in the forests. Ants are the predators of many insect pests (Geometridae, Tortrix viridana, Lymantria monacha, Coleophora laricella, etc.). Large colonies of ants attract certain species of useful birds to which they are prey.

<table>
<thead>
<tr>
<th>Species</th>
<th>Order</th>
<th>Family</th>
<th>Tree host</th>
</tr>
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<tbody>
<tr>
<td>Pityokeines curvidens Germ.</td>
<td></td>
<td></td>
<td>fir</td>
</tr>
<tr>
<td>Ips sexdentatus L.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>Ips acuminatus Gyll.</td>
<td></td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>Orthotomicus suturalis Gyll.</td>
<td></td>
<td></td>
<td>pine, spruce</td>
</tr>
<tr>
<td>Ips typographus L.</td>
<td></td>
<td></td>
<td>spruce</td>
</tr>
<tr>
<td>Pityogenes chalcographus L.</td>
<td></td>
<td></td>
<td>spruce</td>
</tr>
<tr>
<td>Scolytus ratzburgi Yans.</td>
<td></td>
<td></td>
<td>birch</td>
</tr>
<tr>
<td>Scolytus multistriatus Mrsh.</td>
<td></td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Scolytus laevis Chap.</td>
<td></td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Scolytus intricatus Ritzb.</td>
<td></td>
<td></td>
<td>beech, hornbeam</td>
</tr>
<tr>
<td>Scolytus carpinii Ritzb.</td>
<td></td>
<td></td>
<td>hornbeam, beech</td>
</tr>
<tr>
<td>Scolytus maiali hbst.</td>
<td></td>
<td></td>
<td>apple</td>
</tr>
<tr>
<td>Lepersinus fraxini Panz.</td>
<td></td>
<td></td>
<td>ash, apple, walnut</td>
</tr>
<tr>
<td>Hylesinus crenatus F.</td>
<td></td>
<td></td>
<td>ash, lilac</td>
</tr>
<tr>
<td>Hylesinus oleiperta F.</td>
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<td></td>
<td>ash, lilac</td>
</tr>
<tr>
<td>Emoporus fagi F.</td>
<td></td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Emoporus tiliae Panz.</td>
<td></td>
<td></td>
<td>hornbeam</td>
</tr>
<tr>
<td>Taphrotynchus bicolor Hbst.</td>
<td></td>
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<td>beech, birch</td>
</tr>
<tr>
<td>Trypodendron domesticum L.</td>
<td></td>
<td></td>
<td>beech, birch, hornbeam, alder</td>
</tr>
<tr>
<td>Anisandrus dispar F.</td>
<td></td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Xyleborus saxeseni Ritzb.</td>
<td></td>
<td></td>
<td>beech, hornbeam, willow</td>
</tr>
<tr>
<td>Xyleborus signatus F.</td>
<td></td>
<td></td>
<td>birch, hornbeam, sycamore maple, alder</td>
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<tr>
<td>Melolontha melolontha L.</td>
<td>Scarabeidae</td>
<td></td>
<td>conifer, deciduous</td>
</tr>
<tr>
<td>Platypus cylindrus F.</td>
<td>Platypodidae</td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Tremex magus F.</td>
<td>Hymenoptera</td>
<td>Sirecidae</td>
<td>beech, sycamore maple, birch, pear, willow</td>
</tr>
<tr>
<td>Xiphidia prolongata Geoffr.</td>
<td></td>
<td></td>
<td>willow</td>
</tr>
<tr>
<td>Xiphidia longicornis Geoffr.</td>
<td></td>
<td></td>
<td>mesteacăn, păr</td>
</tr>
<tr>
<td>Lymexilon navale L.</td>
<td>Lymexilonidae</td>
<td></td>
<td>beech, fir, spruce, pine, birch</td>
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<tr>
<td>Lycus brunneus Steph.</td>
<td>Lycidae</td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Nematus angustatus Htg.</td>
<td>Tenthredinidae</td>
<td></td>
<td>willow, birch, alder</td>
</tr>
<tr>
<td>Cossus cossus L.</td>
<td>Lepidoptera</td>
<td>Cossidae</td>
<td>willow, ash, sycamore maple, walnut, alder</td>
</tr>
<tr>
<td>Rhyacionia buoliana</td>
<td>Tortricidae</td>
<td></td>
<td>pine</td>
</tr>
<tr>
<td>Chermes viridis</td>
<td>Hemiptera</td>
<td>Aphidae</td>
<td>spruce</td>
</tr>
<tr>
<td>Philapis fagi L.</td>
<td></td>
<td></td>
<td>beech</td>
</tr>
<tr>
<td>Mindarus abietinus Koch.</td>
<td></td>
<td></td>
<td>fir</td>
</tr>
<tr>
<td>Dreyfusia nuslini C.B.</td>
<td></td>
<td></td>
<td>fir</td>
</tr>
<tr>
<td>Cnophalodes sroblolobius Kth.</td>
<td></td>
<td></td>
<td>spruce</td>
</tr>
</tbody>
</table>
The representatives of other insect orders contribute to the control of many insect pest populations. Thus, neuropterans destroy aphids and lice. The larvae of Rhaphidia eat tree bark bugs. Predator bugs attack defoliator caterpillars (Arma custos F.), the larvae of leaf bugs (Nabis apterus F.), tree bark bugs (Scoloposcelis pulchella).

Dipterans represented by the families of Cecidomyidae (Aphidoletes sp.), Syrphidae (Syrphus sp.) and Chamaemyidae (Leucopis sp.) feed on aphids and dermestidae. Some species are predators in the tree bark bug galleries.

### 3.3.1.6 Useful Insects - Parasites

The most important parasite insects are members of the Dipterans and Hymenoptera orders. Apart from some species of Cecidomyidae parasitizing aphids and Psilidae (Endaphis sp.) and the Bombiliidae parasitizing caterpillars (Villa sp.), dipterans are represented by two large families - Tachinidae and Sarcophagidae.

The Tachinidae include medium-large size flies parasitizing in various ways, laying eggs directly on or into the host insect body or on leaves eaten by the pests. In the first case, fecundity is medium and affects a large number of defoliators, as e.g. Parasitigena silvestris R.D., Exorista larvarum and Bessa fugax Rond. Compsilura coccinata Meig. ponds its eggs into the host body, thus parasitizing on more than 150 species of defoliators. The parasites that lay eggs on the substrate are very fecund (up to 4000 eggs in Microphthalma europaea Egg. a parasite of the cockchafer larvae).

Of the Sarcophagidae family, a number of species of the genus Sarcophaga (S. uliginosa Kram., S. albiceps Meig., etc.) are known to develop into the caterpillars and pupae of defoliators.

Parasite Hymenopterans are members of the Parasitica sub-order, and an important role in regulating the numbers of pest populations is played by the members of the Paraconidae, Ichneumonidae, Pteromalidae, Encyrtidae and Trichogramidae families. The Braconidae family includes small and medium size insects of various colors. Most are endoparasites and affect the pests in various stages of their development (coleopteran and hymenoptera adults and caterpillars and eggs of the defoliators). As ectoparasites, they select hosts that hide in galleries or twisted leaves.

The most important members of this family of parasites belong to the Apanteles genus. The Ichneumonidae family includes a large variety of species of various sizes and colors. They are common especially in areas of wet climate, as the presence of water is a determining factor in adult life. Most of the parasite Ichneumons on forest pests belong to the Ephialtinae sub-family, which includes endoparasites of lepidopteron pupae, ectoparasites of coleopteran, Lepidoptera and hymenoptera larvae that develop in the wood, twisted leaves, fruit. The Pteromalidae include parasite Pteromalus puparum L. that develops in the pupae of some Lepidoptera and Eupteromalus nidulans (Thoruss.)- an ectoparasite of young defoliator caterpillars.

The Encyrtidae family includes egg eating species, mostly parasitizing on lepidoptera, the genus Ooencyrtus being predominant (O. tardus Ratz., O. concinus Rom., O. neustriae Merc., O. kuwanai How.). Many species of this family are parasites of coccidians and aphids.

The Trichogramidae family includes very small insects (less than 1 mm) parasitizing the eggs of many pest species (Trichogramma evanescens Westw., T. embryophagum Htg., T. semblidis Aur.).

A special category of aquatic invertebrates is the **Bentos fauna**.
Benthic invertebrate communities are very sensitive to stress. Benthos characteristics serve as a useful tool for detecting environmental stress resulting from point and diffuse sources of pollution. Because of the limited mobility of these organisms and the extended life cycles (year or more) of many species, their characteristics are a function of conditions during the recent past. This includes reactions to infrequently discharged pollutants that would be difficult to detect by periodic chemical sampling.

**Figure 3.21. Benthic Taxa Richness**

Knowledge of changes in the community structure (abundance and composition) and function of benthic invertebrates helps to indicate water quality status and trends in the aquatic environment. Table 3-4 presents the physico-chemical parameters of the water in the studied sites. It is evident that low pH and high conductivity occur frequently in the streams of the general assessment area. Table 3-5 presents the list of aquatic families identified at each location (qualitative samples). Table 3-6 provides the numerical abundance of benthic invertebrate families (quantitative samples).

Benthic taxa richness on the investigated sites is shown in Fig. 3.21. Community indices of standing and flowing water systems are presented in Tables 3-7 and 3-8. The results for each system are discussed in the following sections.
### Table 3-4. Physico-chemical Parameters of Water in the Sampled Sites

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Sampling Locations</th>
<th>System</th>
<th>pH</th>
<th>Cond (microS)</th>
<th>Eh (mV)</th>
<th>Temp.water (Cº)</th>
<th>Alkalinity (mmol/l)</th>
<th>O2 dissolved (mg/l)</th>
<th>Hardness (ppm CaCO3)</th>
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</thead>
<tbody>
<tr>
<td>29</td>
<td>Tailing pond Salistea</td>
<td>L</td>
<td>3.9</td>
<td>1090</td>
<td>329</td>
<td>14</td>
<td></td>
<td></td>
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<tr>
<td>17</td>
<td>Taul Salistea</td>
<td>L</td>
<td>9.4</td>
<td>66</td>
<td>11.2</td>
<td>22.3</td>
<td>1.5</td>
<td>13.2</td>
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<td>19</td>
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<td>176</td>
<td>21.6</td>
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<td>11.5</td>
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<tr>
<td>16</td>
<td>Taul Corna</td>
<td>L</td>
<td>8.7</td>
<td>234</td>
<td>126</td>
<td>23.4</td>
<td>2.1</td>
<td>13.4</td>
<td>174</td>
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<tr>
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<td>L</td>
<td>8.4</td>
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<td>158</td>
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<tr>
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<td>Taul Brazilior</td>
<td>L</td>
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<td>1.8</td>
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<td>65</td>
</tr>
<tr>
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<td>L</td>
<td>9.6</td>
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<td>24</td>
<td>19.9</td>
<td>1.2</td>
<td>9.5</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Abrud downstream junction Roșia</td>
<td>S</td>
<td>4.1</td>
<td>1231</td>
<td>323</td>
<td>18.1</td>
<td>No</td>
<td>3.4</td>
<td>No</td>
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<td>1268</td>
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<tr>
<td>24</td>
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<td>S</td>
<td>4.9</td>
<td>1197</td>
<td>245</td>
<td>18.1</td>
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<td>1864</td>
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<tr>
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<td>Aries upstream Abrud junction</td>
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<td>8.6</td>
<td>159</td>
<td>178</td>
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<td>Abruzel upstream stretch</td>
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<td>524</td>
<td>13.2</td>
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<td>Abruzel downstream stretch</td>
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Legend: Grey areas indicated streams stretches with very low pH. L = lakes, S = streams
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### 4.6 Biodiversity

#### Section 3: Baseline Conditions

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### 4.6 Biodiversity

#### Section 3: Baseline Conditions

**Sampling Location and number (as referenced in Table 5)**

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<th>Vârtop upstream</th>
<th>Vârtop downstream</th>
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<th>Corna downstream</th>
<th>Aries upstream</th>
<th>Aries downstream, Taul Brazilor</th>
<th>Taul Salistea</th>
<th>Taul Tarina</th>
<th>Taul Gauri</th>
<th>Taul Corna</th>
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## Table 3-7. Community Indices of Flowing Water Systems Sampling Stations

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<th>Roșia 1</th>
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<th>Bucium</th>
<th>Vârtop amonte</th>
<th>Vârtop aval</th>
<th>Corna sat</th>
<th>Corna aval</th>
<th>Arieș amonte</th>
<th>Arieș aval</th>
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## Table 3-8. Community Indices of Standing Water Systems Sampling Stations

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<th>Taul Brazilor</th>
<th>Taul Corna</th>
<th>Taul Salistea</th>
<th>Taul Tarina</th>
<th>Taul Gauri</th>
<th>Taul Anghel</th>
<th>Taul Mare</th>
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<td>2</td>
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<td>HBI</td>
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<td>5.75</td>
<td>6.00</td>
<td>5.67</td>
<td>5.69</td>
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<td>Taxa Richness</td>
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<td>6</td>
<td>4</td>
<td>4</td>
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<td>7</td>
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</table>

Section 3: Baseline Conditions
3.3.2  Vertebrates

3.3.2.1  Fish
The whole study area is located near the fishing site of Abrud Valley. According to the data provided by the Forestry authority of Campeni (ICAS database, Development 1977-1998), the streams on this site are not stocked with fish. There were attempts to reintroduce dace and barbell, but the results were unsatisfactory because of ARD pollution. Therefore, there can be no question of fish populations being present in the flowing waters of the Roșia Montană mining project site, for the following reasons:

- the physical and chemical parameters of most of the streams (including Abrud River, which drains the Study Area streams) making the water unsuitable for viable fish populations;
- where the water quality is not a limiting factor, the streams have a limited food supply and a flow rate that cannot support fish populations.

Some species of fish of the Cyprinidae (carp, crucian, gudgeon, crucian carp, loach) and Esocidae (pike) families were reported in several local lakes including Taul Anghel, Taul Brazilor, and Taul Corna. They are obviously species that have been introduced over time in the artificial lakes. According to the data obtained from hydro-biological analysis, the water quality in these lakes is affected. One of the causes of this is the unsophisticated historic mining procedures, when long term environmental protection was not a human concern.

3.3.2.2  Amphibians
Concurrent with bird survey, presence of amphibian and reptile species was also recorded. Five amphibian species and four reptile species were recorded in the Project Area.

Table 3-9.  Amphibian Species Recorded in the Project Area

<table>
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<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Typical Habitat</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caudata</td>
<td>Salamandridae</td>
<td>Salamandra salamandra</td>
<td>Slamander</td>
<td>Wet forests</td>
<td>Uncommon</td>
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<tr>
<td></td>
<td>Triturus vulgaris</td>
<td>Common Newt</td>
<td>Temporary and permanent ponds</td>
<td>Common</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triturus alpestris</td>
<td>Mountain newt</td>
<td>Temporary and permanent ponds</td>
<td>Common</td>
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</tr>
<tr>
<td>Anura</td>
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<td>Bombina variegata</td>
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<td>Temporary and permanent ponds</td>
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<td>Bufo bufo</td>
<td>Brown toad</td>
<td>Temporary and permanent ponds, terrestrial habitats</td>
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<td>Rana temporaria</td>
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</table>

3.3.2.3  Reptiles
Four species of reptiles have been identified in the study area. These species are presented, along with the habitat in which they were identified and relative abundance, in the following Table.
Table 3-10. Reptile Species Recorded in the Project Area

<table>
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<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific Name</th>
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<th>Typical Habitat</th>
<th>Relative Abundance</th>
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<td>Wall lizard</td>
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<td>Anguidae</td>
<td>Anguis fragilis</td>
<td>Adder</td>
<td>Scrubland, heaths, hedgebanks</td>
<td>Uncommon</td>
<td></td>
</tr>
<tr>
<td>Colubridae</td>
<td>Natrix natrix</td>
<td>Slow worm</td>
<td>Wetlands</td>
<td>Uncommon</td>
<td></td>
</tr>
</tbody>
</table>

3.3.2.4 Birds

Eighty-three bird species were recorded in the project area. Considering the timing of the inventory, it may be assumed that most of these breed in the area. A complete list of bird species recorded in the project area is included in Table 3-11.

About 45% of the birds recorded as breeding in the Project area are migratory. The other 55% are resident species.

Approximately 77% of the breeding bird species recorded are forest species. About 9% of species are found in each of the following habitats: meadows and pastures, forest margins and small forest patches, and in localities. Only around 4% of bird species are associated with wetlands.

The typical territory size in the breeding season for the recorded species varies between approx. 0.3 ha (wren *Trogloidytes troglodytes*) and more than 180 ha (buzzard *Buteo buteo*).

There are eight top-predator bird species, both diurnal (goshawk *Accipiter gentilis*, sparrowhawk *Accipiter nisis*, buzzard *Buteo buteo* and kestrel *Falco tinnunculus*) and nocturnal (Scops owl *Otus scops*, little owl *Athene noctua*, tawny owl *Strix aluco*, and long-eared owl *Asio otus*). Raptors are particularly sensitive to disturbance, especially within their breeding territories.

Other area-sensitive species that were recorded in the project area include several species of woodpeckers (such as white-backed woodpecker *Dendrocopos leucotos*, middle spotted woodpecker *Dendrocopos medius*, black woodpecker *Dryocopus martius* grey-headed woodpecker *Picus canus* and green woodpecker *Picus viridis*), which require large, forested blocks of at least 10 ha for their habitat.

A description of some of the most important habitat-sensitive species found in the Project Area is included below:

- **White-backed woodpecker** (*Dendrocopos leucotos*) is a resident species with strict habitat requirements, preferring natural forests free of any forestry management practices and with a high proportion of decayed or fallen timber. It is estimated that Romania maintains between 20.0% and 29.4% of the European breeding population. It is uncommon in the area, but it was observed on Vartop Valley. It is estimated that there are 1-2 pairs in the Project area, i.e. 0.004-0.012% of the estimated population in Romania according to Birds in Europe 2, Birdlife International 2005.

- **Middle spotted woodpecker** (*Dendrocopos medius*) is also a resident species with strict habitat requirements, characterized by a relative lack of adaptability capacity and dependence on traditional woodpecker habitats, which involves vulnerability to direct or indirect human impact, especially to replanting or other forest management practice. Between 0.7% and 5.0% of the European breeding population is found in Romania, i.e. about 20000-24000 pairs. It is rather uncommon in the area, but it was
observed on Vartop Valley. It is estimated that there are 3-5 pairs in the Project impact area, i.e. 0.012-0.025% of the Romanian population.

- **Black Woodpecker** (*Dryocopus martius*) is a resident species preferring both for feeding and nesting tall trunks in mature forests (particularly mixed beech and fir forests). The species is vulnerable to increasing human encroachments, as shown by patchy and islanded pattern of distribution in lowland areas with severe deforestation. Between 0.7% and 2.1% of the European breeding population is found in Romania. Romania hosts an estimated population of 40000-60000 pairs. 1-2 pairs exist in the Project impact area, in Vartop Valley, i.e. 0.0016–0.005% of the Romanian population.

- **Red-backed Shrike** (*Lanius collurio*) is a long distance, trans-Saharan migrant. It requires as breeding habitat sunny, sheltered, warm, dry or even semi-arid, and plain or gently sloping terrain, with scattered or open growth of thorny bushes, shrubs, or low trees providing hunting look-out posts around areas of short grass and heath suitable for small prey. Between 15.4% and 24.0% of the European breeding population is found in Romania. Well represented in Romania, where the estimated population is 1380000-2600000 nesting pairs. Rather common in the impact area, where the presence of 35-55 pairs has been estimated, i.e. 0.0013-0.004%.

- **Woodlark** (*Lullula arborea*) is a short-distance migrant, and sometimes-resident species. It has very strict habitat requirements. Changing land use and human disturbance accordingly play a more than locally important role in affecting survival, expansion, and stability of woodlark populations. It is estimated that between 1.5% and 3.3% of the European breeding population is found in Romania, i.e. 65000-87000 pairs. Very rare in the Project area.

- **Scops Owl** (*Otus scops*) is a nocturnal arboreal species, hunting in open areas; it requires ample cover of trees providing quiet shaded roosting sites and nest-holes near open ground rich in large insect prey; accordingly, avoids both closed forest and extensive open tracts, preferring broad-leaved and mixed open woodland with underbrush and old hollow trees. Such natural habitats have, however, progressively been superseded by managed situations. Romania hosts an estimated population of 25000-40000 pairs. In the area impacted by the Project, 2-3 pairs may be encountered.

- **Redstart** (*Phoenicurus phoenicurus*) is a short distance migrant. It requires as breeding habitat sheltered but fairly open wooded or parkland areas with access to dry secure nest-holes in trees, rocks, walls, banks, or other places and without too dense or tall unbroken undergrowth or herbage. It is estimated that Romania maintains between 6.0% and 11.1% of the European breeding population. It is common in the area impacted by the Project, where 50-60 pairs are estimated. This would account for 0.03-0.04% of the Romanian population.

- **Grey-headed Woodpecker** (*Picus canus*) is a resident species. It feeds mostly on the ground, although its dependence on holes in trees for nesting and roosting governs its distribution. It is estimated that Romania maintains between 25.0% and 27.8% of the European breeding population. 10 to 12 pairs are assumed to be present in the Project area. Romania hosts an estimated population of 45000-60000 pairs.

- **Green Woodpecker** (*Picus viridis*) is a resident species. It is ground feeder and, like the grey-headed Woodpecker, sensitive to changes produced by grazing or deforestation. It is estimated that Romania maintains between 2.5% and 2.9% of the European breeding population. Up to 15 pairs are estimated in the study area, i.e. about 0.015% of the Romanian population.
Only a few of the species impacted by the Project have been described above. They have been selected because most are considered priority forest species (Tucker, G.M. et al 1997). All the species will be taken into account in impact mitigation, especially those listed in the annexes to various laws and conventions.

Most species (63%) have relatively low densities. Low abundance species include woodpeckers and raptors. Two-thirds of the low abundance species are passerines (35 species). The majority of medium-abundance species (20-60 individuals observed) are passerines, and only two are non-passerine species (woodpigeon and cuckoo). All the high-abundance species are passerines.

A list of bird species recorded in the project area is presented in the following Table.

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Typical Habitat</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anseriformes</td>
<td>Anatidae</td>
<td>Big Duck</td>
<td>Anas platyrhynchos</td>
<td>Wetlands, lakes</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Falconiformes</td>
<td>Accipitridae</td>
<td>Goshawk</td>
<td>Accipiter gentiles</td>
<td>Forest</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Sparrowhawk</td>
<td>Accipiter nisus</td>
<td>Forest</td>
<td></td>
<td>Uncommon</td>
<td></td>
</tr>
<tr>
<td>Common kite</td>
<td>Buteo buteo</td>
<td>Forest, meadows</td>
<td></td>
<td>Common</td>
<td></td>
</tr>
<tr>
<td>Red kestrel</td>
<td>Falco tinnunculus</td>
<td>Meadows,</td>
<td></td>
<td>Uncommon</td>
<td></td>
</tr>
<tr>
<td>Galliformes</td>
<td>Fasianidae</td>
<td>Partridge</td>
<td>Perdix perdix</td>
<td>Meadows, pastures</td>
<td>Common</td>
</tr>
<tr>
<td>Quail</td>
<td>Coturnix coturnix</td>
<td>Meadows,</td>
<td></td>
<td>Uncommon</td>
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<tr>
<td>Common pheasant</td>
<td>Phasianus colchicus</td>
<td>Forest, meadows,</td>
<td></td>
<td>Uncommon</td>
<td></td>
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<tr>
<td>Gruiformes</td>
<td>Railidae</td>
<td>Moorhen</td>
<td>Gallinula chloropus</td>
<td>Wetlands</td>
<td>Rare</td>
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<tr>
<td>Columbiformes</td>
<td>Columbidae</td>
<td>Woodpigeon</td>
<td>Columba palumbus</td>
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<td>Common</td>
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<tr>
<td>Ring dove</td>
<td>Streptopelia decaocto</td>
<td>Towns, villages</td>
<td></td>
<td>Common</td>
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</tr>
<tr>
<td>Cuculiformes</td>
<td>Cuculidae</td>
<td>Cuckoo</td>
<td>Cuculus canorus</td>
<td>Forest, meadows</td>
<td>Common</td>
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<tr>
<td>Strigiformes</td>
<td>Strigidae</td>
<td>Scops owl</td>
<td>Otus scops</td>
<td>Old orchards, wooded areas</td>
<td>Rare</td>
</tr>
<tr>
<td>Tawny owl</td>
<td>Athene noctua</td>
<td>Towns, villages</td>
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<td>Uncommon</td>
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<tr>
<td>Little owl</td>
<td>Strix aluco</td>
<td>Forest, parks</td>
<td></td>
<td>Uncommon</td>
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<tr>
<td>Long eared owl</td>
<td>Asio otus</td>
<td>Forest</td>
<td></td>
<td>Rare</td>
<td></td>
</tr>
<tr>
<td>Coarciiformes</td>
<td>Upupidae</td>
<td>Hoopoe</td>
<td>Upupa epops</td>
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<td>Rare</td>
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<tr>
<td>Piciformes</td>
<td>Picidae</td>
<td>Gray Woodpecker</td>
<td>Picus canus</td>
<td>Forest</td>
<td>Rare</td>
</tr>
<tr>
<td>Green Woodpecker</td>
<td>Picus viridis</td>
<td>Forest, meadows</td>
<td></td>
<td>Uncommon</td>
<td></td>
</tr>
<tr>
<td>Black Woodpecker</td>
<td>Dryocopus martius</td>
<td>Forest</td>
<td></td>
<td>Rare</td>
<td></td>
</tr>
<tr>
<td>Large spotted woodpecker</td>
<td>Dendrocopos major</td>
<td>Forest, gardens, orchards</td>
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<td></td>
</tr>
<tr>
<td>Middle spotted woodpecker</td>
<td>Dendrocopos medius</td>
<td>Forest</td>
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<td>Rare</td>
<td></td>
</tr>
<tr>
<td>Grey-headed Woodpecker</td>
<td>Dendrocopos leucotos</td>
<td>Forest</td>
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<td>Rare</td>
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<tr>
<td>Paseriformes</td>
<td>Alaudidae</td>
<td>Crested Lark</td>
<td>Galerida cristata</td>
<td>Meadows, cultivated fields</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Woodlark</td>
<td>Lullula arborea</td>
<td>Open forests</td>
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<td>Skylark</td>
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<td>Hirundinidae</td>
<td>Hirundo rustica</td>
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<td></td>
</tr>
<tr>
<td>Order</td>
<td>Family</td>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Typical Habitat</td>
<td>Relative Abundance</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pastures</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>House martin</td>
<td>Delichon urbica</td>
<td>Towns, villages, meadows, pastures</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motacilidae</td>
<td>Forest pipit</td>
<td>Anthus trivialis</td>
<td>Common</td>
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<td></td>
<td></td>
<td>Meadow pipit</td>
<td>Anthus pratensis</td>
<td>Pastures, scrubland</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mountain wagtail</td>
<td>Motacilla cinerea</td>
<td>Running water</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>White wagtail</td>
<td>Motacilla alba</td>
<td>Wet pastures, running water, villages</td>
<td>Common</td>
</tr>
<tr>
<td>Troglodytidae</td>
<td>Wren</td>
<td>Troglodytes troglodytes</td>
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<td>Forest</td>
<td>Common</td>
</tr>
<tr>
<td>Prunellidae</td>
<td>Dunnock</td>
<td>Prunella modularis</td>
<td>Forest</td>
<td>Forest, gardens</td>
<td>Common</td>
</tr>
<tr>
<td>Turdidae</td>
<td>Robin</td>
<td>Erithacus rubecula</td>
<td>Forest</td>
<td>Forest, gardens, bush</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Reddish nightingale</td>
<td>Luscinia megarhynchos</td>
<td>Forest</td>
<td>Forest, bush</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Black Bird</td>
<td>Turdus merula</td>
<td>Forest</td>
<td>Forest, gardens, localities</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Fieldfare</td>
<td>Turdus pilaris</td>
<td>Gardens, parks</td>
<td>Gardens, parks, localities, meadows, forest</td>
<td>Common</td>
</tr>
<tr>
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<td>Song Thrush</td>
<td>Turdus pilaris</td>
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<td>Forest, gardens</td>
<td>Common</td>
</tr>
<tr>
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<td>Mistle Thrush</td>
<td>Turdus viscivorus</td>
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<td>Common</td>
</tr>
<tr>
<td></td>
<td>Black firetail</td>
<td>Phoenicurus ochruros</td>
<td>Towns, villages</td>
<td>Towns, villages, rocks</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Redstart</td>
<td>Phoenicurus ochruros</td>
<td>Forest</td>
<td>Forest, gardens, localities</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Whinchacker</td>
<td>Saxicola rubetra</td>
<td>Meadows with bushes</td>
<td>Meadows with bushes</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td>Black Whinchacker</td>
<td>Saxicola torquata</td>
<td>Meadows with bushes</td>
<td>Meadows with bushes</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Stonechat</td>
<td>Oenanthe oenanthe</td>
<td>Cliffs, dry pastures</td>
<td>Cliffs, dry pastures</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Sylvidae</td>
<td>Field warbler</td>
<td>Sylvia communis</td>
<td>Shrub, forest</td>
<td>Shrub, forest</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Blackcap</td>
<td>Sylvia atricapilla</td>
<td>Forest, gardens</td>
<td>Forest, gardens</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Small warbler</td>
<td>Sylvia atricapilla</td>
<td>Shrub, forest</td>
<td>Shrub, forest</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Small warbler</td>
<td>Phylloscopus collybita</td>
<td>Forest</td>
<td>Forest, gardens</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Whistling warbler</td>
<td>Phylloscopus collybita</td>
<td>Forest</td>
<td>Forest, gardens</td>
<td>Common</td>
</tr>
<tr>
<td>Regulidae</td>
<td>Kinglet</td>
<td>Regulus regulus</td>
<td>Forest</td>
<td>Forest</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Crested wren</td>
<td>Regulus ignicapillus</td>
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<td>Uncommon</td>
</tr>
<tr>
<td>Muscicapidae</td>
<td>Flycatcher</td>
<td>Muscicapa striata</td>
<td>Gardens, localities</td>
<td>Gardens, localities, forest</td>
<td>Common</td>
</tr>
<tr>
<td>Aegitalidae</td>
<td>Crested Tit</td>
<td>Aegithalos caudatus</td>
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<td>Common</td>
</tr>
<tr>
<td>Paridae</td>
<td>Grey tit</td>
<td>Parus palustris</td>
<td>Forest, gardens</td>
<td>Forest, gardens, parks, bush</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Mountain tit</td>
<td>Parus montanus</td>
<td>Forest</td>
<td>Forest</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td>Crested Tit</td>
<td>Parus cristatus</td>
<td>Resinous Forest</td>
<td>Resinous Forest</td>
<td>Rare</td>
</tr>
<tr>
<td></td>
<td>Spruce tit</td>
<td>Parus ater</td>
<td>Forest</td>
<td>Forest</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Blue Tit</td>
<td>Parus caeruleus</td>
<td>Forest, gardens</td>
<td>Forest, gardens, bush</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Great Tit</td>
<td>Parus major</td>
<td>Forest</td>
<td>Forest, gardens, bush</td>
<td>Common</td>
</tr>
<tr>
<td>Sittidae</td>
<td>Nuthatch</td>
<td>Sitta europaea</td>
<td>Forest</td>
<td>Forest</td>
<td>Common</td>
</tr>
<tr>
<td>Certhiidae</td>
<td>Forest</td>
<td>Certhia familiaris</td>
<td>Forest</td>
<td>Forest</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Laniidae</td>
<td>Red shrike</td>
<td>Lanius collurio</td>
<td>Forest, bushes</td>
<td>Forest edges, thorny bushes</td>
<td>Common</td>
</tr>
</tbody>
</table>
### 3.3.2.5 Mammals

Thirty one mammal species were recorded in the project area. Top predators recorded included European common weasel, European polecat, Pine marten and Stone marten. No resident large carnivores were registered. Very occasionally, wolf tracks were observed to cross the territory.
<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Typical Habitat</th>
<th>Relative Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insectivore</td>
<td>Erinaceidae</td>
<td>Erinaceus concolor</td>
<td>Eastern hedgehog</td>
<td>Forest, grassland, scrub, cultivated land, gardens, localities</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Soricidae</td>
<td>Sorex araneus</td>
<td>Common shrew</td>
<td>Meadows, bush, forest</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Talpidae</td>
<td>Talpa europaea</td>
<td>Mole</td>
<td>Deciduous woodland, arable land and pasture.</td>
<td>Common</td>
</tr>
<tr>
<td>Chiroptera</td>
<td>Vespertilionidae</td>
<td>Myotis myotis</td>
<td>Common large bat</td>
<td>Mature, sparse forest, parks, localities Breeding colonies in church steeples Winters in rock hollows, mining pits, crevices</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Myotis blythii</td>
<td>Common little bat</td>
<td>Forested land, bush, parks, localities Winters in caves, mine pits</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Myotis nattereri</td>
<td>Natterer’s bat</td>
<td>Sparse forest, cultivated land with lakes and ponds, occasionally in localities. Breeding colonies in tree hollows, under the bark of dead trees or in buildings. Hibernates in caves, mine pits .</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Myotis daubentonii</td>
<td>Water bat</td>
<td>Open forest and waterside habitats. Breeding colonies in hollowed trees or crevices Winters in tunnels and caves</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Eptesicus</td>
<td>Eptesicus serotinus</td>
<td>Broad-winged bat</td>
<td>Thin forests, parks, meadows Breeding colonies in buildings Typically hibernates in buildings</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Plecotus</td>
<td>Plecotus austriacus</td>
<td>Grey large eared bat</td>
<td>Cultivated fields, forests. Hibernates in caves, mine pits Breeding colonies in buildings</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Plecotus</td>
<td>Plecotus auritus</td>
<td>Red large eared bat</td>
<td>Forest, parks, orchards Breeding colonies in tree hollows. Hybernates underground, less frequently in buildings and hollow trees</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Nyctalus</td>
<td>Nyctalus noctula</td>
<td>Red greenhouse bat</td>
<td>Forests, parks Breeding colonies in tree hollows. Breeding colonies in hollowed trees, less frequently crevices, buildings</td>
<td>Uncommon</td>
</tr>
<tr>
<td></td>
<td>Pipistrellus</td>
<td>Pipistrellus pipistrellus</td>
<td>Little pipistrelle</td>
<td>Broad range of habitats, except very exposed. Breeding colonies in small spaces in buildings Wintering colonies in buildings, hollowed trees, rarely caves or mine pits</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Lagomorpha</td>
<td>Leporidae</td>
<td>Lepus europaeus</td>
<td>Field hare Farmland (pastures, grassland), woods</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td>Rodentia</td>
<td>Sciuridae</td>
<td>Sciurus vulgaris</td>
<td>Red Squirrel All types of forests, also parks, gardens</td>
<td>Common</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clethrionomys</td>
<td>Wood mouse</td>
<td>Areas with good</td>
<td>Uncommon</td>
</tr>
</tbody>
</table>
### 4.6 Biodiversity

#### Table 3-13. Hunting surface area uptake

<table>
<thead>
<tr>
<th>Name of the hunting ground</th>
<th>Total area (ha)</th>
<th>Of which, on Project site (ha)</th>
<th>Of which, on Project site (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Detunata</td>
<td>14057</td>
<td>1481</td>
<td>10</td>
</tr>
<tr>
<td>7 Ciuruleasa</td>
<td>12347</td>
<td>164</td>
<td>1</td>
</tr>
</tbody>
</table>

As regards reduction of the areas considered “game productive” (forest, arable, hay meadows, etc.) the implementation of Rosia Montana Project will create the following situation:

**3.3.3 Game**

From a hunting perspective, the Project site will take up an area belonging to two hunting grounds, i.e.:

- hunting ground no. 8 Detunata, with an area of 1481 ha, i.e. 10% of the total hunting ground area;
- hunting ground no. 7 Ciuruleasa, with an area of 164 ha to the north of the site, i.e. 1% of the total hunting ground area;

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Typical Habitat</th>
<th>Relative Abundanc e</th>
</tr>
</thead>
<tbody>
<tr>
<td>glareolus</td>
<td></td>
<td>vegetation cover: Forest, bush</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arvicola terrestris</td>
<td>Water rat</td>
<td>Densely vegetated ditch, dyke, river and stream banks</td>
<td></td>
<td></td>
<td>Rare</td>
</tr>
<tr>
<td>Microtus arvalis</td>
<td>Field vole</td>
<td>Dry meadows, farmland, field margins</td>
<td></td>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Apodemus flavicollis</td>
<td>Yellow neck mouse</td>
<td>Forests, rarely bysh at forest edges</td>
<td></td>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Apodemus agrarius</td>
<td>Striped field vole</td>
<td>Grassy fields, cultivated areas, forests</td>
<td></td>
<td></td>
<td>Rare</td>
</tr>
<tr>
<td>Apodemus sylvaticus</td>
<td>Wood mouse</td>
<td>Grassy fields, cultivated areas, woodlands and forests</td>
<td></td>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Rattus norvegicus</td>
<td>Norway rat</td>
<td>Around human settlement</td>
<td></td>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Mus musculus</td>
<td>House mouse</td>
<td>Houses, barns, granaries</td>
<td></td>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Muscardinus avellanarius</td>
<td>.....</td>
<td>Abundant in deciduous and mixed forests and thickets</td>
<td></td>
<td></td>
<td>Uncommon</td>
</tr>
<tr>
<td>Carnivora Canidae</td>
<td>Vulpes vulpes</td>
<td>Fox</td>
<td>Generalist; prefer fragmentary/diverse vegetation pattern</td>
<td>Common</td>
<td></td>
</tr>
<tr>
<td>Mustelidae</td>
<td>Meles meles</td>
<td>Badger</td>
<td>Forest</td>
<td>Uncommon</td>
<td></td>
</tr>
<tr>
<td>Mustela nivalis</td>
<td>Weasel</td>
<td>Generalist; fields, meadows, forests, riverbanks, lake shores</td>
<td></td>
<td>Uncommon</td>
<td></td>
</tr>
<tr>
<td>Mustela putorius</td>
<td>Polecat</td>
<td>Forest, orchards, waterbanks, localities</td>
<td>Uncommon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Martes martes</td>
<td>Pine marten</td>
<td>Forest</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Martes foina</td>
<td>Stone marten</td>
<td>Forest, localities</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artiodactyla Suidae</td>
<td>Sus scrofa</td>
<td>Wild boar</td>
<td>Moist forests and shrublands</td>
<td>Rare</td>
<td></td>
</tr>
<tr>
<td>Cervidae</td>
<td>Capreolus capreolus</td>
<td>Roe deer</td>
<td>Forests, pastures</td>
<td>Rare</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3-14. Surface areas of Project impacted hunting grounds by category of use

<table>
<thead>
<tr>
<th>Name of the hunting ground</th>
<th>Category of land use</th>
<th>Surface Area</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total ha</td>
<td>%</td>
<td>Impacted by Project ha</td>
<td>%</td>
</tr>
<tr>
<td>8 Detunata</td>
<td>forest</td>
<td>4429</td>
<td>32</td>
<td>175</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>arable, hay meadows, grassland, pastures.</td>
<td>9586</td>
<td>68</td>
<td>514</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>alpine meadow</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7 Ciuruleasa</td>
<td>forest</td>
<td>4874</td>
<td>40</td>
<td>21</td>
<td>0,4</td>
</tr>
<tr>
<td></td>
<td>arable, hay meadows, grassland, pastures.</td>
<td>7182</td>
<td>59</td>
<td>106</td>
<td>1,4</td>
</tr>
<tr>
<td></td>
<td>alpine meadow</td>
<td>146</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The total surface area of hunting ground 8 Detunata is 14057 ha, and the distribution by land use categories is as follows:
- 10,944.30 acres of forest accounting for 32% of the total area;
- 14,211.03 acres arable, hay meadows, vineyards, etc., i.e. 41% of the total area;
- 9,476.49 acres meadows, grassland, pastures, accounting for 27% of the total area;
- 17.30 acres water surface (watercourtses, channels, ponds, lakes);
- 35 ha of non-productive hunting ground.

The total surface area of hunting ground 7 Ciuruleasa is 12347 ha, and the distribution by land use categories is as follows:
- 4874 ha of forest accounting for 40% of the total area;
- 3086 ha arable, hay meadows, vineyards, etc., i.e. 25% of the total area;
- 4096 ha meadows, grassland, pastures, accounting for 33% of the total area;
- 146 ha of alpine meadow accounting for 1% of the total area;
- 18 ha water surface (watercourtses, channels, ponds, lakes);
- 313.82 acres of non-productive hunting ground.

The following is an analysis of the game species of interest on the Project site and neighboring areas.

Of the total site area (1645 ha), 164 ha are on 7 Ciuruleasa hunting ground, and 1481 on 8 Detunata hunting ground.

On the Project site, according to the records of the Hunter’s Association Campeni there are about 5-10 deer, 15-20 hares, 1-3 boars, 6-10 foxes, 6-10 badgers, and 8-10 quail.

The mammal inventory was conducted by direct and indirect observations, and scat and footprint monitoring, the records of animal presence held by Hunter’s Association Campeni.

**Roe Deer** (*Capreolus capreolus*) is a wide spread species in the country; it is a medium size animal, 95-135 cm long, 65-75 cm height at its withers, and weight that in eviscerated males ranges from 20 to 25 kg.

Its preferred habitat is plains and hill regions with alternate farmland, hay meadows and small woods, of deciduous or mix of deciduous and conifer species. Both for shelter and...
food, it requires young stands or forests with thickets. In some areas, such as the west of the country, deer spend all their time on open ground, which proves the high plasticity of the species and allows for widespread distribution.

The rating categories established for 1000 ha of forest are: category I: 90-110 individuals; category II: 70-89 individuals; category III: 51-69 individuals; category IV: 5 -50 individuals. According to the records of the Hunters' Association in Campeni, there are 5-10 deer in the Project area.

The rating of Detunata 8 hunting grounds for deer is category IV.

**Boar** *(Sus scrofa)* is a common mammal in the country, encountered anywhere between the Danube Delta and the hills and mountain regions. Its distribution depends on the availability of shelter and food, which gives a certain variability of its body shape and hair color.

The presence of boars is strictly related to the forest and their occasional appearance on floating islands or reeds in the Delta is considered an exception. The best conditions are those of oak and beech forests, where food and shelter are both available. Conifer forests, although better for shelter, are far poorer in food. Because it needs quiet, the boar prefers extended forests, with wallows. Of the station factors that limit its breeding, low temperatures and a thick snow cover.

By rating category, it is estimated that the best, category I distribution is 7-8 individuals in 1000 ha; category II, 5-5 individuals in 1000 ha, category III 3-4 individuals in 1000 ha, category IV 0.2-2 individuals in 1000 ha.

Note that optimum density of the boar species is calculated for 1000 ha of forested land. According to the records of the Hunters' Association in Campeni, there are 1-3 boars in the Project area.

The rating of Detunata 8 hunting grounds for deer is category IV.

**Common hare** *(Lepus europeus)* is a small mammal, common and widespread in the country. Hares show preference for cultivated farmland and, 1-15% small woods. They avoid swampy and wet land, the best breeding grounds being located up to 400 m elevation. Their density varies depending on station, and density categories, according to the rating are: category I: 201-380 individuals per 1000 ha; category II: 151-200 individuals; category III: 101-150 individuals; category IV: 20 -100 individuals.

According to the records of the Hunters’ Association in Campeni, there are 10-20 hares in the Project area.

The rating of Detunata 8 hunting grounds for hare is category IV.

**Fox** *(Vulpes vulpes)* is a widespread small carnivore mammal, living all the way between the Delta and high ground forests. Maximum density is attained in hill and plain regions, where it can easily find mice, its favorite food. It chooses clayey-sandy soil land, where it can dig galleries with sunny exposure, that it also selects for its den. This habit, as well as other features, make foxes attached to their territory.

According to the records of the Hunters' Association in Campeni, there are 6-10 foxes in the Project area.

The rating of Detunata 8 hunting grounds for hare is category IV.

**Badger** *(Meles meles)* is an animal encountered anywhere between the plains and the mountains, in forests and thickets, near cultivated farmland, very attached to its territory. It is an omnivore living in families.
According to the records of the Hunters’ Association in Campeni, there are 6-10 badgers in the Project area.

Of the bird species of hunting concern, only partridges can be found in the Project area.

**Partridge** (*Perdix perdix*) is a small bird, 27-34 cm long, weighing 320-440 g. An European-Turkestanic element, it is found in plains and cultivated hill regions. On the ground, it needs thickets for shelter. It may be encountered on higher ground, 800-1100 m (1800 m). It prefers flat land, with sandy, permeable soil, with sparse precipitation during breeding, sheltered from extreme temperatures, with shallow snow cover; wind and blizzards have a strong influence on numbers.

They feed on insects, larvae, worms, ant eggs, seeds, buds and various leaves. They forage during the day, and are useful for agriculture, as they eat weed seeds and pest insects.

According to the records of the Hunters’ Association in Campeni, there are 8-10 partridges in the Project area.

In regard to the above species (boar, deer and hare), migration routes are not of concern, as they are all resident species. They do move according to the season, but cover much shorter distances than birds. Thus, boars, during years with a rich acorn harvest, will leave their normal grounds in conifer forests and converge to the areas with more plentiful food. Deer, although a stationary animal, will travel relatively long distances in search of females during the breeding season, if the females available on its normal grounds are too few or, if the snow cover is too deep, deer and hares will converge to places where food is more accessible.

### 3.3.4 Migration Routes

The Project impact area lies away from the main migration routes crossing Romania.

Some local bird species (about 37%) are migratory, but the potentially affected populations within the impact area account for minute percentages of the Romanian, and even European populations.

### 3.3.5 Animal shelters for breeding, feeding, resting and wintering

An individual’s habitat may be defined as the portion of land suitable for the species it belongs to, where there are adequate opportunities for feeding, shelter, resting, breeding and the rearing of the young. From this point of view, it may be stated that within each habitat there is an optimum area, with conditions gradually becoming poorer toward the periphery, until living conditions are no longer suitable and then impossible for the animal.

### 3.3.6 Protected or Particularly Relevant Species of Fauna

#### 3.3.6.1 The Statute of Rare Invertebrate Species

A number of protected invertebrate, especially insect species were identified in the study area based on site investigation, available literature, and the analysis of natural habitats (Table 3-15).

Of the insect species and genera specific to the above-mentioned forest lands, only one species is listed as rare, protected under both European and national legislation. *Rosalia alpina* (Table 3-15). It is a very rare coleopteran in the study area, as it prefers old beech forests, with standing dead trees. As such forest habitats are very limited in the Project area, the species is also very rare on the site.
The species in Table 3-15 do not form important populations, calling for exceptional protective measures at the national, regional, or local level. These species form strong and stable populations elsewhere in Romania, and some even occur in large numbers (Lucanus cervus, Parnassius mnemosyne, Callimorpha quadripunctaria).

Given that no unique, key habitats were identified for the preservation of valuable species invertebrates for eco-economic, scientific, or other reasons, we consider that protective measures are not justified on any area of the Project site.

### Table 3-15. Protected Species of Invertebrates

<table>
<thead>
<tr>
<th>Class</th>
<th>Order</th>
<th>Species</th>
<th>MO 1198/2005*</th>
<th>L. 13 /1993 Bern</th>
<th>European Directives Habitats (92/43/EEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecta</td>
<td>Coleoptera</td>
<td>Rosalia alpina</td>
<td>X</td>
<td>X, X</td>
<td>X, X</td>
</tr>
<tr>
<td></td>
<td>Lepidoptera</td>
<td>Parnassius mnemosyne</td>
<td>X</td>
<td>X, X</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collia chrysotheme</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cucullia gnaphalii</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conisania poeli</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muschampia cribrellum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muschampia tesselum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pyrgus sidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insecta</td>
<td></td>
<td>Nymphalis vaualbum</td>
<td>X, X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lepidoptera</td>
<td></td>
<td>Lycaena dispar</td>
<td>X</td>
<td>X, X</td>
<td>X, X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maculinea alcon</td>
<td>X</td>
<td>X, X</td>
<td>X, X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maculinea teleius</td>
<td>X</td>
<td>X, X</td>
<td>X, X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maculinea nausithous</td>
<td>X</td>
<td>X, X</td>
<td>X, X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eumedonia eumedon</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proserpinus proserrina</td>
<td>X</td>
<td>X, X</td>
<td>X</td>
</tr>
<tr>
<td>Orthoptera</td>
<td></td>
<td>Callimorpha quadripunctaria</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mollusca</td>
<td>Gastropoda</td>
<td>Helix pomatia</td>
<td>X</td>
<td>X, X</td>
<td>X</td>
</tr>
</tbody>
</table>

**The Statute of Rare Vertebrate Species**

The vulnerability status of vertebrate species was assessed on the basis of: Bird and Habitat European Directives (92/409/EEC and 92/403/EEC, respectively), the Bern Convention and Romanian law 1198 (25/11/2005) updating Annexes 1, 2, 3 of Emergency Government Ordinance No. 236/2000 on the regime of natural protected areas, natural habitats, wild flora and fauna conservation, approved with amendments by Law No. 46/2001.

The following Table presents the number of protected vertebrate species in the study area.
Table 3-16. Protected Species of Vertebrates

<table>
<thead>
<tr>
<th>Specie</th>
<th>Bern Convention/1996</th>
<th>European Directives Birds (79/409/EEC) and Habitats (92/43/EEC)</th>
<th>MO 1198/25.11.2005*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Amphibians</td>
<td>1</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Reptiles</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Birds</td>
<td>56</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Mammals</td>
<td>8</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>

*Annex 2: species requiring the designation of special conservation areas
Annex 3A: species of community interest requiring strict protection
Annex 3B: species of national interest requiring strict protection
Annex 4A: Species of community interest that need to be the culling and use of which require management measures.
Annex 4B: Species of national interest that need to be the culling and use of which require management measures.

The assessment of conservation importance for bird species was additionally based on Species of European Conservation Concern (SPEC) score, and status as listed by IUCN-The World Conservation Union and Romanian authorities. IUCN was previously known as the International Union for Conservation of Nature and Natural Resources, and represents a partnership between governments, non-government organisations and scientific bodies that strive for the protection maintaining or creating sustainable ecosystems. Table 3-17 shows the number of species, within each vertebrate group, listed under each status level for the three scientific bodies.

Of the total vertebrate and invertebrate species in the surveyed territory, 20 species are mentioned on the Red List, as follows: 7 species of amphibians, 2 species of reptiles, one species of bird, and 10 species of mammals.

Table 3-17. Number of Species According to Status

<table>
<thead>
<tr>
<th>Specie</th>
<th>SPEC status</th>
<th>IUCN status</th>
<th>Red List</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>II</td>
<td>III</td>
<td>IV</td>
</tr>
<tr>
<td>Amphibians</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Reptiles</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Birds</td>
<td>4</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>Mammals</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Table 3-18. Vertebrate species in the Project area protected under national and international legislation

<table>
<thead>
<tr>
<th>Class</th>
<th>Order</th>
<th>Species</th>
<th>Romanian Legislation MO 1198/2005</th>
<th>Bern Convention L. 13/1993</th>
<th>European Directives 92/43 Habitats and 92/409 Birds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 3A 3B 4A 4B</td>
<td>1 2 3</td>
<td>2 4 5 1 2 3</td>
</tr>
<tr>
<td>Amphibia</td>
<td>Urodea</td>
<td>Salamandra salamandra</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triturus vulgaris</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triturus alpestris</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Anura</td>
<td></td>
<td>Bombina variegata</td>
<td>x x</td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bufo bufo</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hyla arborea</td>
<td>x</td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rana temporaria</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Reptilia</td>
<td>Squamata</td>
<td>Anguis fragilis</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lacerta agilis</td>
<td>x</td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Podarcis muralis</td>
<td>x</td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Natrix natrix</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aves</td>
<td>Anseriformes</td>
<td>Anas platyrhynchos</td>
<td>x</td>
<td>x x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Falconiformes</td>
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### 4.6 Biodiversity

#### Section 3: Baseline Conditions

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<th>European Directives 92/43 Habitats and 92/409 Birds</th>
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<td>Corvus monedula</td>
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### Protected Species of Fish

On the study area, there are no species of fish protected at the national level or under international regulations.

#### Protected Amphibians
Two amphibian species (the European treefrog, and the yellow-bellied toad) are listed as strictly protected fauna species (Directive 92/43 – Annex IV) and listed by the IUCN as vulnerable. All the listed species are mentioned under various protection statuses in the Romanian legislation (MO 1198/2005) and the Bern Convention (see Table 3-18).

Protected Reptiles
Of the recorded reptile species two (*Podarcis muralis* – the wall lizard and *Lacerta agilis* – the grey lizard) are strictly protected (Directive 92/43 – Annex IV). Under the Bern Convention, all four species are protected (two Annex 2 and two Annex 3 species) *Podarcis muralis* – the wall lizard, is also included on the red list of vertebrates in Romania.

Protected Birds
Fifty-six bird species breeding in the Project Area are listed under the Bern Convention (Appendices II and III).

Six species are of conservation concern under the EU Bird Directive 79/409 and require special conservation measures for their habitats.

Four are species of European conservation concern, whose world population is concentrated in Europe (SPEC II).

Four species are listed on both the Bern Convention (Appendix II) and the EU Bird Directive lists. Combined with the four species identified under SPEC II, a total of nine bird species have been identified as priority conservation species in the Project Area. These species are: white-backed woodpecker (*Dendrocopos leucotos*), middle spotted woodpecker (*Dendrocopos medius*), black woodpecker (*Dryocopus martius*), red-backed shrike (*Lanius collurio*), woodlark (*Lullula arborea*), Scops owl (*Otus scops*), redstart (*Phoenicurus phoenicurus*), grey-headed woodpecker (*Picus canus*) and green woodpecker (*Picus viridis*).

Only a few of the species impacted by the Project have been described above. They have been selected because most are considered priority forest species (Tucker, G.M. et al 1997). All the species will be taken into account in impact mitigation, especially those listed in the annexes to various laws and conventions.

Protected Mammals
Under the Bern Convention, 8 species are listed in Appendix II and 10 in Appendix III, Also, 2 species are listed in Annex II of the Habitat Directive (92/403/EEC). The Eastern Hedgehog and the dormouse are cited as vulnerable by the IUCN. All the bat species are listed by the IUCN and protected under Romanian law.
4 Assessment of Impacts on Biodiversity

Forecasted Project impacts include:

- change of biotope surface area on the site and of land use categories;
- changes in the forest composition by change of vegetation features such as age, species composition, types of forest;
- habitat loss and change;
- change/ Loss of plant populatons;
- change of resources of economically important plant species;
- mushroom resource modification
- change/ Loss of protected animal habitats
- alteration of the invertebrate, reptile, amphibian, fish, mammal and bird species and populations;
- dynamics of the game and rare fish species;
- migration route modification
- change/ loss of animal shelters for breeding, feeding, resting and wintering

4.1 Changes of Biotope Surface Areas on the Site

In implementing the Project, the land use categories in the impacted area will undergo long-term changes, which is a direct, long-term and partly irreversible impact. Compared to the baseline situation described in Figure 13, Chapter 4.6.3.1, where pastures/hay meadows (60%) and forests (18%) were the major land uses (78%), project implementation will cause a significant and long-term reduction of the two categories of land use, which will account for only 28% (i.e. 22.5% pastures/hay meadows and 5.6 %forest), with a parallel 13 time increase of unproductive land (from 5% to 64.5%).
In the case of water bodies, although they only account for 0.9% of the surface area, they will undergo a serious reduction, primarily by the Loss of Corna Valley and its tributaries, to be covered by the Tailings Management Facility, with a local direct and permanent impact.

Water quality on the upper Corna Valley as established based on the Hilsenhoff Biotic Index (HBI – Chapter 4.6.2, “Hydro-Biological Approaches”) classifies as very poor, with high acidity (pH = 4.7 – Table 3-4). In other words, the upper reaches of the Corna Stream have been heavily impacted by current and historic anthropogenic activities and are no longer able to support a suitable habitat for a diverse population of aquatic fauna.

**4.2 Changes in the Forest Stock by Change of Vegetation Features**

Distribution by *age class* prior to Project implementation was described in Chapter 4.6.3.2.1 and Figure 17. Deforestation by Project implementation will not change age class distribution for either total area or site area (Fig. 3.2). However, small areas of existing forest of all age categories will remain on the site.
The impact is direct, long term and strictly local. For the total study area, the stands outside the direct impact area of the Project will display an age class distribution similar to the baseline.

*The relative species proportion* is described in Chapter 4.6.3.2.1 and Figure 18. For the overall study area, it is noted that no species will disappear (Fig. 3.3). Fir stands, localized in the N-E part of the site, near the future Carnic Pit, will be protected and maintained. Spruce is not well represented on the site, and its cutting will not significantly impact its distribution over the entire study area. The tree stands that will be cut mainly consist of beech and hornbeam, the coverage of which will be significantly reduced on the site, but insignificantly for the whole area.

Project implementation will not leave pure stands, that might restrict biodiversity and affect the balance of forest ecosystems in the study area. Impacts will be local and partly reversible over time, once the site is closed and rehabilitated. Moreover, the establishment of protective vegetation screens along industrial roads, around facilities and on previously degraded land, for stabilization, may trigger a diversification of forest species.
Figure 4.3.  Change of distribution by species of the tree stands caused by the Rosia Montana Project

Stand distribution by *type of basic natural forest* was presented in Chapter 4.6.3.2.1 and Figure 15. All the pre-Project implementation types of forests will continue to exist after the clear cutting of the surface areas needed for Project development (Figure 3.4). The conifer species forest types (1111, 1114 – spruce and 2131, fir stands) will not be impacted by the Project. The beech-hornbeam stands will cover a reduced area, but will continue well represented over the study area. The most affected will be type 4151, Mountain beech with *Luzula luzuloides*, but the respective stands are low yield, and their protective role need not be repaced with the changes of relief brought about by project development.
Forests in the Project impact area fill primarily protective functions (Table 16, Chapter 4.6.3.2.1). The cutting of important forest areas will impair the overall protective function in stands supporting slopes of more than 30 degrees inclinations and sliding land. The change of relief configuration on the site (the leveling of Corna Valley, Loss of some slopes) will determine a change of protection needs. The vegetation that will be installed after Project closure will have to protect/ stabilize the stockpiles and other artificial forms of terrain generated by site operations.

Stands installed on older landfills (1/3J) will not be impacted, as they are not located on the site. This stand category will have to be extended in the future.
4.3 Habitat Loss and Modifications, Including Protected Habitats

Based on Natura 2000, 3 types of forest habitats were identified in the Project area (Fig. 14, Chapter 4.6.3.2.1). For the entire study area, none of the identified forest habitats will be destroyed by the Project, but their area will be reduced. Habitat type 9130 – *Asperulo-Fagetum* beech forests, which is Romanian classification R 4118 – Dacian beech (*Fagus sylvatica*) and hornbeam (*Carpinus betulus*) forests with *Dentaria bulbifera* is well represented both on and off site (Exhibit 2), with the note that they form compact forest massifs (u.a. 104, 110, 111) off site, rather than the scattered, fringed patches as on Corna Valley that will be covered by the TMF.

None of the identified forest habitats of the impact area is classified as “priority habitat” under Romanian law (MO 1198/12/25/2005) or under Natura 2000.

Habitats with the greatest area of impact are Cultural Meadows. However, these are all anthropogenic community types and their loss will not have a significant impact on biodiversity at a local or regional scale. Cultural meadows are very common throughout the Southern Carpathian Mountains.

Given the considerable anthropic influences, primary natural habitats are almost completely absent, being replaced by secondary habitats, many of which are degraded. Thus, for the project site, correlation with the types of natural habitats according to the Manual of natural...
habitat interpretation would be risky at best. Description of the vegetation cover and
classification of the existing vegetation associations is also a task of very limited relevance to
both the final goal of creating a compensatory ecological network, and to the initial
assessment which, from the onset, reveals the existence of very limited areas of natural
succession.

Figure 4.6. Change of distribution by types of habitats in the tree stands caused by
the Rosia Montana Project

Natural habitats of the beech or beech and hornbeam types of forest will be largely removed
from the Project site. But beech and beech-hornbeam forest is common in the Project Area
and in the region as a whole. While its loss represents a negative long-term local impact, it is
not significant on a regional scale. Large beech stands, such as those in the Seliste Valley
and in the lower Rosia creek valley will not be impacted by the project and will continue to
provide an important measure of protection and preservation for this habitat.

4.4 Forecasted Impacts on Plant and Animal Populations

It is important to consider the fact that the study area may be classified as mining ever since
Roman times, with mining gradually gaining ground during the Middle Ages and in
Communist times, when it reached its maximum development.

Gradually, environmental impacts have become more obvious. As may be noticed at
present, the Communist age created serious environmental impacts by failing to observe
mining operation norms.
With increased impacts on the local habitats and species, a normal response was for them to withdraw to less impacted areas farther afield. Other, more athropophyle species, adapted to human presence and industrial activity.

Considering the current state of biodiversity and habitats on the mining project site, the following impacts may be predicted:

### 4.4.1 Construction Phase

An important impact during construction will be the stripping of the vegetation cover on the process plant site, TMF and future access roads.

Thus, habitat loss will trigger the loss of fungi and other plants related to such habitats. A number of less mobile invertebrates (Ortopters, Araneida, mollusks, insect larvae, Heteroptera, Hymenoptera, etc.) will also be seriously affected.

Species mobility is a very important factor in population stability. Less impacted species in the construction phase will include the more independent ones. They include species of birds and mammals.

The timing of construction works will be crucial. Invertebrate species are very sensitive to impacts in the early stages of development, i.e. egg, larval and pupa.

As for vertebrates, impact will be highest during the breeding and early development stages. Based on the main inventoried groups of vertebrates, the following impacts may be predicted:

**Amphibians**

The amphibial species identified in the study area are closely related to wetlands. Loss of such habitats will cause loss of amphibians. All the listed species lay eggs in flowing and standing waters, and have an aquatic larval stage. In newts, full adult development takes four years, a time during which the individuals are more vulnerable to habitat change.

The presence of larger numbers of amphibians in the mining Project area, so impacted by mining, including with chemical pollutants, by traffic, etc. proves that amphibians can survive this type of activities.

In conclusion, it may be stated that the impact on such species will be significant, but of a limited, local scope. All the listed species are common for Romania.

Amphibians, which are less mobile than birds or mammals, are very dependent on specific habitats. The loss of slightly more than one hectare of ponds will result in some loss of breeding areas for amphibians. Amphibian species at risk include Fire salamander, common toad and European treefrog, which are all listed as vulnerable by the IUCN. European treefrog is also strictly protected under the Bern Convention. As species associated with ponds and wetlands are generally rare to uncommon in the Project Area, the loss of these habitats represents a significant impact on the local scale. However, the loss of these communities will not have a significant impact on the overall populations of these species.

**Reptiles**

The identified reptiles are related to forest, meadow, and mountain cliff habitats.

Reptiles are poorly represented in the Project area, but still present, in spite of the harmful activities related to the historic operations and the total lack of protective measures. Most of them are common species, so that the loss of some small populations in the central Project site area will not create a major impact on the regional or national populations.
4.6 Biodiversity

Birds
Birds, being highly mobile species, will be less affected by the Project. A critical period is breeding and the rearing of the young, closely dependent on nesting places. Knowing that about 77% of the bird species nest in forests, during the construction phase, the percentage of bird habitats affected being lower, the impact of construction activities will also be low. Disturbance of the bird fauna will be caused by SHLO traffic, construction materials, and sandstone and andesite quarrying.

Birds may also be affected by the noise, traffic, air pollutants, and therefore measures will be included to limit such impacts by using modern, high standard equipment, complying with the maintenance schedules and with the approved working regimes.

Rare woodpecker species are mainly located on Vartop Valley and will not be affected, as this is away from the Project impact area.

Other habitat specific birds may also be affected by the loss thereof. As there are no strictly habitat specific species in the Project area, and the Project site habitats are widely represented in the region, such species will not be affected at the regional and/or national level.

In conclusion, a local "migration" of birds from affected or lost habitats to surrounding areas of better living conditions might be predicted.

Mammals
Large mammals, anyway rare and with no established population in the Project area, will leave it completely and settle surrounding sites. Good habitat management in such surrounding areas will help mitigate the impacts.

Bats may be affected by the loss of their feeding habitats and summer and winter roosting places.

4.4.2 Operations phase
Apart from the continuation of some negative impacts of the construction phase similar to those described above, a further hazard will be intoxication, especially of aquatic species, with chemicals discharged into the tailings ponds. The low concentration of cyanide discharges into the ponds, as regulated by the European legislation, and the relatively short time of maintaining the decant ponds will eliminate some of the problems that might occur due to their presence in the area. Also, the presence of small aquatic bird populations in the region, and the location of the Project site away from the main aquatic bird migration routes, will make the use of such ponds less likely. As decant ponds are not suitable to the development of rich algal and other aquatic plant populations, nor of macro-invertebrate populations, they might be used as resting places at most.

During operation, the chemicals discharged into the decant ponds will be below the Romanian and EU limits. However, bioaccumulation might still occur. The relatively short time in which the ponds will remain active and the low discharge concentrations, as regulated by the Romanian and EU law, will reduce the possibility of major impacts on the populations coming into contact with the ponds.

4.4.3 Closure phase
During closure, with the re-vegetation of the area, birds will be among the first to repopulate the Project site.

The birds will not actually leave their habitats outside the most heavily operated site, which is proved by their presence in the area, even with the currently destroyed habitats, polluted waters and major impacts.
After closure and restoration, the mammal populations in the impact area will be restored naturally or by re-introduction.

At this stage, amphibian habitats will have been improved, even compared to the current state. Amphibians and reptiles are expected to repopulate the area from unaffected stock on the fringes and neighbourhood of the Project.

If necessary, RMGC will bear the costs of re/introducing species that will be considered less likely to repopulate the area naturally.

The relatively large number of plant and animal species will make it practically impossible to assess the exact impact of the works on each and every species. Each species is a separate ecological “individual”, occupying a well defined ecological niche. An accurate assessment of the impacts and, therefore, of the relevant mitigation measures, will require further monitoring studies throughout the Project lifetime.

### 4.5 Forecasted Impacts on Game

#### 4.5.1 Construction Phase

Large mammals, anyway rare and with no established population in the Project area, will leave it completely and settle surrounding sites.

Air pollutants and noise may become stress factors for the mammals in the area.

#### 4.5.2 Operations Phase

Negative impacts from the preceding phase may continue, especially increased traffic, vibrations and noise.

A potential hazard will be the decant ponds, containing toxicants. Large and medium-size mammals will be prevented by fencing from reaching them.

#### 4.5.3 Closure Phase

After closure and restoration, the mammal populations in the impact area will be restored naturally or by re-introduction.

Table 3-13 shows that the change of forest and arable surface areas, those of meadows and grazing land will have a low impact on hunting grounds, based on land use category.

Due to the major anthropogenisation and intense activity in the local mining sites, all these mammals have reached the limit of their optimum habitat or even survival limits.

This can be noted in the layout plan of feeders and saltlicks on the hunting grounds included in the study area, away from the Project site (Exhibit 1).

All the species are outside the Project site, merely crossing it occasionally.

During operations, traffic along the access road and other roadways creates potential for increased mortality rates from vehicle strikes. The potential for disturbance of fauna from noise, vibration and visual sources is present throughout the Project Area, particularly in areas adjacent to the open pits, plant site and roadways.

The contamination of surface waters through the emissions of fluids and solids, as well as the presence of the tailings decant pond (where water will pool once discharged tailings have settled out in the Tailings Management Facility) has the potential to impact drinking water for birds and mammals.
4.6 **Mushroom resource modification**

Forest clearing on the mining site will cause loss of forest ecosystems, with all their components.

After forest removal from the mining site, the mycorhizal fungi will disappear altogether, as they are all symbiotic species. Xylophagous species will first increase in numbers – during forest cutting, with the increased amount of dead wood (stumps, logs, debris) – then significantly drop in numbers, with stump rotting and soil removal.

In forests adjacent to the industrial sites, fungi numbers and frequency will change, based on direct pollution effects, i.e. enhanced direct human activity. The influence of industrial activities will be stronger the closer the forests are to the site, and decrease with the distance from pollution sources. Fructification frequency in mycorhizal species will gradually reduce in forests that are closer to the site. Xylophagous species are typically stimulated by reduced vitality in forest trees, their frequency decreasing in forests weakened by pollution and anthropogenic activity (various wounds).

4.7 **Modification of Resources of Economically Important and Protected Plant Species**

Current resources of economically relevant species have been largely degraded by both uncontrolled harvesting, overgrazing, or mining-type industrial activities that caused a reduction of productive areas. Resources will be further depleted by the Project development, but the economically relevant plant species are found in surrounding areas, the negative impacts being restricted to the local level and not affecting the resource nationally or regionally. Protected species of flora have not been identified in the Project area, with the exception of *Galanthus nivalis*, which can be found both in adjacent areas, and on the rest of the investigated site.

4.8 **Forecasted Impacts on Protected or Particularly Relevant Species of Fauna**

4.8.1 **Invertebrates**

Invertebrate species, as presented in Table 3-15 (Chapter 4.6.3.3.6) do no form important populations, calling for exceptional protective measures at the national, regional, or local level. These species form strong populations elsewhere in the Romania, and some even occur in large numbers.

Given that no unique, key habitats were identified for the preservation of valuable species invertebrates for eco-economic, scientific, or other reasons, we consider that protective measures are not justified on any area of the Project site.

Impacts from existing and historic mining activities have resulted in generally poor aquatic taxa richness. As a result, the loss of stream habitats will not have a significant impact on populations of aquatic invertebrate species. Over time, the Project will result in the improvement of water quality of in local streams, which will result in better conditions for aquatic invertebrates, with a positive long-term impact on the populations of aquatic invertebrate species.

4.8.2 **Vertebrates**

As the Project area contains few representative and very suitable habitats for protected vertebrate species, and the communities of such species are not representative, the impact on such populations will not be significant.
In the case of amphibians and reptiles, less mobile than birds and mammals, a reduction of their specific habitats will have significant impacts on the strictly local level, but the establishment of a functional compensatory ecological network will prevent such populations from being affected.

In the case of mammals and birds, their high mobility might determine a gradual withdrawal to more favourable habitats around the site, including in the Environmental Protection Zone (EPZ).

4.9 Change/Loss of Migration Routes

The Project impact area lies away from the main migration routes crossing Romania. Some local bird species (about 45%) are migratory, but the potentially affected populations within the impact area account for minute percentages of the Romanian, and even European populations.

4.10 Change/Loss of Animal shelters for Breeding, Feeding, Resting and Wintering

In the case of Rosia Montana Project, the impact on the game species resource dynamics is low, as, due to the centuries of anthropogenisation of the area by mining, all such species find shelter, food and rest in areas adjacent to the Project.

4.11 Assessment of Impacts on Biodiversity Caused by Accidents

The hazard of natural environment loss and hence of biodiversity impacts is detailed in Section 7 Risks.

4.12 Transboundary Impact

Impacts to biodiversity as a result of the project will be locally significant, but will not affect populations of flora or fauna at the regional scale or beyond. The Project area is not significant for bird migration, as most bird species are sedentary.
5 Biodiversity Impact Mitigation Measures and Recommendations

5.1 General Measures and Recommendations

One of the most important mitigation measures is the conduct of forest cutting during autumn-winter, when the number of bird species is reduced by 45%, and the resident species can withdraw to remoter areas.

The effects of habitat loss will be mitigated by the gradual deforestation, avoidance of cutting during the breeding season, and good management of the conservation areas.

The main impacts relate to the loss of wetlands. RMGC will restore the lost wetlands in the conservation zone of the Project. Together, they will cover an area at least equivalent to the lost coverage. Wetland building will be initiated during construction and will continue through into the closure phase. The other types of habitats used by some species of amphibians outside the breeding season will be preserved in the conservation areas of the Project.

Oil spills will be avoided by enforcing speed limits on the Project site, thus preventing accidents, and so will improper handling of machinery and equipment.

The effects of habitat fragmentation will be reduced by the use of ecological tunnels and corridors.

In the forests around the edges of the Project area, practices that will foster the condition of the bird fauna will be promoted, including: preserving dead, hollow trees, placing man-made holed logs, maintaining the bush vegetation.

Habitat fragmentation, especially for small and medium sized animals will be partly mitigated by the use of culverts and ecological corridors.

To reduce impacts on the bat populations, all the buildings in the historic area that will be preserved will be repaired with care for the presence of bat colonies roosting in them. This will involve leaving open access to the attics, basements, etc., and the building of man-made shelters near the demolished buildings with current roosting places. Bat shelters will also be placed in the protected area forests, and good management will be provided for all the habitats in this area, maintaining a mottled structure in the neighboring habitats and reconstructing the wetlands. Priority protection will be provided to the hollow trees in the protection zones. Where possible, old mine galleries, crevices and rock hollows will be protected.

In the case of hazards generated by the presence of decant ponds and toxics in them, large and medium size mammals will be stopped from getting to them by fencing. Small mammals that may pass through such fences might be affected by cyanide or bioaccumulate and pass these chemicals on in the food chain. Because of the low concentrations in the pond water and the relatively small numbers, the effects will not be catastrophic. Also, the preservation of vegetation free belt around the ponds and other animal repellent methods will make the vicinity of such ponds unattractive for mammals.

5.2 Proposed Creation of a Compensatory Functional Ecological Network

The Biodiversity Management Program mainly concerns the restoration of displaced natural elements of the natural environment in the best proportion possible in a functional compensatory ecological network with the following objectives:
4.6 Biodiversity

- Mitigate the “GAP” effect;
- Take over the burden in the affected biostrata;
- Continue to provide eco-stability;
- Provide continuity of service in the natural media;
- Mitigate impacts on adjacent ecosystems;
- Guarantee the success of post-closure restoration.

Explanation of the terminology in the proposed Functional Compensatory Ecological Network:

- Network – assumes establishment of a system of inter-connected habitats that include tri-dimensional elements (both positive - plantations, rocks, other erect structures) and negative (excavations to enable the installation of wetland or shallow underground communities, etc.). The network will include the following elements:
  - biodiversity reserves including large size target natural habitats, meeting the ecological (space and feed) needs of the criterion species;
  - corridors are long habitats resembling the biodiversity reserves in structure and facilitating the movement of habitat specific elements through them;
  - nodal points are created at the cross points of ecological corridors, and may be of the same type of heterogeneous, if the intersecting corridors are of different types;
  - the matrix refers to the complex of habitats including the reserves, corridors and nodal points.

The key attribute of an ecological network is connectivity. This attribute ensures movement between different points of the network and communication within and without, connecting to other similar networks or to natural habitat massifs.

- Ecological – is the attribute defining the purpose for establishing the network as preserving natural balances and positive parameters of the environmental media;
- Functional – assumes the creation of a set of elements that should meet the topo-climatic criteria and be accepted by the whole of characteristic fauna and flora species, for support and for natural habitat-related services;
- Compensatory – defining the additional role the network will play in the project, that of mitigating the GAP effect in the biostrata and take on the burden caused by loss of other habitats, providing an opportunity for species survival.
- Given that soil, as an environmental medium, is very limited in its substratum role for the project, the strategy will focus on increasing the support capacity of habitats surrounding the Project implementation site as close as possible to the principles of sustainable development.

The functional compensatory ecological network will include for replication only elements of the local natural habitat, avoiding the introduction of non-native or extra-zonal species. Starting from the regional matrix (see Exhibit 1), major impact points, medium impact sites and acceptable habitat conservation areas were identified. As a first step, a buffer system will be created, to isolate the medium impact area containing the major impact sites.
Between the medium impact sites and the buffer areas, protective screens and impact mitigation bio-structures will be installed to reduce the impact of disturbing factors on the network itself. Protective screens will include sturdy, high vitality, eurybiontic elements, but with an easy to control dynamics, this being an absolute requirement for the post-closure phase, when they will be replaces by elements of the functional compensatory ecological network.

Compact adjacent habitats, of the reserve type, will be the object of intensive rehabilitation and reconstruction management for compaction and enlargement, where possible, and fringe reduction to reduce the edge effect and increase natural stability.

The whole area will acquire a high degree of connectivity by the installation of ecological corridors both in the buffer area and between it and the “reserves”.

Within the medium impact area, included in the operations site, connections with the buffer zone will be identified and gradually re-vegetated in a centrifugal approach, in order to enable the filling of gaps in the post-operational phase.

In this regard, based on a detailed analysis of the high resolution aerial photographs, a number of potential connectivity sites have been identified, and a functional corridor pattern was selected (see Exhibit 2).

A diversified, superimposed habitat system will be required for the ecological network, thus ensuring habitat diversity that might support the largest number of species possible.

Several corridor patterns have been proposed, the most frequently used being built along access roads, of the type marking existing property limits in Rosia Montana.

![Type of proposed ecological corridor along access roads and property boundary-type, respectively](image)

**Corridors along access roads will have the following structure:**

- In the immediate vicinity of the road surface, chalk gravel will be spread on a 0.5m wide strip which, apart from enhancing the road visibility (especially at night time) whether black top or cobbled, will also retain much of the runoff into the porous rock;
- excess water will be collected into the storm ditches, which will have embedded rocks acting as riffles and retaining some of the loads, thus creating a buffer environment on the bottom that might be cleaned regularly to prevent wetland siltation of or stream pollution.
- connected to the storm ditches, a polder system has been conceived for the handling of overflows during storms and floods. These will be sized according to land availability, and will range between a few centimeters to several meters. This measure will help rebuild wetland environments that will considerably enhance...
biodiversity indicators and provide a highly valuable set of services (thermal buffer, suspended particle retention, excess water handling, denitrification agent, etc).

**Property boundary type of corridors:**

Such corridors have complex morphology, including a number of representative habitats of particular relevance for species of flora and fauna. The model was conceived based on field observations of habitats developed on property boundaries, many of which long standing and therefore favourable to the development of a particular ecosystem, a local characteristic of Rosia Montana. The particulars of this type of ecosystem include the possibility to replicate some of its components.

The main components of such a corridor are the following:

- good grass vegetation of the hay meadow or rich meadow type, shaped by the type of management: late mowing, or reasonable grazing, respectively; such a strip should be at least 3 m wide and 6-7 m wide at best;
- ruderalized vegetation strip, interspersed with hawthorn (Crataegus monogyna); black thorn (Prunus spinosa) or dogwood (Cornus mas), developing next to the mural component;
- the mural component includes rock and boulder accumulations creating 30 to 90 cm tall and 30 to 60 cm wide fences, with gaps and collapsed parts in places, providing a wealth of ecological niches, bioschenes and synusies of great value to the species of vertebrate and invertebrate micro-fauna; based on exposure, the mural component will be supplemented with etrophyle, schiaphyle, umbrophyle or even hygrophyile (moss, fern, etc.) vegetation, in solidarity with repent species (especially ivy). Association of this component with evergreen species (Buxus sp., Ligustrum sp., Juniperus sp.,) at critical impact points with suspended particles works very efficiently to retain dust particles, and is also an important obstacle to wind, snow drifts, etc.) and a valuable shelter for bird species throughout the year.
- the nemoral component includes very diverse species of local native bush flora (Corylus avellana) associated with tree species (Tilia cordata, Quercus sp., Fagus sylvatica, Carpinus betulus, Betula pendula, Alnus sp., etc.). Of special importance, ash (Fraxinus excelsior) and willow (Salix sp.) on moist land, if cut in “chairs” will provide very valuable nesting, shelter, and other habitats. The nemoral component may be supplemented by native poplar species (Populus tremula) which are fast growers and provide good wind protection.
- bushes will complete the corridor make up, preference being given to hip rose (Rosa canina).

Biodiversity Management Initiatives will be summarized by RMGC in all the Project phases in order to minimize the impacts on biodiversity and thereby preserve biological diversity in the Project area. A more detailed discussion of these initiatives is presented in the Roșia Montană Environmental and Social Management System Plans, Plan H, Biodiversity Management Plan and is based on the features of ecological significance identified in Ecological Baseline Report. The proposed initiatives have also been developed in accordance with the legal and regulatory framework pertinent to biodiversity conservation in Romania (including international conventions).

Detailed baseline analyses conducted as part of pre-construction activities revealed that the area is of low conservation priority. The intent of the Biodiversity Management Plan therefore extends towards improving the existing ecological conditions, which have been degraded by centuries of mining activity.
6 Management of Biodiversity

6.1 Objectives of Biodiversity Management

RMGC’s Biodiversity Management Plan involves an integration of programs within the project area with the priority areas of the National Strategy and Action Plan for the Biological Diversity Conservation and Sustainable Use of its Components in Romania. Where practical, it also applies the principles and actions identified by the Biodiversity sub-component of the Mining, Minerals and Sustainable Development project.

6.2 Approaches and Techniques for Biodiversity Management

The Biodiversity Management Plan addresses requirements throughout the construction, operation and closure phases of the Project. As such, the approaches prescribed under the plan are intended to correspond with project activities. The BMP incorporates three integrated approaches:

- Ecological Protection, Restoration and Rehabilitation;
- Habitat and Wildlife Monitoring; and,
- Promoting Stewardship Ethic.

The following sections describe the three approaches. Specific techniques to be used in implementation are also provided. Where applicable, the techniques will be defined within RMGC’s Standard Operating Procedures as a means of providing consistent, high-quality performance. Standard Operating Procedures will be finalised in the Pre-Construction Period.

6.2.1 Ecological Protection, Restoration and Rehabilitation

Impacts on biodiversity resources will vary throughout the construction, operations, and closure phases of the project. As a result, the level of effort afforded in implementing management activities geared towards restoring and rehabilitating natural habitats must reflect needs at that point in the project life cycle. Throughout the life of the project, the following will be the primary foci of RMGC’s ecological restoration and rehabilitation activities:

- **Environmental Protection Zones (EPZs):** Establishment of a network of EPZs that provide conservation for priority habitats, as identified through the ecological baseline studies, with an emphasis on protecting rare or unique habitats within the project area.

- **Wildlife Corridors:** Establishment of a network of vegetated corridors within and between selected EPZs that allow for species migration. Where gaps exist, habitat planting may be required.

- **Riparian Planting:** The planting of native species along degraded stream banks and other watercourses that provide breeding habitat and migration corridors for wildlife, and provide shade and nutrients to enhance stream quality.

- **Micro Habitats:** The installation of nest boxes for birds, roost boxes for bats, and areas of habitat for reptiles and amphibians (e.g. decaying logs, pond coverage, basking areas).

- **Habitat Plots:** Habitat plots, mostly located within the EPZs, and managed as seed banks, nurseries for plants used for rehabilitation of project-affected and/or degraded land, or sites into which selected plants from affected areas could be transplanted.
Stream Rehabilitation: The ability of degraded streams in the Project area to support healthy aquatic communities will be enhanced through the installation of riffles, runs and pools that promote oxygenation and habitat for aquatic biota.

The locations for the application of these conservation opportunities within the Project Area are shown on Figure 3. The following sections describe the relative effort afforded to each activity during the construction, operations, and closure phases of the project. Upon the completion of each activity, a Record of Conservation Activity should be completed. The Standard Operating Procedure for completing a Record of Conservation Activity will be developed.

6.2.1.1 Ecological Restoration and Rehabilitation Management during Construction

Environmental Protection Areas
As described in Section 5.6, there are six areas of ecological significance in and in vicinity of the Project Area. Two of these sites are located entirely outside of the project area, while the remaining four will be affected to varying degrees. These areas should be designated as EPZs, and development should be limited in the sites situated within the project footprint. The locations of the six EPZs are shown on Figure 3. During construction, tree clearing may be required from the EPZs. A minimum amount of tree cutting should be undertaken in these areas for which a Standard Operating Procedure for tree cutting will be developed. If rare flora are encountered that will be damaged by construction activities, they should be relocated according to a Standard Operating Procedure to be developed.

Wildlife Corridors
Prior to construction, existing and potential corridors will be identified, catalogued and prioritized for management during the operations phase. The locations of potential wildlife corridors between the EPZs are shown on Figure 3. The corridors will serve to connect forest and other natural vegetation patches. Preference will be given to the existing links, such as wide hedgerows or riparian vegetation. The primary strategy will be to enhance the value of the corridors by plantings of suitable, habitat-adapted native shrub and tree species.

Riparian Planting
Prior to construction, riparian habitats that require restoration will be identified, catalogued and prioritized for management. Sites where riparian vegetation is presently best preserved will be replanted first. At each site, only native and preferably locally sourced stock will be used. The plantings will be modelled on the natural vegetation zonation so that the rehabilitated sites blend into the natural framework.

Micro Habitats
Prior to construction, habitats that support target species will be identified, catalogued and prioritized. Habitat requirements to sustain species viability will be determined through background research, and species- and habitat-specific designs will be developed for implementation during the operations phase. Potentially best sites for microhabitat development are large forest patches and these are shown on Figure 3.

Habitat Plots
Section 5.6 identified six EPZ sites that contain the best examples of representative or rare habitats in the project area. Within these EPZs, habitat plots may be developed that will function as seed banks and nurseries for indigenous species to be used in restoration activities. Because of the high internal diversity of habitats, the EPZs may also serve as sites for relocating selected or sensitive flora from affected habitats in the project area. Potential sites for habitat plot development are shown on Figure 3.

Stream Rehabilitation
Prior to construction, sections of degraded streams will be identified and mapped for implementation during the operations phase.

6.2.1.2 Ecological Restoration and Rehabilitation Management during Operations

**Environmental Protection Areas**
The EPZ network will be completed during the operations phase of the project, and managed as four separate units (i.e., those that are located wholly or partially within the project area: Taul Mare/Taul Corna Rock Outcrops, Tarina Valley, Cimic Fir Forest and Lower Rosia Valley Beech Forest). Where possible, habitat plantings within and/or between EPZs will be undertaken to improve landscape continuity. Standard Operating Procedures will be prepared for planting and habitat restoration and to control introduced and invasive species.

**Wildlife Corridors**
During operations, vegetated wildlife corridors will be established where appropriate. In some cases, plantings will be required to restore severances made to wildlife corridors during construction, and to establish new corridors between remaining woodlots.

**Riparian Planting**
Habitat planting along selected watercourses will be undertaken in accordance with needs identified in the construction phase; Standard Operating Procedures will cover working in and adjacent to watercourses.

**Micro Habitats**
During operations, nest boxes for birds, roost boxes for bats, and areas of habitat for reptiles and amphibians (e.g., decaying logs, pond coverage, basking areas) will be installed according to Standard Operating Procedures.

**Habitat Plots**
In order to promote healthy populations of native species, introduced and invasive species will be controlled according to Standard Operating Procedures.

**Stream Rehabilitation**
Stream improvements will be made by the installation of riffles, runs, and pools.

6.2.1.3 Ecological Restoration and Rehabilitation Management during Closure

**Environmental Protection Areas**
During closure, the EPZ network will be managed as priority areas within the larger regional network of habitats. Management activities initiated during the operations phase will continue.

**Wildlife Corridors**
During closure, wildlife corridors will be maintained in the larger regional network of natural habitats. Management activities initiated during the operations phase will continue.

**Riparian Planting**
During closure, riparian habitats will be maintained in the larger regional network of natural habitats. Management activities initiated during the operations phase will continue.

**Micro Habitats**
During closure, micro habitats installed during the operations phase will be maintained. Where repairs are required, facilities will be repaired or replaced.
Habitat Plots
During closure, habitat plots will continue to be managed as integral part of EPZs within the regional network of habitats. Management activities initiated during the operations phase will continue.

Stream Rehabilitation
During closure, streams will be maintained as part of riparian habitats in the larger regional network of natural habitats. Where necessary, repairs or replacements will be performed.

6.2.2 Habitat and Wildlife Monitoring
This program is intended to monitor changes in biodiversity at the community and ecosystem levels. It is concerned mainly with the effectiveness of maintaining the extent and quality of habitat, and of maintaining ecosystem processes. As the maintenance of ecosystem processes directly affects the success of biodiversity conservation, it is desirable that these processes should be monitored. This section describes four tasks that have been identified by the World Bank as reliable means of monitoring biodiversity at the community and ecosystem levels (World Bank, 1998).

Ecological Baseline Studies (Roşia Montană Project Baseline Reports: Report 7) describe biological diversity conditions prior to commencement of the project (although mining has been ongoing in the area for the past two millennia, and has shaped the landscape and ecological features contained therein). This comprehensive study serves as a benchmark against which management-induced changes can be identified and measured. However, it is important to note that future monitoring generally does not need to update the full data set gathered during the baseline studies. In most cases, management is concerned with trends rather than absolute values. Absolute values (total number of species, exact densities, etc.) are generally not needed on a day-to-day basis. Changes in relative indices of these parameters (trends) will provide the information that environmental managers need to show progress is being made, or if indicators are falling dangerously close to unacceptable levels.

The following sections summarize the monitoring activities to be undertaken as part of the Biodiversity Management Plan. These monitoring activities should be undertaken on an annual basis.

6.2.2.1 Habitat Mapping
Habitat mapping should be undertaken on an annual basis, and will focus on:

- Habitat Distribution
- Vegetation Structure

Habitat Distribution
Habitat distribution will be monitored by mapping changes of habitat boundaries, including riparian habitats. The location of habitat boundaries can show expansion or retreat of crucial habitats, and can be determined through annual surveys/fixed point photography of permanent plots or transects. Changes in riparian vegetation can have significant effects on aquatic biodiversity through direct (e.g. change in water temperature and light availability) and indirect (e.g. increased runoff and siltation) impacts. The use of remote sensing, combined with surveys of plots or transects, can be used to measure the area and boundaries of riparian vegetation.

Vegetation Structure
Vegetation structure will be monitored by the change in the percent of crown cover in the upper canopy level (whether it be tree, shrub, grass, etc.). This is accomplished through standard canopy cover measurement methods, conducted seasonally, or at least annually in the same season. Significant habitat disturbance is generally indicated by changes in
canopy cover and dominant species. However, records need to be taken over an extended
time period to take into account short-term fluctuations due to factors such as fires and
weather patterns.

A Standard Operating Procedure will be developed for undertaking habitat mapping.

6.2.2.2 Wildlife Monitoring
The change in the number, composition, and distribution of wildlife species (birds, mammals,
herptiles, fish and benthic invertebrates) can indicate changes in ecological processes,
particularly the ability to support sustainable populations of keystone species. Monitoring of
local wildlife will be undertaken through surveys along transects and/or in strategic sites
(depending on the type of wildlife being surveyed) on an annual basis. Monitoring of nest
boxes, roost boxes and other measures intended to provide habitat opportunities for wildlife,
can be used to evaluate the effectiveness of these initiatives.
Standard Operating Procedures will be developed for undertaking wildlife monitoring.

6.2.2.3 Rare Species
Occurrence records of any rare species encountered in the project area will be kept. These
records will include rare species that are encountered both during the formal wildlife
monitoring programs and from casual observations. A Standard Operating Procedure for
recording rare species will be developed.

6.2.2.4 Indicator Events
Natural events, which are related to biodiversity health at the community/ecosystem level,
will be recorded and mapped as they occur. Examples of such occurrences include
landslides, floods, forest fires and wildlife mortality. A Standard Operating Procedure for
recording such events will be developed.

6.2.3 Promoting Stewardship Ethic
Community participation in conservation activities from an early stage in the Project will sow
the seeds of environmental responsibility, and eventually a responsible stewardship ethic
that will extend beyond the life of the project. Community involvement in conserving
biodiversity resources will develop trust and foster open dialogue between the community
and the project. Two critical components for the success of the Biodiversity Management
Plan are:

- Increased awareness of environmental issues by residents in the Roşia Montană
  area; and,
- Promotion of research and cooperative efforts with non-government organizations,
  universities and Romanian conservation institutes.

Local awareness of environmental issues will be increased through the adaptation of an
environmental extension program supported by RMGC. The scope and complexity of the
extension program should be defined through a participatory consultation process including
RMGC, local government agencies, and interested stakeholders. Specific activities
undertaken as part of the extension program can range from simple (such as naming new
streets, buildings and other facilities after local flora and fauna) to more complex (such as
volunteer wildlife monitors, guidebooks and newsletters).

RMGC will endeavour to make formal agreements with relevant non-government
organisations, universities and institutions to undertake research, and implement
management activities in the project area. This transfer of knowledge and skills will provide
improve knowledge both in the project area and throughout Romania.
6.3 Evaluation of the Biodiversity Management Plan

Annual evaluations of the BMP should be conducted to monitor the progress of implementation, and to ensure that the desired results are being attained. This section outlines the logic and practical framework for the evaluation process.

6.3.1 Evaluation Framework for the Management Plan

The evaluation framework utilizes a Logical Framework Analysis to establish indicators for each of the objectives of the Biodiversity Management Plan. The Logical Framework Analysis is an organizational framework, typically a 4 by 4 matrix that identifies the components for a program or project in its planning, monitoring and evaluation phases. The Logical Framework Analysis was developed by USAID in the late 1960s and early 1970s and has become a common tool for development project planning and management.

The traditional Logical Framework Analysis employs a double logic – the horizontal logic and the vertical logic – presented in the four rows and columns of the matrix, forming sixteen ‘views’. The key principle to the Logical Framework Analysis is the interconnected cause and effect and non-overlapping relationships between elements of the vertical logic, which represent the linkages between the four hierarchical levels (Goal, Objectives, Outputs, and Inputs). These levels are described as follows:

Goal: The highest level in the hierarchy, located in the top row of the Logical Framework Analysis. It is the major purpose of the plan.

Objectives: Objectives are the desired effects after production of the outputs. They are the operational results against which success is normally judged and contribute to the achievement of the goal.

Outputs: Outputs relate to the achievement of particular activities that result from the use of inputs, and are meant to be the cause of achieving the objectives.

Inputs: Inputs refer to the baseline conditions and stakeholder resources that initiate outputs. Given the nature of the Biodiversity Management Plan, only inputs related to biodiversity in the project area are considered.

The Logical Framework Analysis used to evaluate the Biodiversity Management Plan is shown in Table 6-1.

This section provides a description of the vertical and horizontal logic applied by the Logical Framework Analysis for this study. The horizontal logic, as presented in the column, deals with three main elements: the Narrative Summary, which describes the levels; the Objectively Verifiable Indicators of the study levels; and the Means of Verification for the measurement of these indicators. It also identifies Critical Assumptions that are beyond the control of the study, but could affect the measurement of indicators at the four levels, as well as the accuracy and validity of the study. These assumptions include the context in which the study takes place, and the risks that may be inherent in that context. Specific indicators for the BMP have been described in Section 6.2. Means of verification have been incorporated into RMGC’s Standard Operating Procedures, and are referenced accordingly.
### Table 6-1. Evaluation Framework for the Biodiversity Management Plan

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<tr>
<td>Reducing risks to biodiversity</td>
<td>Change in frequency of indicator events</td>
<td>Indicator events records</td>
<td></td>
</tr>
<tr>
<td>Promoting Stewardship Ethic</td>
<td>Change in levels of awareness and participation</td>
<td>Awareness surveys</td>
<td></td>
</tr>
<tr>
<td>View 5: Results</td>
<td>View 6: Output Indicators</td>
<td>View 7: Output Measurements</td>
<td>View 8: Output Assumptions</td>
</tr>
<tr>
<td>Environmental Protection Areas</td>
<td>Establishment of EPZs throughout the Project site</td>
<td>Tree cutting and woodlot clearing</td>
<td>Existing conditions have not surpassed critical point of no return</td>
</tr>
<tr>
<td>Wildlife Corridors</td>
<td>Area of vegetated corridors planted</td>
<td>Relocating specimen flora and rare plants</td>
<td></td>
</tr>
<tr>
<td>Riparian Planting</td>
<td>Area of vegetation planted along stream courses</td>
<td>Controlling introduced and invasive species guidelines</td>
<td></td>
</tr>
<tr>
<td>Micro Habitats</td>
<td>Numbers of bird boxes, bat roosting boxes, and areas of habitat for reptiles and amphibians erected</td>
<td>Planting and habitat restoration guidelines</td>
<td></td>
</tr>
<tr>
<td>Habitat Plots</td>
<td>Area of protected habitat plots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream Rehabilitation</td>
<td>Number of riffles, runs and pools in place Improved water quality</td>
<td>Working in and adjacent to watercourses guidelines</td>
<td></td>
</tr>
<tr>
<td>Environmental extension program</td>
<td>Activities by RMGC staff and participants implementing BMP</td>
<td>Records of conservation activities</td>
<td></td>
</tr>
<tr>
<td>View 1: Inputs</td>
<td>View 2: Input Indicators</td>
<td>View 3: Input Measurements</td>
<td>View 4: Input Assumptions</td>
</tr>
<tr>
<td>Existing ecological conditions</td>
<td>Existing area of natural habitats</td>
<td>Ecological baseline study and annual updates from monitoring program</td>
<td>Data are available, current and accurate</td>
</tr>
<tr>
<td>Resources provided by stakeholders</td>
<td>Funds and personnel provided by RMGC</td>
<td>Agency management reports</td>
<td></td>
</tr>
</tbody>
</table>

**Section 6: Management of Biodiversity**
6.4 Responsibilities, Budgets, and Schedule of Implementation

This section consists of Tables 6-2 and 6-3 below, that specify the responsibilities, budgets and schedules for ecological restoration and rehabilitation activities, and habitat and wildlife monitoring, respectively.

**Table 6-2. General Responsibilities for Ecological Restoration and Rehabilitation Management**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Action</th>
<th>Place</th>
<th>Responsibility</th>
<th>Estimated Cost ($US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree cutting and woodlot clearing</td>
<td>Implement BC-01</td>
<td>Throughout the entire Project site.</td>
<td>RMGC Personnel</td>
<td>To be determined</td>
</tr>
<tr>
<td>Working in and adjacent to watercourses</td>
<td>Implement BC-02</td>
<td>At locations where stream crossings are made, or where construction/operational activities are conducted within the top-of-bank of watercourses.</td>
<td>RMGC Personnel</td>
<td>To be determined</td>
</tr>
<tr>
<td>Controlling introduced and invasive species</td>
<td>Implement BC-04</td>
<td>In areas that are being actively managed for conservation, including habitat plots and riparian habitats.</td>
<td>RMGC staff, supported by environmental extension program participants.</td>
<td>To be determined</td>
</tr>
<tr>
<td>Planting and restoring habitat</td>
<td>Implement BC-05</td>
<td>In areas that are being actively managed for conservation or rehabilitated, including EPZs, wildlife corridors, habitat plots and riparian habitats.</td>
<td>RMGC staff, supported by environmental extension program participants.</td>
<td>To be determined</td>
</tr>
<tr>
<td>Recording conservation activities</td>
<td>Implement BC-11</td>
<td>Each location and occasion that an activity takes place.</td>
<td>RMGC Personnel</td>
<td>To be determined</td>
</tr>
</tbody>
</table>

**Table 6-3. General Responsibilities for Habitat and Wildlife Monitoring**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Action</th>
<th>Place</th>
<th>Responsibility</th>
<th>Estimated Cost ($US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat Mapping</td>
<td>Implement BC-06</td>
<td>Throughout the entire Project site.</td>
<td>RMGC Personnel</td>
<td>To be determined</td>
</tr>
<tr>
<td>Wildlife surveys</td>
<td>Implement BC-07</td>
<td>In areas that are being actively managed for conservation or rehabilitated, including EPZs, wildlife corridors, habitat plots and riparian habitats.</td>
<td>RMGC staff, supported by environmental extension program participants.</td>
<td>To be determined</td>
</tr>
<tr>
<td>Recording rare species</td>
<td>Implement BC-08</td>
<td>Throughout the entire Project site.</td>
<td>RMGC staff, supported by environmental extension program participants.</td>
<td>To be determined</td>
</tr>
<tr>
<td>Recording indicator events</td>
<td>Implement BC-09</td>
<td>Throughout the entire Project site.</td>
<td>RMGC Personnel</td>
<td>To be determined</td>
</tr>
<tr>
<td>Awareness surveys</td>
<td>Implement BC-10</td>
<td>Throughout the entire Project site.</td>
<td>RMGC staff, supported by environmental extension program participants.</td>
<td>To be determined</td>
</tr>
</tbody>
</table>
6.5 Biological Resource Protection and Restoration

During construction and Operations, access to the Roşia Montană Industrial Zone will be restricted. As such, exploitation of biological resources by local communities will not occur. Upon Closure, traditional land uses will be re-established and exploitation can continue. Protection and restoration activities undertaken as part of the Biodiversity Management Plan should ensure that key biological resources are conserved, and that stocks are improved in terms of quality and quantity.
7 Biodiversity Conventions and Regulatory Framework

Romania has demonstrated its interest in, and commitment to, the conservation of biodiversity and natural areas through signing of international agreements, the passage of national regulations and the designation of a large number of protected areas. The following section describes relevant World Bank Group Operational Policies, International Conventions, European Directives, and Romanian legislation, policies and plans, as they apply to biodiversity conservation at the project level.

Despite these efforts, Romania has experienced difficulties in implementing policies and strategies to achieve effective biodiversity conservation. There is a lack of a comprehensive conservation management strategy as well as appropriate institutional arrangements for biodiversity conservation. Coordination among the various governmental organisations involved with nature protection activities is often inadequate and the public participation into the decision-making process often occurs on an ad-hoc basis.

7.1 World Bank Group Operational Policies

The contents of this Biodiversity Management Plan have been designed to meet the overall documentation requirements of the World Bank Group for Category “A” projects. This section describes the applicable Operational Policies of the World Bank Group as they relate to biodiversity conservation.

7.1.1 Operational Policy 4.04 Natural Habitats

This policy affirms World Bank Group’s commitment to promote and support natural habitat conservation and improved land use, and the protection, maintenance, and rehabilitation of natural habitats and their functions in its project financing. The World Bank Group does not support projects that involve significant conversion or degradation of critical natural habitats.

7.1.2 Operational Policy 4.36 Forestry

World Bank Group involvement in the forestry sector aims to reduce deforestation, enhance the environmental contribution of forested areas, promote afforestation, reduce poverty, and encourage economic development. World Bank Group does not finance commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests (although neither of these instances apply to the Rosia Montana Project). This policy is now under review.

7.2 International Conventions

Since 1990 Romania has ratified several international conventions relating to biodiversity and nature conservation. The following are the conventions ratified by the Romanian Government:

- Convention Concerning the Protection of the World Cultural and Natural Heritage (1972), accepted by decree 187/1990;
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971), ratified by law 5/1991;
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979), to which Romania adheres to by law 13/1993;
- Convention on Biological Diversity (Rio de Janeiro, 1992), ratified by law 58/1994;
4.6 Biodiversity

- Cartagena Protocol on Biosafety, ratified by Law No. 59/2003;
- Convention of the Protection and Use of Transboundary Watercourses and International Lakes (signed at Helsinki, on 17 March 1992) – ratified by Law No. 30/1995;

It should also be noted that Romania is a party to the Convention on environmental impact assessment in a transboundary context (the Espoo Convention signed in 1991 – ratified by Law No. 22/2001), and to the Convention on access to information, public participation in decision-making and access to justice in environmental matters (the Aarhus Convention signed in 1998 – ratified by Law No. 86/2000).

Other acts of relevance in the field of international cooperation include:
- Agreement between the Government of Romania and the Government of the Ukraine on cooperation in the field of frontier water management (signed at Galati, 1997, ratified by Law. No. 16/1999);
- Agreement between the Government of Romania and the Government of the Republic of Hungary on cooperation in the field of environmental protection (signed at Bucharest, 1997);
- Agreement between the Government of Romania and the Government of the Republic of Hungary on cooperation for the protection and sustainable use of frontier waters (approved by GD No. 577/2004);
- Agreement between the Ministry of Waters, Forests and Environmental Protection of Romania and the Environmental Protection Department of the Republic of Moldova in the field of environmental protection and sustainable use of natural resources;
- Agreement between the Ministry of Environment and Land Use Planning of the Republic of Moldova, the Ministry of Waters, Forests and Environmental Protection and the Ministry of Environment and Natural Resources of the Ukraine on cooperation in the area formed by the protected natural areas of the Danube Delta and lower Prut River (signed at Bucharest, 2000 – not yet into force);
7.3 European Union Directives

In meeting the objectives of international conventions and legislation of the European Union, Romania has approximated its national legislation with the requirements set by:

- Directive 79/409/EEC on the conservation of wild birds (Birds Directive), and,

The aim of Directive 92/43/EEC is to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild flora and fauna. Measures taken pursuant to this Directive are designed to maintain or restore at a favourable conservation status the natural habitats and flora and fauna of interest; while taking into account economic, social and cultural requirements and regional and local characteristics.

No transition period was requested by the Government of Romania (therefore, no implementation plan prepared); hence all requirements must be complied with on accession date (2007).

7.4 Romanian Legislation

7.4.1 General Framework

The Constitution of Romania provides a regulatory framework for all legislation pertaining to the conservation of biodiversity in Romania. Revised in October 2003, the Constitution includes specific references to the following:

- The State recognizes any person’s right to a healthy and ecologically balanced environment.
- The State shall ensure the legislative framework for the exercising of this right.
- Natural and legal persons shall have the duty to protect and improve the environment

The general framework for the conservation of biodiversity in Romania is the Environmental Protection Law No. 137/1995, as amended, as amended by EGO No. 91/2002, approved by Law No. 294/2003. It contains a special chapter on protection of natural resources and conservation of biodiversity (chapter III). Priorities of the law include protection of wildlife species and habitats, as well as creating protected conservation areas. This law also states the requirement that environmental protection authorities be notified regarding any accidents or activities that may affect terrestrial ecosystems. It also places the fiscal responsibility of project remediation on the project sponsor.

A number of subsequent secondary legislation and technical norms supports Law No. 137/1995 and relate to ecosystem protection and for the conservation and sustainable use of biological diversity components, and for ensuring human health.

Law No. 13/1993 provides for Romania’s accession to the Convention regarding wildlife and natural habitats protection in Europe.

7.4.2 Forest protection

The Forest Code establishes administration of the forest fund and forest vegetation. Goals include biological diversity conservation and woodland scenery through the creation of national parks and other protected areas.

### 7.4.3 Bird Protection

Romania transposed the EU Habitat and Birds Directives into national legislation through Governmental Emergency Ordinance No. 236/2000 (Nature Protection Act), as approved, with amendments and additions, by Law No. 462/2001. Several pieces of subsequent legislation have been adopted to support the implementation of the above-mentioned regulations.

Additionally, Law No. 89/2000 for the ratification of the Agreement for the protection of the European-ASIatic migratory water birds that was adopted in the Hague on June 16, 1995.

### 7.4.4 Fish stock protection and preservation

Aquatic wildlife protection in Romania is governed by Law No. 192/2001 on fish stock, fishing and aquaculture, republished in 2003 and subsequently amended by Law No. 481/2003, Law No. 298/2004 and EGO No. 69/2004. Special provisions are provided under the Forest Code for the conservation of fish ‘stock’ in mountainous waters.

### 7.4.5 Game wildlife

The Law of Hunting Fund and Protection of Game (Law 103/1996) provides for the conservation of wildlife diversity and maintaining the ecological balance of game species. This law established annual harvesting quotas, technical rules on hunting, and wild fauna that are protected. In 2000, the Emergency Ordinance of Romanian Government No. 69/2000 was passed regarding the modification and completion of the Law on Hunting Fund No. 103/1996.

### 7.4.6 Special Provisions for Mountain Areas

The mountainous area in Romania is subject to a specific regulatory framework provided by Law No. 347/2004 (“mountain law”), which provides for the sustainable use of mountain resources and landscape and biodiversity conservation.

### 7.4.7 Brief assessment of provisions in Mining Law in relation to nature protection requirements

The most critical provision in Law No. 85/2003 in regard to nature protection and conservation stipulates that mining activities may not be carried out in natural reserves, interpreted to include all established protected natural areas.

The license holder is also obliged to submit bi-annual or annual reports that should also contain the works and expenses made for environmental reconstruction.

In determining the location of the project, consideration must be given to special protection areas, appointed by Law No. 462/2001 for approving the Ordinance of emergency of the Government No. 236/2000 on protected natural areas regime and conservation of natural habitats and flora and wild fauna or areas in which determinations are made in order to include them in the areas classified as protected areas.

### 7.4.8 Brief notes on land use planning legislation

All legal acts provide for obligations, competencies and the procedure for obtaining the development consent, in accordance with the land use and urban planning documentation.
If constructions are to be made within protected natural areas reflected in the approved land use and urban plans, it is necessary to obtain The Ministry of Environment’s prior approval, which is given through actually the environmental agreement. If the protected natural areas are of local/county interest, the approval must be obtained from the local public administration authorities.

It also needs to be corroborated with art. 14 (3) of the Law on natural protected areas stipulating that the administration of the protected natural area shall authorize the activities carried out within the protected natural areas and in their vicinity.

According to the general urban planning rules, no constructions or works can be permitted to be carried out on forested land, but for constructions that are necessary for forest protection and wood collection or forest breeding, with the endorsement of the specialized competent public authority.

7.4.9 Other legislation relevant for nature protection
In the field of biosafety, Romania has ratified the Cartagena Protocol through Law No. 59/2003 and transposed the EU Directives 90/219/EEC and 90/220/EEC through Government Ordinance No. 49/2000, as approved, with amendments and additions, by Law No. 214/2002. Subsequent legislation is needed for the implementation of the existing law.