VIRGIN FORESTS AT THE HEART OF EUROPE

The importance, situation and future of Romania's virgin forests

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Content

1 Virgin and old-growth forests and their ecological significance

2 Where in Europe do virgin forests still exist?

3 Romania's natural forest types – A biogeographic and phytosociological overview

4 Virgin and old-growth forests in Romania – What do we know about their distribution?

5 European beech forests as a UNESCO Natural World Heritage site ("Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe")

6 The political situation in Romania and its impact on virgin and old-growth forests

7 The situation vis-à-vis the protection of virgin and old-growth forests in Romania

8 The European Union and the debate over virgin forests in Romania

9 Latest developments in the protection of virgin and old-growth forests in Romania

10 Outlook

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1 Virgin and old-growth forests and their ecological significance

This report will provide an overview of the distribution, situation and (in particular), perception of the last remaining large-scale virgin forests in Central Europe, with a particular focus on Romania.

As well as being a scene of forest destruction, Romania is an EU Member State and a country with close and good relations with Germany[1]. Numerous observers and stakeholders are able to provide us with reliable and up-to-date information. The country has been the backdrop to an unfolding drama for many years. Mention the destruction of (ancient) forests, most people usually only associate it with images of the rain forests of the Amazon and Borneo; but this is also happening right here on our doorsteps, in plain sight. Even protected areas such as national parks are still subject to large-scale logging, both legal and illegal. Our mission is to share information and encourage readers to get involved. The virgin and old-growth forests of the Carpathians are highly relevant to us all, also in Germany and in other countries, we can and must try to exert influence wherever can.

We in Europe share a global responsibility to protect our unique, irreplaceable natural heritage. These Carpathian forests are some of the last remaining wildernesses, and a precious archive of information, images and beauty. As consumers, processors and sellers of timber and wood-based products we all (and not only the German people) share responsibility for the pressures placed on these forests and have a duty to safeguard this natural heritage for future generations. Each of us has an ethical and scientific obligation to protect the last remaining large-scale (European) virgin forests, not least for our own self-interest (cf. Bücking et al. 2000, Brang 2005, Wirth et al. 2009, Veen et al. 2010, Commarmot & Brang 2011, Scherzinger 2012, Mikoláš et al. 2014 and 2019, Biriş 2017, Musavie et al. 2017, Schoof et al. 2018, Watson et al. 2018). These are some of the most compelling reasons:

1 Spared from the direct influence of civilisation, virgin forests (wilderness areas) contain vital reserves of evolutionary genes. Intra-species variability that has evolved over thousands or even millions of years has been spared utilisation-based selection. The same is true of species-specific adaptation processes in interaction with the natural environment, which have remained uninfluenced by anthropogenic selection. In (German) managed forests, for example, twisted and intertwined trees are removed during the thinning process, unless preserved as "habitat trees" as part of "old-growth and deadwood concepts" (Nagel 2016, Gustafsson et al. 2019).
The existence of genetically diverse populations is vital against the backdrop of climate change and the search for climate-adaptive tree species and provenances (cf. for example Hohnwald et al. 2020). Forest communities of European beech[2] *(Fagus sylvatica*) and silver fir *(Abies alba*) exist across a wide gradient of locations and climates in the Carpathians, helping to perpetuate habitat traditions that have persisted since their post-glacial re-colonisation (Magri et al. 2006, Liepelt et al. 2009, Stoiculescu 2007) (see also Box 1). The genetic diversity of these species and hence their potential for "climate-adaptive" evolutionary advancement is far less pronounced after long-distance migration (such as current distribution sites in Germany) than among stands in or near their periglacial refugia (cf. *inter alia* Knutzen 2016, Roibu et al. 2017).

1 Since most authors are German, the report may have subjective viewpoints on certain aspects.
2 In the following, the European beech (*Fagus sylvatica*) will only be referred to as beech.

2 In terms of their temporal, spatial and functional dynamics, virgin forests function as refugia and original biotopes for highly specialised species which depend on consistent long-term habitat and environmental conditions only found in virgin forests (such as specialised xylobionts among fungi, lichens, beetles, hymenoptera and dipterans with limited dispersion). Only extensive virgin forests can provide the requisite habitat tradition and associated structures and processes correlating to developmental and age phases which even very near-natural managed forests lack (e.g. Merchant et al. 2018).

3 Virgin forests provide a rare source of immensely practical and economically relevant knowledge for managed forest ecosystems, by integration use and protection. For example, research in virgin forests has led to practical guidelines on the minimum threshold values for deadwood, old-growth trees, disturbance sites and microstructures needed to achieve a high degree of forest-specific species diversity, as vital components of a comprehensive, sustainable approach to forest management (see Kaufmann et al. 2018). Such objectives cannot even be achieved in managed forests with deadwood and habitat tree concepts (see Krumm et al. 2020).

4 Virgin forests function as reference ecosystems and vital research laboratories for documenting and analysing long-term trends in environmental change. They also serve as reference ecosystems for natural forest development versus forest management, and therefore as a guide to adaptive forest management based on the iterative development of adaptation and mitigation strategies to address climate change (see also Box 2).

Box 1: Tertiary relics in the Carpathians

The classification of the Carpathian beech forests as tertiary relics refers to species of the herbaceous layer. From pollen analyses, there is no evidence that the beech survived in the Carpathians during the Ice Age. These analyses indicate that the beech has occurred discontinuously in northern Romania since the end of the Preboreal period, and it was only 5000 years later that it developed its structure and zonality in large stands in the Subatlantic, to coincide with an improvement in the climatic conditions of the Holocene (Pop 1942, Raţiu 1982). Stoiculescu (2007) even describes beech forests as "Europe's most recent phytocoenosis". As a zonal unit, they have existed in the mountain regions since the Subboreal phase and then developed explosively in the Subatlantic, i.e. 3000 years ago. Beech trees *(Fagus* spec.) were recorded among Pleistocene flora and existed during the quaternary of the Würm interstadials and then in the Preboreal period (Pop 1942, 1945, Doniţă 1989). The beech *(Fagus sylvatica*) first migrated to Romania in the Subatlantic, probably from the nearby Southeastern Balkan Peninsula or the Podolian Highlands (Pop 1942, 1945, Doniţă 1989).

The post-glacial migration of tree species also marked the arrival and evolution of numerous Dacian and Dacian-Balkan endemics such as *Aconitum moldavicum, Cardamine glanduligera, Hepatica transsilvanica, Pulmonaria rubra, Symphytum cordatum,* considered as characteristic species of the beech forests of the Romanian Carpathians (Doniţă 1989, Stoiculescu 2007). Differentiation between these endemic species is thought to have begun towards the end of the Tertiary Period, and their genera were thought to have been present in the Pliocene beech forests, which were ecologically similar to today's beech forests. Biogeographical evidence of this is found in the endemic Balkan species *Hepatica transsilvanica Fuss.,* which has an unusually wide disjunct distribution and taxonomic discordance from its closest relative, the *Hepatica henryi* from China, and must therefore be considered a tertiary relic (Pop 1976, Sârbu et al. 2013). The endemic cleaver species *Galium baillonii* D. Brândză, another tertiary relic, has a similarly disjunct distribution to *Hepatica transsilvanica*. It is endemic to beech forests on the southern edge of the Southern Carpathians around the Red Tower Pass. Its closest relative *Galium valantioides* M. Bieb. is found in the Caucasus (Schneider-Binder 1971).

Box 2: Virgin and old-growth forests within the debate of climate protection

Calculating a forest's storage or sink function for CO_2 is a highly complex process, determined to a large extent by development status and management. During the growth phase, forests play a vital role by absorbing large quantities of carbon dioxide from the atmosphere and storing it for long periods in biomass (wood) and forest soils (e.g. Gleixner et al. 2009, Luyssaert et al. 2008, Nord-Larsen et al. 2019). Afterwards, a forest ecosystem enters a period of homeostasis of variable length, during which the CO_2 is balanced out by simultaneous accumulation and decomposition processes. The storage function of the forest floor is rather different. Studies by Musavie et al. (2017) show that CO_2 is stored continuously in the upper soil horizons, even in ancient forests with high levels of biodiversity. However, the destruction of such old-growth forests can cause serious climate problems if these large quantities of carbon are suddenly released (Nord-Larsen et al. 2019). As a general rule, virgin forests (in a biogeographical context) continuously store CO_2 over a period of several centuries (provided they are not disturbed), and during their optimal phase have an extremely high long-term storage function for CO_2 which they later release, generally over an equally lengthy decay phase.

A study by Schulze et al. (2020) found that the CO_2 climate mitigation potential of managed forests in Central Europe is 10 times that of uncultivated forests (virgin forests). However, this contradicts findings from other studies (including Glatthorn et al. 2017, Kun et al. 2020 and Booth et al. 2020). This is a highly relevant issue against the backdrop of climate policy recommendations, and a prudent and serious scientific debate is essential, since the calculations published by Schulze et al. (2020) are cited as justification by those opposed to the protection of virgin and old-growth forests.

The study by Schulze et al. (2020) and its statements prompted a lively debate among experts. The study is based primarily on comparing data sets from the third German Forest Inventory of 2011 and 2012 (for managed forests) with inventory data from Hainich National Park (2000 and 2010 for unmanaged forests). The authors calculate a CO_2 mitigation effect of between 3.2 and 3.5 t of CO_2 equivalents per hectare per annum for managed forests in Germany versus carbon storage of just 0.37 t CO_2 equivalents per hectare per annum in uncultivated forests (based on inventory data from Hainich National Park). Hainich National Park issued a statement on these results (Hainich National Park Administration 2020), alleging that data in the study by Schulze et al. (2020) had been incorrectly evaluated and interpreted, as it refers to incomparable reference areas. Only identical forest areas should be compared over a given time series to determine periodic growth. In Hainich, the average growth is 9 m^3 per hectare per annum over a decade, roughly on a par with the findings of the third Federal Forest Inventory (11.2 m^3 per hectare, per annum). This figure is also consistent with the highly productive forest phases used for this comparison, which is very different from virgin forests optimum physiological homeostasis.

In another article evaluating the methodological approach used by Schulze et al. (2020), Bolte et al. (2020) adopt a similarly critical stance: "The low representativity of the Hainich National Park for set-aside forests in Germany limits its general significance in comparisons of managed and unmanaged forests. We strongly recommend to expand the underlying data basis for the evaluation of short-term advantages of either setting aside Central European forests or using them for bioenergy in climate protection, because exclusively using aggregated inventory data from NP Hainich will not answer this question due to methodological restraints and poor transferability".

But what is the core issue here? Generally, it must be noted that there are no (ancient) virgin forests in Germany to serve as reference areas. Also, we are talking about two equally important but distinct objectives, i.e. (virgin) forest ecosystems as vital tools of the climate mitigation strategy on the one hand, and (virgin) forests as places for conserving biodiversity on the other; these two functions are not comparable. This becomes particularly questionable when (pseudo)scientific studies are used to pave the way for political decision-making. The same applies to arguments refuting the need to protect virgin forests in Romania based on the expertise of the Forestry faculty at Transilvania University of Brașov (UTB 2020a and b, see also Chapter 2), which explicitly cites the study by Schulze et al. (2020), among others.

Until the 1970s, (German-speaking) forest science barely covered the ecology of virgin forests. There are several reasons for this:

1. Apart from a handful of small areas, virgin forests have long ceased to be part of the environment and what is associated with "nature" and "nature conservation" in Central Europe.
2. Virgin forests are discounted as economic resources (timber production) by the forestry sector. This also affects the resources available to forest science (for example in Romania research funds tend to be allocated to politically desirable areas).
3. The forests of the Carpathian Arc are among the few natural ancient forest ecosystems with some functional similarities to the commercial forests that now dominate Central Europe. Under the socialist regimes, access to, familiarity with and scientific work in these regions was virtually impossible. Our (German, Western) knowledge of the functionalities, processes and biodiversity in forest ecosystems is therefore largely based on short, incomplete sections of the cycle of natural development phases in our commercial forests.

Large-scale virgin forests can still be found in the southern parts of the Romanian Carpathians. The picture shows the Boia Mica Valley in the Făgăras Mountains; around 1,000 hectares of wilderness with virgin forests in different development stages that are also home to lynxes and bears. Boia Mica was recently accepted for the national catalog of virgin and quasi virgin forests on the basis of studies at the Rottenburg University and after long negotiations with authorities. (Photo: Rainer Luick, 2019).

In recent years, there has been a growing polarisation among academics regarding European virgin forests and old-growth forests in general: Some scientists are convinced of the need to conserve the last remaining European virgin forests. Others virtually deny that these virgin forests are ecologically relevant and source of valuable knowledge, arguing that virgin forests are essentially dispensable and that further protection should not be a normative imperative (e.g. UTB 2020a, b).

The much-cited comparative meta-study on comparative biodiversity in European forests by Paillet et al. (2010) considered numerous studies on deciduous forests in Central Europe which concluded that a greater biodiversity of vascular plants is found in either unmanaged or managed forest. The opinion paper by Schulze et al. (2014a), which concluded that high levels of biodiversity in forest ecosystems depend on forest functions such as timber production, forest management and forest development, sparked a heated debate. The authors argued that such functions are necessary to create the appropriate ecologically relevant structures and processes to facilitate a high level of diversity (see the opinion and response by Mikoláš et al. 2014 and Schulze et al. 2014b). Similar arguments are put forward by Walentowski et al. (2013) in their recommendations on using modern western forestry technology to manage NATURA 2000 protected beech forests in the Southern Romanian Carpathians: The authors postulate that regular thinning and continuous, sustainable use with appropriate infrastructure development is an option to safeguard and promote desirable species.

A characteristic feature of certain virgin forest development phases (especially the terminal phases) and a significant difference to commercial forests is the high proportion of dead wood. Every structural type of deadwood (whether standing or lying) and every dimension, and of course the tree species itself, are characteristic and also very different habitats in a temporal continuum. (Photos: Rainer Luick, 2018).

How did these contradictions arise, is there an explanation, and what is the position of objective scientific analyses (see also Luick & Reif 2013)? These findings become problematic when used to support the argument that managed forests have a greater conservation value than natural forests.

One general problem when assessing forests from a conservation perspective, at least in Central Europe, is the widespread lack of reference conditions for virgin forests, i.e. location-typical natural forests of a sufficient size containing a complete inventory of species, ecosystem processes and life cycles. The existence of large numbers of species in a given area (alpha diversity) is an important but inadequate criterion of ecosystem quality. Species numbers depend on the selective inclusion of taxa because they are often limited to vascular plants and a few fauna species. The meta-study by Bernes et al. (2015) comparing managed forests in boreal and temperate biogeographical regions with uncultivated forests in order to evaluate their conservation importance concluded that around 17,000 studies relied almost exclusively on structures and vascular plants as benchmarks.

However, any assessment of habitats should consider more than just species numbers, especially those from just one taxon. In particular, they should also incorporate the following (see also Schmidt et al. 2011, 2014):

1. Near-naturalness: The existence of site-typical and characteristic structures; the existence of forest species versus non-forest species; the existence of natural processes;
2. The rareness and threat to certain species;
3. The completeness of biocoenoses, structures and processes typical of that habitat;
4. Restorability (elasticity);
5. Resistance (stability);
6. Connectivity of habitats; and
7. Representativeness of the ecosystem.

The importance and weighting of these criteria in relation to one another is an unsolved challenge. The following four examples illustrate the cardinal problem of combining (agglomerating) criteria for both normative and scientifically intended evaluation in nature conservation. Such comparisons are often characterised by an implicit and suggestive incorporation of incomparable criteria, such as:

1 An urban area of allotments, small and large plots of fallow land with different trophic levels, parks and intensively maintained, green spaces show a higher diversity in almost every group of organisms than a structurally rich agricultural landscape with a high proportion of extensive use and endangered species.

2 An intact raised bog may have significantly less species diversity than an anthropogenic peat bog with a mosaic of peat ditches of different ages and sizes interspersed with patches of remaining moorland, but it is near-natural, very rare, extremely endangered and almost impossible to restore.

3 A managed beech forest with diverse structures, including clearings created by selective shelterwood cutting, has an exceptionally high level of diversity including nearly all known phanerogams that characterise a beech forest ecosystem; while a beech forest such as the Semenic virgin forest in Romania during its "optimum phase" may offer considerably less diversity.

4 Using xylobiontic organisms (including fungi and beetles) to compare the developmental stage of a Central European managed forest with the terminal phase of a natural forest reveals that most managed forests are (almost) completely devoid of "virgin forest relic species".

No objective academic study should compare incomparable entities (such as nature conservation criteria) without further justification. Science-based inventory and evaluation procedures for biotopes and ecosystems are not based on diversity alone, but also include other parameters relating to natural and near-natural forest ecosystems. Using species numbers as the sole criterion implies either ignorance of other valuable parameters, or must be regarded as unacceptable reductionism.

The diversity and special needs of saprophytic beetles and the importance of dead wood with its species-rich tree-fungus communities are well known. For example, in the old-growth forests in the core zones of Hainich National Park, and of the biosphere reserves Swabian Jura and Schorfheide-Chorin, 1254 saprophytic fungi species were found (Purahong et al. 2018). Especially standing dead wood from large trees provides diverse habitats for decades. (Photos: Rainer Luick, 2018).

2 Where in Europe do virgin forests still exist?

A Forest Europe study (2020) identified some 227 million hectares of forest in Europe (including Eastern European countries and Russia), corresponding to 33% of its land area. At best, some 4.6 million hectares (2.2%) of European forests are still characterised as natural with little or no human influence[1], i.e. "virgin forests and old growth forests"; of these, some 3.6 million hectares (2.4%) are in the EU.

However, this information relates to statistics from the individual countries and is not identical with the publication date of the report. This means that data of the Forest Europe (2020) study mirrors the situation of different time periods before and data can also come from different years for the individual countries, see also Box 3.

In the popular and also the scientific academic literature, there is a tendency to use a number of different terms to express the clear and unambiguous German terms "Urwald" (virgin forest) and "naturnaher Wald" (near-natural forest). Details about the terminology and definitions relating to virgin forest are presented in Box 4.

Box 3: Statistical data on European forests

Current EU statistics cover some 182 million hectares of forest in (still) 28 Member States, which corresponds to around 5% of the world's forested areas (EU 2019a). Forest covers around 43% of the EU's total area, although some 130 million hectares (about 70%) are located in just six Member States (Sweden, Finland, Spain, France, Germany and Poland). Some countries have more than 60% forest (Sweden and Slovenia) while others have barely 10% (Netherlands and Ireland). Germany has 11.4 million hectares of forest, covering 32% of its land area. Hesse and Rhineland-Palatinate are the most densely wooded federal states (42.3% in each case), while Schleswig-Holstein is the least densely wooded with only 11%. Interestingly, the forest area is increasing among EU countries and has grown by around 25 million hectares since 1990. This is primarily attributable to succession and abandonment of marginal agricultural land and, to a lesser extent, afforestation. The Forest Europe 2020 study lists in the "undisturbed by man (virgin forest)" class the following values: North Europe (3.9%), Central-West Europe (0.3%), Central-East Europe (2.0%), Southwest Europe (0.3%) and Southeast Europe (2.8%) with an average for the EU-28 of 2.4%.

The most recent comprehensive inventory of the existence and biogeographic distribution of European virgin forests is based on empirical data provided by Sabatini et al. (2018). It also subsumes the terms "quasi-virgin" and "old-growth forests" under the category of "primary forests". The methodological processes chosen were unsuitable for delineating "genuine" virgin forest.

The Sabatini et al. (2018) study was a shocking revelation of how little we actually know about remaining virgin forests and their distribution, because there have been almost no systematic surveys and no reliable statistics (plausible estimates at best). Reliable data is available for the Czech and Slovak Republics and for Hungary. Partial data records (often limited to specific geographical regions or protected areas) are available for Romania, Ukraine, France and Italy. Incoherent data is available for Sweden, Austria, the United Kingdom, Bosnia and Herzegovina, Montenegro and Serbia. No analysable data records exist for Lithuania, Belarus, Moldova and Ireland. Sabatini et al. (2018) came up with a rough estimate of approximately 1.1 million hectares of boreal forests, approximately 0.2 million hectares of montane beech and beech-fir forests and approximately 0.07 million hectares of subalpine coniferous forests. Sabatini et al. (2018) found out, that for six out of 54 European forest types virgin forests are missing, and that for 70 % of the European forest types no virgin or quasi-virgin forest areas exist.

1 In the Forest Europe study (2015) 7.3 million hectares (3.3%) of European forests were listed as undisturbed by man, this means a decline of 2.7 million hectares between the two reporting periods (2015 to 2020). Since the 2020 report compares the developments between the two reporting periods a statistical error cannot be assumed.

Box 4: What are virgin forests, what are old-growth forests – Definitions according to Biriș & Veen (2005), Fanta 2005, Wirth et al. (2009) and Commarmot et al. (2013)

Virgin, primeval, primary (natural, intact, undisturbed, mature)**:** A forest undisturbed by man, i.e. without significant human intervention, or where the last significant human intervention was so long ago that the natural species composition and processes have re-established themselves.

Old-growth, quasi-virgin, ancient, near-virgin: Forests previously managed but which have been left to develop naturally. They show characteristics of old-growth forests, e.g., mixed tree ages, development phases with senescent and dead trees, and deadwood in all decay stages.

A comprehensive definition of the term "virgin forests" is provided by Fanta (2005): "Virgin forest is a natural woodland where tree and shrub species are present in various stages of their life cycle (seedlings, young growth, advanced growth, maturity and old growth) and as dead wood (standing and lying) in various stages of decay, with more or less complex vertical and horizontal structures as a result of natural dynamics. This process enables the natural forest community to exist continuously and without limit in time".

In virgin forests the dynamics inherent to living systems are connected to ecological properties (including longevity) of the dominant tree species, impact of other organisms (e.g. outbreak of insects) and of abiotic factors related to the substrate, climate, topography, and water table (e.g. wind, snow, flooding, landslides). This dynamic may lead to the temporary occurrence of gaps or larger treeless stages.

Virgin forests differ within the given phytogeographic zone, forming specific forest communities with characteristic species composition, spatial structure, dynamics and overall diversity due to site conditions related to the position above sea level and topography, macroclimate, and nutrient and water availability. Virgin forests reflect herewith the natural unity of forest community and abiotic conditions, fully rooted in their millennia-long continuous Holocene development.

Commarmot & Brang (2011), among others, have undertaken an in-depth analysis of the definitions used in German-speaking countries:

The term "virgin forests" is used if there is no knowledge or indication of any earlier human usage, or if such usage was so insignificant and so far in the past that it does not influence the current species composition, forest structure, amount of deadwood or forest dynamics in any way. This definition of virgin forest is largely consistent with what the Pan-European Ministerial Conference on the Protection of Forests in Europe (MCPFE) calls "forest undisturbed by man". Undisturbed virgin forests are characterised by the following features:

- Giant and old-growth trees are common.
- Some trees have reached their maximum biological age.
- Standing and fallen deadwood is found in varying degrees of decomposition.
- The stand structure is heterogeneous, with different development phases alternating in a mosaic-like pattern.
- All development phases, especially decay phases, occur.
- The development phases overlap.
- The age of the trees and the diameters of the trunks differ within a small area.
- The amount of biomass is high.
- The species composition is natural.
- There are no visible traces of anthropogenic usage such as tree stumps caused by felling, log trails, plantations, grazing tracks, etc.

"Natural forest" is the term used to describe forests that have emerged from natural regeneration and been left to develop freely over a long period without human intervention. Natural forests contain the same tree species that would occur in natural plant communities; however, they may exhibit traces of earlier forest management. Natural forests pass through the natural development cycle up until the decay phase and contain significant quantities of fallen deadwood, old-growth trees and dry standing trees. Provided that they have not experienced any major natural disturbances – over time, natural forests become more and more similar to virgin forests.

Disregarding the virgin boreal forests in the northern regions of Finland and Sweden (and also Russia), just over 80% of Europe's virgin forests are located in the Carpatian arc of Ukraine, Romania and Slovakia (s. figure 1). In relation to Central Europe Gratzer et al. (2012) calculate a share of more than 90% that are located in the Carpathians. This indicates, that very few primary forests remain in the rest of Central Europe; most of these are small, isolated patches in remote mountainous regions. Germany's virgin forests have long since disappeared. Within the European Union, Romania has more hardwood-dominated virgin forest than any other Member State. Having a forest cover of only 29 %, Romania cannot be called a "forest country". Valid estimates indicate that Romania is home to two-thirds of the EU's remaining virgin and quasi-virgin forests; an impressive statement, yet it only accounts for

Figure 1: Geographical overview and subdivisions of the Carpathian Mountains. The Apuseni mountain range (Munții Apuseni or Apusen in Romanian) is often referred to as Transylvanian Western Carpathians (see Kliment et al. 2016). The mountain range stretches from the far eastern Czech Republic (3%) in the Northwest through Slovakia (17%), Poland (10%), Hungary (4%), and Ukraine (10%), Serbia (5%) and Romania (50%) in the Southeast. The highest range is known as the Tatra Mountains in Slovakia and Poland (the highest peak is Gerlachovský štít in Slovakia with 2654 m). The second-highest range is the Southern Carpathians in Romania, where the highest peaks reach between 2,500 m and 2,550 m in the Făgăraş Mountains.

	1997	2020
Total area (million hectares)	22,987	
Forest area (million hectares)	6,360	6,639
Forest as a proportion of total area (%)	27.7	28.9
Virgin and very near-natural forests (hectares)	200,000 to 500,000	100,000 to 300,000
Proportion (%)	3 to 7	2 to 3
State-owned forest (%)	66	34
Privately-owned forest including municipal forest (%)	34	66
Coniferous forests (%)	Approx. 31	Approx. 27
Hardwood forests (pure beech forests and mixed stands with beech) (%)	Approx. 31	Approx. 30
Hardwood forests (pure oak forests and mixed forests with oak) (%)	Approx. 18	Approx. 19
Official statistics on wood use (million cubic metres per annum)	Approx. 14.8	Approx. 18
Estimated illegal felling according to official data (million cubic metres per annum)	max. 0.03	Approx. 0.2
Estimated timber stocks according to official data (billion cubic metres)	1351	2350
Estimated timber stock according to official (different) data (cubic metres / hectare)	211 (2010)	281 – 322
Estimated growth according to official (different) data (cubic metres / hectare)	5.6	7.8 – 8.7

Table 1: General data on forests and forestry in Romania, compiled from various sources (Borlea 1999, Roering 2000, Livio et al. 2015, FTP 2020, EUSTAFOR 2020, FAO 1995, 1997 & 2015, Ciceau et al. 2019, Global Forest Watch 2020). It is important to remember that many of the derived figures (stocks, growth) are based on the "official" approved (legal) logging figures of 18 – 22 million solid cubic metres of timber per annum. A more realistic figure would be at least 38 million solid cubic metres per annum including approx. 20 million cubic metres of unknown origin (see Chapter 6).

around 0,5–1% of Romania's total forest area (Biriş 2017). Table 1 summarises some of the key statistics on Romania's forests based on a range of sources. Chapter 3 provides an overview of the biogeographic and phytosociological characteristics of natural forests and their original and recent distribution in Romania.

While the virgin forests of Western and Central Europe were cleared thousands of years ago (towards the end of the Middle Ages at the latest) and those that remained were subject to large-scale anthropogenic changes, in the Carpathians large areas of virgin forest were preserved until well into modern times. Much of our knowledge about the approximate historical distribution and loss of virgin forest we owe to the summarising works of Stoiculescu (1983, 2007 and 2011, *inter alia*) and Biriş (2017). Given the fact that Romania is a relatively young nation with multiple and significant border changes there is a lack of precise data on the extent of virgin forests. Maps and statistics tend to refer to forest distribution in general. In 1907, the Book of Statistics of Romanian State Forests recorded 709,840 hectares of uncultivated state-owned forests within Romania's political borders at that time (out of a total of 908,000 hectares), a large proportion of which was thought to be virgin. No information on other forms of ownership is available. However, it can be assumed that in inaccessible regions large forest areas under municipal, church and private ownership were still untouched.

View from the Transylvanian Basin to the long chain of the Southern Carpathians, also known as the Transylvanian Alps (in Romanian *Carpații Meridionali*). In the foreground are extensive grasslands. The highest peaks reach altitudes of more than 2500 m. The mountains separate Transylvania in the North from Wallachia in the South, and until modern times have been a cultural, political and economic border. There were and still are very few mountain passes crossing. As part of the Carpathians the Banat Mountains extend towards Southwest as far as Serbia; the eastern border is the Predeal pass near Braşov, which is the most important traffic connection (road and railway) between Wallachia and Transylvania. (Photo: Rainer Luick, 2018).

For Transylvania and a large portion of the Carpathians, which were under the ownership of Austria (Hungary) prior to 1918, there are records available which indirectly indicate the proportion of virgin forest (compiled in Rösler 1999 and Rus 2017)[2]: For example, references to "forest rangers" and "forbidden forests" (restricted-access forests) have been documented repeatedly since the 16th century. Documents from the 17th century (1693) refer to a "bush custodian". Among the Romanian population of "Fogaras" in Southern Transylvania, there are mentions of forest custodians known as "Brănișteri", tasked with guarding the "forbidden forests". The term was used to refer to forests under general protection and is still in use today, even though forest

2 During the "Great Turkish War" (1683 to 1699), the Habsburgs under Emperor Leopold I occupied the Principality of Transylvania, a vassal of the Ottoman Empire, and forced Prince Michael Apafi to relinquish his empire to the supreme rule of the Habsburg Empire. In 1690 Transylvania was directly incorporated into the Habsburg Empire. In 1765, the Grand Duchy of Transylvania was proclaimed by Maria Theresa and her son Joseph II and granted special separate status within the Habsburg Empire. As early as 1734, Transylvania was colonised by German-speaking Protestant "Landler" deported from Habsburg under Charles VI and Maria Theresa. In the early 13th century, the region had been colonised by the Transylvanian Saxons who immigrated from the Moselle-Franconian region at the invitation of the Hungarian kings. In 1868 the Grand Duchy of Transylvania with all its state institutions (including the state parliament) was dissolved and subsequently ruled from Budapest.

The mountain range of the Transylvanian Alps shows a steep gradient with deeply incised valleys from both the North and the South. The picture shows the massif of the Piatra Craiului Mountains in the eastern part of the Southern Carpathians. With increasing elevation the near-natural *Fagus sylvatica* forests are replaced by virgin and quasi-virginspruce forests. (Photo: Rainer Luick, 2018).

management methods have changed. A protected forest owned by the town of Sibiu is mentioned as recently as 1909 by Binder. The Habsburg (Josephinian) forest regulations of 1781 included some very progressive rules on the use, conservation and maintenance of forests, including the designation of "forbidden" and "permitted" forests. In 1858, the Austrian Forest Act of 1852 was extended to include Transylvania, with statutory provisions governing the management, referencing and designation of protected forests. This was replaced in 1879 by the Hungarian Forest Act, which was based on the Bavarian Forest Act of that time and identified a number of (virgin) forest categories for Transylvania, including: Forest reserves set aside for conservation (172,445 hectares), protection forests (319,296 hectares) and drift sand forests (7,225 hectares). The beech (virgin) forests in the Southern Carpathians are particularly important. To this day, they include the largest preserved areas of hardwood-dominated virgin forest (at least within the EU). The key factors here are:

1. The status as a border region between distinct cultures, countries and political jurisdictions that were separated for many years.
2. Specific cultural-geographical factors, such as minimal settlement activity in the mountain regions and limited mining due to geological factors (limestone mountains).
3. Difficulty of access, as the steep mountain valleys were largely inaccessible and often remain so to this day.
4. Limited opportunities for the transportation of timber, as heavy beech wood cannot be floated downstream.
5. Insufficient economic viability for harvesting and transporting firewood or charcoal for sale (distance from major cities, lack of industrial development).

The northern Romanian regions of the Carpathians are in a completely different situation, now dominated more by coniferous trees. The last remaining extensive virgin forests had already disappeared before the First World War. While the region was still part of the Austro-Hungarian Empire in the second half of the 19th century, the forests were systematically developed and the virgin forests with their extensive wood reserves were almost completely obliterated. For the Putna forest district in the northeastern region of Bucovina, the prevalence of virgin forests and their rapid loss from the end of the 19th century onwards is well documented, as the following statistics indicate (Imich 1988 and Seghedin 1983): 1878: 82%, 1898: 70%, 1922: 52%, 1944: 33%; by 1968, the virgin forests had almost completely disappeared. Single narrow-gauge forest railway tracks to access and transport the timber were

laid in many valleys. The Vaser Valley railway in Vișeu de Sus (Calea Ferată Forestieră Vişeu or Mocănița de pe Valea Vaserului) is the last one still in operation in Romania. Although it is mainly used by tourists now, it also still transports timber.

Various sources (quoted and compiled in Biriş 2017) reported on the existence of impressive virgin forests in the Southern Carpathians before the Second World War and at the start of the communist era. Initially, change was gradual under the communist regime, which nationalised all forests in 1950, because many valleys in the Southern Carpathians remained inaccessible. Between 1960 and 1980, however, the state invested in a development programme, and the virgin forests contracted accordingly. Duduman's paper (2019) outlines the history of forest planning in Romania. After the collapse of the communist regime and the ensuing economic downturn, the legal use of forests declined while illegal use increased (Ruşdea et al. 2005). Some of the authors witnessed personally the gradual change of vast forest areas with virgin and old-growth forest in the Apuseni Mountains from the year 2000 until present. In less than 20 years, most timber resources with economic value were depleted almost in total.

As the economy recovered, particularly when Romania joined the EU in 2007, Romanian forests increasingly became the focus of commercial exploitation. A study by Global Forest Watch (2020) suggests that between 2001 and 2019 Romania lost 349,000 ha of old-growth forest including many quasi-virgin stands. A recent study by the Joint Research Centre of the EU (JRC) on the massive increase in wood harvesting in many EU countries for the period 2014 to 2018 comes to a similar conclusion for Romania (Ceccherini et al. 2020). Clear-cutting, often on a massive scale, characterizes the Romanian forest management. Softwood-rich and old-growth stands are the most exploited. These practises are officially denied, because according to the Romanian forestry laws, large-scale clear-cuttings with more than three hectares are only allowed in exceptional situations. In reality, large-scale cuts are often the result of permitted large-area shelterwood interventions (see Box 5).

Box 5: Forestry in Romania – Principles and practices

With forest covering less than 30% of its land area, Romania can no longer be regarded as a "forest county". The majority of the forests is restricted to the Carpathian Mountains. The proportion of forest has decreased steadily since the 19th century. In the communist era, forest use was strictly controlled but also exploitative and not sustainable. After the end of the communist period, the 1990s saw further, often unregulated use (plundering) of forests. Forest stocks (old stands) were successively cut, and forests are now dominated by relatively young stands, as indicated by the current forest inventory (IFN 2020, see also Figure 3). At the same time in poorly accessible regions the largest areas of virgin forest in Europe remained.

Compared to Germany and other countries, the Romanian forests are comparatively undeveloped in terms of infrastructure. According to FTP (2020), Romania has an average of 6.4 m of forest roads per hectare; in Germany, the equivalent figure is 20 m (Schmidt 2014). When being built at all, forest roads are designed to be used once. Often the timber extraction takes place via forest watercourses. Heavy machinery is pulling the logs downhill in the river beds causing massive damage to the ecology and structure of the watercourses, as evidenced by Enache (2013) in his study on forest roads in the Southern Carpathians.

The "continuous cover forest" principle with the selective use of individual trees is rarely practised. Shelterwood cutting as often mentioned in management plans is designed to encourage natural regeneration. The theory is that by preserving an open canopy with a remaining loose tree cover a complete clearance should not take place until a maximum of 20 years. Thus allowing natural rejuvenation. This is also outlined in the Romanian Forest Code. But the reality often shows complete clearance over a period of three to five years with no guarantee of rejuvenation.

Large-scale clear-cutting is common practise at all sites, even on steep slopes. The consequences are often erosion and degraded soils, making it difficult to re-establish young stands. Spârchez et al. (2009) investigated erosion effects caused by logging operations in Romanian forests and ascertained average soil losses of 40 m^3/ha per year (and that for several years) following intervention. These practices are officially denied, because according to the Romanian forestry laws, large-scale clear-cuttings with more than three hectares are only allowed in exceptional situations.

As practised in other countries (such as France, Sweden, Finland), the wood is sold "from standing stock". This means that forest areas are named or trees are marked and then auctioned off, including necessary investments for full logistics services (road construction, harvesting and extraction) and afforestation. These concession holders with fixed-term contracts have no interest to invest in expensive infrastructure like roads, bridges, etc. for long-term, sustainable use. And there is little fear to risk control, and sanctions practically never happen.

Administrative district	Total area (ha)	Forest area in 2000 (ha)	Forest area in 2010 (ha)	Forest area in 2018 (ha)	Forest proportion in 2018 (%)	Loss 2001-2018 (ha)	Loss since 2000 (%)
Suceava	862,241	466,738	464,402	440,702	51	52,996	11
Harghita	670,140	329,463	336,897	323,970	48	34,556	10
Călărași	513,031	19,910	20,644	19,349	4	1,711	9
Cluj	674,008	224,974	209,149	203,043	30	18,797	8
Maramureş	635,703	355,345	338,023	326,916	51	24,672	7
Ialomița	449,507	21,570	23,859	22,968	5	1,228	6
Argeș	689,026	346,850	327,120	320,301	46	16,706	5
Bacău	668,246	301,492	288,132	282,634	42	14,655	5
Bistrița-Năsăud	540,065	241,781	241,523	236,321	44	11,767	5
Brăila	480,436	20,768	25,665	24,981	5	971	5
Dolj	747,851	67,644	57,978	56,477	8	3,535	5
Alba	630,202	275,065	268,197	262,062	42	12,267	4
Bihor	762,066	248,820	239,318	233,553	31	10,891	4
Brașov	540,924	244,143	236,738	232,634	43	8,575	4
Covasna	374,163	184,922	187,406	183,461	49	7,737	4
Mureș	678,483	261,535	253,149	248,035	37	10,469	4
Neamț	594,546	286,006	282,723	277,322	47	12,146	4
Satu Mare	446,193	85,666	78,936	77,567	17	3,413	4
Sibiu	548,065	249,240	244,947	239,753	44	9,120	4
Teleorman	585,027	24,772	24,668	24,292	4	904	4
Vrancea	490,237	203,448	194,106	190,321	39	7,318	4

Table 2: Deforestation statistics for Romania; highlited are districts with > 4% deforestation in 2000 – 2018 (according to MONGABY 2020; https://rainforests.mongabay.com/deforestation/archive/Romania.htm). Source: tree cover loss: Hansen/UMD/Google/USGS/NASA via Global Forest Watch. Administrative boundaries: Global Administrative Areas Database (GADM), version 3.6.

MONGABAY (2020) provides more regionally differentiated data on forest areas, timber stocks (losses) and exploitation pressure in Romania. This data is based on an evaluation of satellite-based landcover data. In this study, an average forest stand with at least 75% tree cover wass classed as dense.

These figures are used to calculate changes for identical area units over specified periods. Table 2 contains a statistical summary of developments in Romania, with units indicating decreases of more than 4% (tree and volume losses) between 2000 and 2018: Together, 10 regions account for 54% of the losses in key locations between 2001 and 2018; 10% or more of the losses occurred in the northeastern and eastern Romanian districts of Suceava (in the Northeast) and Harghita (in the East).

Other sources report a significant increase in both forest area and timber stocks by calculating increment growth (cf. *inter alia* FAO[3] 2015, LIVIU et al. 2015, MMAP 2017 und 2019[4], FTP[5] 2020, IFN[6] 2020, see also Table 1). These figures and the related analyses are based in part on the official felling figures reported by the Romsilva State Forestry Administration. For years, fellings

3 FAO: Food and Agriculture Organization of the United Nations.
4 MMAP: Ministerul Mediului Apelor și Pădurilor (Ministry of Environment).
5 FTP: Forest-based sector Technology.
6 IFN: Inventory Forestier Național.

Year	Recorded felling (million m³)	Permitted felling (million m³)	Utilisation rate
2005	15.7	20.3	0.77
2006	15.7	22.3	0.70
2007	17.2	22.3	0.77
2008	16.7	18.1	0.92
2009	16.5	18.6	0.89
2010	16.9	19.7	0.86
2011	18.7	21.0	0.89
2012	19.0	21.1	0.90
2013	19.2	21.1	0.91
2014	17.8	22.1	0.81
2015	18.1	22.2	0.82
2016	17.2	22.0	0.78
2017	18.3	22.0	0.83

Table 3: Recorded and planned (permitted) felling based on the management plans (from CICEAU et al. 2019).

of around 18 million cubic metres per annum[7] were reported including an insignificant amount of unrecorded (illegal) felling of just 0.2 million solid cubic metres per annum (CICEU et al. 2019, see also Tables 3 & 4 and Figure 2). We question the accuracy of these figures. As we will explain in detail below (see Chapter 6), the Romanian Ministry of the Environment estimates actual felling of at least double the official statistics (*inter alia* ROMANIA-INSIDER 2019a, IFN 2020).

When calculating the growth rate for a given forest area, it is also important to define what is meant by the term "forest". It is true to say there has been a marked decline in agricultural land use resulting in succession, particularly in the structurally disadvantaged rural (mountain) regions, which is classed as forestland once it passes a certain development stage. Essentially, both approaches are correct: Virgin and old-growth forests are lost and are under constant pressure from exploitation, and new forest land has been gained as agricultural land use has been abandoned in the mountains due to succession.

A position paper by the Forestry Faculty at Transylvania University Brașov on the protection of virgin forests (UTB 2020a, b)[8] proposes a completely different explanation as to why virgin and very near-natural forests still exist in Romania (translated from Romanian): *"Forestry-related decision-making has consciously preserved virgin forests in Romania, thanks to consistent protection efforts rather than any special cultural or geographical situation".* In general, it claims, Romania's forests are all in a very natural state compared to its Central and (in

Year	Total volume of illegally harvested timber (m³)	of which from state-owned forest (m³)	of which from privately-owned forest (m³)	of which from municipal forest (m³)
2007	175,743	3260	7157	41,317
2008	174,542	2957	12,373	59,263
2009	179,475	5674	9362	34,478
2010	189,892	2696	9379	68,403
2011	266,220	5403	20,185	98,244
2012	331,408	7052	7716	130,853
2013	915,100	-	-	-
2014	291,900	-	-	-
2015	153,400	-	-	-
2016	191,400	-	-	-
2017	203,800	-	-	-

Table 4: Overview of reported illegal felling in Romania, 2007 to 2017 (from CICEAU et al. 2019). Note that there is a massive discrepancy between the numbers of the total volume of illegally harvested timber and the sources of its origin (ownership). The document does not provide any explanation on this matter. This is crucial since the data is part of the official Romanian National forestry accounting plan to the EU for the compliance period 2021-2025 (s. also Chapter 9).

7 It is not possible to determine from the sources whether these figures refer to standing gross volume over bark or cubic metres of harvest. The former includes standing trees and forests with bark, but only wood above the so-called "solid wood limit" (in Germany, this is measured at the weaker end at 7 cm diameter). One cubic metre of harvest is calculated as one standing gross volume over bark minus approx. 10% bark losses and approx. 10% timber harvesting losses. This is pivotal to interpretation of the data, although the definitions of standing gross volume over bark and cubic metres of harvest used in Romania differ from those in Germany (see also chapter 6).

8 UTB: Universitate Transilvania din Braşov.

particular) Western European neighbours, thanks to a very sustainable and conservation-minded approach to forestry in Romania, even during the communist era. The authors cite the fact that Romania's forests have been spared the effects of climate change, unlike the dominant plantations of non-native tree species in Central and Western Europe, as evidence of their claims.[9] The Forestry Faculty of the Transylvania University Brașov (UTB) has a long tradition and enjoys a well-recognized academic reputation. However, these expert statements have no scientific evidence, are therefore surprising, and can only be explained by the very close linkage and dependence on the state forest administration Romsilva and their authority of opinion and interpretation on almost all forest topics in Romania. A recent dissertation at UTB (BĂLĂCESCU 2020) on the complex of illegal logging in Romania concludes, for example: (1) that the illegal logging of timber in Romania is not very relevant in terms of quantities, (2) that most claimed incidences of illegal logging are actually in accordance with Romanian forest regulation, (3) that the topic of illegal logging is scandalized in the media as completely exaggerated and states also (4) that illegal logging is essentially a social phenomenon whereas proven corruption and bribery on a grand scale are not mentioned at all (s. also chapter 6.2).

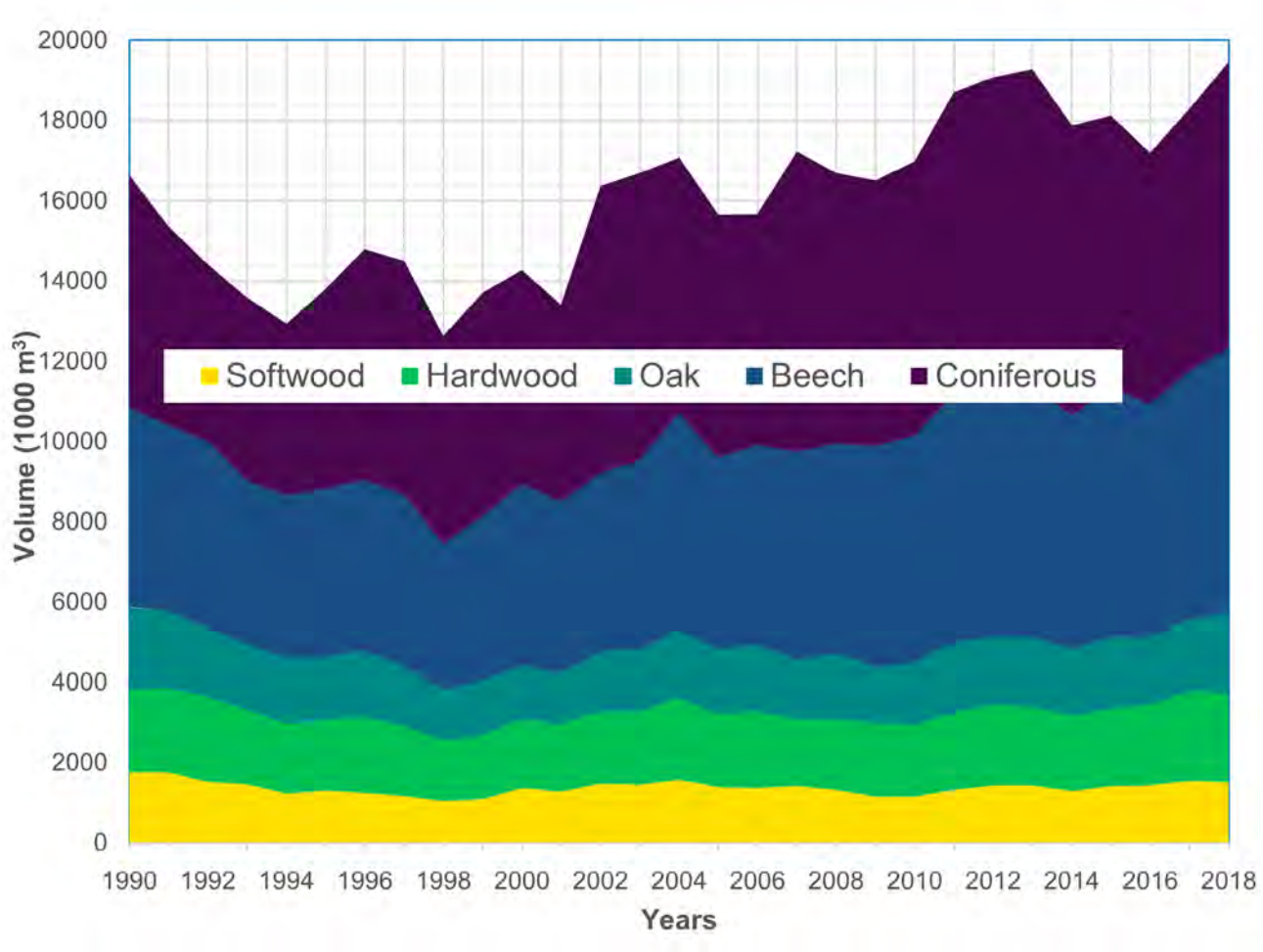


Figure. 2: Logging volumes by timber species groups, 1990 to 2017 (Ciceu et al. 2019; based on data from the National Statistical Institute INS).

9 The authors' own observations directly contradict these experts. For example, virgin spruce forests in the high altitudes of the Fogaras mountains of Bâlea and in the Serbota valley in the Southern Carpathians suffered widespread dieback in 2018 and 2019; this was clearly due to drought stress and subsequent bark beetle calamities.

Some of the authors were eyewitnesses to how since the year 2000, vast forest areas in the Western Romanian Carpathians (Munții Apuseni) with large stands of old-growth forests disappeared: In the subsistence economy of the local population, the Motzen (in Romanian “moți”), the use of the forest has always played an important role. The integration into a badly controlled market economy, the improved access to remote mountain regions by roads, the possibility of selling log wood, boards and timber made the Apuseni a scene of the plundering of the forests. In less than 20 years, a large part of the merchantable wood resources were exploited almost completely. (Photos: Rainer Luick, 2010, 2011, 2016, 2019).

3 Romania's natural forest types – A biogeographic and phytosociological overview

Romania is no longer a forest-dominated country. Forests now cover around 29% of its land area. Without anthropogenic influences, it is thought that natural tree-dominated ecosystems would cover between 70 and 80% of the country's land area (Biriş 2017).

The alpine zone, the steppes of the lowlands, and the margins of river meadows and bogs were unforested. Analysis of prevalent biomes indicates that most of the extended landscapes of the lowlands and the colline zone today are largely unforested; their natural forests were destroyed in historical times and converted into agricultural landscapes. *Quercus-Carpinus betulus* and *Fagus sylvatica* forests have survived only locally and especially on the northern slopes, and among the side valleys of the Târnava Mare in the Southern Carpathian Mountain range.

There are still large closed forests in the Carpathian Arc as the last remaining extensive, coherent natural forests with a wilderness character in Europe's moderate climate. In addition, there are also large-scale age-class commercial spruce forests in the north-eastern Carpathian region. Very regionalised or localised extra-zonal and azonal forests with their specialised flora (and fauna) are highly significant from an ecological, cultural and scientific perspective. They are often located at the periphery of the species range and are particularly vital for preserving the gene pool and evolutionary development of many species.

Romanian forests are among the most diverse and species-rich forest ecosystems in Europe. Doniță et al. (1990) differentiate approximately 150 natural forest ecosystems. The most common tree species are *Fagus sylvatica* (32%), *Picea abies* (20%), *Abies alba* (19%) and *Quercus* spp. (17%) (IFN 2020). Key differentiating factors of these natural habitats include climate, altitude zone and soil. In terms of phytogeography, the macro climate subdivides the country's habitats and forests into a Pontic and a Central European region (Horvat et al. 1974, Meusel et al. 1965, 1992). The Pontic lowlands

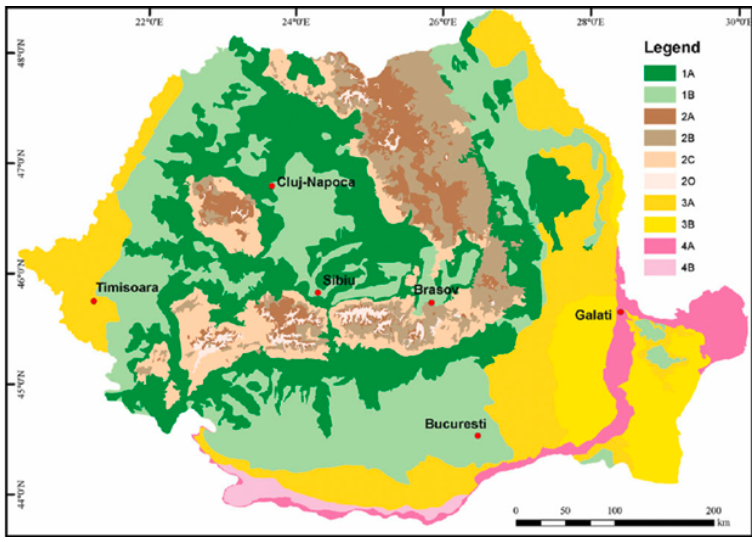


Figure 3: Comprehensive and consistent cartographic mapping of the vegetation of Romania is scarce. This map taken from Knorn et al. (2012) gives a general view of Romania's natural forest-ecozones: 1A = beech and sessile oak mixed forests, Hungarian oak (*Quercus frainetto*) and mixtures, on high and medium hills; 1B = forests with pedunculate oak (*Quercus robur*), Turkey oak (*Quercus cerris*), Hungarian oak and other species, on low hills and plains; 2A = spruce forests; 2B = coniferous and beech mixed forests; 2C = beech mountainous forests; 2O = alpine grasslands and/or bare rocks; 3A = xerophytic oak forests in silvosteppe; 3B = steppe (no natural forest vegetation); 4A = floodplain forests with poplar (*Populus* spp.), willow (*Salix spp.*), alder (*Alnus glutinosa*) and some pedunculate oak; and 4B = high floodplain forests with pedunculate oak and ash (*Fraxinus excelsior*).

with their warm, dry continental climate can be further subdivided into the "Danubian" lowland, the "Thracian" Plateau of Dobruja in Southeastern Romania, the "Pannonian" plain (from Hungary to Western Romania) and the "Transylvanian Basin", which was filled with tertiary sediments during the uplifting of the Carpathian mountains and became a flattened basin. The mountain ranges (Eastern and Southern Carpathians, Apuseni Mountains) and the "Illyrian" uplands in Banat (Southwest Romania) are characterised by a temperate climate. The subdivisions mentioned above partly coincide with the geobotanical-floristic provinces (Borza 1965 in Borza & Boscaiu 1965):

(1) The European East Carpathian province, (2) The Dacian-Illyrian province, (3) The Balkan-Moesia province, (4) The Pontic-Sarmatia province (5) The Euxinian and (6) The floodplain of the Danube and its delta (s. also fig. 3).

Due to the altitude above sea level and related climatic factors, all altitudinal zones occur. From lowland, colline (foothills), submontane and montane (mountainous zone) to subalpine and alpine (zones above the tree line). The different macroclimate (continental with cold winters in the Northeast; temperate to sub-mediterranean in the Southwest) cause the geographical range of these altitudinal zones and their (forest) vegetation. Local climatic factors such as Foehn effects in leeward mountain sites or late frost in plateaus and depressions lead to further climatic differentiation. The influences of geology and soil also play a role.

According to the diversity of climates and soils, many biogeographic flora and fauna elements meet in Romania. The different tree species and their biogeographic distribution types illustrate this well:

- **Submediterranean and oromediterranean species:** *Carpinus orientalis, Fraxinus ornus, F. angustifolia*, *F. pallisae*, *Pinus nigra*, *Quercus pubescens s.l.* incl. *Q. virgiliana, Sorbus domestica, S. torminalis* and *Staphylea pinnata*.
- **Pontic species:** *Acer tataricum, Quercus pedunculiflora = Q. robur ssp. pedunculiflora*, *Q. polycarpa, Q. dalechampii* (both related to *Quercus petraea*); *Fraxinus coriariaefolia* (related to *F. excelsior*, rare and very local distribution in the Danube delta).
- **Species of the Central Balkans:** *Quercus cerris*, *Q. frainetto, Tilia tomentosa, Corylus colurna*.
- **Central European species**: *Fagus sylvatica, Abies alba, Quercus petraea, Q. robur, Tilia cordata, T. platyphyllos, Acer pseudoplatanus, A. platanoides*, *Carpinus betulus, Prunus avium* and *Taxus baccata*.
- **Nordic-continental species:** *Picea abies, Larix decidua, Pinus sylvestris, P. cembra, P. mugo* ssp. *mugo* and *Betula carpatica.*

This climatic and species diversity has created unique habitats in Romania, many of which also have Europe-wide significance as NATURA 2000 habitat types (under the EU Habitats Directive) (*inter alia* Horvat et al. 1974, Doniță et al. 1992, 2005, Gafta & Mountford 2008). An overview of the forest types and their most important tree species is presented below (see also Table 5).

In the Danube canyon at the "Iron Gate" in the "Illyrian" Southwest (Banat), winter mild, summer dry sub-mediterranean forests are widespread. Characteristic tree species are *Carpinus orientalis, Quercus pubescens, Acer monspessulanum, Corylus colurna, Fraxinus ornus* and *Celtis australis*. In Central Europe, *Corylus colurna* is regarded as a candidate for the development of "climate-resilient forests of the future". In the foreground *Syringa josikaea,* a shrub species occurring at the natural drought limits of forests (Photo: Rainer Luick, 2018).

Altitude level	Zonal forests					Azonal forests and shrublands	
		Tree species	Sea level (MASL)	Temperature °C (annual average)	Precipitation mm (annual average)	Rocks and skeleton-rich soil	Floodplains
Sub-alpine 2	Dwarf pine (*Pinus mugo ssp. mugo*) shrubland	*Pinus mugo* ssp. *mugo*	1800 – 2300 1500 – 1600, Eastern Carpathians	0 – 2	1100 – 1225		Green alder *(Alnus viridis*) shrubland
Sub-alpine 1	Spruce *(Picea abies*) forest: Hieracio rotundati-Piceetum, Soldanello majoris-Piceetum (base-poor) Leucanthemo waldsteinianae-Piceetum (medium)	*Picea abies*	1300 – 1850 1200 – 1500, Eastern Carpathians	2 – 4		Larch *(Larix decidua*), stone pine *(Pinus cembra*) forest	Green alder *(Alnus viridis*) shrubland
Montane	Beech / silver fir / spruce forest: Epipactedo-Fagetum (stony/rocky, rendzina, limestone) Pulmonario rubrae-Fagetum (fresh, base-rich to calcareous) Dentario glandulosae-Fagetum, Symphyto cordati-Fagetum (medium) Festuco drymejae-Fagetum (medium to base-poor); Hieracio rotundati-Fagetum (base-poor)	*Fagus sylvatica, Abies alba, Picea abies*	900 – 1500 700 – 1200, Eastern Carpathians	4 – 7	800 – 1200 (– 1400)	Scots pine *(Pinus sylvestris*) forest: Daphno blagayanae-Pinetum sylvestris, Eastern Carpathians Black pine *(Pinus nigra* ssp. *pallasiana*) forest: Southern Carpathians	Tamarisk shrubland (Salici-Myricarietum germanicae) Grey alder *(Alnus incana*) alluvial forest (Telekio speciosae-Alnetum)
Sub-montane	Beech forest: Galio schultesii-Fagetum (base-rich) Hornbeam forest: Lathyro hallersteinii-Carpinetum (moderately acidic)	*Fagus sylvatica, Carpinus betulus*	700 – 900	7 – 8	Approx. 800	"Pino-Quercetum": *P. sylvestris, Quercus robur, Q. petraea* (Eastern Carpathians, siliceous)	Grey alder *(Alnus incana*) alluvial forest
Colline	Dacian oak and hornbeam forest alternating with Turkey oak/sessile oak forest	*Carpinus* betulus, *Quercus sp., Tilia tomentosa*	500 – 700	8 – 9	650 – 800	Dry grassland, transition to oak forest *(Quercus pubescens, Q. petraea*)	Black alder *(Alnus glutinosa*) / alluvial forest with ash
Sub-colline	Turkey/Hungarian oak forest (Quercetum cerris-frainetto), locally downy oak *(Q. pubescens)*	*Quercus cerris, Q. frainetto, Acer tataricum, Tilia tomentosa, Sorbus sp.*	100 – 500	9 – 10.5	500 – 650	(Dry grassland)	
Planar	Forest steppe	*Quercus sp.*	<200	>10.5	<500	(Dry grassland, steppe)	Hardwood alluvial forest: *Quercus robur, Fraxinus angustifolia* Softwood alluvial forest: *Salix alba, S. fragilis, Populus nigra*

Table 5: Altitudinal zoning of the forests of the Southern Carpathians (after Mayer 1984, Coldea 2004).

Steppes, forest steppes, oak forest and mixed oak forest

In the Romanian lowlands, with pronounced summer droughts and cold winters, the Ukrainian steppes peter out towards the West. In the Southeast of Romania (Dobruja, Wallachia), there is a transition from steppe to "forest steppe" to oak and mixed oak forests (Doniță et al. 1992).

The northern part of the Transylvanian highlands as far as Mureș, the so-called "Câmpia Transilvaniei" ("Mezőség"), is classified as forest steppe (Pascovschi & Doniță 1967, Niedermaier 1983), with transitions to natural Pontic-Sarmatian steppic grasslands that are home to numerous Pontic flora and fauna elements (Schneider-Binder 2012, 2015).

As the water supply improves the "forest steppe" turns into deciduous oak and mixed oak forests. Especially on base-rich soils, oak-dominant forest stands mixed with *Sorbus torminalis, S. domestica*, *S. aria*, *Pyrus communis* and *Malus sylvestris* support a rich diversity of species.

Romania is a centre of taxonomic and genetic diversity for deciduous *Quercus* species. Speciation is still ongoing (cf. Neophytou 2014). We distinguish the following types of oak forests:

- **Carpathian colline mixed forests** with *Quercus petraea* incl. *Q. dalechampii* as dominant tree species dominate the sunny slopes and ridges of the colline zone across large areas of northwestern Romania on acidic to moderately acidic brown earth (Indreica 2011, 2012) between 450 and 700 m above sea level, with annual average temperatures of 7 to 8°C and annual precipitation of 600 to 750 mm (Coldea & Pop 1996). Apart from *Quercus petraea* incl. *Q. dalechampii*, the species-rich tree layer also includes *Prunus avium, Acer campestre, A. tataricum*, *Sorbus torminalis* and other tree species. Large areas of colline mixed forest with *Quercus petraea* are also found at the foot of the Southern Carpathians, with more submediterranean species on the southern side (Doniță 1968, Bohn et al. 2002/2003).
- **Quercus frainetto forests (*Quercus cerris* and *Q. frainetto*)** (habitat type 9280, Quercetum frainetto-cerris) are found in the western parts of Transylvania as far as the Someş uplands, sporadically scattered among terraces and gentle sunny slopes on weakly acidic brown to red-brown, part-pseudogley, part-podzol soil on sedimentary rock, at elevations ranging from (250) 300 to 500 (600) m above sea level. Average annual temperatures in this weakly submediterranean climate range from 8–11 °C. *Quercus cerris* and *Q. frainetto* dominate, in some cases mixed with *Quercus polycarpa*, *Acer campestre* and *A. tataricum* (Coldea & Pop 1996, Doniță et al. 1992). Forests with *Quercus cerris* and *Q. frainetto* are also widespread in Wallachia. The Iron Gate in Southwestern Romania marks the transition to **forests of Oriental hornbeam** (*Carpino orientalis-Quercetum cerridis*).

Forests with *Quercus cerris* and *Q. frainetto* (Quercetum frainetto-cerris) in the western part of Transylvania up to the Somesch highlands in the submontane zone occur from 300 to 500 m. The climate is slightly sub-mediterranean with average annual temperatures between 8 and 11°C. For centuries, these forests supply firewood and charcoal and also were grazed. Oak species are adapted to these conditions and uses. The picture shows a previously coppiced *Quercus cerris*-forest near Petrindu in transition to high forest (Photo: Albert Reif, 2019).

- **Forests with Downy oak** *(Quercus pubescens)* colonise local calcareous or marly rendzinas. They are found in the Transylvanian Basin at altitudes of 250 to 450 m above sea level, in the Danubian plain, in the South of Moldova and in the Dobruja region. Stands are mixed with *Quercus pedunculiflora*, *Sorbus aria, S. torminalis, Fraxinus ornus, Cornus mas* and *Staphylea pinnata* (Coldea & Pop 1996).

- Forests with **Oriental hornbeam (*Carpinus orientalis)*** are found:

  1. In the Illyrian-influenced Southwest (Banat) with its mild winters, with species such as *Fraxinus ornus*, *Quercus pubescens*, *Acer monspessulanum*, *Corylus colurna* and *Celtis australis*. Lilacs *(Syringa vulgaris)* (Syringo-Carpinetum orientalis) occur at the drought limit of forests (cf. Matacă 2003).

  2. In the very continentally influenced Dobruja, close to the Black Sea coast with its milder winters ("Paeonio-Carpinetum orientalis"). Other tree species found here include *Quercus pubescens*, the east Pontic *Fraxinus coriariaefolia, F. ornus, Ulmus minor, Acer tataricum, Sorbus torminalis* and *S. domestica* (Doniță 1968). The sparsely growing low-tree layer (6 to 10 m in height) marks the transition to the steppe (Doniță 1970).

- The forest vegetation of Southeastern Romania is heavily influenced by Bulgaria's **Thracian forest** species, both climatically and phytogeographically. In the lower Danubian plain with its continental climate and hot summers, species-rich *Quercus* forests with *Quercus pedunculiflora* form the zonal xerothermic forests, mixed with *Q. pubescens, Q. cerris* and *Q. frainetto, Tilia tomentosa, Acer tataricum* and *Fraxinus ornus*. This marks the transition from forest steppe to Pontic steppe (Doniță 1970, Bohn et al. 2002/2003).

- **Forests with Sessile Oak** (*Quercus robur*) enjoy special status. They are found in locations with warm, dry summers and in periodically wet, loamy sites, such as the Pannonian lowlands of northwest Romania (Carici brizoidis-Quercetum roboris; habitat type 9190) (Karácsonyi 1995, Doniță Doniță et al. 1992). Enclaves of *Quercus* forests comprising *Quercus robur* mixed with *Q. petraea* and *Acer tataricum* are also found in the inner-Carpathian basins in the Southeastern Carpathians, in locations with late frosts and loamy / sandy soils.

The Măcin Mountains, reaching 467 m, are located in the South-East of Romania in the Dobruja region (in Romanian Dobrogea). The strongly continental climate is hot in summer and low in precipitation. The hillside forests are rich in species including *Carpinus orientalis, Quercus pubescens, Fraxinus coriariaefolia, F. ornus, Celtis glabrata, Ulmus minor, Acer tataricum, Sorbus torminalis* and S. domestica. The Măcin Mountains contain the transition from subcontinental forests to the Sarmatian-Pontic steppes. (Photo: Albert Reif, 2005).

Forests with oaks (*Quercus sp.*) and hornbeam (*Carpinus betulus*)

Forests with *Quercus* and *Carpinus* develop on less extreme sites, i.e. those with a better supply of water compared to oak forests. The shade-creating and hence shade-tolerant, relatively late-frost-resistant hornbeam is dominant here, often mixed with *Quercus petraea* on drier soils (habitat type 9170) and *Q. robur* on periodically wet, argillaceous soils, or late frost-prone basin sites in Transylvania (Horvat et al. 1974). Mixed tree species include *Tilia cordata, Acer campestre* and *Prunus avium*.

Many of the stand structures in forests with *Quercus* and *Carpinus* show signs of coppicing and coppice-with-standards management; the hornbeams in the understorey, which re-sprout from the stump, were mainly used for firewood. In the overstorey, *Quercus robur*, once essential for livelihood and widely promoted, supplied construction timber and was used in pig feed. Forests with *Quercus* and *Carpinus* form the zonal vegetation of the Transylvanian Highlands on medium to deep soils that are often rich in clay. Further occurrences of *Quercus* and *Carpinus* forests are found in the foothills of the Eastern Carpathians (Mayer 1984).

Illyric forests with *Quercus* and *Carpinus* (Asperulo taurinae-Carpinetum betuli, = Querco cerris-Carpinetum betuli Boscaiu 1966 p.p.) are characterised by thermophilic species such as *Quercus petraea* and *Q. cerris*, *Carpinus betulus, Tilia tomentosa* and sub-Mediterranean species of the herbaceous layer such as *Aremonia agrimonoides*, *Ruscus aculeatus, R. hypoglossum, Asperula taurina, Galium kitaibelianum, Helleborus odorus* and *Erythronium dens-canis ssp. nivea*.

The naturally widespread **Dacian Quercus-Carpinus betulus forests** (Lathyro hallersteinii-Carpinetum, Carici pilosae-Carpinetum) thrive at colline and submontane altitudes. However, most of them have been converted into agricultural land or semi-open oak-rich pastures. In Dobruja, above an altitude of around 250 m, we find Pontic forests with *Carpinus betulus, Tilia tomentosa* and *Quercus petraea* (Tilio tomentosae-Carpinetum betuli) (see Doniță 1992).

Forests with *Fagus sylvatica* and *Fagus sylatica* mixed forests

The greater the altitude above sea level, the lower the risk of summer drought stress (decrease in evaporation, increase in precipitation). This allows *Fagus sylvatica* to survive extremely dry years at submontane altitudes. With increasing altitudes, *Fagus sylvatica* forms mixed stands with the thermophilic, relatively drought- and late frost-resistant *Carpinus betulus* at submontane altitudes, and displaces this shorter-lived, slower-growing species on sites with a better water supply, such as on shady slopes or deep soils. *Fagus sylvatica* therefore forms the zonal vegetation across large areas. Together with *Carpinus betulus*, light-dependent species such as *Quercus sp.* are also being displaced to extrazonal and azonal, dry sites being challenged by the highly shade-tolerant *Fagus sylvatica*.

In the Transylvanian Highlands, the transition between ***Quercus-Carpinus betulus*** and ***Fagus sylvatica*** forests is at around 700 m (Borza 1958/59). This limit is modified by the local climate, especially due to topographical differences in irradiation (and hence evaporation), as well as by the soil's capacity to store water. For example, *Fagus sylvatica* forests are still found at 150 m on shady slopes and valley bottoms in Southwestern Romania (Oprea et al. 2011). It is difficult to reconstruct this natural lower limit of *Fagus sylvatica* today. It has moved upwards as a result of historical coppicing practices, because of the superior ability of *Quercus-Carpinus betulus* forest species to resprout from the stump.

In Bucovina and Moldova, *Fagus sylvatica* extends far to the Northeast, close to its natural eastern limit, which is presumably caused by more frequent late frosts combined with summer drought. Surprisingly, beech forests retain the ability to form tall, productive stands near this macroclimatic limit. As *Fagus sylvatica* thrives in both acidic and calcareous soils, it associates with a range of different (tree) species across several widespread forest types. Carpathian species such as *Dentaria glandulosa* and *Festuca drymeia* occur in the understory. Occurrences of "pre-Alpine

Natural spruce forests cannot be compared with the dense, evenaged, evensized and planted stands replacing beech forests which shape our perception of forest in many parts of Central Europe. The stand structure of these forest have natural gaps and openings, with a high proportion of naturally dead trees. The undergrowth consists of carpets of *Vaccinium* species; this is also the classic habitat of the capercaillie (*Tetrao urogallus)*. In Romania, the subalpine zone with spruce forest extends to the climatic tree line between 1600 m above sea level in the Northeast Carpathians and 1900 m in the Southern Carpathians. Spruce forests naturally dominate in the Eastern Carpathians between 1100 and 1500 m. In the Southern Carpathians, the subalpine spruce belt becomes increasingly narrow, dissolves into disjunct areas to the West, and finally disappears in the Parâng and Godeanu Mountains in the western Southern Carpathians. (Photos: Rainer Luick, Karol Kalisky 2019).

pre-Carpathian" species such as *Aposeris foetida*, *Salvia glutinosa* and *Veronica urticifolia* are also worth noting. *Fagus sylvatica* forests offer a particular wealth of species, especially on base-rich soils, including broad-leaved trees such as *Acer pseudoplatanus* and *Ulmus glabra*.

Illyrian *Fagus sylvatica* forests are found in the Southwestern Carpathians with their milder winters, while **Dacian *Fagus sylvatica*** forests occur in other regions. The following forest associations have been recorded:

- Galio schultesii-Fagetum (habitat type 9130; = Lathyro veneti-Fagetum), at 200 to 400 m in SW Romania with its mild winters, colline to submontane.
- Aremonio agrimonoidi-Fagetum in Banat (SW Romania) on moderately acidic brown earth (mesotrophic), montane.
- Symphyto cordati-Fagetum (mesotrophic to eutrophic soils, weakly acidic, zonal forest type in the montane southeast Carpathians, habitat type 9130).
- Festuco drymejae-Fagetum (base-rich to base-poor soil).
- Hieracio transsilvanici-Fagetum (base-poor soil; habitat type 9110).
- Phyllitidi-Fagetum (azonal on skeleton-rich soils on limestone, shady slopes).

The slow-growing, undergrowth-rich beech forests on skeleton-rich or rocky rendzina, especially calcareous soils (Epipactido microphyllae-Fagetum, Resmeriță 1972; = Seslerio rigidae-Fagetum, Coldea et al. 2015), e.g. in the southern and southwestern Carpathians (Vida 1963), enjoy a special status. These forests are the equivalent to Central Europe's "orchid beech forests" (*Carici-Fagetum*, habitat type 9150). In the Cerna Valley and in the deep side valleys of the Danube Gorge near the "Iron Gates", beech forests provide shelter to several thermophilic species that are typical of the region, such as *Daphne laureola*, *Dioscorea communis*, *Asperula taurina*, *Helleborus odorus* and *Knautia drymeia*.

A notable, disjunct small patch of beech is found near the Danube in the Dobruja region near Luncavița in the Măcin mountains, within the "Valea Fagilor" nature reserve. Even here, at the southeastern edge of its distribution, the beech is (co-)dominating and mixed with *Carpinus betulus*, *Tilia tomentosa* and *T. cordata* (Dihoru 1962, Gafta & Mountford 2008). However, there is also the scientific view that this beech actually is already *Fagus taurica* or a hybrid with *F. sylvatica (*Oprea et al. 2011*)*. Another opinion is that *Fagus taurica* is not a seperate species but a hybrid between *F. sylvatica* and F. *orientalis* (Willner et al. 2017).

Other notable occurrences of *Fagus sylvatica* include the subalpine stands, such as those found in the Southern Carpathians (Godeanu Mountains, Parâng Mountains in the Caraș-Severin district). The lack of long-lasting frost periods, abundant snow, summer drought prevent the formation of a subalpine spruce (*Picea abies)* forest zone, and allows beech to form the climatic tree line (Borhidi 1971, Horvat et al. 1974, Stanisci et al. 2000, Surina & Rakaj 2007). This is the equivalent of the tree line in the Southern Alps, the mountains of Southern Europe and western Central Europe. To some extent, this argumentation also applies to the virgin *Fagus sylvatica* forests in Semenic at the sources of the Rivers Nera and Nergănița. These forest stands are comprised almost entirely of a pure *Fagus sylvatica* stand, which (inexplicably) contains no *Abies alba* even at the montane zone, and beech is reaching the tree line at 1500 m.

Regarding the accompanying flora, the Carpathian *Fagus sylvatica* forests ("Symphyto-Fagion") are home to many endemic Dacian and Dacian-Balkan species such as *Aconitum moldavicum, Cardamine glanduligera, Pulmonaria rubra* and *Symphytum cordatum* (Doniță 1989, Stoiculescu 2007, Kliment et al. 2016). *Hepatica transsilvanica* appears to be an endemic tertiary relict species (Pop 1976, Sârbu et al. 2013), whose closest relative is the *Hepatica henryi* from China (Pop 1976). A similarly disjunct tertiary relic is *Galium baillonii*, which occurs in the *Fagus sylvatica* forests of the Southern Carpathians near the Red Tower Pass (Pasul Turnu Roşu). Its closest relative is *Galium valantioides* from the Caucasus (Schneider-Binder 1971).

Beech-fir-spruce mixed mountain forests

Fagus sylvatica mixes with *Abies alba* in the montane zone. The lower limit of this mixed mountain forest occurs in the Eastern Carpathians at around (470-) 700 (-1120) m (Mardari et al. 2015). The upper limits for these mixed mountain forests dominated by *Fagus sylvatica* and *Abies alba* (Pulmonario rubrae-Fagetum p.p.) are found at around 1300 m in the Eastern Carpathians and around 1400 m in the Southern Carpathians (Oprea et al. 2011; Meusel 1968). In the montane Southeastern Carpathians (Cenaru-Vrancea), yew *(Taxus baccata*) occurs locally on limestone in the understory of *Fagus sylvatica* and *Abies alba*. *Taxus baccata* was undoubtedly more widespread in the past, as evidenced, for example, by the presence of single specimens in the Serbota Valley of the Făgăraș Mountains (personal observations). At the upper montane (=oreal) zone with a higher share of coniferous trees, *Fagus sylvatica* and *Abies alba* are joined by *Picea abies*, such as in the high-montane "Leucanthemo waldsteinii-Fagetum" on low-base/acidic soils and mesotrophic to eutrophic brown soil (with *Acer pseudoplatanus* in the case of the latter) (Coldea et al. 2015).

Spruce forests

Above the mixed mountain forest with increasingly low winter temperatures, shorter vegetation periods and less summer drought, spruce forms a coniferous forest belt in the lower subalpine zone. This spruce forest belt forms the climatic tree line between 1600 m above sea level (Maramureş in the Northeastern Carpathians) and 1900 m (South Carpathians) (Meusel 1968, Resmeriță 1975). Spruce forests naturally dominate the Eastern Carpathians in a 200 km long, 75 km wide zone between approximately 1100 and 1500 m. In the Southern Carpathians, the sub-alpine spruce belt becomes increasingly narrower, dissolving into isolated stands to the West, and finally disappearing in the Parâng and

Godeanu mountains (western South Carpathians).

Several spruce forest types can be found depending on the geology (COLDEA et al. 2015; cf. also COLDEA 1991; DONIȚĂ et al. 1992; GAFTA & MOUNTFORD 2008): The Soldanello oreodoxae-Piceetum forms the tree line on base-poor siliceous soils, while on moist, nutrient-rich soils, the forb-rich spruce forests (Leucanthemo waldsteinii--Piceetum) occur. They correspond to the Adenostylo-Piceetum of the Alps (cf. MAYER 1984). The high-montane (boreal) transition between the mixed beech-fir mountain forests and the spruche forests is formed by the Doronico columnae-Piceetum (habitat type 9410) whereas on silicate it is a montane fir-spruce forest with only a subordinate share of beech ("Abietetum"). Silver fir *(Abies alba*) and spruce *(Picea abies*) exhibit "excellent growth performance" on marlacious flysch in the Eastern Carpathians (BARBU & BARBU 2005; MARDARI et al. 2015). In the montane zone, the less competitive but more stress-tolerant spruce also forms azonal forests on special sites such as the borders of mires, boulder slopes or in depressions, areas where *Fagus sylvatica* and *Abies alba* cannot thrive due to the wet or shallow soils or late frosts.

In the montane zone of south-eastern European mountain ranges, such as here in the Domogled-Valea Cernei National Park (in Romanian "Parcul Național Domogled-Valea Cernei"), the mixed mountain forest on shallow, rocky sites reach its drought limit. Here is found the transition to forests with drought-tolerant pine species such as *Pinus nigra*. (Photo: Rainer Luick, 2016).

Subalpine shrubland with dwarf pine

In the upper subalpine zone, shrubland with dwarf pine (*Pinus mugo ssp. mugo*) (BORATYŃSKA et al. 2015) replaces the coniferous forests, with the Balkan dwarf shrubs *Rhododendron myrtifolium* and *Erica spiculiflora* in the undergrowth. The green alder *(Alnus viridis*) thrives in agrillaceous, wet soils such as those found in the Bucegi Mountains (MEUSEL 1968, COLDEA 1985).

Azonal forests in extreme sites

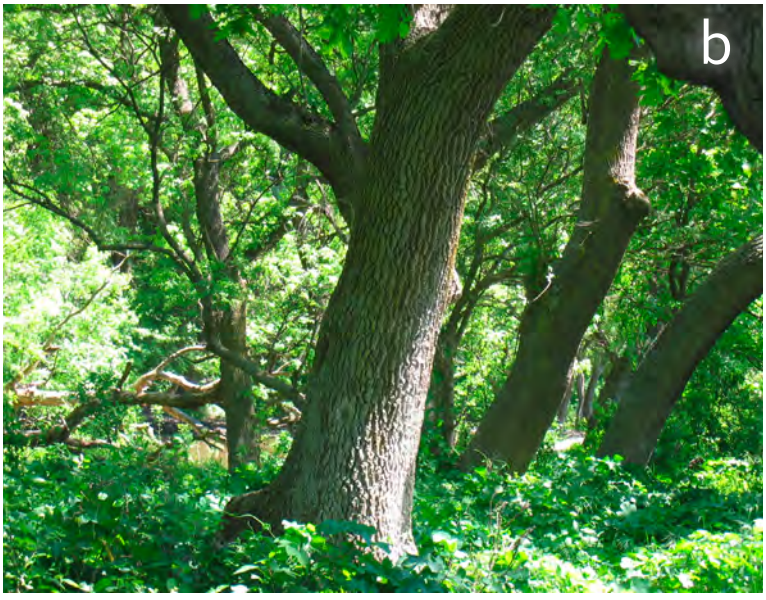
Drought is the dominant location factor in sunny, shallow, rocky sites. Forests in these areas are comprised of drought-tolerant species:

- On the skeleton-rich calcareous soils of Southwestern Romania (Banat, Oltenia), the **black pine** *(Pinus nigra* ssp. *pallasiana*) dominates large Genisto radiatae-Pinetum pallasianae forests which extend to altitudes of 1000 m above sea level (BOŞCAIU & BOŞCAIU 1999).
- On rocky, shallow soils in the montane zone, forests of **Scots pine (***Pinus sylvestris)* replace the oak species, which colonise these types of sites at lower altitudes (longer vegetation period). Late frost-prone, intramontane basins in the Eastern Carpathians also favour Scots pine (GAFTA & MOUNTFORD 2008). The slow-growing *Leucobryo-Pinetum* is found on siliceous sites. The Scots pine forests on limestone (Seslerio rigidae-Pinetum, Campanulo carpaticae-Pinetum) are the equivalent of winter-flowering heather pine forests (Erico-Pinetea) in the Alps (COLDEA et al. 2015). Daphno blagayanae-Pinetum sylvestris is found on siliceous soils in late frost-prone intramontane basins of the Eastern Carpathians.

- In the subalpine zone, a few disjunct areas with relict stands of **European larch** *(Larix decidua*) and **Stone pine** *(Pinus cembra*) occur on shallow, acidic soils, scattered and surrounded by spruce forest (habitat type 9420) (Meusel 1968, Blada 2008, Fărcaş et al. 2013). However, the Carpathians lack the a continuous larch-pine belt as found in the Central Alps.
- On unstable soils on slopes, zonal vegetation is replaced by **Broadleaf forest types** (Aceri-Fraxinetum, habitat type 9180) with species such as *Acer pseudoplatanus*, *Fraxinus excelsior*, *Ulmus glabra* and *Tilia cordata*, which have the ability to resprout.

Riparian forest and shrubland

Riparian habitats are habitats characterised by flooding. The location and magnitude of the water body, the duration, height, time, frequency and flow rate of the flood, the chemistry of the water body and redistribution processes (erosion, sedimentation) create phytosociologically diverse, dynamic, complex habitats.



The islands of Caraorman and Letea in the extensive Danube Delta are results of the formation of coastal dunes, which were cut off from the Black Sea by the growing Danube Delta. In the near-natural hardwood flood plain forests on the island of Caraorman, the southeast European "Fraxino pallisae-Quercetum pedunculiflorae" can be found with tree species such as *Q. pedunculiflora* (picture b*)* and *Fraxinus angustolia* (also described as *F. pallisae* or *F. parvifolia*). These tree species can survive floods that often last for weeks, as here in 2005. Steppes with *Stipa* species border on slightly higher places. On the Letea Island there are virgin stands of *Quercus pedunculiflora*. (Photos: Albert Reif, 2005).

Along the numerous watercourses of the Danube Delta extensive softwood flood plain forests occur. *Salix alba*, *Populus alba, P. x canescens* and *P. nigra* can be found. (Photos: Rainer Luick, 2016).

- Along streams and small rivers, forests of black alder *(Alnus glutinosa)* in the Stellario-Alnetum glutinosae (low-lying areas) and grey alder *(Alnus incana)* in the Telekio speciosae-Alnetum incanae dominate the submontane and montane floodplains, mixed with ash and *Salix fragilis*. *S. triandra*, *S. viminalis* and (rarely) *S. pentandra* occur in the willow pioneer forests of the submontane zone in the Eastern Carpathians.

- Along fast-flowing mountain rivers (braided river zone), flood periods are shorter, while the flow rate and sediment turnover are more pronounced. The vegetation of these montane floodplains is characterised by erosion and sedimentation of gravel. The impacts of these factors vary widely depending on their location in proximity to or at the edge of the main channel. The floodplain vegetation is characterised by pioneer stands of the low growing shrub *Myricaria germanica*. The succession to pioneer stands of *Salix purpurea*, which finally end in a grey alder forest can sporadically and locally be accompanied by *S. eleagnos*. Some mountain valleys also contain large stands of *Hippophae rhamnoides*.

- In the lower reaches of large rivers and streams (meander zone), the flow rate is slower, and fine-grained sediments (loam) are deposited. Pioneer copses of the Salicaceae family colonise the mineral soils created by the natural river dynamics in the gallery forest closer to the mean water level.

- Forests of *Salix alba*, locally also *Salix fragilis*, *Populus nigra*, *P. alba* and *P. x canescens* are widespread, for example, along the larger rivers (Jiu, Olt, Ialomița, Siret) and in the Danubian delta. Softwood pioneer forests on the lower Danube mainly consist of *Salix alba*, *Populus alba* and *P. x canescens*. In floristic

terms, however, they are more closely related to Mediterranean softwood gallery forests than to the forests of Southeast Central Europe (Schneider et al. 2009). These pioneer forests are in contact with copses of *Salix triandra* and *Tamarix ramosissima* under long-lasting flood stress. Tamarisk are found on the Danube from the Olt estuary and on the lower reaches of the rivers Olt, Ialomița, Buzău and Siret and forms larger stands in the brackish water of the Danubian delta. Larger stands of sea buckthorn are also found in some areas.

- Riparian hardwood forests with *Quercus robur, Ulmus laevis*, *U. minor, Fraxinus excelsior* and *F. angustifolia* occur on slightly elevated river terraces formed from sediment. Large populations of *Vitis sylvestris* are still found to this day. *Periploca graeca* thrives near the town of Giurgiu, and especially in the delta, with the Danube forming the northern limits of its range. The riparian hardwood forests of Southeast Romania are unique, especially those in the dunes of Letea and Caraorman sand banks in the Danube delta. Tree species such as *Quercus pedunculifora* and relatives of *Fraxinus angustifolia* occur here in the Fraxino pallisae-Quercetum pedunculiflorae (Sanda et al. 1998, Coldea et al. 2015). Smaller areas of riparian hardwood forest are also found upstream in the Lower Danube region (Schneider et al. 2009).

Where climate conditions allow almost every site, no matter how small or extreme, is conquered by trees. They often appear dwarfed and can still be hundreds of years old (Photo: Rainer Luick, 2016).

4 Virgin and old-growth forests in Romania – What do we know about their distribution?

Romanian law makes a distinction between virgin forest (păduri virgin) and ancient, very near-natural forests known as "quasi-virgin forest" (păduri qvasivirgine)[1]. Knowledge of their precise distribution is unsatisfactory, given the lack of any comprehensive, systematic inventory and documentation.

The "Romanian National Sustainability Strategy" and associated documents, published in 1999, is an interesting source of information (Strategia Națională pentru Dezvoltare Durabilă 1999 & ICAS 2005). It sets out 13 measures to protect biodiversity, explicitly highlighting the multifunctionality and importance of protecting virgin and quasi-virgin forests in the Carpathians. The enclosed documents also refer to the existence of some 400,000 hectares of virgin and quasi-virgin forest.

An initial objective overview was provided by the 2005 PIN-MATRA inventory (Biriş & Veen 2005), a study financed by the Dutch Ministry of Agriculture, Nature & Food Quality & Foreign Affairs (PIN-MATRA / 2001/018). The Royal Dutch Society for Nature Conservation (KNNV) and the Institutul de Cercetări şi Amanajări Silvice (ICAS, Forest Research & Management Institute)[2] were responsible for technical-scientific implementation of the study, with the involvement of the IUCN European Office and independent European forest experts.

The project was carried out between 2001 and 2004. It reflected the status of knowledge and data available at that time (maps, aerial photographs, academic studies, data from the Romanian forest institution and its own surveys, plus mapping by experts and student groups). The key findings of the PIN-MATRA study were:

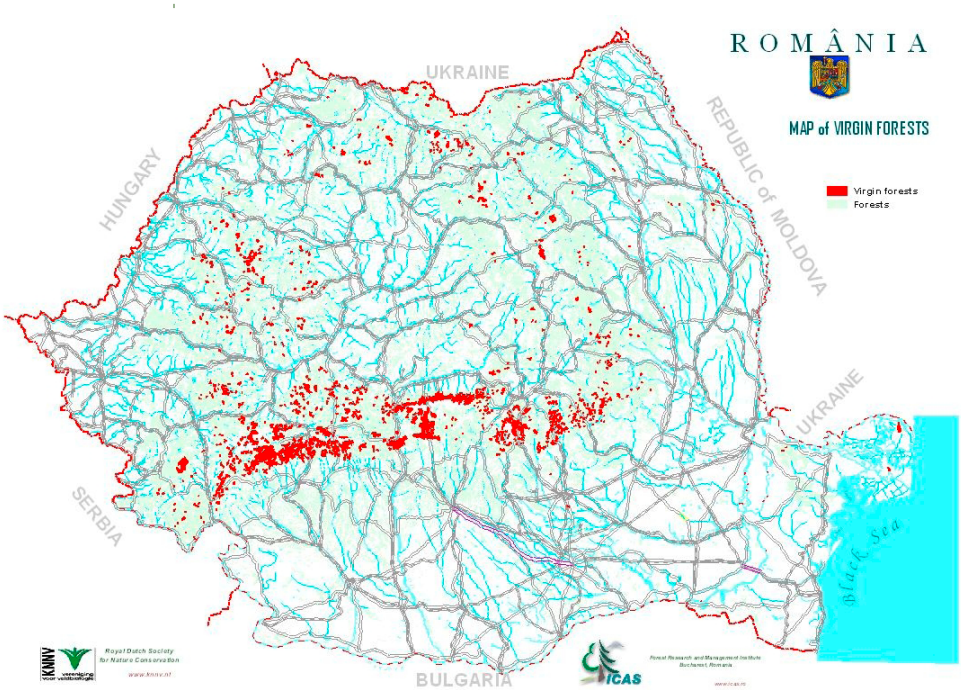


Figure 4: Areas of virgin forest (sites) identified by the PIN-MATRA inventory, 2001 to 2004; the concentration in the Southern Carpathians is evident (Biriş & Veen 2005).

- The last remaining areas of virgin forest are concentrated in the Southern Carpathians; large areas of virgin forest have disappeared from other parts of the Romanian Carpathians or been reduced to very few and fragmented pockets (see Fig. 4).
- In total, the project mapped some 220,000 hectares of virgin forest.

In retrospect, the quantitative results of the PIN-MATRA study must be viewed with some reservations:

- Given the short term of the project, it was not possible to produce a comprehensive overview (inventory) based on field investigations.

1 http://apepaduri.gov.ro/paduri-virgine/ (definitions according regulation MO 3397/2012).
2 In 2015, the ICAS was reorganised and renamed Institutuli National de Cercetare-Decvoltare in Silvicultură "Marin Drăcea" (INCDS) (National Institute for Research and Development in Forestry).

- The maps, satellite images and aerial photographs existing at that time were not as comprehensive or current as the ones we have today, and the technology at that time did not support the level of sophisticated analysis now at our disposal.
- In theory, access to forest management plans was granted. But research work for the National Catalogue of Virgin Forests and Quasi-Virgin Forests (see chapter 7.1) has since revealed that the statistics from many forestry institutions were and still are inaccurate, whether deliberately falsified or not.
- The survey was limited to a very narrow definition of virgin forest. Had it also included the category of quasi-virgin forest ("old-growth forest"), we estimate that it would have included a further 200,000 hectares.
- Not all forest administrators have shared information with the authors of the study. There are, for example, large areas in the Southern Făgăras Mountains that were not included due to lack of data.

From a contemporary perspective, the PIN-MATRA study is still the best-quality, most comprehensive survey of Romanian virgin forests at the start of the 21st century. However, from a political (designation of protected areas) and analytical perspective, these data records should be viewed with the following reservations:

- We can reliably assume that the statistics do not include all virgin forest sites.
- The areas and perimeters of some of the areas surveyed are incorrect, as recent analyses have shown. Many of them are too small or incorrectly located.
- Recent follow-up mapping has shown that many of the virgin forest sites mapped by the PIN-MATRA study no longer exist. However, this should not be taken to mean that the method and results of the study were fundamentally flawed. 20 years have elapsed since then, and the overexploitation of timber resources in Romanian old-growth forests (virgin forests) did not really take off until after 2007 when Romania joined the EU. We now know that at least half of the PIN-MATRA virgin forest areas have been degraded since they were mapped, as a result of both legal and illegal timber uses (see also Schickhofer & Schwarz 2019). With the help of dendrochronological analyzes of stumps, which are still possible many years after an intervention, conclusions can be drawn about an age of several hundred years a forest stand may have had.

The Romanian authorities (namely the Romanian State Forestry Administration Romsilva) subsequently tried to discredit the results of the PIN-MATRA study. Certain government agencies even claimed that the PIN-MATRA study did not exist and that the Romanian State Forestry Administration had no knowledge of it, even though the study was carried out primarily by Romanian experts from a government institution (ICAS, **I**nstitutul de **C**ercetari si **A**menajari **S**ilvice / Institute of Forest Research and Management). In a press release dated June 2017, the then-Undersecretary of the Ministry for the Environment, Water and Forests, Istrate Ștețco, announced: *"This PIN-MATRA inventory study is a fake thing and does not exist. We do not have it, ICAS does not have it, ROMSILVA does not have it"* (Euronatur 2017a). The complete study, including the geographical and cartographic details of the areas identified, was later published during the transitional government period (November 2015 to January 2017, see also Chapter 6); the data is currently (as of March 2021) freely accessible via a government portal (MMAP 2020a).

In 2017, Greenpeace published a study it had commissioned on potential virgin forest areas in Romania, which identified some 296,000 hectares (Ibisch et al. 2017b). The study is based on an evaluation of current and freely available data records:

Especially after Romania joined the EU in 2007, large-scale logging in the Romanian Carpathians increased dramatically. This is also the case in regions with virgin and old-growth forests and in many national parks. The picture from 2015 shows an area of the Southern Făgăras Mountains in the area of the municipality of Nucsoara. Previously they were covered by extended virgin and old-growth forest. Altogether several thousands of hectares were cleared in a very short time. The steep slopes become extremely sensitive to erosion. (Photo: Christoph Promberger / Fundația Conservation Carpathia, 2015).

- Satellite data from Sentinel-2 (2015 and 2016) with a resolution of 10 m for visible and near-infrared light (freely available from the Copernicus data pool).
- SRTM (Shuttle Radar Topography Mission) to create a digital elevation model with a spatial resolution of 30 m.
- Google Earth 4 images (CNES, Airbus, DigitalGlobe) for visual verification.
- Data on changes in global forest areas (Hansen et al. 2013, Google Earth 2019).
- OpenStreetMap (OSM) 6 to represent the infrastructure.
- Corine Land Cover (CLC) data (2012) as a reference for the distribution of forest stand types.

The authors emphasised that they saw the results as search areas with a high probability of virgin and very near-natural old-growth forests (corresponding to the Romanian category of quasi-virgin forests) within the delimited polygons. These results provided the basis for a further study into potential virgin and old-growth forests (Schickhofer & Schwarz 2019). The PRIMOFARO inventory (**PRIM**ary and **O**ld growth **F**orest **A**reas of **Ro**mania) identified some 525,000 hectares of search areas thought to contain virgin and near-natural old-growth forest (quasi-virgin forest). Conceptually, there are good correlations with existing protected areas (approx. 330,000 hectares, or around two thirds of the identified potential areas). However, the study also notes that around half of the pure virgin forests identified in the PIN-MATRA inventory in 2005 do not or no longer exist. The PRIMOFARO study was based on an evaluation of the following data records:

- Analysis of the PIN-MATRA polygons using satellites and aerial images (Sentinel and Google Earth) to identify the influences of usage (including clear-cutting, shelterwood cutting, homogeneous tree stands which indicate planting or extensive even-aged or large-scale regeneration after felling).
- Analysis of winter and autumn images (satellite and aerial photographs) to detect typical virgin forest structures such as standing and fallen deadwood, veteran trees, as well as indications

of forest development (such as forest roads, log trails)

- Inclusion of polygons from the Greenpeace study.
- Inclusion of data from numerous field studies (including the REMOTE project[3] by the University of Prague, see Box 6).

The PRIMOFARO study on potential virgin and old-growth forest areas sparked a heated debate, which is still ongoing (including EWS 2020b)[4]. The Romanian Environment Ministry commissioned the Forestry faculty of Braşov University to prepare an expert opinion on the findings. A comprehensive anonymous report by a group of forestry experts has since been published, alleging that the PRIMOFARO study was based on unscientific work and unverifiable conclusions (UTB 2020a, b). However, the Forestry faculty of Braşov University is not known to have been actively involved in locating and mapping old-growth forests meriting protection in Romania, nor has it made any contributions to the National Catalogue of Virgin and Quasi-Virgin Forests that we are aware of (see chapter 7.1).

The REMOTE (REsearch on MOuntain TEmperate) research project is an international network with the aim of setting up a system of long-term survey plots in remaining virgin and quasi-virgin forests in Central, Eastern and Southeastern Europe. The project is organized by the Forestry Faculty of the University of Life Sciences in Prague. Since it started in 2010, several hundreds of plots have been set up in primeval forests in Albania, Bosnia-Herzegovina, Bulgaria, Germany, Croatia, Romania, Slovak Republic, Slovenia and Ukraine. A valuable treasure is a collection of several thousand dendrochronological samples. On this basis, not only the individual history of a tree can be reconstructed, but one can trace several hundred years of forest history of the region and local climate events. (Photo: Rainer Luick, 2018).

3 REMOTE: Research on Mountain Temperate Primary Forests.
4 EWS: European Wilderness Society.

Box 6: REMOTE Project (REsearch on MOuntain Temperate, Primary Forests) by Prague University and associates (https://www.remoteforests.org/project.php)

The REMOTE (**RE**search on **MO**untain **TE**mperate Primary Forests) project is a long-term international collaboration based on a network of permanent sample plots in the forests of Central, Eastern, and Southeastern Europe. Since 2010, an international team led by the University of Prague has developed a system for monitoring selected remaining primary forests in the region. These primary forests play a key role in providing habitat for many rare species and other important ecosystem functions. The network of systematic permanent inventory plots collects extensive data on forest structure and long-term dynamics of individual trees. Dendroecological analyses (analyses of past tree growth based on tree rings from individual trees across tree, stand, and landscape levels) is part of the work. The REMOTE project has built up one of the largest dendroecological databases in the world including thousands of individual trees. The overall goal is to contribute to the long-term scientific understanding of those unique remaining primary forests. Another main intention is to contribute to the protection of remaining primary forests, which are threatened from many sides. At present permanent plots in virgin forest stands have been set up in the following countries: Albania, Bosnia, Bulgaria, Croatia, Romania, Serbia, Slovakia and Ukraine.

The cornerstones of the scientific work are samples for dendroecological analyses and the associated information on the structural parameters of the stands obtained from the research areas. The structural data, which includes aspects such as the height and diametre of trees, the amount of dead wood, and light conditions, were recorded at selected localities during regular field trips. Investigations also include microsites that emerge in different forms on old or dying trees, which are important for many kinds of mammals, birds, and insects. Samples of tree growth rings were extracted using special wood drills (increment borer). These samples enable scientists to look at their development throughout their lives. The width of the growth rings indicates the conditions under which these forests grew and so it is possible to predict how they will react to prospective climatic changes in the future. The history of the trees hidden in the growth rings reveals when and what types of disturbances they faced. The growth ring series database, includes more than twenty thousand tree core samples, demonstrates that these disturbances form a natural part of the forest development cycle. Results of scientific works are already extensively published (*inter alia* Cailleret et al. 2018, Vítková et al. 2018, Mikoláš et al. 2019, Lábusová et al. 2019).

Volunteers from the Prague University REMOTE Project conducting research in Romanian virgin forests (Photos: Martin Mikoláš, 2020).

5 European beech forests as a UNESCO Natural World Heritage site ("Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe")

Two tree species are particularly vital European contributors to our global natural heritage, as their evolutionary history and distribution is confined to Europe: The beech (Fagus sylvatica) and the silver fir (Abies alba).

Beech forests shaped the zonal ecosystems during the postglacial period across large parts of Northwestern, Central and Eastern Europe with a moderate climate. Extrazonal occurrences are also found in the mountains of Southern and Southeastern Europe. However, these forests have long since disappeared from the planar regions, apart from a few exceptions covering only small areas (see Fig. 5). Beech-dominated forests are still common in montane regions, but native and very near-natural beech and beech/silver fir (spruce) forests are now extremely rare due to their history of exploitation (cf. *inter alia* Dierschke & Bohn 2004, Bohn & Gollub 2007, Knapp 2007). Romania's virgin and quasi-virgin forests are unique because of their originality and extensiveness.

There is a long-held ambition to safeguard the most important remaining areas of native and old-growth beech forests by recognising them as UNESCO World Natural Heritage Sites and highlighting their ecological and cultural uniqueness. This has been a laborious process (see Tables 6a-c). The first beech forests in the Carpathians in Slovakia (four areas) and Ukraine (six areas) were inscribed as "Beech forests of the Carpathians" in 2007. In 2011, they were joined by ancient beech forests in Germany, including parts of the Grumsin nature conservation area in the Schorfheide-Chorin biosphere reserve (Brandenburg), the national parks Kellerwald-Edersee in Hesse, Hainich in Thuringia and Müritz and Jasmund in Mecklenburg-Western Pomerania. This extension to 15 sub-areas also coincided with a name change to "Ancient and Primeval Beech Forests of the Carpathians and Germany".

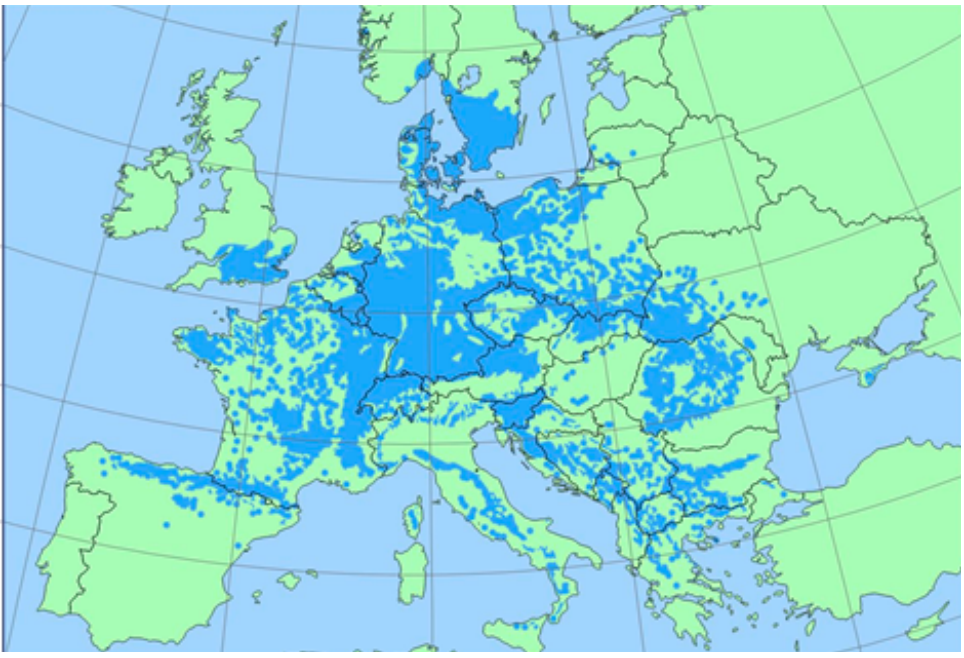


Figure 5: Natural (original) distribution of the European beech *(Fagus sylvatica)* (EUFORGEN 2009). EUFORGEN: European Forest Genetic Resources Programme.

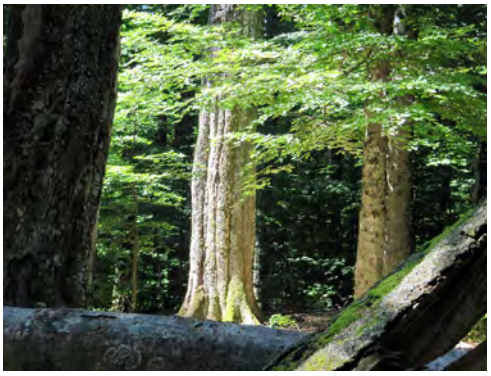
At the recommendation of the UNESCO World Heritage Committee, an attempt was made to identify other valuable beech forests in Europe. A research project supervised by the Federal Agency for Nature Conservation (BfN) identified more than one hundred old-growth beech forests in a total of 20 European countries and selected potential candidates for addition. As the outcome of a process spanning several years, Austria submitted an enlargement application to UNESCO in 2016. The identified areas included

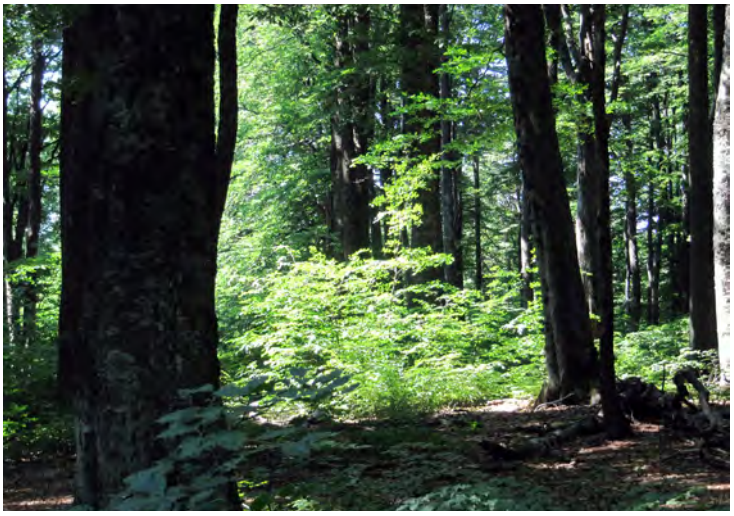
the most southwestern occurrences of European beech forests in Spain, a remnant of ancient beech forests in the Atlantic region of Belgium, the last remnants of virgin beech forests in the Austrian Alps, forests containing the world's oldest beech trees in Italy, montane forests in Slovenia, Croatia, Albania and Bulgaria as well as other forests in Romania and the Ukraine (Kirchmeir et al. 2016, Ibisch et al. 2017a).

In 2017, the World Heritage Site was expanded significantly to include 78 sub-areas in 12 countries with a total area of around 92,000 hectares. Nearly 70% of this land is in the Carpathian Arc; Romania and Ukraine each have about 24,000 hectares and Slovakia about 5,800 hectares. This enlargement prompted a further name change, and it is now entitled: "Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe". Tab. 6a provides an overview of areas with a detailed list of the sub-regions in Romania. A recent enlargement proposal following a process coordinated by the Swiss UNESCO Committee would add a further 37 sub-areas in 10 countries (including beech forests in eight countries not currently represented) with a total area of 19,155 hectares (see also Tab. 6b, UNESCO 2020b).

Inscription on the World Heritage List obligates a country to permanently and effectively guarantee the integrity of its sites and ensure they are protected against deterioration and damage. It is "the best of the best" of the last remaining ancient hardwood forests in Europe. Most are in poorly accessible, hard-to-use locations, but there are also some forests, which have been spared from exploitation for many decades due to a conscious decision by the owners or responsible foresters. These have been preserved as small areas of virgin forest or areas which have evolved back to quasi-virgin forests.

The beech forests of the Carpathian Mountains in Romania and Ukraine are repeatedly cited as unique because of their large size. There are still several thousand hectares of undissected beech forests, often mixed with silver fir and spruce. They tend to span many sites and altitudes and therefore provide exceptional ecological diversity. However, some of them entailed a





Virgin forests have many characteristics that are fascinating in detail, as here in the national park "Parcul Național Semenic - Cheile Carașului" or Semenic for short. Worth mentioning are so-called methusalem trees, i.e. mighty giant trees that are often hundreds of years old. On sample plots of dense and old stands, 1000 cubic meters per hectare (and more) of solid timber can be measured. Adjacent to such a stand, however, there can also be a young regenerating forest stand having barely more than 100 cubic meters per hectare of solid timber (or even less). Inventory data from COMMARMOT et al. (2005) in the Uholka national park in the Ukrainian Carpathians (an unique virgin beech forest) gave maximum volume values of 1042 (255) cubic meters and minimum values of 421 (27) cubic meters per hectare with an average of 770 (111) cubic meters per hectare. Additionally, large volumes of deadwood occur (values in brackets). (Photos: Rainer Luick, 2016).

protracted political process before being added to the UNESCO catalogue, some of which are still ongoing. Several other virgin forest areas would have merited inclusion but have been prevented by various factors: ownership, lack of interest, a reluctance among countries and institutions to take responsibility, as well as a lack of support and protection options. Geographical location, landscape integration and use in the surrounding area affecting the availability and designation of buffer zones can also make protection difficult or even impossible.

UNESCO's guidelines on the inscription and management of World Cultural and Natural Heritage Sites cites the designation of buffer zones as an important part of the nomination procedure (UNESCO 2019a). Martin & Piatti (2009) have already published general recommendations on this topic, which include the IUCN principles (see also Box 7):

- Protection of values of the protected area (including the OUV = Outstanding Universal Value of Cultural World Heritage Properties).
- Maximize the connectivity of World Heritage property with other natural lands.
- Integrate World Heritage property with landscape scale conservation and sustainable use.

The current proposal to extend the UNESCO World Heritage beech forests calls for a differentiated approach to the designation of buffer zones (Kirchmeir et al. 2020, Jovanović et al. 2020):

- Buffer zones with a protective function (protection buffer or p-buffer) and
- Buffer zones with landscape conservation and networking functions (landscape conservation buffer or l-buffer).

Generally speaking, the designation of buffer zones is now a mandatory requirement for World Natural Heritage sites. To guarantee the functionality of buffer zones, a further requirement is that these zones must be on land under the direct or indirect access and control of the respective country – essentially, public property. Where World Natural Heritage sites border on private property, buffer zones must be designated accordingly within the World Heritage site. Silvicultural interventions considered admissible by the responsible agencies or trustees, provided they do not compromise the conservation purpose of the World Natural Heritage Site, and are a major problem for the designated buffer zones around beech forests. This is the case in Romania (see further explanation in chapter 5).

Box 7: Characteristics and requirements for buffer zones around protected areas, especially World Heritage sites as defined in Art. 103 – 107 of the Operational Guidelines for the Implementation of the UNESCO World Heritage Convention (UNESCO 2019a)

- Wherever necessary for the proper protection of the property, an adequate buffer zone should be provided. For the purposes of effective protection of the nominated property, a buffer zone is an area surrounding the nominated property, which has complementary legal and/or customary restrictions placed on its use and development to give an added layer of protection to the property. A clear explanation of how the buffer zone protects the property should also be provided.
- The area constituting the buffer zone should be determined in each case through appropriate mechanisms. Details on the size, characteristics and authorized uses of a buffer zone, as well as a map indicating the precise boundaries of the property and its buffer zone, should be provided in the nomination. This should include the immediate setting of the nominated property, important views and other areas or attributes that are functionally important as a support to the property and its protection.
- Where no buffer zone is proposed, the nomination should include a statement as to why a buffer zone is not required. Although buffer zones are not part of the nominated property, any modifications to or creation of buffer zones subsequent to inscription of a property on the World Heritage List should be approved by the World Heritage Committee using the procedure for a minor boundary modification. The creation of buffer zones subsequent to inscription is normally considered to be a minor boundary modification.

Country		Area (ha)	Year of inscription
Albania (2 regions)		3,391	2017
Belgium (5 regions)		269	2017
Bulgaria (9 regions)		10,989	2017
Germany (5 regions)		4,391	2011
Italy (10 regions)		2,127	2017
Croatia (3 regions)		3,321	2017
Austria (5 regions)		7,119	2017
Romania (12 regions, first column: area of buffer zones)		23,983	2017
Cheile-Nerei-Beusnita National Park (parts)	5,960	4,292	
Codrul Secular Șinca	446	338	
Codrul Secular Slătioara	429	609	
Cozia National Park (parts) – Masivul Cozia		2,286	
Cozia National Park (parts) – Lotrisor	2,409	1,103	
Domogled National Park – Valea Cernei – Coronini-Bedina		5,111	
Domogled National Park – Valea Cernei – Launa Craiovei		3,517	
Domogled National Park – Valea Cernei – Ciucevele Cernei	51,461	1,104	
Grosii Țibleșului – Izvorul Șurii		211	
Grosii Țibleșului – Preluci	564	136	
Izvorarele Nerei in Semenic-Cheile Carasului National Park	2,495	4,677	
Strimbu Băiut	713	598	
Slovak Republic (4 regions)		5,766	2007
Slovenia (2 regions)		795	2017
Spain (6 regions)		886	2017
Ukraine (15 regions)		28,985	2007 / 2017
Total: 78 regions (component parts) in 12 countries (state parties)		92,023	

Table 6a: Overview of existing transnational UNESCO-word heritage sites “Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe” (UNESCO 2020a).

Country	Area (ha)	Planned year of inscription
Bosnia and Herzegovina (1 region)	295	2021
France (9 regions)	1,540	
Italy (6 regions)	2,851	
Montenegro (2 regions)	2,304	
Northern Macedonia (1 region)	193	
Poland (4 regions)	4,071	
Switzerland (2 regions)	1,002	
Serbia (5 regions)	2,699	
Slovakia (6 regions)	4,287	
Czech Republic (1 region)	448	
Total: 37 regions (component parts) in 10 countries (state parties)	19,155	

Table 6b: Overview of planned transnational UNESCO-word heritage sites “Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe” (UNESCO 2020a).

	2007	2011	2017	Planned for 2021
Countries	2	3	12	20
Regions	10	15	78	115
Area (ha)	29,278	33,669	92,023	111,178

Table 6c: Development of existing and planned transnational UNESCO-word heritage sites "Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe" (UNESCO 2020a).

At the 43rd session of the UNESCO World Heritage Committee in Baku in 2019, UNESCO acknowledged a number of serious violations relating to several Romanian World Natural Heritage sites and criticised the inadequate protection given to those sites (Box 8, UNESCO 2020c). Specifically, this concerned extensive timber felling in UNESCO World Natural Heritage sites and in the adjacent buffer zones, as well as road building through core zones. Some high-profile examples occurred in the Ciucevele Cernei section of the UNESCO World Heritage Site at Domogled Valea Cernei National Park, where the construction of National Road 66a through a core zone is planned. In July 2019, the then-Romanian Minister of Transport, Răzvan Cuc, announced that construction was due to commence shortly (Romania-Insider 2018, Euronatur 2019a).

EURONATUR gave the following commentary on these developments: "*We fear that this extraordinary World Heritage Site will soon be given "endangered" status – and that will then include the German territories. The management of Romanian sites has failed to improve in recent years, and urgent action is now needed. The World Heritage Committee is already entering escalation stage 1 with its announcement of a reappraisal of the World Heritage sites. We can only hope that the Romanian government will bow to this pressure and rethink its approach. Romania is the guardian of precious virgin forests that have long since disappeared from most other parts of Europe*" (Euronatur 2019b).

Box 8: Documentation of reports and infringements in Romania's UNESCO World Natural Heritage Sites (UNESCO 2020c)

On 12 November 2018, the World Heritage Centre sent a letter to the State Party of Romania regarding third party information about logging operations in old-growth forests in the buffer zones of the Romanian components of the property. On 8 January 2019, the State Party replied, noting that logging was undertaken in the buffer zones of the respective components and had no impact on their Outstanding Universal Value (OUV). The forest interventions were undertaken in accordance with the national legislation and the relevant Management Plans. On 24 January 2019, the World Heritage Centre sent a follow-up letter asking for additional information regarding the exact location of the undertaken logging operations. On 12 March 2019, the State Party of Romania provided information on the location, the amount of harvested wood and the size of forest area affected by the operations in the buffer zones of the two components in question. In this respect, it is noted that issues related to logging in the buffer zones remain of concern in several parts of the property. The information provided by the State Party of Romania regarding logging operations in the buffer zones in Domogled-Valea Cernei and Cheile Nerei-Beusnita National Parks raises concern. According to the spatial data provided by the State Party, logging operations were limited to buffer zones only, but some locations appear to be very close, or even adjacent, to the boundaries of the components. In fact, the States Parties' joint report notes the possibility of negative impacts from the opening of the canopy of stands adjacent to the property and recommends a minimum distance of 50 m for openings larger than one tree height, and a crown cover not to fall below 80%.

6 The political situation in Romania and its impact on virgin and old-growth forests

6.1 Corruption and abuse of authority as a structural problem

To understand the current situation, status and development of virgin and old-growth forests in Romania, they must be viewed within the context of socio-political conditions and structures.

It is a difficult undertaking because the country has our full sympathy: Magnificent landscapes and ecosystems, unique cultural (historical) contributions and the Romanian people's exceptional hospitality. However, the political culture must also be criticised for its interpretation of democracy, tolerance, freedom of expression and access to public information, although Romania is not the only EU Member State with significant deficits in this respect.

In the post-communist era since 1990, politics has been dominated by the "social democratic" party (PSD= Partidul Social Democrat); like its predecessor, the Front for National Salvation, it has been the strongest party in all Romanian elections since 1990. In the early days, the party was recruited largely from the old communist elites. From 2015 until his arrest in May 2019, the leading light of the PSD was its chairman, the entrepreneur Liviu Dragnea. Dragnea himself was not permitted to hold office, having been convicted and sentenced by the high courts for electoral fraud and corruption. However, Liviu Dragnea continued to direct policy from behind the scenes, including allocation of the most senior positions. Since the PSD's poor performance in the local elections in September 2020, Marcel Ciolacu, elected Chairman in August 2020, has increasingly distanced himself from Liviu Dragnea.

The penultimate change of government in Romania was on 4 November 2019, after the PSD under Prime Minister Viorica Dăncilă, Dragnea's (largely powerless) puppet, had been toppled by a vote of no confidence on 10 October 2019. Dăncilă had already lost her parliamentary majority in August 2019 when the liberal ALDE party withdrew its cooperation with the PSD. The newly elected Prime Minister Ludovic Orban was Chairman of the opposition party PNL (National Liberal Party) and formed a minority government. In February 2020, the opposition party PSD led a successful vote of no confidence against the Orban government. President Klaus Iohannis then nominated Finance Minister Florin Cîțu as the new Prime Minister and instructed him to form a government. However, shortly before the Parliamentary vote, Florin Cîțu withdrew his candidacy, and Ludovic Orban was re-elected interim president of a transitional government with limited powers. The parliamentary elections originally planned for June 2020 have been postponed to December 2020 due to the Covid-19 pandemic (see also chapter 9).

The latent government crisis was accompanied by some extremely questionable interpretations of democracy and the law by the PSD-led government under Viorica Dăncilă and the predecessor government led by Victor Ponta (also PSD). Since the PSD came to power in Romania, there has been a steady rise in public protests against the corruption that pervades many areas of society. Nevertheless, the PDS has managed to be continuously re-elected or to form majorities under its leadership. In essence, the country has staggered from one government crisis to the next in recent decades.

Numerous scandals in the education sector (forged and purchased university degrees), the health sector and also to a large extent the forestry sector are widely known, but no action has been taken, and no government officials or other government-related institutions have been held legally accountable. A planned judicial reform of the PSD gave rise to protests when the EU deemed it incompatible with EU law, because it

would have made bribery (corruption) largely exempt from prosecution. The nadir of this immoral legal development was a paragraph indemnifying all actively or passively corrupt private individuals, public officials and civil servants from prosecution, provided they turned themselves in within a year of discovery.

Corruption, nepotism and abuse of authority are mass phenomena that have been structurally engrained in Romanian society since communist times. A "culture of corruption" is said to be deeply rooted in the moral, conceptual and practical attitudes of large sections of Romanian society and the economy; corruption is often accepted as the logical solution to a problem (Der Spiegel 2019). Very little has changed in this regard since the country's accession to the EU in 2007. The EU publishes a progress report on the matter each year, and the 2019 report was once again scathing (EU 2019b), concluding that the problem had in fact worsened in some areas. The PSD's governing coalition with the Liberals until November 2019 is thought to be the main culprit, with an alleged network of co-conspirators across the country. Observers refer to institutionalised corruption, with Deutschlandfunk (2019) calling the PSD is *"a mafia-style organisation."* Politicians use their office to get rich, embezzle state funds on a grand scale (including large sums of EU funding), cash in on the privatisation of public property, accept bribes for public tenders, and award public sector jobs and lucrative contracts to family members, friends and acquaintances without advertising them to anyone else (Der Spiegel 2019). Die Zeit (2020) describes Romania *"as the most corrupt member of the European Union"*.

Romania is currently at number 70 on Transparency International's ranking of 180 countries (Transparency International 2020), making it the fourth most corruption-afflicted country in the European Union after Hungary, Greece and Bulgaria. Sadly, Romania's global corruption ranking has worsened continuously in recent years (2018: 61st place; 2016: 48th place; 2014: 43rd place; 2012: 44th place). Corruption in the agricultural and forestry sector is a key factor here (EIA 2015[1], Bayerischer Rundfunk 2019, 2020). There are countless instances of illegal sales of agricultural and forest land being endorsed by official corruption, as well as illegal logging, which rose dramatically following EU accession in 2007. The problem flagged up back in 2005 at an expert congress on the problem of deforestation in Romania's protected areas: *"A mafia-like mixture of financial interests and corruption facilitates large-*

Numerous steeply cut valleys, both from the north and south side, are typical of the Southern Carpathians. Until today, many of these valleys are only accessible via dirt roads, even in the lower parts. The upper areas of the mountains that are still completely trackless today, often cover large-scale remnants of virgin forests. The picture shows the Valea Laitei, seen from the entrance of the Transylvanian Basin, and a drone image of the upper area with virgin and old-growth forests in various forms. (Photos: Rainer Luick, 2018, Ion Holban, 2019)

1 EIA: Environmental Investigation Agency.

scale deforestation, even in protected areas, causing permanent damage to the forest ecosystems of Romania" (DBU 2005).

In January 2019, the Romanian Minister in charge of forestry at that time, Ioan Deneş (PSD), told a hearing before the European Parliament that illegal logging was limited to a few private forests and was not a widespread phenomenon (Süddeutsche Zeitung 2019). However, the Romanian Special Prosecutor's Office against Organised Crime (**D**irecția de **I**nvestigare a **I**nfracțiunilor de **C**riminalitate **O**rganizată şi **T**errorism, DIICOT) had already painted a completely different picture back in 2018: After searching 23 branch offices (of predominantly foreign companies), DIICOT concluded that the timber industry, in cooperation with government agencies and the Romsilva State Forestry Administration, had been involved in large-scale illegal logging since at least 2011 (The Guardian 2018). DIICOT also made reference to a secret 2013 report (INS 2013) by the Romanian National Institute of Statistics[2]. It estimated that between 1990 and 2011 at least 80 million cubic metres of timber with a market value of €5 billion were felled illegally, adding that this was a very conservative estimate, as it had only been able to statistically detect and verify a handful of variants of systematic illegal logging.

During the transitional "technocratic" that ruled Romania government from November 2015 to January 2017, large-scale illegal logging became a political issue, and its prosecution a national priority. The Prime Minister of this transitional government was Dacian Cioloş, the former EU Commissioner for Agriculture, who announced that timber poaching in Romania had reached such proportions that it threatened the country's national security. Cioloş estimated illegal logging at 8.7 million cubic metres per annum (proplanta 2016, Romania-Insider 2016).

A report by Radio România Internațional (RRI 2018)[3] cited more than 20,000 known incidents of illegal logging in 2017, around 5,500 of which were the subject of official proceedings, but just 605 of which ended up in court. In that year alone, 1,465 vehicles used to transport illegally logged timber were temporarily impounded. Hot spots included the regions of Suceava, Harghita, Maramureş, Cluj and Sibiu, which accounted for more than 50% of illegally felled timber in Romania in 2017. Two government track and trace systems for logging and timber transport provided the informal basis for these revelations:

1. At the initiative of the WWF, the SUMAL satellite-based timber tracking system went online in 2014 **(S**istem de **U**rmărire a **MA**terialelor **L**emnoase, Automated System for Lumber Tracking, WWF 2015). SUMAL should be seen in the light of the Member States' obligation to implement the 2010 EU Timber Trade Regulation (EU Regulation No. 995/2010) (see also Box 10). The tracing process begins in timber storage yards, which are often supplied by different companies covering a large geographical area. From there, consignments are delivered to end customers or other intermediaries. SUMAL was discontinued in August 2017 by the Ministry of Water and Forests on the grounds that the system was too unsophisticated and generated too many false reports. For several years, NGOs have been calling for SUMAL to be reactivated. In spring 2020, Environment Minister Costel Alexe reintroduced SUMAL 2.0 on a trial basis, with the idea of tracking of every timber consignment from loading to unloading and providing a daily overview of all timber stores (Green Report 2020). The SUMAL is now once again a legal requirement and full activation was actually scheduled for 2020 (ADZ 2020a)[4]. But most recent reports from Romania raise concern that the system is only working poorly or often not at all.
2. In 2016, the Romanian transitional government installed an app-based real-time tracking function, the so-called "forest inspector" (Inspectorul Pădurii). Using the number plates

2 INS: *Institutul Național en Statistică.*
3 RRI: Radio România Internațional.
4 ADZ: Allgemeine Deutsche Zeitung für Rumänien.

The series of images shows that the felling of hardwood (especially beech) is not aiming at quality but at quantity. Quality and dimension of the trees play a minor role in the production of chipboard. Even giant trees several hundred years old are cut. The stocks of wood are usually completely removed at large-scale regardless of species and age of the trees. At regional collection yards, the felled wood often comes from several logging areas and from several subcontractors. Next it is transported to the sawmills. Often very large-sized pieces of ancient trees remain because they are too heavy and difficult to transport. The truck actually was photographed outside of the Kronospan factory in Sebeș (Photos: Rainer Luick, 2018, Ion Holban, 2020).

of timber transporter vehicles, it can ascertain whether the transport has been registered, the type and quantity of timber loaded, and the location where the logs were loaded (WWF 2017). However, the relevant players soon found a way to cheat the tracking system and when the PDS came to power in 2017, it gradually shut down the "forest inspector" and associated reporting and tracking options (ŞTIRILE PROTV 2018, 2019). NEPCon's studies on compliance and risk assessment in the Romanian timber trade included detailed examples of the tricks used (NEPCon 2016 and 2017). A petition initiated by DECLIC to reinstate the "forest inspector" failed (DECLIC 2018).

With the shutdown and blocking of SUMAL and the "forest inspector", the issue of illegal logging soon disappeared from the daily political agenda, and it was even dismissed as fake news and unverified NGO propaganda (EURONATUR & AGENT GREEN 2019).

On 22 November 2019, the new (acting) Romanian Environment Minister Costel Alexe made a surprising announcement in which he conceded the inexplicability of some of Romania's logging data from previous years (ROMANIA-INSIDER 2019a). He cited the National Forest Inventory (IFN, Inventarul forestier național, see also IFN 2020), which estimated recent average logging figures in Romania at around 38.6 million solid cubic metres of timber per annum, which is around 20 million cubic metres higher than the official government figures. Yet the figure published by Romsilva, the State Forestry Administration, was just 18.5 million solid cubic metres, suggesting that more than half of all logging has been unrecorded for years. Alexe also admitted that this lent credibility to the secret report by the National Institute of Statistics for 2013 (INS 2013), deliberately concealed by the previous government and the forestry administration.

The Forest Inventory Project was set up to meet mandatory compliance principles when Romania joined the EU. Existing timber stocks, growth rates, age classes and other information are recorded at regular intervals in line with recognised scientific standards. Romanian forest engineers and forest scientists attended special training courses in France, Switzerland and Finland. The first survey between 2008 and 2012 created a complete data record of timber resources in Romanian forests, covering all types of forest ownership. From 2013 to 2018, these

studies were repeated using the same methods and compared against the first survey. On average, analysis revealed that 38 million solid metres of timber per annum were felled between 2012 and 2018. Costel Alexe conceded that illegal practices were the only explanation for this figure, which is more than double the official felling statistics. Based on the inventory results, said Alexe, illegal logging in privately owned forests is the biggest culprit, followed by municipal forests, and in third place, forests within Romsilva's remit. Public reporting of the facts by politicians and the media has enduring relevance (see also chapter 9).

In this context, Costel Alexe gave an interview to the Romanian G4 media channel shortly after taking office in November 2019, in which he said: *"The first thing I wanted to see when I came to the ministry was the National Forest Inventory report. I was familiar with the subject from the discussions of the Environmental Commission of the Chamber and from press articles, but I was curious to see the official version. I found some shocking figures there, so shocking that, at first, it was hard for me to believe them. I called Mr. Marin Gheorghe, the person in charge of the IFN, to explain to me exactly how the entire documentation process was carried out, what were the techniques used, which are the indicators, and, after listening to all the explanations, I tell you that I have wholly accepted this report. The data there is real."* (G4Media 2019, Romania-Insider 2019a).

Participating scientists decided to go public with this study and its highly controversial figures after their superiors had prohibited its publication or disclosure. First, the scientists from the IFN project presented the study to their parent institution, the National Institute for Research and Development in Forestry (INCDS), which in turn forwarded it to the responsible Ministry of the Environment, but without the controversial figures. Presumably emboldened by the improved political situation in November 2019, the head of the IFN project, Gheorghe Marin, made a statement to the media channel Recorder Romania in October 2019: *"We have not received any explanation for why they refused to validate the figure. I told them that it was very important that this figure must be communicated to the ministry because, of the 38 million cubic meters, only 18 million are taxed. And most importantly, based on this information, the ministry can get a situation with hot areas, where much wood is cut and security measures need to be increased. You see very well what is going on: forests die because they are not sufficiently guarded in certain areas."* (Romania-Insider 2019a).

In a television report on 20 November 2019, Gheorghe Marin gave a detailed account of how the former Minister of Forestry, Ioan Deneș, had obstructed publication of the results, in the light of various controversial aspects that deserved an explanation (RISE Project 2019). Somewhat inevitably, following its publication in full on 22 November 2019, the inventory study was heavily criticised by the State Forestry Administration, forest owners' associations and timber processing companies, who questioned its veracity. For example, INCDS Director Ovidiu Badea argued that *"the figures published in the IFN project are not representative and do not correspond to the official statistical data on timber stocks"* (HOLZKURIER 2019).

The Romanian State Forestry Administration (Romsilva, see next chapter 6.2) also cast doubt on the figures. In November 2019, its Director-General Gheorghe Mihăilescu (who held this office until February 2020) stated in an interview (Romania-Insider 2019a) that *"Forestry and haulage contractors and the wood processing and furniture industries would have noticed if double the amount of wood had been harvested, transported or processed."* He voiced a suspicion *"... that IFN may have simply miscalculated and used an incorrect algorithm, causing the figures to double. Romsilva has calculated that between 40,000 and no more than 50,000 cubic metres of timber are unintentionally, rather than deliberately, harvested each year without a permit,"* Mihăilescu concluded.

IFN Director Gheorghe Marin retorted that the researchers had used legitimate scientific investigation and evaluation methods and that the data had been validated and verified by foreign experts from Germany, France and Switzerland.

He also added that Romsilva was surely delighted about another finding of the inventory, namely, that the total timber stock in Romanian forests currently totals some 2.35 billion solid cubic metres (Romania-Insider 2019a). The Special Prosecutor's Office for Organised Crime (DIICOT) is now investigating this matter as well.

Romanian forestry law has since been amended, following calls by environmental groups for many years, and entered into force when published in the official journal (Monitorul oficial Part I No. 823) of 8 September 2020. The principal features of the new law are as follows: (1) All timber theft, regardless of quantity or value, will be considered a crime in future, rather than a misdemeanour; (2) Vehicles caught transporting illegally harvested timber may be confiscated; (3) Clear-cutting in nature reserves is prohibited; (4) All wood transportation, including consignments of sawdust, tree bark and all other wood residues, must be registered via SUMAL. The penalties are severe, with prison sentences of up to seven years if convicted, and 50 percent higher for persons found carrying a weapon, narcotic or paralytic substance. Increased sentences also apply to acts committed at night, in protected areas of national interest or by forest staff. In addition, access for motorised vehicles, explicitly including mopeds, has been significantly restricted; and in protected areas requires a permit from the relevant administration (AGROINTEL 2020).

Dietmar Gross, Head of the Lichtenfels Forestry Commission (Bavaria) for many years before returning to his roots in Transylvania, sees this law as a first step in the right direction: *"Of course it's not perfect, but no forestry law in the world is. For the first time, the forest is seen as an ecosystem, rather than just a supplier of timber. What's more, once activated, SUMAL will be a world-first and role model. However, there are still problems associated with long-term implementation and, above all, the need for corruption-proof monitoring. Unfortunately, a motion to expand the core zones and impose a general ban on logging in the national parks failed to gain a parliamentary majority"* (ADZ 2020a).

6.2 The Romsilva Romanian State Forestry Administration

The Romsilva State Forestry Administration is the lynchpin of all economic activities and policies relating to Romania's forests. It was established in 1990 after the collapse of the communist regime and manages all state-owned forests.

In communist times, all forests – regardless of size – were state-owned. Currently, Romsilva manages about 3.4 million hectares of forest, equating to around 52% of the total forested area in Romania (FTP 2020). Approximately 2.2 million hectares (approx. 34% of forested area) are under the direct ownership and control of the state. This also includes some substantial areas, which Romsilva claims are state-owned, but which are in fact private or municipal, due to unclear legal titles in cases where the cadastral documents are historically vague, non-existent or have disappeared, as well as landowners who are unclear about or unaware of forest ownership. After several generations, private individuals may have forgotten an inherited forest, are unable to produce the relevant documentation or are reluctant to take legal action to recover their title. As a result, Romsilva manages (oversees) some 1.2 million additional hectares of forest (approx. 18% of forested area) with diverse ownership structures, some of which remain unresolved.

Romsilva currently employs around 16,500 people in a highly complex, inefficient and completely overstaffed administration to manage and maintain some 3.4 million hectares of forest (Die Zeit 2019, EUSTAFOR 2020). There are numerous directorates on County levels and dependent structures, including the administration of 12 of Romania's 13 National Parks, which are entirely financially dependent on Romsilva (salaries, management, etc.). The desire to protect its 16,500 direct employees in rural areas and numerous other indirectly dependent jobs

probably explains how Romsilva manages to maintain its operations largely independently from political directives. It funds all its activities (salaries, investments, infrastructure measures, support, advice, education and also "research") itself, and also transfers revenues to the state. However, given that corruption is so widespread, a transparent financial administration and an honest presentation of income and expenditure seem doubtful to say the least. This is the only logical explanation for the bloated management team and elaborate public façade of this new nomenklatura, which has been singled out for widespread criticism by the media. Tellingly, a corruption-related scandal involving the Director General of Romsilva Gheorghe Mihăilescu (who has since been dismissed) emerged in November 2019 (DIGI24 2019).

Public-sector jobs with organisations such as Romsilva are highly sought-after in Romania, especially in structurally weak rural regions. Although the majority of Romsilva's employees are quite poorly paid by Romanian standards, their jobs are usually secure. Many require little in the way of skills or responsibilities. This, combined with low wages, goes some way towards explaining the widespread corruption in Romanian public administration.

A minimum academic qualification is required to work for the better-paid public institutions. Superficially, administration jobs are awarded to individuals with proven academic qualifications in a competitive process. In reality, however, jobs are often awarded to "mates" in exchange for "brokerage commission." In recent years, for example, a number of the "universities" that have sprung up in Romania have also introduced "paid study courses" in forestry. Access to these courses is easy and they basically "guarantee" a successful degree. Corruption in Romanian education begins at school level, and the Baccalaureate needed to study at university is not particularly meaningful. Since private universities rely on tuition fees and therefore have a vested interest in high enrolment rates, the quality of the Baccalaureate and the manner in which it was obtained is rarely questioned. This problem has been exacerbated by the significant decline in student numbers at Romanian universities in recent years (inter alia Petrescu 2018). A significant number of qualified students (especially from higher-income social classes), therefore prefer to study abroad.

6.3 The role of foreign investment in the Romanian forestry sector

As we have seen, in many regions of Romania, the forests are under enormous pressure. This even affects virgin and old-growth forests in protected areas such as national parks, nature reserves and conservation areas under the Habitats Directive.

Many of the driving forces behind unchecked exploitation, both legal and illegal, originate from outside of Romania, as large proportions of the harvested timber are exported either directly or after processing. However, there are no reliable official export statistics and we must rely on indirect calculations. For example, HS Baco Panels, part of the HS Timber Group, reports that 80% of timber products from four sites in Romania employing 2500 people are exported (Broszeit 2020). Romania Insider reports that, according to official statistics, wood and wood-based products worth €1.63 billion were exported in 2018, more than half of which went to countries outside the EU (Romania Insider 2019b).

Timber products are in great demand in Europe (and also overseas, especially in Asia). However, there is a fierce price war, as global supply chains and logistics become increasingly interlinked. It is perfectly possible that a cheap shelf sold in a furniture shop in Germany or the slats and boards found in most DIY stores originates from virgin mountain spruce or a "quasi-virgin" forest

in Romania, Slovakia or Ukraine. Even many of the logs, wood pellets and wood briquettes sold in sacks, pallets and containers in DIY stores and online are labelled as originating from Eastern Europe.[5] It is not uncommon for them to be sourced from giant trees several hundred years old. Impressive capacities have also been built up for chipboard production in many Eastern and Southeastern European countries, including Romania. For this, wood resources can be used almost independently of type, quality, age and dimension; the main thing is that the raw material is cheap. The huge demand for packaging materials associated with the rapidly expanding online retail sector, takeaway food packaging and supposedly "sustainable" wood-based substitutes for plastic packaging and transport materials (i.e. petroleum) are also helping to fuel the pressure on cheap timber resources.

Over the last two decades several Western European and also globally active wood processing companies have set up huge factories in Romania, all of them are located in the surrounding of the Carpathians. The picture shows the sawmill Sebeș (in German Mühlbach) of the Austrian HS Timber Group (until 2019 Holzindustrie Schweighofer) including its yard. The red factory buildings to the left belong to the Kronospan company. This proximity with shared use of the infrastructure indicates the interdependence and common interests of both companies. The production in the Sebeş location began in 2003. According to the company, the annual processing capacity is 1.45 million cubic meters of round timber (https: //hs.at/en/company/production-sites/sebes.html). The company also has other sawmills in Romania: Rădăuți site (annual processing capacity 1.45 million cubic meters of round timber, https: //hs.at/en/company/production-sites/radauti.html) and Reci (annual processing capacity 1.2 Million cubic meters of round timber, https: //hs.at/en/company/production-sites/reci.html). Other sawmills from other companies with similar dimensions exist also. (Photo: Ion Holban, 2020).

Until recently, before the effects of climate change were seen in the forests of Central Europe and timber prices collapsed over the last three years, timber resources in the Carpathian region offered unrivalled value for money. Because wages, concession fees and leases are low despite large volumes of wood per unit area, work safety requirements are minimal, and social structures are corruptible. This guarantees high profits and explains the attraction for the many international groups that have established huge plants in the Carpathian Arc in recent years. They all have one thing in common: a high, ever-growing demand for timber as a raw material. The principal players in Romania are listed in alphabetical order:

- Egger (headquartered in Austria, turnover: approx. €2 billion), in Rădăuți since 2008.
- HS Timber Group, until 2019 Holzindustrie Schweighofer (headquartered in Austria, turnover: approx. €0.6 billion), since 2003 in Sebeș, 2008 in Rădăuți, 2009 in Siret, 2010 in Comănești, 2015 in Reci.
- Kronospan (headquartered in Austria, turnover: approx. €4 billion), since 1997 in Sebeș, 2009 in Braşov.

In the wider region which also includes timber sourced from the Carpathian region:

- International Papers (headquartered in the USA, turnover: approx. €20 billion), located in Kwidzyn (Poland) since 1992.
- Mondi Group (headquartered in South Africa, the United Kingdom and Austria, turnover: approx. €7 billion), since 2004 in Ružomberok (Slovakia).

5 These statements refer to the situation prior to climate-related forest dieback of coniferous timber in particular, leading to a collapse in the "regular" timber market, especially in Central European countries. However, the cheap German softwood flooding the market does not necessarily mean that more of these types of products will now be manufactured in Germany, since many other aspects along the value chain also dictate pricing and the price drop for raw timber has spread to the European markets as a whole.

- Swiss Krono (headquartered in Switzerland, turnover: approx. €1.6 billion), since 2016 (predecessor company 1988 - 2011) in Vásárosnamény (Hungary).

The major players in Romania include three Austrian companies: the HS Timber Group, the Salzburg-based Kaindl family operating internationally under the company names Kronospan and Swiss Krono, and the Tyrol-based Egger Group. They collaborate closely and their plants are often located in close proximity to each other, as their product and value chains are closely intertwined.

The processing capacity of these companies exceeds the volume of timber available from "official" Romanian sources. This prompted them to adopt to a common approach to the problem, which has been pivotal to the destruction of forests in the Carpathian region for many years and until very recently: Timber is procured from Romanian sources, and its true (often illegal) origins are concealed using sophisticated methods. Timber is also imported from other countries, particularly from Ukraine and Belarus (Belarus), again often from undefined (and illegal) sources. This illegal felling of timber, which persisted until very recently (but is fortunately now declining), relied on the cooperation of willing stakeholders (forest owners, politicians, administrations, logistics companies and the timber industry). Several investigative studies have exposed how complex and well-organised these cartels were and probably still are. The following sources are particularly noteworthy in this connection: WWF (2005), EIA (2015), Knapp (2017), Earthside (2018), ADDENDUM (2019) and EDJN (2020).

6.4 The Romsilva-Harvard-IKEA complex

The Romsilva State Forestry Administration is embroiled in numerous scandals and legal disputes (see also the comments on corruption in Romania).

It is alleged that several tens of thousands of hectares of land, some with disputed ownership, was sold on to foreign investors. Some cases have actually gone to court and resulted in convictions, the Harvard-Ikea complex among them:

Harvard University in Boston (USA) is the ultimate symbol of intellectual and political power in America; its alumni include eight US presidents and many current and former board members of US and global companies. But Harvard is also a powerful business enterprise; in 2018, the Harvard Foundation owned fixed assets totalling some US$ 40 billion (CNBC 2020). In 2014, Harvard University hit the headlines for the wrong reasons when it emerged that an agent of the Harvard Foundation had been accused of accepting bribes of around €1 million plus other substantial gifts from Romanian sources in return for persuading the Foundation to invest in Romanian forests. The transactions were handled by a Harvard subsidiary, SCOLOPAX SRL (Handelsblatt 2014). In total, by 2013 SCOLOPAX had acquired some 35,000 hectares of Romanian forest, making it the second-largest forest owner after the state. From an investor's perspective, it was a lucrative prospect: the land and its vast timber reserves were purchased very cheaply and rights of use obtained very easily, thanks to the "well-oiled" relations with the state forestry administration – in reality, the forests were being savagely plundered through large-scale clear-cutting.

In 2015, Harvard University found itself in the Romanian courtrooms. While determined to retain control of its Romanian investments, investigators revealed that the sale of these forests had been fraudulent and that the Romanian state had been the victim of a major scam (see also Handelsblatt 2014, Netzfrauen 2017 and OCCRP 2016)[6]. The Harvard Foundation had parked these ethically questionable investments in nested offshore companies, ultimately all controlled by the Harvard investment fund. When the story

6 OCCRP: Organised Crime and Corruption Reporting Project.

went public, Harvard's "independent" offshore companies sold their Romanian forest properties to IKEA. When Harvard and IKEA closed the deal in 2015, it was already known that the Romanian government was investigating corruption and taking action to reclaim what it believed to be illegally acquired forest land from Harvard. Three months before the sale, the Romanian citizen who had purchased the forests on Harvard's behalf as a nominee was convicted. Unconcerned, IKEA went on to acquire almost all of Harvard's land (around 98%). Court cases are still pending today, as it is extremely difficult for the Romanian state to secure a conviction for illegality and corruption.

IKEA's timber requirements are immense, but precise details are scarce. Its global demand is estimated at approximately 17 million solid cubic metres (AlJazeera 2020, Raiffeisenlandesbank Vorarlberg 2016). IKEA has set up a separate timber procurement company, IKEA Resource Independence Forest Assets (IRI Forest Assets). In addition to the 33,600 hectares of forest purchased from Harvard, in 2016 IRI Forest Assets acquired some 18,500 hectares of forest in the northeastern Romanian region of Moldova (5400 hectares in Iași County, 7700 hectares in Neamț County and 5700 hectares in Covasna County) (Handelszeitung 2016) from the insolvent German wind turbine manufacturer Prokon. The same year, it acquired a further 12,800 hectares of forest land in Iași and Neamț Counties in the Northeast of Romania from unknown sources. IKEA is now the largest private forest owner in Romania, with around 70,000 hectares (Netzfrauen 2017).

Pictures a, b and c exemplarily show how forestry is practiced in the remote Maramureş region in the northern Carpathians. All clear cuts have dimensions of several hundreds of hectares each. All these areas are located within the perimeter of the Maramureş Nature Park (in Romanian "Parcul Natural Munții Maramureșului"), and protected by EU law as Natura 2000 areas. Many of these areas are difficult to access and public awareness about these forests is much more limited than about the ones in the Southern Carpathians. It can be assumed that in the areas shown virgin and old-growth forests existed before. However, detailed and reliable information is not available. Picture a shows clear cuts in the area of the Prislop Pass which connects Maramureş with the Bukovina region (intervention probably in the period 2010 – 2019). Picture b illustrates situations in the Toroiaga community (intervention probably during 2010 – 2015); picture c shows the Valea Ursului area in the east of the nature park (intervention probably during 2007 – 2010). (Photos: Ion Holban, 2020)

6.5 Ukrainian timber

The enormous demand created by the ever-expanding timber processing industry in the Carpathian region, reports in the national and international media on illegal logging and the scandalous over-exploitation of Romania's forests, public protests and the occasional lawsuit by a Romanian government have now shifted focus of procurement activities of timber resources just over the Romanian border into the Ukrainian Carpathians.

Several reports (including Saveparadise-Forests 2018b-, Der Spiegel 2018, Ukraine-Nachrichten 2018) reported on the vast scale of illegal clearcutting in the Ukrainian Carpathians and its links with the timber industry and Ukrainian politics. It emerged that the Ukrainian forestry administration was just as corrupt as its Romanian counterpart. Particularly during Viktor Yanukovych's time in office (from 2002 to 2005 and again in 2006 as Prime Minister, then from 2007 to 2014 as President of Ukraine), criminal structures had become established involving players at every level: from regional and state politicians, to lawyers and bankers, to forest directors through to those in charge of customs and state railways. An evaluation of satellite images suggests that around 193,000 hectares were deforested in the Ukrainian Carpathians in 2016 and 2017 alone. 70% of Ukraine's annual timber exports with a market value of about €1 billion were sent to the EU, mainly to neighbouring Poland, Slovakia, Hungary and Romania. Officially, these exports are "legal", but it is estimated that at least 50% of them originate from illegal sources. Commenting on the scale of this trade, the Warsaw Institute (2018) notes that between 2015 and 2018, more illegal timber was imported into the EU from Ukraine than from all other countries in the world put together.

At that time, the Austrian timber group EGGER, which owns a large plant in Rădăuți on the border with Ukraine, was the main buyer of Ukrainian timber. EGGER was "legally" importing several tens of thousands of tonnes of FSC-certified timber from Ukraine every month, declared as firewood from so-called sanitation felling which is permitted for export (see following chapter). In reality, it was high-quality sawn round timber, which is banned from export under Ukrainian law. Research by EARTHSIGHT (2018) indicates that the HS Timber Group factory, at the same location, was also supplied with timber. "Ghost trains" loaded with wood crossed the border almost daily, especially at night (Der Spiegel 2018).

EARTHSIGHT (2018) gives a detailed account of the practices used: In order to purchase timber well below the market price, corporations with plants in Romania made payments to shell companies in Belize and Panama under the name of the wife of the then-director of the Ukrainian Forestry Administration. He is accused of between 2011 and 2014 alone having received a total of €13.6 million in bribes from four timber companies, including HS Timber Group (until 2019 Holzindustrie Schweighofer). Documents collated by the Kiev-Pechersk state prosecutor suggest that the company was the largest buyer of Ukrainian timber at that time. Purchases were allegedly made by Schweighofer's Slovakian joint venture company Uniles s.r.o., from which payments to the dummy companies are likewise alleged to have originated. As ADDENDUM (2019) reports, internal investigations at HS Timber Group "failed to identify any such events".

Parallel to this development, there has been a huge increase in FSC certification of forests in Ukraine since 2013. The Danish-based certification company NEPCon[7] alone reports an increase from 115,000 hectares of certified and managed forests in 2013 to 1.9 million hectares in 2019, accounting for almost half of the 4 million or so hectares of FSC certified forests in Ukraine. NEPCon itself is

7 NEPCon: Nature, Environment & People Consult. In October 2020 NEPCon takes on a new name – Preferred by Nature (https://preferredbynature.org/newsroom/nepcon-takes-new-name-preferred-nature).

doubtful that the FSC's principles and certification requirements are observed and enforced in Ukraine (NEPCon, 2019). An EU audit report on the situation and implementation of governance mechanisms and structures in the Ukrainian forest sector likewise uncovered extreme levels of corruption and suggested that all contracts and certifications should be called into question (EU-TAIEX 2018).

In July 2018, the HS Timber Group (until 2019 Holzindustrie Schweighofer) reported that 60% of timber processed by it in Romania originated from abroad, with a bonus of €2 per solid metre payable for FSC-certified round timber (Holzindustrie Schweighofer 2018). Interestingly, another press release from July 2018 (Ukrinform 2018) reported that the Austrian Embassy in Ukraine had praised Petro Poroshenko (President from 2014 to 2019) for vetoing a law, which would have tightened the export ban on certain timber grades.

However, the situation changed in April 2019 when a new government came to power in Ukraine. This is also thought to have affected the "small-scale cross-border" timber trade between Ukraine and its neighbours. In an official press release in May 2019, the newly elected Ukrainian President Volodymyr Zelensky declared war on the overexploitation of and illegal trade in timber as one of his government's central tasks (President of Ukraine 2019). An initial step in this direction has already been taken: 4,750 hectares of virgin and old-growth forest in the Transcarpathian and Ivano-Frankivsk districts were declared "National Natural Landmarks", following a 2017 change in the law to facilitate this. Like the core zones in national parks, all activities likely to affect the ecosystem are prohibited in such areas (EWS 2020c). However, as always, political declarations of intent and regulations alone are not enough; effective protection relies on monitoring, and violations must be prosecuted where necessary. Just how successful Ukraine will be in achieving this, only time will tell.

The forest management described for Romania and status of the few remaining virgin and old-growth forests is not unique to the country. It continues almost seamlessly in the neighboring countries - the Slovak Republic and even more dramatically in Ukraine. The picture shows a large-scale intervention in the Fatra Mountains in the Slovak Carpathians in the Smrekovica area. Specifically, it is the buffer zone to the Great Fatra National Park (Veľká Fatra in Slovak). It is one of many such interventions in this region. Only 20 years ago, the mountain forests of the High Fatra were a coherent habitat for capercaillie, one of the most important in Slovakia. Today the populations are isolated. In the area shown the numbers of capercaillie have declined drastically. (Photo: Štefan Koreň, 2019).

6.6 The timber mafia

Illegal logging and trade generate huge untaxed profits. The system is well-organised and well-connected with politics and administrations.

Anyone who stands in the way of the "timber mafia" can expect dire consequences. The recorder.ro news channel reported on the tricks used in the northeastern Romanian region of Bukovina to "legalise" illegally felled timber (Romania-Insider 2019a). The Northeast, with its extensive spruce forests dating back to the Habsburg-Hungarian period, is a hotspot of illegal logging and related crime (The Guardian 2020) involving the timber trade and processing industry, timber harvesting and transport companies and – in particular – the administration. One simple, commonly used technique is the so-called addition method: Areas of "weak, worthless or dead trees" are sold at auction for low prices, while in reality they contain large, healthy stands that are marked and felled. The company therefore receives two cubic metres of timber for every legal cubic metre of timber felled, but is only invoiced for one. In Romania's corrupt social system, the actual payments are distributed as bribes among administrative staff, local decision-makers and party officials and hence also indirectly finances some parties' election campaigns, which naturally have no interest in clamping down on these criminal operations.

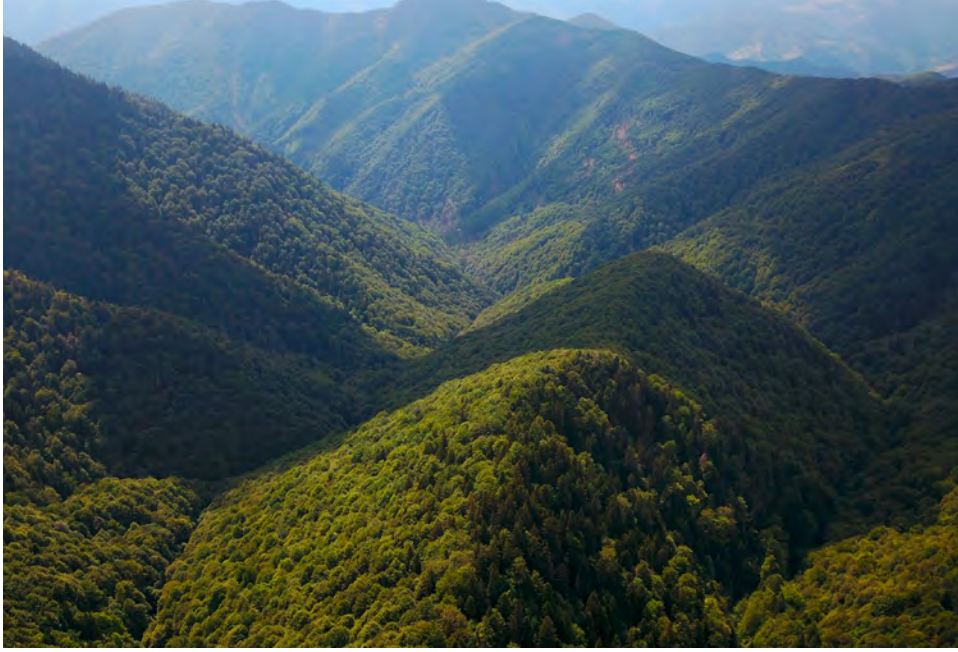
Another practice is a simple accounting trick: Researchers found that many forest inventories and their calculated timber stocks, as well as local information on the age and structure of forests, are inaccurate or outdated, or simply falsified, as there is minimal public access to such documents. The books can easily show significantly higher timber stocks than are actually available. This facilitates large-scale clearcutting which appears to be legal from an accounting perspective and during checks, because the agreed residual quantity is left, or timber stocks appear only "slightly reduced". However, another even simpler and widely documented method is the illegal harvesting large areas of forest as a deliberate criminal act (*inter alia* EIA 2015, Klawitter 2015, Pearce 2015, Knapp 2016, Der Spiegel 2017, Barberá 2019, DECLIC 2019, AlJazeera 2020, Bayerischer Rundfunk 2019, 2020, Romania Journal 2020).

The most commonly and continuously used method, now almost ubiquitous, is to deliberately understate harvest volumes. Employees of the administrations mark a tree for felling, and record in the official statistics that it is 18 m tall with a diameter of 25 cm, while in fact it is 30 m or more with a diameter of 40 cm plus. The difference translates into a lot of money. Impoverished communities with extensive forest ownership are particularly vulnerable to such fraudulent practices and happy to issue logging permits under this system. The felled timber is sold to middlemen, who transport and store it at large regional collection points then later sell and deliver it to the sawmills quite legally, often even with a PEFC or FSC seal of approval. The sawmills, in turn, do not question the system, and are most likely knowingly involved. Anyone who refuses to play along risks their job and even their life. Detection systems such as SUMAL or the Forest Inspectorate – even if they worked – would be powerless in such cases.

In January 2018, Doina Pană, the minister responsible for forestry at the time, unexpectedly resigned. The official line was that she had suddenly become seriously ill. In a media interview in May 2019 (Ziar de Suceava 2019), the former minister described how she suddenly began to feel increasingly unwell with heart palpitations in autumn 2017; her doctors were baffled and she thought she was dying. After she had resigned, a toxicological report revealed that she had probably been poisoned with high doses of mercury over an extended period. In the interview, the minister (now recovered) alleged that the only possible perpetrators were the timber mafia, because: "*The regulations she adopted would have impeded illegal logging and caused huge losses to the cartels*". The investigation by the public prosecutors is still

ongoing. However, it is worth pointing out that the SUMAL tracing system was shut down during her term in office.

Recent developments in the illegal logging trade in Romania culminated in the tragic murder of two foresters in September and October 2019 in the northern Romanian Counties of Iași and Maramureş. Obstructing timber theft can be fatal: According to the umbrella organisation of the Romanian forest workers' unions (Consilva), six foresters have been murdered in recent years, and there have been some 650 violent assaults, some of them with serious physical injuries. The police identified three employees of a timber trade company as suspects but released them when they explained that the forester had accidentally shot himself and was subsequently run over by a wooden cart because he had scared the horses (Der Tagesspiegel 2019, The Guardian 2020). The recent Global Witness report on threats to and systematic killings of environmental activists and journalists worldwide also refers to recent events in Romania (Global Witness 2020).



The spruce-dominated forests in the higher-altitude valley areas of the Southern Carpathians are of high economic interest. Until recent they have hardly been opened up. The felling is mostly performed as large-scale clear cuts and even on steepest slopes. This causes severe environmental impacts. The picture shows a clear cut made a few years ago in Valea Satului in the Făgăraş Mountains. Investments for road construction were minimized. Where possible, the logs were often simply pulled down with bulldozers in stream beds (although not allowed) with devastating consequences for the water ecosystems. (Photos: Rainer Luick, 2018, Ion Hoban, 2020).

7 The situation vis-à-vis the protection of virgin and old-growth forests in Romania

7.1 The National Catalogue of Virgin and Quasi-Virgin Forests

There is legislation in place in Romania stipulating that forests are to be managed sustainably and virgin forests protected. Romanian forests are also subject to European law, such as the Habitats and Birds Directives, setting out minimum forestry standards.

However, there is a lack of enforcement at all levels. In theory, virgin forests are protected under Article 26 of the Forest Act of 2008 (Codul Silvic, Legea 46/2008): *"Conserving the biodiversity of the forest ecosystems implies measures of sustainable management, by applying intensive treatments, which are promoting the natural regeneration of the species from the natural fundamental forest types and by conserving "virgin" and "quasi-virgin" forests."* Unfortunately, there were no further explanations or definitions of what precisely constitutes a "virgin" or "quasi-virgin" forest at that time. Nor were any details provided of the form any such protection should take. This was only specified by the 2012 Ministerial Order (Ministerial order No. 3397/2012):

In 2011, the WWF launched a widely publicized campaign to "save Romania's virgin forests", highlighting the fact that less than 20% of the presumed 250,000 hectares remaining are in protected areas (WWF 2011). They also cited László Borbély, then- Environment Minister with responsibility for forestry: *"I am committed to adopting a law by the end of the year that will permanently safeguard all our virgin forests".* Borbély added that "*€100 million of EU funding will be made available to compensate private forest owners for ensuring that their forests are maintained in their original state*." He had already held talks with the EU Commission on this matter, he said. Borbély also announced "*that the 250,000 hectares of virgin forest will be surveyed, researched and permanently protected from mid-2012, replacing an outdated study from 2003* [presumably the PIN-MATRA study] ".

What happened to these promises? A subsequent Memorandum of Understanding between the WWF and the Ministry set out the specific steps needed to legally protect Romania's most valuable forest areas (WWF 2011). In 2012, the government passed a forestry law to protect the remaining virgin and quasi-virgin forests (i.e. very near-natural forests with the characteristics of a virgin forest) (MO 3397 / 2012). The law also stipulated that the areas of virgin forest mapped by the PIN-MATRA project must be protected against silvicultural interventions, even when the 10-year forest management plans for these areas permit usage. Unfortunately, however, a serious ancillary provision was added stating that the approval of the ITRSV (Inspectoratele Teritoriale de Regim Silvic și de Vânătoare, Territorial Inspectorate for Forest and Hunting Regime) was required. The Inspectorate must certify that sites meet the legal criteria for virgin and quasi-virgin forests and has the power to certify that certain sites no longer meet the criteria and may therefore legally be used. This explains to some extent how, in practice, the legal protection of virgin and virgin-like forests is largely ineffective, with countless exemptions, imprecise formulations which are open to interpretation, plus the ubiquitous corruption. It also facilitated the deforestation described above, often as a deliberate criminal act, and served as an "open invitation" to the relevant stakeholders to devalue potentially protected areas as quickly as possible.

At the same time, the 2012 Forestry Act initiated the establishment of a National Catalogue of Virgin and Quasi-Virgin Forests and formulated a vague list of definitions and principles (Catalogul național al pădurilor virgine şi cvasivirgine din România). A more precise specification of the legal character and structure of this catalogue was only established in 2015/16, when it was amended by the interim expert-led government (MO 2525/2016). Table 7 lists the criteria and indicators that define "virgin" and "quasi-virgin" forests in Romania.

Although developing a National Catalogue of Primeval and Quasi-Primeval Forests is a sovereign task of the Romanian state, no state authority has been entrusted with the project, nor has the government provided the necessary budgets. From the outset, all mapping, studies and all other work associated with inclusion in the catalogue (including numerous presentations, all of them in Bucharest) was carried out by NGOs and volunteer experts. A project by the Rottenburg University, funded by the German Federal Environment Foundation (DBU) played a key role, incorporating a number of important studies between 2017 and 2019 (HFR 2017, SAVEPARADISEFORESTS 2017)[1]. Experiences of the catalogue project's effectiveness and deliberate attempts to politically discredit it were acquired through this direct involvement:

- There is no or minimal technical support available with the provision of materials (aerial photographs, maps, cadastral data, forest management documents), or selected documents are only accessible at a significant cost. Yet NGOs and volunteer experts are obliged to submit any documents (such as historical maps, forest management documents) not in the public domain.
- From 2016 to 2018, the government provided no funding for mapping or expert opinions. Since 2018, the homepage of the responsible Environment Ministry (MMAP= Ministerul Mediului, Apelor și Pădurilor) has mentioned a budget of 2,500,000 Lei (about € 500,000) for preparation of the catalogue. Official institutions and consultants could apply for studies on the basis of tenders. However, the amounts available per hectare were so small that, even allowing for low labour costs in Romania, no bids were submitted, as we were able to deduce from a statement by the Ministry of November 2018 (MMAP 2020b). According to the MMAP website as of November 2020, the plan was to carry out a total of six pilot studies to gather experience, then organise a public tender for inventory studies on this basis (http://apepaduri.gov.ro/paduri-virgine/).
- The highly complex administrative structures involved in the preparation and processing of maps and expert opinions are untransparent and incomprehensible, even by Romanian standards. This is probably an intentional ploy to discredit and impede external involvement. Researchers must contend with a complex system of inconsistent regulations, frequent and uncommunicated changes to requirements, very sudden deadlines for the submission or retrospective delivery of documents and invitations to "defend" expert opinions (all meetings are in Bucharest, travel expenses are not reimbursed).
- Only areas designated as virgin forests in official forest management plans may be processed and inspected; all others are automatically excluded. As we have already seen, most official forest inventories are unreliable and contain false information (both deliberate and unintentional).
- Theoretically, a forest owner could also submit information to the catalogue if the forest management plan confirmed compliance with the criteria. An area could then be added directly to the catalogue without the need for extensive studies by the responsible Technical Committee at the Environment Ministry (CTAS = Comisia Tehnică de avizare pentru silvicultură).

1 HFR: Hochschule für Forstwirtschaft Rottenburg (Rottenburg University of Applied Forest Sciences).

Virgin forests	Quasi-virgin forests
Definition: Virgin forest Originated and developed exclusively under influence of natural factors; Ecosystem processes are taking place accordingly with their natural dynamics; No anthropic (man-made) influence, direct or indirect.	**Definition:** Quasi-virgin forest Derived from former virgin forest; Was exposed to anthropic (man-made) but minor changes which are visible, but not significant with respect to structure, species composition and ecological processes.[1]
Criteria 1: Naturalness / Indicators	
Natural composition and natural distribution of the component species.	
Presence of complex structures stratified vertically and patched horizontally, the specific texture constituted from development phases.	
Presence of historic or recently hinged-up root plates with pit-mound microsites caused by natural uprooting of big trees, mostly after storm.	
Development phases of rejuvenation, youth, maturity/optimal, terminal / senescence, disaggregation are present.	Certain development phases can be missing, mainly the terminal/senescence and the disaggregation phase.
Natural biodiversity, including dimensions, shapes and ages of trees, some trees have ages close to the physiological longevity. Multi-aged structure and texture is predominant.	Near-natural biodiversity, including dimensions and age of the trees, some of them beyond the harvesting age (>150 years). Near-natural multi-aged structure and texture is predominant.
Absence of silvicultural interventions and other human activities, including grazing. No indicators of human intervention, e.g. stumps of trees.	Absence of silvicultural interventions in the last 30 years. Indicators of human intervention is a maximal number of 5 stumps/ha, diameters >15 cm in advanced decomposition phases.
High quantities of dead wood, standing and laying on the ground, in different decay classes.	Presence of dead wood, standing and laying on the ground, in different decay classes.
Natural consistence (crown covering index), accordingly with site conditions, variable, depending on the development stage[2]. In poor site conditions the density index can be considerable below 100%, e.g., oak, pine or spruce forest on limestone rocks or bog margins.	Consistence (crown covering index) natural or close to it (diminished by maximum of 20%), accordingly with the site conditions and depending on the development stage. In poor site conditions, the density index is considerable under 100%. (Spruce stands on limestone rocky slopes, Spruce stands with *Sphagnum* et. al.).
Unaltered soil (except natural mass movements like natural erosion, deposition).	Nearly unaltered soil due to previous human activities. Ancient still traceable logging roads are admitted, underlying natural ecological processes like litter accumulation, topsoil development, establishment of non-vascular and vascular plants including tree regeneration.
Absence of (forest) roads and logging facilities, except infrastructure for scientific research, management, limited touristic thematic pathways; no markings of of forest compartments. Restricted, often difficult access (remoteness).	Absence of (forest) roads and constructions or presence of forest roads that have not been used in the last 30 years. Infrastructure for scientific research and management, some touristic thematic pathways and markings of forest compartments are tolerated at a very low quantity.

Criteria 2: Size of the area and its limits / indicators	
The size of the virgin/qvasi-virgin forests (including all development phases/forest compartments) will be at least 20/30 ha (smaller areas must be regarded as fragments, underlaying disturbance from outside, that do not correspond to the selection criteria). Excepted are rare and endangered ecosystems of high ecologic interest, e.g., *Pinus cembra* ecosystems, riparian ecosystems in the Danube Delta, for which the minimum area will be 10 ha. Rare ecosystems and ecosystems of high ecologic interest will be surrounded by buffer areas.	
Contiguous (compact) forest cover in order to ensure self-regulation and habitat continuity (in time) of the ecosystem.	
In most cases natural limits, e.g. ridges, valleys, creeks, which support the intactness by keeping anthropogenic disturbance outside the forest limits. Qvasi-virgin forest can be limited by artificial borders, e.g. permanent (logging) roads, strips for powerlines, railroads.	
Eventually forest areas in contact with virgin or qvasi-virgin forests can be included if they do not exceed 15% of the total area of the stands fulfilling the selection criteria.	Areas that do not match criteria 1 of naturalness cannot exceed 15% of the total area of the stands fulfilling the selection criteria.

Table 7: Criteria and indicators for identifying "virgin" and "quasi-virgin" forests in Romania under forestry law ([1]The majority of the forests considered as virgin in Europe and in Romania are in fact quasi-virgin; [2]For a virgin forest in its total surface and having all the development phases the index of crown covering cannot surpass 0.7 – 0.8) (MO 2525 2016).

- The preparation and submission of a study requires the written consent of the owner (or owners, where it spans multiple stands). From this consent, it is implicitly understood that no silvicultural interventions may be carried out whilst the study is ongoing, and it is therefore virtually impossible or extremely difficult to obtain permission for such studies in many areas with remaining virgin and quasi-virgin forests, especially those under private or municipal ownership.
- Experience has shown that studies presented to CTAS may be rejected for no apparent reason or with incomprehensible or false claims, or a requirement for unnecessary follow-up work. Since CTAS will not accept the submission of studies from October to February, there is plenty of time to establish "facts" during the winter months, so that the land is disqualified the following year.
- Finally, there were several cases where studies were "lost" by the authority after submission.

Until November 2019, the Romanian government refused to view the preparation of a catalogue of virgin forests as a national task. Its failure to act, and its deliberate obstruction of those willing to contribute, is surely indicative of a fundamental lack of interest on the part of policy-makers – and the Romsilva State Forestry Administration – in protecting the country's virgin forests. The government even attempted to put a time limit on and prematurely terminate the registration of studies for the catalogue.

In principle, the establishment of a National Catalogue of Virgin and Quasi-Virgin Forests is a welcome strategy. However, apart from the administrative obstacles already discussed, we are also critical of the very rigid and untenable ecological/academic criteria and indicators for qualifying sites. The spatio-temporal stochastic processes that characterise virgin and old-growth forests are highly diverse and variable. Criteria such as the dominance of very old trees (160 years or more) and a specified volume of standing and fallen deadwood may be characteristic of virgin forests, but they only apply to certain phases. We would also question the requirement for clear geomorphological boundaries, such as ridges or river courses. If the criteria of this catalogue project were applied to other EU countries, there would be no remaining old-growth forests worthy of protection.

What is the situation four years into the catalogue project? A total of 43,823 hectares (of which 7,402 hectares are virgin forest and 36,421 hectares are quasi-virgin forest) are listed on the Internet (as at November 2020)[2] (see also Table 8). In this respect, it is worth noting that:

2 http://www.mmediu.ro/articol/editia-noiembrie-2020-a-catalogului-padurilor-virgine-si-cvasivirgine-din-romania/3774.

The series of images shows large-scale clear cuts in the Iezer-Păpușa Mountains in the central Southern Carpathians. The whole region is part of the Munții Făgăraș Natura 2000 area. Because of the remoteness of many valleys such interventions can happen almost unnoticed by the public. Comparisons of satellite images show that between 2009 and 2012 there were several hundreds of hectares of clear cuts. The remoteness and previous inaccessibility of the area and dendrochronological assessments of the still visible stump suggest that there were large several hundred years old forests and most probably interspersed with pockets of virgin forests. There have been no signs of reforestation. (Photos: Ion Holban, 2020).

- At first glance this appears to be a gratifying increase of 14,000 hectares since the last status report from November 2019. In the category of real virgin forests, however, there is only a modest increase of 737 hectares. It is also noticeable that 9,500 hectares of the new inscriptions already have protection status as UNESCO World Natural Heritage, so that effectively only 4,500 are to be accounted for as actually new areas.
- The strategy pursued by virgin forest opponents and timber industry lobbyists seems to have been successful: Compared with a minimum potential of 100,000 hectares of virgin forest and a similar amount of very near-natural stands, this is a depressingly poor record.
- Most of the areas currently listed in the catalogue and designated by the government and forest administration are in reasonably non-critical regions already located in national parks and core areas, which were registered for inclusion in the catalogue by the national forest authorities.
- While external research teams are required to submit extensive, up-to-date documentation, we are not aware of any such records for the areas notified by the authorities.
- The lack of funding means that only NGOs and institutions with external, i.e. international, financial support have been able to carry out studies; these include WWF, Greenpeace, the CARPATHIA Foundation (see Chapter 7.3) and the project by Rottenburg University, supported by the German Federal Environmental Foundation (DBU). Together, these organisations have prepared studies for a total of 30,336 hectares in 132 sites. Of these, only 6,075 hectares (20%) in 27 sites have achieved official recognition, as of April 2020. The remaining 24,261 hectares in 119 sites were rejected, either because they were classed as incomplete, or because the studies were "lost". All of them were produced at great financial expense (mainly from donations), with great personal commitment and hard work by all participating players; the majority were unacknowledged and denied fair treatment or discussion by the government authorities.

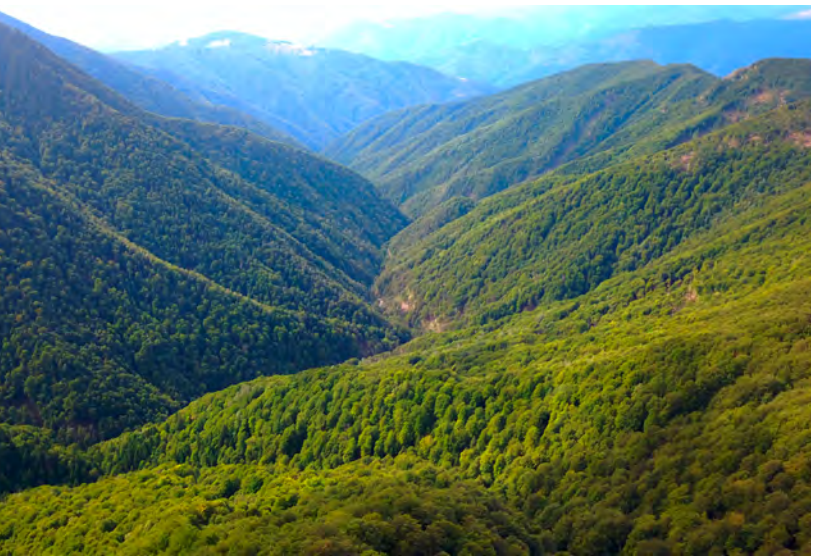
The National Catalogue of Virgin and Quasi-Virgin Forests project also created an expedient, much-needed compensation programme for private forest owners willing to contribute land to the catalogue. Back in 2017, Romania was authorised by the EU Commission to allocate around €14 million annually from the so-called second pillar (rural development) of the EU Common Agricultural Policy (CAP) for the current programming period. These are essentially EU funds, so they do not have to be raised by the Romanian state (EURONATUR 2017c). Assuming a compensation rate of €100 per hectare, per annum, this means that well over 100,000 hectares of virgin and quasi-virgin forest could have been supported during the current EU financial period. The current catalogue (as at 31 October 2020) shows 4,130 hectares of land, distributed over approximately 300 individual plots in private or municipal ownership (MMAP 2020b). We have been unable to find out whether, and if so to what extent, compensation has been applied for or was regularly granted.

Our own research into the revenues of private forest owners' organisations, the "Obşti", indicate average annual profits of between €40 and €60 per hectare. However, this is only the perspective of the forest owner, and does not include upstream value creation. Nevertheless, these are lucrative framework conditions, but what is the reality? From our discussions with representatives of local OBŞTI whose land includes potential catalogue areas it became clear that

- The government, the Romsilva State Forestry Administration and other authorities have kept quiet about the compensation programme and even denied its existence. Essentially, most local stakeholders are unaware that compensation payments are available.
- Applying for compensation requires familiarity with complex bureaucracy. This acts as a deterrent for people in rural villages, who receive no help with the application process.
- Given Romania's administrative procedures and the constant changes in government, there is little confidence in the reliability of government programmes.

	Studies and expert opinions submitted for the catalogue	Individual areas covered by the studies (quantity)	Total area (ha)	Proportion (%)
Studies prepared by external experts (NGOs, universities)	93	132	30,336	100
Studies accepted for the catalogue	22	27	6075	20
Studies that were ultimately rejected	11	40	8891	29
Studies "lost" by the authorities or during processing	17	17	4056	14
Studies returned to the authors due to deficiencies (of which in revision)	43 (4)	48 (4)	11,314 (70)	37 (3)

Table 8: Overview of studies presented for the National Catalogue of Virgin and Quasi-Virgin Forests by external agents (individual sites and areas) EURONATUR (2020a).



The use of drones is an important tool in virgin forest research especially for the identification and mapping of locations with virgin and old-growth forests. Species composition and canopy conditions can be characterized. Drones can be used practically everywhere. Their use creates unique aesthetic impressions which were not possible until a few years ago. They also help to detect the dimensions of clear cuts, which were previously difficult to find. (Photos: Ion Holban, 2018, 2019, 2020).

7.2 Protection and situation in the national parks

Knorn et al. (2012) used aerial photographs to analyse the loss of woodlands over the period 2000 to 2010 in sample regions of Romania with a high proportion of protected areas (Retezat National Park, Apuseni Nature Reserve, Ciucas Mountains and Maramureş Nature Reserve).

Overall, only about 1.3% of forest in the regions examined has disappeared completely over this period. However, the fact that some 70% of silvicultural interventions, some of them severe (small-scale and large-scale clearcutting, shelterwood cutting in rapid succession) took place in protected areas is a cause for concern: 5.9% in national parks, 15.5% in wildlife reserves and 48.6% in NATURA 2000 areas. However, since Romania's accession to the EU in 2007, a far more dramatic destruction of woodlands took place in protected areas, as documented by numerous reports and lawsuits (including Roser 2012, EIA 2015, Euronatur 2017b, 2018).

There is extensive documentation of dramatic, large-scale clearcutting in virgin and old-growth forests in Romania's largest National Park, Domogled-Valea Cernei, covering some 61,000 hectares. It contains three UNESCO World Heritage sites spread over 9,732 hectares, as well as extensive NATURA 2000 protected areas. Another complaint to the European Commission concerned more than 10,000 hectares of clearcutting in NATURA 2000 sites in Maramureş County in northern Romania (Euronatur 2017b, 2020b, Saveparadiseforests 2018a, see also chapter 8). Yet most logging in protected areas is compliant with Romanian national legislation (at least as it is interpreted) and therefore appears superficially legal – how is this possible?

One general problem, not confined to Romania, is the differing definitions of protected areas at national and international level and the associated legal status. The much-cited definitions and objectives set out in the IUCN Guidelines (Dudley 2008, 2013, Lausche & Burhenne 2011) are often interpreted as legal standards but are in fact merely recommendations. Even if the IUCN recommendations for a given protected entity (such as national parks, IUCN Category II) are consistent with the definition in national law, they may be automatically protected, but this is not necessarily enforced. There is a common misinterpretation that logging is strictly prohibited on 75% of a national park's area protected by management plans; but this is simply an IUCN recommendation (see also Box 5). In other words, violations in protected areas cannot be prosecuted unless they violate national laws, EU regulations (EU Habitats and EU Birds Directives) or legally binding international obligations (such as UNESCO World Heritage Sites or UNESCO biosphere reserves).

Romanian law (OUG 2007) defines the zoning of protected areas (national parks) as follows:

1. **Core zone / strict protection zone** (zonă de protecție strictă and zona de protecție științifică): No silvicultural interventions, hence no timber harvesting; approved scientific measures and limited tourism access (development) are permitted.
2. **Integral production zone / core zone** (zonă en protecție integrală): In principle, no silvicultural interventions are permitted (however, preventive sanitation felling and post-damage felling e.g. following wind and snow breakage or bark beetle infestation are admissible subject to approval), but traditional agricultural activities are permitted (such as meadow and pasture use, forest grazing), together with defined tourist activities.
3. **Sustainable conservation zone / buffer zone** (zonă de conservare durabilă): All agricultural and silvicultural uses are permitted. These areas differ from other zones and surrounding land insofar as construction measures require approval and there is a (theoretical) obligation to refrain from plantation-like reforestation after clear-cutting.
4. **Sustainable development zone / buffer zone** (zonă de conservare durabilă): Identical to sustainable conservation zones, except that settlement expansions and tourist facilities (e.g. hotels, winter and summer sports facilities) are permitted.

Table 9 contains a list of Romania's 13 national parks together with key administrative data. It is worth noting that only one national park (Ceahlău in Moldavia in the Northeast) falls outside the administrative responsibility of the Romsilva State Forestry Administration. An analysis of the official information available relating to management zones clearly shows that:

- Three out of 13 national parks have no designated core zones, according to the official information available,
- Six out of 13 national parks have only very small core zones, and
- Only four national parks contain significant areas designated as strict protection zones: Piatra Craiului National Park (6,291 out of a total of 14,766 hectares); Retezat National Park (1,932 out of 38,138 hectares); Semenic-Cheile National Park Carașului (4,271 out of 36,051 hectares); Cheile Nerei National Park Beuşnița (4,271 out of 29,386 hectares).
- According to the IUCN criteria (recommendations) for "national parks" protection category II (see also Box 9 and Dudley et al. 2008, 2013), 75% of the land should be designated as an unmanaged core zone. Not one national park in Romania follows these recommendations in its handling and interpretation of the existing zones (strict protection zone = core area).

Name and webpage	Area (hectares)	Administration (NFA= National Forestry Administration)	Zonation according to management plans (if existing), and forestry interventions (legal and illegal) based on expert opinions ● minor ● high ● extreme				
			CA (ha)	IPA (ha)	SCA (ha)	SDA (ha)	FI
Munții Rodnei National Park (http://www.parcrodna.ro/)	47 202	NFA Romsilva	220 (strictly protected); 5 445 (scientific reserves)	26 369	14 558		●
Călimani National Park (http://www.calimani.ro/)	24 041	NFA Romsilva	744 (strictly protected); 384 (scientific reserves)	15 682	7 747		●
Cheile Bicazului Hășmaș National Park (http://www.cheilebicazului-hasmas.ro/)	6 794	NFA Romsilva	453	4 670	1 878	71	●
Ceahlău National Park (http://www.ceahlaupark.ro/)	7 743	Neamț County Council	371	5 009	2 130	233	●
Piatra Craiului National Park (http://www.pcrai.ro)	14 766	NFA Romsilva	6 291	104	7 034	1 336	●
Cozia National Park (https://cozia.ro/)	16 072 including 3 389 (2 subareas) UNESCO world heritage sites	NFA Romsilva	No information	8 134	7 894	44	●
National Park Buila-Vânturarița (http://www.buila.ro)	4 181	NFA Romsilva	No information	431	1 448		●
Defileul Jiului National Park (http://www.defileuljiului.ro/)	11 127	NFA Romsilva	No information	9 838	1 035	135	●
Retezat National Park (http://retezat.ro/)	38 138	NFA Romsilva	1 932 (strictly protected and scientific reserves)	20 863	15 337		●
Domogled-Valea Cernei National Park (http://www.domogled-cerna.ro/)	61 211 including 9 732 (3 subareas) UNESCO world heritage sites	NFA Romsilva	836	29 081	30 388	906	●
Semenic-Cheile Carașului National Park (http://pnscc.ro/)	36 051 including 4 677 UNESCO world heritage sites	NFA Romsilva	4 271	7 764	23 395	235	●
Cheile Nerei Beusnița National Park (https://www.cheilenereibeusnita.ro)	29 386 including 4 292 UNESCO world heritage sites	NFA Romsilva	4 271	9 676	15 406	19	●
Munții Măcin National Park (http://www.parcmacin.ro)	11 152	NFA Romsilva	449	3 418	7 273	12	●

Table 9: Overview of the 13 national parks in Romania (size, administration, management zoning and expert opinions on the degree of forestry interventions). CA (core area = strict protection zone), IPA (integral production area), SCA (sustainable conservation area), SDA (sustainable development area), FI (forestry interventions).

According to the official Romanian interpretation of ecological importance and protective character, "zonă de protecție strictă", "zonă de protecție științifică" and "zonă de protecție integrală" are considered core zones. By law, silvicultural interventions (logging) are primarily admissible in "zonă de protecție integrală", thanks to various exemptions and a very broad interpretation of the legal requirements. Sustainable conservation zones and sustainable development zones essentially have no restrictions on forestry.

Specifically, this refers to sanitation, conservation and salvation felling, all of which are admissible without a situational review (approval by a scientific council) in all defined management zones, even the strict protection / core zone (zonă de protecție strictă), provided it is deemed "essential" and official approval has been granted. According to official information, only "very limited sanitation and conservation felling" takes place in the defined protection zones, but closer inspection revealed this to be large-scale clearcutting (e.g. Bayerischer Rundfunk 2019, 2020, Euronatur 2019a, b). Under Romanian forest law, such interventions are actually defined and limited as follows (OUG 2007):

- **Conservation cuttings** are used for the regeneration of stands with a special protection to ensure the permanent forest and its eco-protective functions. Normally in forests on steep slopes and shallow soils, in forests with special conservation status (performed as cuttings of 15% of the standing volume every ten years).
- **Hygiene cuttings** means removal of dead wood mostly, in small percentages, normally under 5 m^3/ha/year.
- **Accidental cuttings** means removal of dead trees, wind throws and infected trees from insect attacks. Removal quantities can be as much as 5 m^3/ha/year or more.

Figure 6 illustrates forest harvesting methods and volumes for the period 1990 to 2017 (from Ciceu et al. 2019). In 2017, of the 18 million solid cubic metres felled, approx. 10 million referred to conservation felling. This is a very loose interpretation of the law and its original intention. There is no evidence of any extreme disasters or calamities occurring in beech forest regions to justify the sharp rise in "conservation cuttings"; and there was also large-scale "sanitation felling" in beech-dominated protected areas.

Of the 12 Romanian UNESCO World Natural Heritage beech forest sites, seven are in national parks, more or less entirely within the core zones (zonă de protecție strictă or zonă de protecție științifică), with some significant portions in integral protection zones (zonă de protecție integrală). This contravenes the UNESCO recommendations on the management of World Natural Heritage Sites (UNESCO 2019b), partly based on the legal definition of these categories, but mainly due to abuse. These recommendations state that although protected area categories are designated at a national level, they should follow the requirements of Category Ia protected areas defined in the IUCN classification (Dudley 2008, 2013). Specifically, this means that all silvicultural interventions and uses are prohibited in IUCN Ia areas (see Box 9). The application and interpretation of the requisite buffer zones around UNESCO sites poses a further problem.

As previously mentioned, the administrations of the national parks, barring one exception, are under the full control of and financially dependent upon the Romsilva State Forestry Administration. It therefore comes as no surprise that the national park administrations have not commented on these situations, nor have they objected to the manner and intensity of silvicultural interventions in protected areas. They are under latent pressure, because their jobs and budgets effectively rely on income generated from activities including logging in the park. Even the widely documented large-scale interventions within the perimeters of core zones have not been registered or actioned by the park authorities (e.g. Euronatur 2019a, b, 2020a, b).

Since 2016, the National Agency for Protected Natural Areas (Agenția Națională pentru Arii Naturale Protejate, ANANP), based in Bucharest, has been under the control of the Romanian Environment Ministry (ANANP 2020). Theoretically, its duties also include the management of protected areas, but it is extremely underfunded and barely capable of performing even the minimum of tasks. This explains why no national park administrations have thus far been willing to transfer to ANANP (according to verbal expert opinions). Information on ANANP's ongoing projects, interests and responsibilities make no reference to virgin forests or the "National Catalogue of Virgin and Quasi-Virgin Forests".

Impression from the National Park "Parcul Național Semenic - Cheile Carașului" or Semenic for short. Juvenile and terminal forest development phases with high structural diversity can occur in virgin forests as larger patches (> 1 hectare) and also very small-scale. (Photo: Rainer Luick, 2016).

The following conclusions can be drawn from these findings:

1. Generally speaking, the core areas of the national parks under strict protection should be broadened to 75% of the area to comply with IUCN recommendations for Category II protected areas.
2. In several national parks, the core zone category should be defined and included in a management plan.
3. The buffer zone management category must be clearly aligned with the protection goals in terms of defined and permitted interventions.
4. Permanent, transparent controlling and monitoring is required.
5. The national park administrations must become independent of supervision by the State Forestry Administration and given their own budgets.

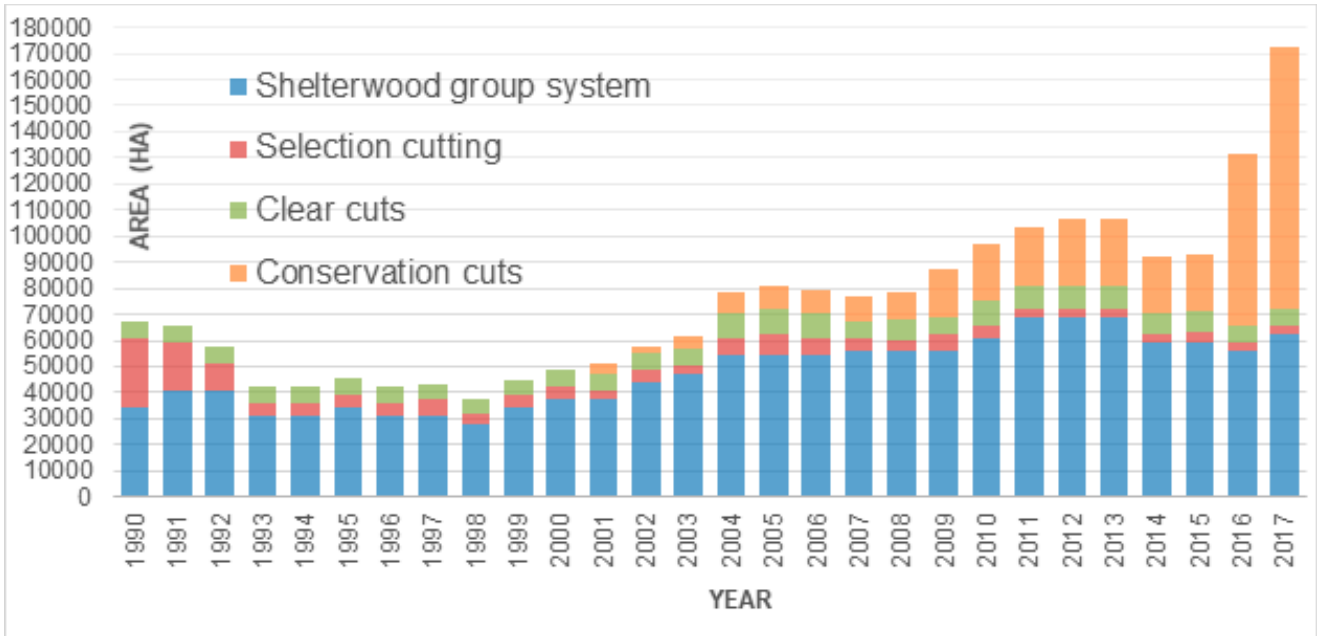


Figure 6: Harvesting methods and associated logging volumes in the period 1990 to 2017 (from Ciceu et al. 2019; based on data from the National Statistical Institute INS).

Box 9: IUCN Category Ia: Strict nature reserve and UCN Category II: National park (Dudley 2008, 2013)

Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring. Primary objective is: To conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/or geodiversity features: these attributes will have been formed mostly or entirely by non-human forces and will be degraded or destroyed when subjected to all but very light human impact. The area should generally:

1 Have a largely complete set of expected native species in ecologically significant densities or be capable of returning them to such densities through natural processes or time-limited interventions;
2 Have a full set of expected native ecosystems, largely intact with intact ecological processes, or processes capable of being restored with minimal management intervention;
3 Be free of significant direct intervention by modern humans that would compromise the specified conservation objectives for the area, which usually implies limiting access by people and excluding settlement;
4 Not require substantial and on-going intervention to achieve its conservation objectives;
5 Be surrounded when feasible by land uses that contribute to the achievement of the area's specified conservation objectives;
6 Be suitable as a baseline monitoring site for monitoring the relative impact of human activities;
7 Be managed for relatively low visitation by humans;
8 Be capable of being managed to ensure minimal disturbance (especially relevant to marine environments).

Category II are large natural or near-natural areas set aside to protect large-scale ecological processes with characteristic species and ecosystems, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities. Primary objective is: To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation. To be able to achieve this, the protected area may need to be complemented by sympathetic management in surrounding areas. The area should generally:

1 Contain representative examples of major natural regions, and biological and environmental features or scenery, where native plant and animal species, habitats and geodiversity sites are of special spiritual, scientific, educational, and recreational or tourist significance.
2 Be of sufficient size and ecological quality so as to maintain ecological functions and processes that will allow the native species and communities to persist for the long term with minimal management intervention.
3 Be to a great degree in a "natural" state in terms of composition, structure and function of biodiversity or have the potential to be restored to such a state, with relatively low risk of successful invasions by non-native species.

7.3 The Carpathian Foundation project

The creation of the Fundația Conservation Carpathia (FCC, Foundation Conservation Carpathia)[3] in 2009 was inspired by feelings of disappointment, powerlessness, rage and fatalism when confronted with the overexploitation and destruction of virgin forests in the Southern Carpathians.

The Foundation is on a mission to create a 250,000-hectare national park in the Făgăraş Mountains, around 60,000 hectares of which will either be acquired directly by the foundation or protected by means of a private compensation programme. The initiative for this visionary project came from Christoph Promberger and his wife Barbara Promberger-Fürpass, two wildlife biologists who came to the Southern Carpathians in the 1990s to research large carnivores. This visionary project, a joint effort by the Prombergers and the FCC, was prompted by the realisation that Romania's protected areas were not being managed with a view to conserving nature. This is also true of national parks that have existed since communist times. Since 2005, the retransfer of forest land to its former owners, be it the state, private individuals, municipalities or owners' associations, has caused major conflicts of use with the new owners; and the national parks

3 www.carpathia.org.

are no exception. Up until 1989, all forests were state-owned, including all areas in forest reserves. Since Romania joined the EU in 2007, more and more forests have been sold off, often directly to Romanian logging companies, and most of them were felled immediately in vast clearcutting operations, with disastrous consequences for the environment and nature. The FCC's simple but logical strategy was to buy up forests to spare them from clearcutting.

A happy coincidence brought Christoph and Barbara Promberger into contact with wealthy philanthropists from various countries who were willing to commit permanently to the project. Since 2009, the foundation has used these funds to buy around 25,000 hectares of forest, former high pastures and sites devastated by clearcutting. The latter have suffered large-scale, highly visible erosion of the degraded soil layers, and are now being painstakingly restored. The FCC has registered more than 1,000 hectares of characteristic virgin forest land for inclusion in the National Catalogue. One major problem was that an ownership title did not automatically empower the FCC to decide over hunting use. Hunting concessions are awarded independently by the state via an auction system, so the FCC decided to set up its own hunting associations, and secure long-term hunting rights not only over its own land, but also over an extended area of (currently) 65,000 hectares. This creates safe habitats for bears, wolves and lynx, as the new owners patrol their own "hunting grounds" to prevent poaching, illegal shooting, trophy hunting and sport hunting.

The FCC is committed to paying a fair market price for the land it buys to prevent speculative price hikes. This has prevented it from acquiring all possible sites to date. The FCC also attaches great importance to cooperation with and acceptance among the local population. The long-term goal of establishing Europe's largest forest national park can only succeed if local people are on board with the project and it creates value for them. The FCC now employs almost 100 people, most of whom are recruited locally, including professional hunters who used to take groups of well-heeled foreign trophy hunters on deer and bear shooting trips and now work as gamekeepers to protect those same animals from poachers. Local people's experiences in the area and their ability to identify with the new goals are vital for ensuring the project's success. Needless to say, the project is not without its opponents. A constant media presence is maintained to counter the omnipresent conspiracy theories in Romania – such as rumours that the local population will be displaced, that there are plans for a private zoo or a hunting ground funded by foreign capital for foreign billionaires, or that locals will be prevented from hiking and using firewood or berries. So far, the government has given scant support to the project.

The most recent FCC project involved releasing bison into the wild in the hope of establishing an independent population in the Făgăraş Mountains – not for hunting, of course, but to help establish a wilderness area and serve as prey for the large carnivores. There is evidence that bison were naturally present in the Romanian Carpathians until the 19th century, when they were exterminated. The first eight orphans were released into freedom in May 2020.

The three-toed woodpecker (*Picoides tridactylus*) is a character species of virgin and old-growth boreal coniferous forests throughout the Palearctic. According to studies by Bütler & Schlaepfer (2004), suitable forest habitats for the three-toed woodpecker are characterized by a threshold value of at least 50 m^3 of standing dead wood (preferrably conifers) per hectare. (Photo: Matej Ferenčík, 2020).

8 The European Union and the debate over virgin forests in Romania

At a political level, various attempts have been made to address the aforementioned developments. For example, in 2015 Members of the Eurpean Parliament (MEPs) complained to the EU Commission about illegal logging in Romania, but no concrete action was taken by the EU institutions and illegal logging actually worsened, as outlined above.

Having evaluated various reports and satellite images, in November 2017 the United Nations Environment Programme also warned that illegal logging in Romanian virgin forests was one of the "most significant threats to sustainability" facing European nature conservation. But even this dire warning failed to achieve anything (UNEP 2017, Süddeutsche Zeitung 2019)[1].

In recent years, individual EU parliamentarians, such as Anna Deparnay-Grunenberg and Martin Häusling (the Greens in the EU Parliament), have organised a series of events in Brussels to highlight the problem of illegal logging in the Romanian Carpathians in contravention of EU law (Häusling 2020). The EU Commission finally initiated the first stage of an infringement procedure against an EU Member State by sending a letter of formal notice to Romania on 12 February 2020 (as per the Treaty on the Functioning of the European Union, TFUE, Lisbon Treaty) (EU 2020b, EMS 2020a, see also Box 10). Essentially, the letter of formal notice urges Romania to properly implement the EU Timber Regulation (see Box 11) and implies that the EU Timber Regulation has been violated, which also has consequences for other areas of the law (including the Habitats and Birds Directives). The letter from the EU Commission includes the following criticisms and requests for information (*inter alia*, RELR 2020a and b):

1. Many protected areas under the EU Habitats and Birds Directives still lack management plans, or such plans are completely inadequate.
2. Countless designated NATURA 2000 sites have disappeared without explanation.
3. Forest management plans have been drawn up without the necessary strategic environmental impact assessments, which furthermore contravene the EU Environmental Information Act because they are not publicly available.
4. Timber harvesting (usually clearcutting) in protected areas has been authorised without the environmental impact assessment required by the Habitats Directive.

Within the context of the EU's infringement procedure, in March 2020 EURONATUR and Agent Green presented photographic documentation of past and current silvicultural interventions in 18 NATURA 2000 sites. These interventions were deemed incompatible with sustainable use and characterised as large-scale destruction, which is prohibited under Romanian forest law. Large areas of clearcutting, many of them on sensitive slopes, also entail brutal transport logistics. Time stamps and precise GPS coordinates are provided to facilitate traceability. There has been no official response to the allegations. Specifically, the allegations concern the following Natura 2000 sites (including many areas in national parks):

- The Făgăraş Mountains (Munții Făgăraș) (ROSCI 0122) in the valleys of Sinca and Stramba, Ucişoara, Ucea Mare, Sambata, Cotil and Curpanului, Arpaselu, Laita, Arpaşu Mare, Boia Mica and the Vidraru dam.
- Domogled-Valea Cernei National Park (ROSCI 0069) in the Radoteasa Valley, the municipality of Cerna Sat, the Ciucevele Cernei limestone cliffs and Iauna Craiova.
- Nordul Gorjului de Vest (ROSCI 0129) with the Vija valley.

1 UNEP: United Nations Environment Programme.

- Semenic-Cheile Carașului National Park (ROSCI 0226) with the valleys of Toplita and Cosava Mare.
- Retezat National Park (ROSCI 0217).

The EU cannot or need not prosecute violations, except in the case of breaches of conservation laws. The according regulations and directives must be observed by all Member States; these include NATURA 2000 sites. However, this also means that infringements in other protected assets, such as the UNESCO World Heritage Sites, cannot be pursued because they do not relate to EU law.

An EU infringement procedure is complex and may take several years (EU 2012):

- The **first stage** is the Letter of Formal Notice. The Member State normally has two months to respond.
- **Second stage:** If the European Commission is not satisfied with the information provided by the Member State and concludes a suspected infringement of an EU law, it sends a "Reasoned Opinion" to comply and an obligation to report to the Commission on the measures taken to implement EU law, again normally within two months.
- The **third stage** of an infringement procedure is recourse to the Court of Justice of the European Union (CJEU).
- If a Member State is found guilty by the CJEU **(fourth stage)**, it must implement appropriate legal corrections and measures at national level within a set time limit.
- If the Member State refuses and the deadline expires, the Commission may ask the CJEU to impose a fine **(fifth stage)**.
- If a MS still refuses to implement EU law, ignores the CJEU ruling and does not pay the fine, the Commission can request a further infringement procedure under Article 260 of the EU Treaty. A further written warning with a final deadline **(sixth stage)** is given, at which point the Commission refers the matter back to the CJEU **(seventh stage)**.

The picture shows a forest road that was built between 2014 and 2016 with EU structural funding in a large privately owned forest area in the Făgăras Mountains (Natura 2000 site). The road runs partly through virgin and old-growth forests. It is just one of many examples of how the destruction of virgin forests in Romania was and is being planned and implemented permitted by official authorities. Usually an "environmental impact assessment" exists certifying that allegedly such projects promote the use of renewable energy and that there are no substantial environmental damages. Information about the forest owner at the time, SRT SilviRom Timber GMBH, based in Hamburg, is interesting and revealing: A major objective of the company is the acquisition, management, sale of and trading in agricultural and forestry land and products. As of 2020 the company belongs via further interconnections (e.g. SilviRom Forest GmbH & Co. KG; also headquartered in Hamburg) to the financial services provider Nordcapital GmbH. A sister company is SRN SilviRom Nawaro GmbH, which owns large forest areas in the Buzău region in the south-eastern foothills of the Romanian Carpathians. In 2015 it became public that this company was embroiled in a massive corruption scandal. It had bought around 5000 hectares of forest from a criminal syndicate that had acquired property titles through corruption in administration and politics. Nordcapital, headquatered in Hamburg, was founded in 1992 by the Rickmers shipping family and is one of the largest investment funds in Europe and active in many sectors. In 2015 the forest ownership of the SilviRom / Nordcapital complex in Romania included ca. 15,000 hectares that were managed by the Austrian Esterhazy group (RISE PROJECT 2015). (Photos: Ion Holban, 2020).

- If found guilty a second time, a fine is imposed, either as a lump sum or daily instalments, calculated as a percentage of the Member State's gross national product for the duration of its non-compliance with the CJEU's ruling **(eighth stage**).

However, very few infringement procedures (5%) are referred to the Court of Justice of the European Union (CJEU), either because (1) the EU Commission is sympathetic and accepts the views expressed, or (2) the MS responds to the first letter of formal notice and makes "adjustments", or (3) a political compromise is negotiated; this is the most common case.

Since response to the letter of formal notice and actions taken by the Romanian government were not satisfying, the EU issued a reasoned opinion on July 2, 2020. If the country's authorities fail to act again, the Commission will take a case before the CJEU, this is the theory. The Commission states verbatim in its reasoned opinion to the Romanian government (EU 2020d): "*The national authorities have been unable to effectively check the operators and apply appropriate sanctions. Inconsistences in the national legislation do not allow Romanian authorities to check large amounts of illegally harvested timber. In addition, the Commission has found that the Romanian authorities manage forests, including by authorising logging, without evaluating beforehand the impacts on protected habitats as required under the Habitats Directive and Strategic Environmental Assessment Directives. Furthermore, there are shortcomings in the access of the public to environmental information in the forest management plans. The Commission has also found that protected forest habitats have been lost within protected Natura 2000 sites in breach of the Habitats and Birds Directives. Having thoroughly analysed the arguments put forward by Romania following a letter of formal notice sent in February 2020, the Commission has concluded that the problems on the ground have not been addressed. Therefore, the Commission is now issuing a reasoned opinion.*

Box 10: EU Letter of Formal Notice to the Romanian government dated 13 February 2020 (Stage 1 of a possible infringement procedure by the EU Commission against a Member State, EU 2020a)

Commission urges ROMANIA to stop illegal logging

The Commission is urging **Romania** to properly implement the EU Timber Regulation (EUTR), which prevents timber companies from producing and placing on the EU market products made from illegally harvested logs. In the case of Romania, the national authorities have been unable to effectively check the operators and apply appropriate sanctions. Inconsistencies in the national legislation do not allow Romanian authorities to check large amounts of illegally harvested timber. In addition, the Commission has found that the Romanian authorities manage forests, including by authorizing logging, without evaluating beforehand the impacts on protected habitats as required under the Habitats Directive and Strategic Environmental Assessment Directives. Furthermore, there are shortcomings in the access of the public to environmental information in the forest management plans. The Commission also found that protected forest habitats have been lost within protected NATURA 2000 sites in breach of the Habitats and Birds Directives. Therefore, the Commission decided today to send a letter of formal notice to Romania, giving it one month to take the necessary measures to address the shortcomings identified by the Commission. Otherwise, the Commission may decide to send a reasoned opinion to the Romanian authorities.

The Commission's intervention follows a series of complaints submitted by Environmental organisations EuroNatur, Agent Green and ClientEarth. A chronology of the infringement procedure and background material is available on the ClientEarth homepage (ClientEarth 2020). Actually, a reasoned opinion also demands that the defendant EU member states responds within two months and takes action. But there have been no further publicly observable developments since. That was the reason why 83 Members of the European Parliament (including a number of MEPs from Romania) send a letter (dated November 11, 2020) to EU Commissioner for Agriculture Janusz Wojciechowsk and to EU Commissioner for Environment, Oceans and Fisheries Virginijus Sinkevičius on the subject of deforestation and illegal logging of Romania's primary forests[2]. This parallels with a written question (dated November 12, 2020) of MEP Victor Negrescu to the Commission[3] asking "*to provide further details*

2 https://violavoncramon.files.wordpress.com/2020/11/letter-meps-illegal-logging-in-romania.pdf.
3 https://www.europarl.europa.eu/doceo/document/E-9-2020-006155_EN.html.

Box 11: The EU Timber Regulation (EUTR) and the FLEGT Agreement (BLE 2020a, b)

EU Regulation No. 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market (European Timber Regulation, EUTR) is designed to prevent trade in illegally harvested timber and timber products in the EU. It prohibits the placing on the internal market of illegally harvested timber and timber products. The Regulation entered into force in all EU Member States on 3 March 2013.

The EUTR explains that illegal logging, i.e. the harvesting of timber in contravention of the applicable laws and regulations in the country of origin, has serious economic, environmental and social implications for some of the world's most valuable forest resources and the communities that depend on them. Furthermore, illegal logging leads to loss of revenue and undermines the efforts of operators to comply with the regulations. Serious consequences include deforestation, loss of biodiversity, greenhouse gas emissions and conflicts over land rights and resources (BLE 2020a).

Operators who place timber and timber products on the internal market for the first time must prove that the timber and timber products have been legally harvested. Proof of compliance with the due diligence regulations is required. The "due diligence system" includes, among other things, information on the nature and origin of the wood, facts about the supplier and procedures to assess and reduce the risk of timber originating from illegal logging. Operators may either set up their own due diligence system or use an approved monitoring organisation.

Traders, i.e. commercial operators who sell or buy timber and timber products already placed on the internal market, must ensure traceability by keeping detailed records of suppliers and customers.

The FLEGT licensing scheme for timber imports from partner countries (BLE 2020b) should also be viewed against the context of the EUTR. FLEGT stands for Forest Law Enforcement, Governance and Trade. FLEGT is based on "Voluntary Partnership Agreements" (VPA), voluntary but binding agreements related to the EU Timber Regulation. In a partnership agreement, partner countries commit to establish a control system to ensure the legality of exported timber products. Once control systems are in place, timber from partner countries may only be imported into the EU with a FLEGT licence. By issuing a FLEGT licence, the licensing authority of the partner country confirms that the timber products exported are of legal origin. Timber products supplied with a FLEGT or CITES licence are considered to have been legally harvested in accordance with the EU Timber Regulation. This exempts the operator from observing the "due diligence system" outlined in Article 6 of EU Regulation No. 995/2010.

In Germany, the Federal Office for Agriculture and Food (BLE) collaborates with the customs agencies when timber is imported from partner countries. The cargo is not released for free circulation until the FLEGT licence presented by the importer to the BLE has been scrutinised and accepted. Indonesia is currently (since 15 November 2016) the only country permitted to issue FLEGT licences for its timber supplies to the EU as proof of legal origin. However, this agreement harbours a wealth of political contradictions and delusions, since it is widely known that Indonesia's rainforests are under extreme threat from overexploitation (fires, deforestation, illegal logging) and are disappearing at a rapid rate (Chitra & Cetera 2018, among others). Apart from Indonesia, six other countries currently have signed partnership agreements (FLEGT Partner Countries): Vietnam, Ghana, Cameroon, Liberia, the Congo Republic (Brazzaville) and the Central African Republic. To date, however, none of these countries has an operational system to verify legality.

regarding the measures it plans to take to assist Romania in putting an end to illegal logging and protecting its natural resources, in line with European practice in this area and with sustainable development principles?"

As of January 2021, we still await to see how the Romanian government responds and acts and, if appropriate, to further EU action (see also POLITICO 2020). It may also be that agreements have already been reached (or will be made soon) with the Romanian government and the infringement procedure will therefore be completed shortly from the EU perspective. This assessment can be derived from a reply (dated January 12, 2020) from the EU Commission to the group of MEPs who inquired about the status of the infringement case at the Commission in November 2020 (EU 2021). The Commission also explicitly states in this response "*that the Commission services do not have the competence to conduct on-site inspections in Member States in order to investigate compliance with EU law in the area of environment; this falls exclusively within the responsibility of Member States".*

The association of Romanian forest owners Nostra Silva gave a piquant reaction to the letter from the 83 EU parliamentarians with vast accusations: It is a confused compilation of verifiably false and twisted facts, of conspiratorially constructed nonexistent connections and dangerously slanderous personal attacks to individual EU parliament members[4].

4 https://violavoncramon.eu/2020/11/19/reply-to-nostra-silva-on-illegal-logging-in-romania/.

9 Latest developments in the protection of virgin and old-growth forests in Romania

In Romania, caution is advisable when analysing and evaluating opinions, "established facts", and almost any social or political issue; this applies across the board to all stakeholders. Deliberately false, unchecked information and partial truths are flagrantly placed in the public domain, causalities are established without any connection, and conspiracy theories are rampant.

The existence of criminal cartels is common knowledge, and with it comes the fear of repression and personal harm. In short, a general sense of distrust prevails across large parts of society, and it can be time-consuming trying to overcome this obstacle to discourse. There are reasons for this social phenomenon, and allowance must be made for it when interpreting many political activities, even within the context of this report.

As is the case in many former Eastern Bloc states, only limited, faltering efforts have been made to process the political legacy of the Ceauşescu dictatorship (cf. *inter alia* MDR[1] 2016, NZZ[2] 2020). In 1999, Romania became one of the last Eastern European countries to legalise the evaluation of its secret service files. At that time, the files were under the administration of the National Intelligence Service (SRI), the successor to the notorious Securitate. As such, it comes as little surprise that only a tiny proportion of tormentors under the dictatorship, especially the omnipresent secret service, have been exposed to date.

According to the CNSAS (Consiliul Național pentru Studierea Arhivelor Securității, National Council for Research on Securitate Archives), less than 0.1% of unofficial staff have been investigated, and around 8% of official staff. Many former Securitate employees simply slipped into the new system virtually unscathed, forged good careers and held positions in politics and business; some are still active today or have established new dependency systems (networks). A commentary by MDR (2016) states "*The profiteers of the Ceaușescu dictatorship are the winners all over again. They have well-paid jobs or receive above-average pensions for their former secret service functions. They use this capital to fund elite schools and studies abroad for their children and secure good jobs for them with the state. Many Romanians are hugely disappointed. "The children of our rulers will be the rulers of our children" is a commonly heard statement, voiced with resignation.*

Current discussions in the forestry sector focus on the results of the national forest inventory, published by Minister Costel Alexe (Minister for Environment in the period 11/2019 until 11/2020). Based on the average annual growth rate, the theoretical total timber stock, minus the official logging figures, the report identifies some 20 million solid cubic metres of timber that remain unaccounted for each year. Such a significant amount cannot simply have vanished or be written off as a statistical inaccuracy. Exhaustive attempts to uncover the truth remain ongoing. However, it would be a mistake to over-hastily accept any one statement, regardless of its originator. A selection of interpretations is provided below (including RISE Project 2019, WWF 2019, EDJN 2020, Fordaq 2020, Klimareporter 2020):

1. Critics, especially many NGOs, cite this as evidence of illegal logging by a cartel of administrations, forest owners and industry, and have used the Environment Minister's statement as the basis for high-profile media campaigns against "overexploitation and deforestation" in Romania.

1 Mitteldeutscher Rundfunk.
2 Neue Zürcher Zeitung.

2 Some politicians and academics cite unrecorded felling of timber for private use as fuel as a possible explanation. Around 3.5 million households in Romania are said to be wholly reliant on wood for their heating. Assuming an annual consumption of 4 to 6 solid cubic metres per household, demand (actual use) could be estimated at around 15 to 20 million solid cubic metres, which might explain the gap; see also the expert opinion on the extent of firewood use by the Romanian anti-trust authority (CCR= Consiliul Concurenței România 2019). Most of this firewood is felled in private and municipal forests, it alleges, but does not appear in the official statistics due to the desire to avoid taxation and is therefore considered illegal. This demand for timber would have been considered "customary law" in communist times and recorded with varying degrees of accuracy, which explains the much higher official felling figures compared to today. This hypothesis makes sense, since in Germany, statistics likewise omit this type of large-scale wood use (firewood harvesting from private forests and larger volumes of "felling residue" are not recorded). If this hypothesis is correct, then the actual annual felling figure must be much higher than the assumed 40 million solid cubic metres, because the illegally felled share of roundwood for commercial and industrial use has been disregarded.

3 According to another hypothesis put forward by representatives of the Romsilva State Forestry Administration and the timber industry, the timber volumes recorded in the balance sheets only refer to saleable timber, i.e. cubic metres of harvest according to the German harvesting method. In fact, there is a methodological discrepancy of about 20% between the estimate unit used in inventories (standing gross volume) and cubic metres of harvest. In practice, however, Romania's statistics only include an estimate of the standing timber before felling, and the actual harvest volume is never measured, so this hypothesis seems implausible. In addition, as previously mentioned, it is common for the forest administration, which estimates and approves the number of cuts, to under-report the volume for accounting purposes, which in turn is reflected in the statistics. Combined with the corrupt practices described above, this would imply a much bigger harvest than is shown on the books.

Box 12: EU Regulation 2018/841 (Land Use, Land Use Change and Forestry Sector LULUCF) (EU 2018)

The key aim of the EU's energy and climate policy is to reduce greenhouse gas emissions by at least 55% for the year 2030 compared to the 1990 reference level (EU 2020b). The land use, land use change and forestry sector (hereinafter "LULUCF") offers considerable potential for helping to meet the Paris Agreement. Because this sector can make active changes (both positive and negative) comparatively quickly, it has been identified as an independent pillar of the EU's climate action policy. The study by Öko-Institut Freiburg (Öko-Institut 2019) offers a useful overview of the Regulation. EU Regulation 2018/841 (LULUCF) establishes mandatory, country-specific accounting and offsetting rules for emissions in the LULUCF sector, including the requirement for regular reporting. Among other things, the forestry sector is required to submit a "National Forestry Accounting Plan". The accounting provisions of the LULUCF Regulation build on existing accounting and offsetting rules and initially apply to the period 2021 to 2030. Specifically, some of the key objectives are: (1) Country-specific accounting parameters and targets; (2) The LULUCF sector in any given country must not generate net overall emissions; and (3) In the long term, substantial sinks must be made available. Each Member State is required to keep accurate, up-to-date records of emissions and sinks and ensure that the accounts and other data reported under the LULUCF Regulation are precise, complete, consistent, comparable and transparent. Romania was the only EU Member State to fail to submit its "National forestry accounting plan" to the EU by the agreed deadline of 31 December 2018 (CICEAU et al. 2019) and was therefore excluded from evaluation in the corresponding EU report (EU 2019c).

The controversy surrounding these figures, the discrepancy between logging statistics and the calculated missing stocks according to the forest inventory, have other political and legal (even global) implications: For example, Romania's National Forestry Accounting Plan, in accordance with EU Regulation 2018/841[3], is based on high growth rates and high stocks (Ciceu et al. 2019).

3 Under the EU's LULUCF Regulation (= Land Use, Land Use Change and Forestry Sector) of 2018, each EU Member State must offset carbon emissions from land use, land use changes and forestry by removing at least an equivalent amount of CO_2 from the atmosphere over the period 2021 to 2030.

This Regulation addresses the issues of carbon emitters, reservoirs and sinks in relation to land use. The regulation is one of three strategic levels for the EU and its Member States to meet the Paris Agreement targets (see also Box 12). The report for Romania assumes a mere 0.2 million additional solid cubic metres of wood that is (illegally) harvested each year. Given that forests play an important role as carbon sinks in the binding national climate action plans of EU Member States, based on the key parameters of inventories, growth and utilisation, this begs the question as to which statistics Romania used for the basis of its national climate action plan. The very high growth rates of 8.5 solid cubic metres per hectare asserted in the current Forest Inventory (IFN 2020) (if they are in fact true, or perhaps the upper range of the model calculations?) produce very high carbon sink effects for an official annual usage of just 18 million solid cubic metres, used to calculate national CO_2 emissions. On the other hand, if the harvest figure is closer to 40 million solid cubic metres per annum and more than half of this is used directly as firewood, the creditable sink effect will be much smaller. Scenarios for the development of the Carpathian forests under the influence of climate change also assume significant decreases in the carbon stocks stored in the aboveground biomass (Kruhlov et al. 2018).

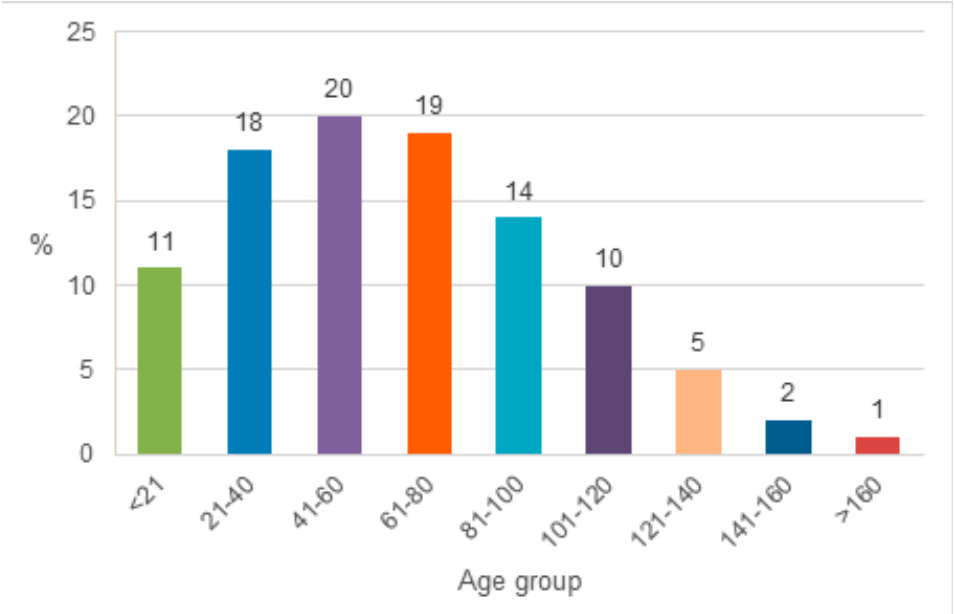


Figure 7: Age class distribution of forests in Romania, taken from the current forest inventory (IFN 2020). It is also an archive of earlier intensive use, as less than 20% of forest stands are more than 100 years old. In statistical terms, very ancient woodlands only account for 1%.

A good, validated forest inventory is an archive of information about past and present utilisation regimes. Assuming this is the case, Romania's data and its age class distribution (Fig. 7) suggests that 70% of forests are less than 80 years old and only 8% of forests are more than 120 years old. From a forestry perspective, this means that there very few large trees remaining in the forests, and those that do exist are concentrated primarily in the few remaining very near-natural, old-growth and virgin forests. Interest in and pressure on these rich reserves and the habitats they provide is therefore understandable, even if the trunk quality of many individual trees is poor.

Looking at the debate about the forest inventory, the interpretation and analysis of data, and the political conclusions that have been drawn, it is evident that since June 2020 the government has increasingly retreated from its initial position at the time of taking office in November 2019. For example, Environment Minister Costel Alexe has accused several NGOs of false information campaigns that are harmful to Romania. He denounced NGOs for allegedly reporting that huge quantities of timber are exported by rail and truck from Romania to other countries (RELR 2020b). However, our own research among NGOs that investigate illegal logging (WWF, Greenpeace, Agent Green, EIA, EURONATUR) found nothing to support his claim; we could not find a single such reference.

At the same time, the Environment Ministry has taken commendable steps to improve the protection of virgin forests and protected areas in general, such as national parks. For example, it plans to update forest legislation and take more concerted action against illegal logging with significantly increased penalties. An improved tracking system (SUMAL) is due to be launched in 2020, as outlined above (MMAP 2020c, e). Possibly in response to the European Commission's infringement procedure (see chapter 8), Costel

Alexe announced extensive improvements to protect forests in national parks. For example, 75% of state-owned forests in the vicinity of national parks were to be designated as strict protection zones, where intensive management is prohibited. He even explicitly highlighted the naturalness of national parks as an essential aspect of marketing these areas to tourists (MMAP 2020d). However, the Environment Minister's proposal was rejected by the opposition's parliamentary majority.

Some progress has also been made with the National Catalogue of Virgin and Quasi-Virgin Forests project, assuming that this is picked up by the responsible institutions and that Romanian governments continue to be guided by it. The good news is that the Catalogue will continue. In March 2020, the Environment Ministry presented a new guide to the mapping of virgin and quasi-virgin forests. Unfortunately, only marginal corrections were made to address the major methodological criticisms levelled at it (see chapter 7.1), and in fact have served to make the administrative procedures even more complicated (MMAP 2020c). No information is available as to whether the new procedures will be applied retroactively and whether rejected studies will be re-evaluated. It would be most regrettable if years of dedication by NGOs to produce high-quality studies had been in vain.

There is also some discussion (as of June 2020) of another attempt to commission studies (mapping) for National Catalogue sites, following the previous failure due to lack of funding. However, internally it has been suggested that only government or government-related institutions will be eligible. Given the negative experiences of the past and the ongoing unfavourable framework conditions, therefore, we cannot currently advise a private initiative to resume this time-consuming work.

The impacts of climate change on Central European forests over the last two years also affect Romania's virgin forests. Drought and subsequent calamities in Germany, the Czech Republic, Slovakia and Poland have led to unplanned felling on a vast scale, especially in spruce stands, producing quantities of timber that cannot be absorbed by national markets. The timber cannot be stored in these quantities and there is insufficient sawmill capacity available. Worst of all, there is insufficient demand, despite a dramatic drop in prices. In a curious twist, over the past two years, international companies with timber plants in Romania have been importing larger volumes of rough-sawn timber from the countries. For example, the HS Timber Group already imports more than half of its requirements mentioned above, allegedly because of Romanian bureaucracy (EDJN 2020). However, the real reason may lie in a combination of the incomparably

In virgin and old-growth forests, "catastrophic" disturbances can occur at any time. Large trees may collapse not only in the terminal phase, but also before. Causes are often storms, local vortex or when an old giant is thrown into the neighboring areas of the forest. Suddenly, larger, openings are created in a dense and dark stand. Minerals that come to the surface as a result of such events are important for the nutrition of the next generation of trees. The root plates, craters and earth mounds also provide ideal cave structures for many animal species. (Photos: Rainer Luick, 2012, 2016, 2019).

low prices for wood from the European calamity regions, the difficulty of legally procuring the desired quantities in Romania, and the shortage of certain varieties in Romanian forests.

In February 2020, Gheorghe Mihăilescu, Director-General of Romsilva, was dismissed under pressure from the Environment Ministry. This was due to a combination of factors, including scandals, political differences between Romsilva and the government, as well as Romsilva's current financial situation (DIGI24 2020). In June 2020, former Regional Director Teodor Țigan was appointed to replace him. However, it soon became clear that there are further confrontations ahead. During an interview with Teodor Țigan in June 2020, the well-known TV journalist and author Ovidiu Balint addressed allegations that Romsilva's 16,500 employees have received no or very irregular salary payments for some time (Balint 2020). When probed by Balint, asking when employees can expect their salaries to be paid and back-paid, Teodor Țigan remained vague, citing factors abroad and hinting at conspiracy theories affecting the Romanian forestry industry:

- The main financial problem, said Țigan, is large-scale imports of cheap wood from Germany and Austria. As well as being of poor quality, this wood is also a major source of disease and pests, he added.
- What is more, Teodor Țigan is convinced that campaigns by NGOs and the media surrounding alleged abuses and illegal practices in Romanian forests are financed by foreign governments to bolster their own interests. The images and videos produced as evidence, he claimed, were fake and had been staged abroad rather than in Romania (cf. also chapter 8 and Euronatur & Agent Green 2020).

A general observation and explanation of major disappointments a young Romanian forester has after entering state or private forest administration is (1) that practically all activities revolve only around logging, (2) that sustainable forest management principles are widely ignored and acted against even when officially being lined out in management plans, (3) that one is exposed to an intricate system of subordination and any kind of courageous personal initiative will immediately be suppressed.

Such perceptions parallels what in sociology is described as social context during the communist regime: the lack of interest for what is currently happening and auto-censorship and the absorption of each individual personality in a closed group with strict hierarchy (Neculau 2004). It is hard to understand why such a social context is so long lived in a democratic society – even 30 years after the collapse of the communist regime? One possible explanation is related to the still existing massive influence of informal education on all levels still relying on opportunistic behaviour as a stereotype.

The topicality of our report ends with events in December 2020 and January 2021: On December 6, 2020, there were parliamentary elections in Romania. How disenchanted with politics the Romanian population is and how little they rely on the effectiveness of democratic principles and their possibilities for change becomes clear from the turnout of only 32% of the electorate. The Social Democrats (PSD) went down to 30.5% of the votes but remained the strongest parliamentary group in the House of Representatives. Prime Minister Ludovic Orban's ruling liberal-conservative PNL party won 29% of the vote, well below their expectations; he himself announced his resignation on election evening. The eco-liberal party alliance USR-Plus[4], which was founded 2019 and received 15.9% of the votes, gives hope. In the run-up to the elections, the PNL and USR-Plus had announced a possible government coalition, but this will not be possible after the election results alone. Three Romanian centre-right parties (PNL, USR-Plus and UDMR[5], the party representing Romania's Hungarian minority) now signed a coalition agreement for a future government led by ex-banker Florin Cîțu. On December 23 (2020), Florin Cîțu, who

4 Coalition of the two parties USR: Uniunea Salvați România (USR) and PLUS: Partidul Libertate, Unitate și Solidaritate (PLUS).
5 UDMR: Uniunea Democrată Maghiară din România.

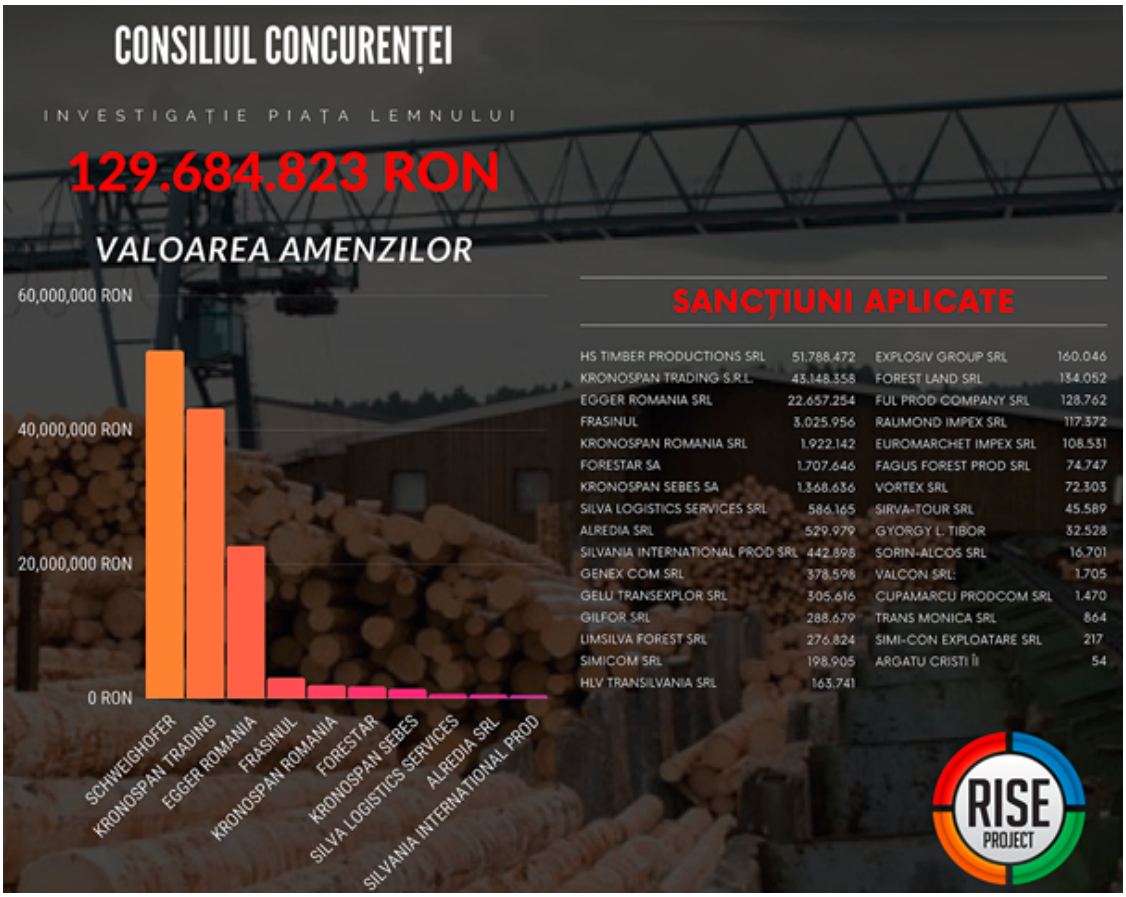


Figure 8: On January 21, 2021, the Romanian antitrust authority (CCR = Consiliul Concurenței România) sentenced 30 companies of the forest and timber sector, including the Austrian companies HS Timber Group (formerly Holzindustrie Schweighofer), Egger and Kronospan, to significant high fines. These are the highest fines ever imposed by the CCR. The judgment concerns violations of competition law in the years 2011 to 2016; basically, one can also speak of an anti-corruption sentence (CCR 2021, RISE Project 2021).

has served as Minister of Finance in 2020, was elected with majority as the new prime minister by the House of Parliament. The new minister for environment is now Barna Tánczos from the party of the Hungarian minority UDMR; banker by profession and in the previous government State Secretary in the Ministry of Transport. So far, Barna Tánczos has been conspicuous with his demand for a drastic reduction in the bear population: "*Romania is not the zoo of Europe*" (ADZ 2020b). It remains uncertain whether there will be significant improvements in the protection of virgin forests in Romania.

On January 21, 2021 the Romanian antitrust authority (CCR = Consiliul Concurenței România) issued a previously unprecedented court ruling on the subject of this report. It sentenced 30 companies of the forest and timber sector, including the Austrian companies HS Timber Group (formerly Holzindustrie Schweighofer), Egger and Kronospan, as well as several of their suppliers, to significant high fines (CCR 2021, RISE Project 2021). According to a settlement concluded with the Romanian state, 13 of these companies pay fines of around €26 million, of which HS Timber Productions SRL €10.7 million, Kronospan around €9.5 million and Egger almost €5 million (DerStandard 2021, see also Figure 8). They are the highest fines ever imposed by the CCR. The judgment concerns violations of competition law in the years 2011 to 2016. The following facts are explicitly named in the judgment of the CCR: (1) cartel formation in tenders, (2) disclosure of confidential information, (3) neutralization of competition; in principle, one could also speak of cases of proven corruption and its condemnation for it.

10 Outlook

There are thought to be between 100,000 and 150,000 hectares of virgin forest still remaining in the Romanian Carpathians; more precise data is not available.

Disregarding the boreal forests of northern Finland and Sweden, this would equate to between 50 and 70% of all virgin forests in the EU, the last remaining extensive areas of wilderness in the heart of Europe. There are thought to be a further 200,000 to 300,000 hectares of very old-growth and near-natural forests which would immediately qualify as protected areas in any other EU country. Yet in Romania, these categories of forest continue to vanish at a significant rate, even from protected areas such as national parks and Natura 2000 sites.

How do we ascertain what is reality, what are valid estimates, what are assumptions, and what is fake news from the statistics presented by various Romanian governments on illegal logging, which range from between 0.03 and 0.2 million solid cubic metres per year over the last 10 years, to between 8.7 and 20 million solid cubic metres? The explanation may lie in a combination of effects: unrecorded firewood removal, statistical and methodological effects and, of course, fraudulent, illegal large-scale timber harvesting. The enduring images of the Romanian Carpathians are undeniable: (1) large areas of clearcutting, often without any assured natural regeneration or follow-on plantings, even in protected areas, (2) streams that have been eroded and ravaged by timber transportation, (3) giant specimens of virgin forest trees left lying where they were felled due to the difficulty of removing them, and (4) local collection points for chopped wood, often obtained from ancient trees.

It is also important to stress that the forests and cultivated landscapes of the Romanian Carpathians are by far the most important habitats of brown bears, lynx and wolves in the EU. This is due to the expansiveness of many regions, the low density of transport infrastructure and human settlements, limited tourism, reasonable wildlife management, and until 20 years ago, limited forestry measures in many regions, despite the aforementioned abuses. Furthermore, forest types in many regions (excluding the North, and without valuing the approach to forest management) are still comprised predominantly of site-typical tree species.

The criticisms levelled at Romania are representative of many regions around the world where the exploitation of resources is at stake. The failure of governance structures in Romania is only part of a larger truth, and the overexploitation and continuing disappearance of Europe's unique natural heritage is due to a multitude of factors; Romania is both perpetrator and victim here. This includes competition-driven companies on the supply side in search of the cheapest possible raw materials, as well as processors and customers on the demand side for whom the price of a resource or product is a pivotal consideration.

Romania is a poor country with generally low wages and subsistence economy that is still predominant in some rural regions. Especially in the rural regions of the Carpathians, the forest is often the only reliable source of income for many municipalities and small private forest owners, as well as the basis for housing, heating and therefore basic survival. Enforcing protection requirements and demands by imposing bans and sovereign powers is not a sustainable strategy, because it does not create solidarity or encourage citizens to lend their support to protection and conservation strategies for the last remaining virgin forests. Such misplaced approaches will most likely be interpreted as arrogance from wealthy Western and Central European countries. For example, Germany has long since lost all its virgin forests, and we are still a long way from the targets of "2% wilderness" and "5% of Germany's forests to be permanently left to develop naturally on a legally binding basis" as formulated in the 2007 National Biodiversity Strategy (see also Engel et al. 2016). In countries like Romania or the Ukraine, this

complex combination of industrial, entrepreneurial greed, a willing administration backed by the approval of political structures and the supply interests of resource owners is the result of unscrupulous, immoral global demand. Unlike the tropical and Nordic forest regions, this felling is taking place "on our doorstep" and in front of our eyes. Specifically, we would call for the following:

1 It is surely in the interests of Europe as a whole to conserve and protect the last remaining extensive virgin forests in Central Europe. The Carpathians play a central, irreplaceable role as an enclosed conservation landscape for European woodlands where the original populations of large carnivores can be protected.

2 The EU has set ambitious targets in its new Biodiversity Strategy 2030, including the protection of virgin forests, and is urging the strict protection of all remaining virgin and old-growth forests (EU 2020c). However, these goals cannot be met unless the Parliament and the European Commission work in parallel to adopt clear and detailed guidelines on implementation, coupled with a system of control mechanisms and sanctions for infringements. Attractive, reliable, long-term funding programmes (compensation for non-use), in turn, must accompany this. Private and municipal forest owners are perfectly entitled to demand financial compensation for the permanent non-utilisation of resources.

3 We need creative ideas and concrete initiatives to integrate wilderness areas into regional development concepts to establish sustainable value chains with inclusion of local acteurs (e.g. Kozak et al. (2013). Simply limiting access to these impressive forests to a few specialists will not be enough. Financial resources must also be made available, and assistance given to our Romanian partners to aid implementation. Our efforts should focus on promoting genuinely sustainable projects that do not jeopardise the area's unique ecological qualities.

Natural watercourses in areas with virgin and old-growth forests are special and fascinating habitats in themselves. A characteristic feature of such running waters is the high proportion of wood in all dimensions. Wood in rivers is constantly changing flow features and creates new structures and habitats (Photo: Martin Mikoláš, 2019).

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This report provides an overview of the distribution and situation of the last remaining large-scale virgin forests in Central Europe, with a particular focus on Romania. Most people usually associate images of destruction of forests with tropical rain forests, e.g. of the Amazon and Borneo. But this also takes place right here on our doorsteps. We in Europe share a global responsibility to protect our unique, irreplaceable natural heritage. These Carpathian forests are some of the last remaining wildernesses, and a precious archive of biodiversity, history, of impressive images and beauty. As consumers, processors and sellers of timber and wood-based products we all have responsibility to stop the pressures placed on these forests, and have the duty to protect this natural heritage for future generations.