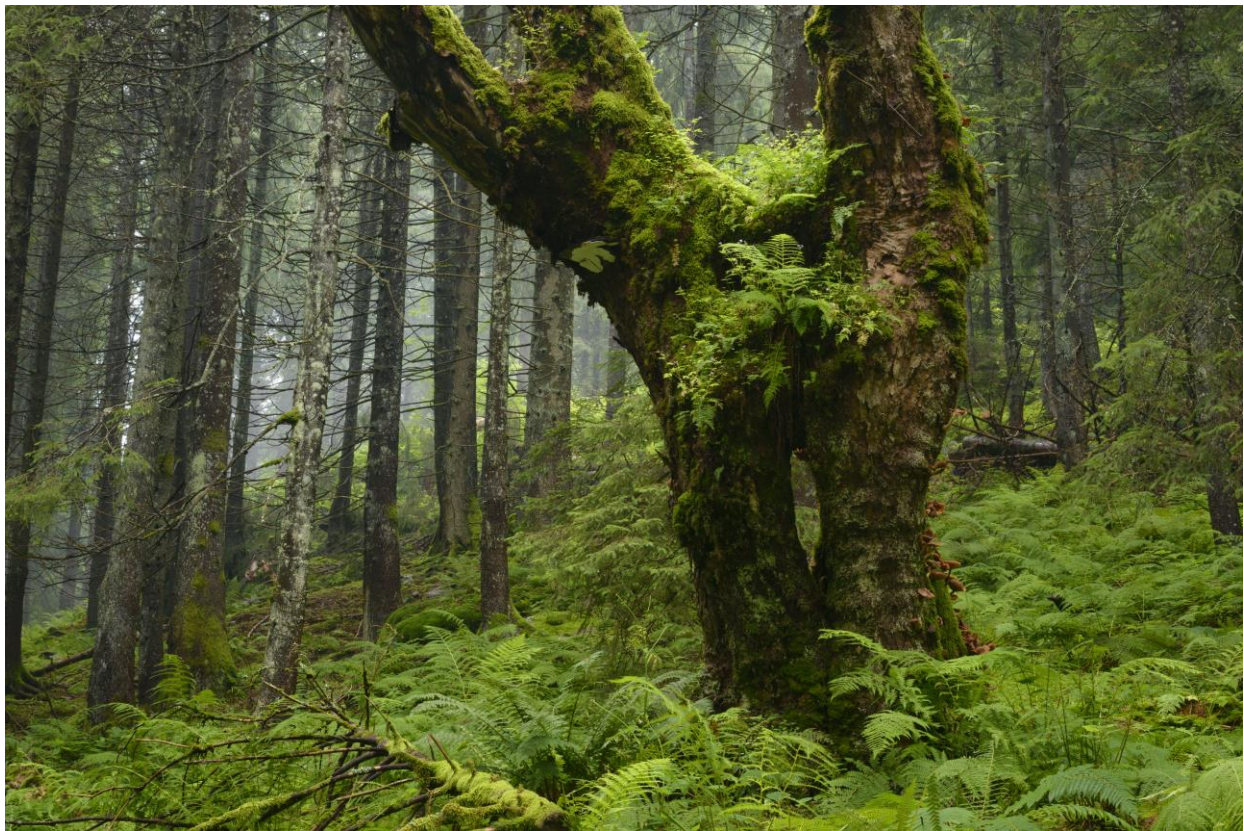


PRIMOFARO - Inventory of Potential Primary and Old-Growth Forest Areas in Romania

Identifying the largest areas of intact forests in the temperate zone of the European Union



Report commissioned by EuroNatur Foundation

euRONATUR FOUNDATION

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About EuroNatur

EuroNatur is a nature conservation foundation based in Radolfzell, Germany. Our efforts for a Europe with free-flowing rivers, ancient forests and a rich variety of cultural landscapes are trans-boundary in nature; we strengthen local conservation organizations and create international networks between them. Together with our Europe-wide partner network we create solutions that allow humans to live and work in harmony with nature. Our aim is a powerful network committed to protecting our European natural heritage.

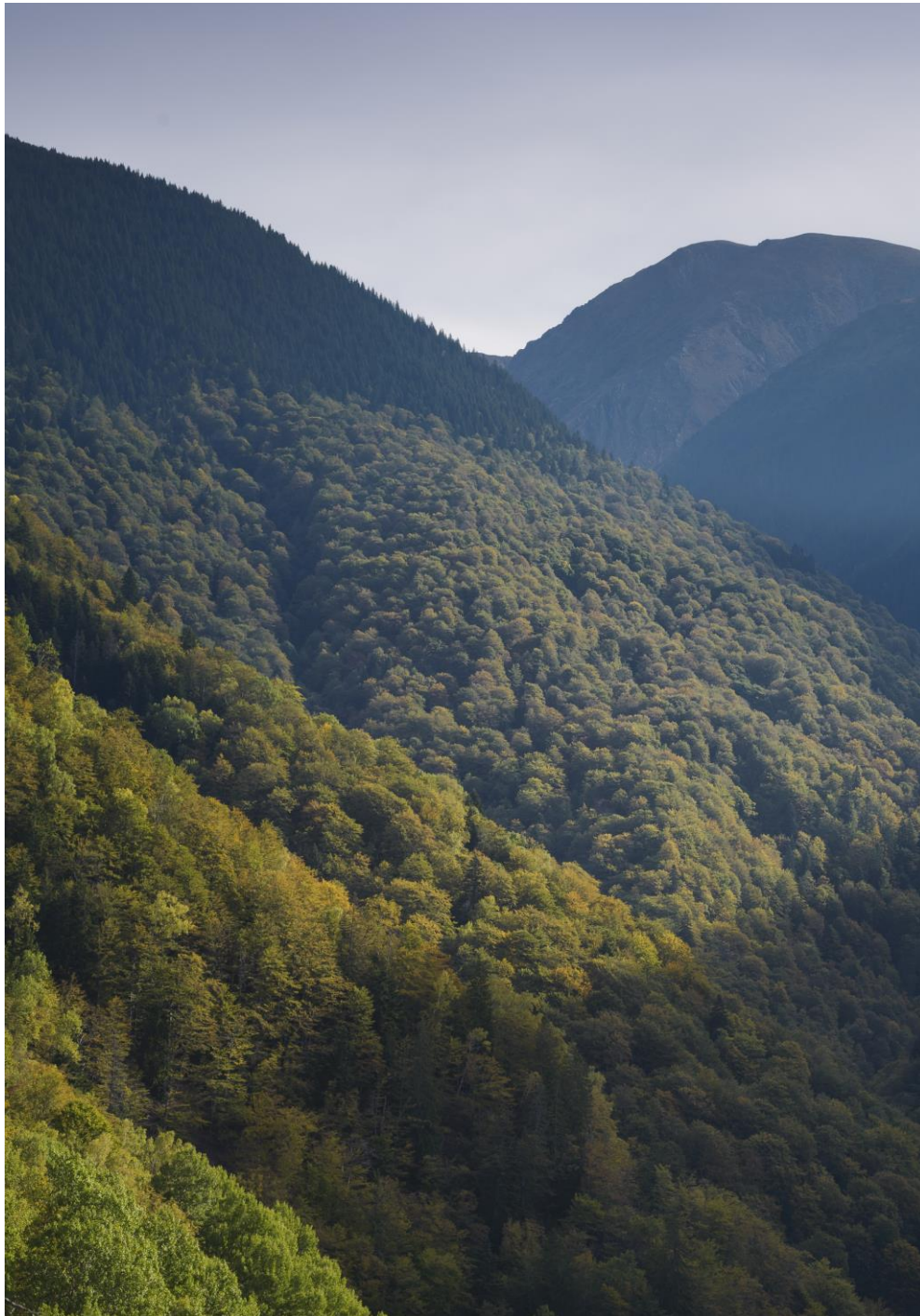


Image 2: Pathless, but unprotected: Boia Mica Valley in Fagaras Mountains Natura 2000 site harbours one of the most valuable remains of forest wilderness in Europe. It is approximately 1,000 hectares of primary mixed beech and mountain spruce forest - including some of Romania's oldest trees (Photograph: Matthias Schickhofer).

Image 1 (front page): Ancient sycamore tree in Sambata valley in Romania's Fagaras Mountains Natura 2000 site. This high biodiversity value subalpine primary spruce forest is not protected from logging (Photo: Matthias Schickhofer).

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Abstract:

In 2005, a forest inventory revealed that Romania still hosted almost 220,000 hectares of “virgin” forest (*Pin Matra* project; Biris and Veen 2005). This constituted the largest tracts of primary forests in the European Union (EU) outside of Scandinavia. However, since this time, numerous reports by non-governmental organisations (NGOs) and media have indicated that logging, both legal and illegal, poses an ongoing threat to this important natural heritage. According to NGOs, despite legal improvements, a substantial portion of the areas that were mapped in 2005 have since been lost. So far, conservation efforts have been restricted almost exclusively to strictly defined “virgin” forests. Other close-to-nature forests with high biodiversity value (primary and old-growth forests) lack effective protection and are disappearing due to logging operations.

A major obstacle to forest conservation efforts is the lack of contemporary data about sites and the extent of intact natural forest ecosystems that should be protected under EU Natura 2000 legislation and international conventions such as the Convention on Biological Diversity (CBD). For this reason, EuroNatur Foundation commissioned a thorough analysis to provide up-to-date and detailed information on the remaining old-growth and primary forests in Romania, including areas beyond the narrow scope of the Romanian definition of “virgin” forests.

This data was compiled by visual analyses of satellite and aerial images (as provided by Google Earth) over an exhaustive period of more than a year. Existing primary forest inventories were evaluated and other areas were examined for intact remains of primary and old-growth forests. A set of defined criteria for identification of potential primary and old-growth forests was developed and applied. Sample images of confirmed primary forests and data from several field missions were used for calibration of the remote sensing search.

The resulting polygons were validated by performing overlays with historic satellite images of Romania from the 1960s for 12 focus regions with high densities of natural forests. Some smaller areas showing cuttings or roads were excluded from the digital map.

The final dataset for the entire country based on the focus region analysis and additional forest stands identified outside these areas reveals the potential existence of more than 525,000 hectares of primary and old-growth forest in Romania. This represents around 8% of Romania’s total forest cover.

This constitutes the biggest cluster of close-to-nature (old-growth and primary) forest in an EU country outside Scandinavia. However, only 116,589 hectares (or 55%) of the 2005 *Pin Matra*¹ inventory still appear to be in an intact status. 332,844 hectares (63%) are located within Natura

¹ The figure is based on the *Pin Matra* report (Biriş and Veen 2005) which revealed 218,000 ha of virgin forest. However, the GIS file provided by the Romanian Ministry for Water and Forests shows only 210,503 hectares. All calculations in the study are based on the official dataset. <http://www.mmediu.ro/articol/proiect-pin-matra-padurile-virgine-din-romania/2068>

2000 sites, which are overlapping with national parks. In these “protected areas” natural forests are not safe from logging.

Therefore, EuroNatur and its Romanian NGO partner Agent Green call on both the EU Commission and the Romanian government to take urgent action to improve protection of this unique European natural heritage.

Preface

The Carpathian Mountains harbour the largest remaining tracts of old-growth and virgin forests of the temperate zone of Europe, embedded in extensive mountain forest landscapes. Old-growth and virgin forests of the Carpathians are the most important natural heritage that Romania brought to the European Union with its accession in 2007. Romania has a long tradition in forest research and careful use as well as initiatives for forest protection (Stoiculescu 2007, Stoiculescu 2011 and Stoiculescu 2013 with a comprehensive bibliography). Large expanses of forests are located in protected areas of different categories including Natura 2000 sites under EU legislation.

The largest type of forest landscape in the Carpathians is dominated by beech and mixed beech forests. Their extraordinary importance is underlined by their recognition as UNESCO World Natural Heritage. The serial transnational World Heritage Site *Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe* consists of 78 component parts in 12 countries of Europe, covering 92,023 hectares of forests. Nearly two-thirds of this area is located in the Carpathian Beech Forest Region. Romania contributes 24,000 hectares (26%) to the site, the second largest portion of the entire area, after Ukraine (31%) and before Bulgaria (12%). This figure confirms the outstanding value and importance of the Romanian Carpathians for the protection of temperate deciduous forests worldwide. Former inventories such as the *Pin Matra* study (2005) have documented many more areas with high value natural forests in Romania.

However, since joining the European Union in 2007 and the opening of the national economy to the global market, the demand pressure on Romania's forests has increased dramatically. Nearly half of the virgin forests identified by the *Pin Matra* study have been lost. Logging and timber trade (legal as well as illegal) are a profitable business. Before the eyes of Romanian and European authorities, forests are clear-cut and the integrity and functionality of entire forest landscapes are destroyed. Even in national parks, Natura 2000 areas and buffer zones of World Heritage component parts, old-growth forests are degraded by intensive logging at industrial scales. The degradation of intact natural forest landscapes counteracts efforts to protect the World Heritage of beech forests and runs completely counter to their conservation aims.

Due to pressure from NGOs and civil society, illegal logging has seemingly been becoming more difficult through better control. However, reports suggest that illegal logging is nevertheless increasing and even legal logging leads to the destruction of old-growth forests and degradation of intact forest landscapes. The general protection of primeval forests by Romania's *National Catalogue of Virgin and Quasi-virgin Forests* is indeed a pioneering tool and a step in the right direction, but the identification of virgin forests and their recognition is a complicated and protracted process. While NGO experts and forest authorities argue over the definition and recognition of virgin forest areas, the forests themselves continue to be logged. For the conservation of the most important and largest natural forest treasures within the EU, an immediate moratorium of the logging in all remaining primary and old-growth forests is necessary.

The “Inventory of potential PRIMary and Old-growth Forest Areas in ROmania – PRIMOFARO” is a science-based pragmatic approach for the identification of natural forest areas in their topographic and ecosystemic context. After an overview of the forests, their history and the history of the protection of primeval forests in Romania, the methodical procedure of PRIMOFARO is presented in detail. It is based on defined criteria for visual identification of primary and old-growth forests on satellite and aerial images. The analysis of canopy structures, their calibration by sampling in the field, and the comparison with historical images allow reliable identification and assessment of primary and old-growth forests by experts with comprehensive experience in forest structures and dynamics.

The authors of PRIMOFARO have a comprehensive knowledge and experience of virgin forests all over Europe, as well as the critical view for a serious evaluation of the available data. Ulrich Schwarz and Matthias Schickhofer have created a great and deserving work without an expensive state research program. The results are impressive and shocking at the same time. On the one hand, significantly more intact forest landscapes have been preserved until today than expected; on the other hand, almost half of the primary forests identified fifteen years ago in the *Pin Matra* study have been destroyed in the meantime.

The remaining intact natural forest landscapes of the Romanian Carpathians are a unique treasure of Europe’s natural heritage. They are too valuable for shredder and planks. Their industrial exploitation and degradation is an ecological crime. They have to be strictly protected to fulfil irreplaceable ecosystem functions and to deliver longterm and sustainable benefit. The proposed solutions as well as the conclusions and recommendations for policy makers are consistent and must be strongly supported by civil society and implemented by politicians and responsible authorities.

Prof. Dr. Hans D. Knapp, Chair of the European Beech Forest Network e.V.

1. Why this study?

1.1. Romania is a prime harbour of the EU's last intact forest landscapes

Old-growth and primary (virgin) forests have become very rare in Europe. Less than 4% of the forests within the EU are in a more natural status, more or less “undisturbed by man” (Forest Europe 2015). Forests “undisturbed by man” means that the “natural forest development cycle has remained or been restored” and these forests “display the characteristics of natural tree species composition, natural age structure, deadwood components and natural regeneration, and no visible sign of human activity” (Forest Europe 2015). This figure also includes forests where there may have been human impacts in the past, but where the forest has had the chance to develop naturally again.

Romania holds the largest share of old-growth and primary forests within the EU outside of Scandinavia. However, this natural heritage is vanishing due to intensive logging. As a consequence, numerous scientists² and civil society organisations have been calling on the Romanian government and the EU to take action to halt the loss of these internationally important forest treasures and to preserve these fragile ecosystems on a large scale.

The degree of naturalness of Romania's forests is still exceptionally high in comparison to the rest of temperate Europe. However, critique by NGOs and other analyses (Knorn & Kuemmerle 2012) reveals that logging also has an increasing negative impact on the integrity of protected areas. This also threatens numerous forest dependent and protected species such as the capercaillie (Mikolas and Tejkal 2016).

Therefore, the remaining old-growth and primary forests of Romania need to be the subject of urgent and improved conservation efforts - as it should already be the case according to the Natura 2000 program and to international conventions such as the CBD.

It is crucial, experts and NGOs argue, to act quickly, because of the high speed of logging. In order to preserve the ecological integrity of these precious forest habitats - and the species that inhabit them - the comprehensive protection of larger, connected forest ecosystems is needed. If logging continues at the current pace, intact natural forest habitats will be even more fragmented and the establishment of larger protected areas will be less possible in several Romanian regions. A scattered system of small and isolated “forest museums”, surrounded by a landscape impacted by intensive logging, would not have the same ecological value.

It is of paramount importance that all primary and old-growth forests are conserved as comprehensively as possible.

² <https://www.saveparadiseforests.eu/en/200-scientists-and-forest-ecology-experts-call-on-romania-to-take-action-for-paradise-forests/>

Only the protection of larger connected complexes and natural (as well as semi-natural) forest landscapes will prevent vast areas in the Carpathians from ending up the same as highly degraded forests in other parts of Europe: isolated patches of natural forests within large areas of industrial forestry zones – including clear-cuts, even-aged monocultures and non-natural tree crops.

The aim of this inventory “**PRIMary Old-growth Forest Areas in ROMania**” (**PRIMOFARO**) is to provide a detailed and (as much as possible) validated map of the spatial existence of Romania's potential old-growth and primary forests to better inform and help enhance conservation programs.

This inventory study was commissioned by EuroNatur Foundation whose intent is to inform policy makers about the existence of these valuable forests and to initiate effective and targeted action that preserves their outstanding European natural heritage values.

1.2. No comprehensive mapping of all close-to-nature forests

Unfortunately, effective forest protection in Romania is difficult today as there is no sufficient knowledge about the full extent of Romania’s old-growth and primary forest remains.

The first systematic inventory of Romania’s “virgin and quasi-virgin” forest - the *Pin Matra* project - (Biris and Veen 2005) revealed approximately 218,000 hectares of these rare ecosystems. This number conflicts slightly with the *Pin Matra* dataset provided by the Romanian Ministry for Water and Forests of 210,503 hectares which was used as base for the analysis in this report.

However, there are indications of the existence of more primary and old-growth forests outside of the *Pin Matra* inventory. Therefore, the *Pin Matra* figure appears very likely to be an underestimate.

In 2017, Greenpeace published an inventory of potential virgin forests in the Romanian Carpathians (area of Carpathians Convention) based on computer analyses of satellite data (Greenpeace CEE Romania 2017). This comprehensive mapping indicated the existence of almost 300,000 hectares of primary forests. This work was used to inform the PRIMOFARO inventory.

However, desktop analyses and field trips gave indications that in addition to the previously mapped “virgin and quasi-virgin” forests, a significantly larger surface area of very close-to-nature forests exists in Romania. But these forests have not yet been comprehensively mapped.

Logging is happening at high speed within these forests. Efforts by the Romanian Government to protect these highly valuable forests are not able to keep pace with this development. Many NGOs have been calling for the rapid improvement and enlargement of protected areas in Romania.

For the development of effective protection schemes for high conservation value ecosystems, the exact location and delineation of potential protected areas needs to be determined. Without

detailed, contemporary knowledge about the location of old-growth and primary forest remains, this is hardly possible.

1.3. Public focus on “virgin” forest protection alone excludes large high conservation value ecosystems from conservation

To date, forest protection regulations and efforts in Romania have been almost exclusively focused on “virgin and quasi-virgin” forests, defined by a rather strict set of criteria for their identification, which are part of Romanian legislation. These criteria describe mainly mature development phases of virgin forests and determine (among other factors) that only those forests are to be protected where there is a frequent presence of dead wood and frequent presence of complex structures or frequently, multi-aged and relatively multi-aged structure. The areas should be difficult to access and have natural borders. These criteria exclude many original forest ecosystems (e.g. natural spruce forests developing after large scale wind falls). In such a case the very forest is still in an intact natural status, but may not contain frequent presence of dead wood and shows a more homogenous structure.

According to public criticism from NGOs and experts, these strict criteria have been used to exclude forests from protection, particularly where a single criterion is not considered by the authorities to be sufficiently fulfilled.

Furthermore, both with international legal obligations (such as the EU Nature Directives) and global nature protection regimes such as the Convention on Biological Diversity (CBD) or IUCN guidelines for protected areas, the indicator of whether a forest is considered “virgin” is not defined as the only criterion for its conservation.

There is no publicly available comprehensive database on the complete natural forest cover of Romania. For this reason, it was decided to expand the scope of this inventory and try to identify, in addition to potential primary forests, the most important natural forest stands.

The extent to which these mapped forest areas meet the criteria for “virgin and quasi-virgin” forests cannot be determined at this point without precise on-site inspections. But they very likely include a substantial share of “near virgin” forest remains according to forest classifications defined in literature (Buchwald 2005).

1.4. Ecological importance of old-growth and primary forests

Humankind and the biosphere are facing a serious combined global crisis: the catastrophic heating of the climate system and the rapidly progressing decline of the Earth’s natural ecosystems. As the “Global Assessment Report on Biodiversity and Ecosystem Services” (IPBES 2019) points

out, these two crises reinforce each other, leading to a dangerous, if not lethal, threat to human civilisation and millions of species.

In large parts of Europe, plantations and unnatural production forests are already severely damaged by drought, forest fires, storms and bark beetle calamities. Many experts are deeply concerned that Europe may lose a significant share of its forest area in the coming decades due to the effects of the climate crisis. However, natural forests are more resistant to disturbances caused by a rapidly changing climate. Experts point out that they should be preserved as refuges for stable and better-adapted forests and to support future reforestation efforts.

Thus, scientists and NGOs call for strengthened efforts to protect all remaining natural ecosystems, in particular oceans and intact natural forest landscapes. This also applies to Europe, where there are hardly any natural forest landscapes left. The huge areas of primary and old-growth forest in Romania deserve special attention in this regard.

Old-growth and primary forests are also important storages of carbon (Houghton 2013) and they show a higher resilience in relation to expected disturbances and stress caused by the climate crisis.

Also, the latest special report “Climate Change and Land” (IPCC 2019) underpinned the importance of intact forest ecosystems for mitigation of climate change.

Watson & Evans (2018) argue that, “maintaining and, where possible, restoring the integrity of dwindling intact forests is an urgent priority for current global efforts to halt the ongoing biodiversity crisis, slow rapid climate change and achieve sustainability goals. Retaining the integrity of intact forest ecosystems should be a central component of proactive global and national environmental strategies, alongside current efforts aimed at halting deforestation and promoting reforestation.”

Concerning carbon, intact forest ecosystems differ significantly from degraded systems: they store more carbon above and below ground. “Intact forests continue to function as major net carbon sinks, actively sequestering carbon into soils and living biomass.”

Intact forests regulate local and regional weather regimes and contribute to a reduced risk of droughts. They “have a positive effect on the redistribution of runoff, stabilise water table levels and retain soil moisture by altering soil permeability”. Furthermore, they “buffer human settlements against negative effects of extreme climatic events” and harbour “consistently higher numbers of forest-dependent species” than in degraded forests.

Natural disturbance regimes help to “sustain habitat resources, constitute selective forces to which species are adapted, or otherwise influence community composition.” Intact natural forests also contribute to reduced health impacts of wildfires.

Degraded forest ecosystems are more vulnerable to regional and global stressors. “Intact forests have been shown to be more resilient in response to short-term climatic anomalies (for example,

droughts and wildfires during drought) than degraded forests.” (all quotes: Watson & Evans 2018).

Intact primary forests have greater mitigation value than logged, degraded and plantation forests. They store “30–70% more carbon than logged and degraded forests”. “Keeping the current forest carbon stock intact and undisturbed from industrial land use, and promoting ecological restoration of degraded forest carbon stocks, is a critically important mitigation action if we are to avoid dangerous climate change” (Intact 2015).

1.5. Climate crisis and European forest cover

Recent droughts and the subsequent break down of large forest areas due to wildfires or bark beetle infestations have stimulated heated debates in several EU member states about the future of European forests. Forest ecologists have critically argued that the traditional industrial approach to forestry is a major contributor to the current forest crisis. Large plantations with trees not adapted to the ecological conditions of the location, practices of clear-cuts and creation of even-aged forests with reduced biodiversity has led to significantly degraded forest ecosystems, which show a high vulnerability to climate crisis impacts.

In the public debate, there seems to be a growing consensus that forest management needs to be turned into a close-to-nature forestry system including avoiding clear-cuts. The conversion to a more “climate proof” type of forestry is needed (see also: Reyer & Guericke & Ibisch 2009). Numerous experts and NGOs also call for a paradigm shift in forest management - from industrial wood production with plantations and large cuttings to a low impact and close-to-nature forest management approach - and reduced stress from logging on intact forest ecosystems.

2. Romania's "virgin" forests - and their protection

2.1. The situation of Romania's old-growth and primary forests

In the years after 2005 when the "*Pin Matra*" virgin forest inventory was published, Romania's forests were subjected to an intensified wave of logging. This negative development was partly fueled by restitutions of former forest owners, which allegedly happened largely illegally and in many cases were based upon forged forest ownership papers.

The wave of logging did not stop after Romania's accession to the EU in 2007, when Romania's Natura 2000 sites were declared. In fact, in many of the designated Natura 2000 sites such as Sites of Community Interest (SCIs) and Special Protection Areas (SPAs) logging even expanded, probably expressing some sort of "panic harvesting" before the EU rules and regulations were to be met.

Thus, a significant part of these identified virgin forests has been logged or degraded since their identification, as confirmed by NGOs and scientists in Romania. Due to a lack of contemporary inventory data it is not known exactly how much of these forests are still intact and where exactly they are located.

Despite national legal obligations to preserve "virgin and quasi-virgin forests" (Forest Act, Ministerial Orders 3397/2012 and 2525/2016 regarding protection of virgin forests) and EU regulations (Birds Directive 79/409/EEC and Habitat Directive 92/43/EEC), which stipulate protection of natural habitat types and listed species in a good conservation status, logging of virgin and natural forests is omnipresent in Romania.

Most of the high biodiversity value forest stands are located in mountain regions of the Carpathians, especially on steep slopes and in remote valleys, because historically they have been less accessible for timber exploitation. The main clusters of old-growth and primary forests are: Bihor mountains (incl. Apuseni), the so-called "Transylvanian Alps" (incl. Poiana Rusca, territories of Semenic - Cheile Carasului, Cheile Nerei - Beusnita, Domogled - Valea Cernei and Retezat National Parks, Valcan mountains, Parung mountains, Cozia National Park, Fagaras mountains, Pietra Craiului National Park) and the Eastern Carpathians (including Rodna and Calimani National Parks and Maramures mountains).

The Intact Forests Landscapes (IFL) initiative³ tries to identify large forest ecosystems exhibiting no remotely detected signs of human activity or habitat fragmentation and which are large enough to maintain all native biological diversity, including viable populations of wide-ranging species. IFLs have high conservation value and are critical for stabilising terrestrial carbon storage, harbouring biodiversity, regulating hydrological regimes and providing other ecosystem functions. The first global IFL map was prepared in 2005-2006. The only IFL in continental Europe was

³ <http://intactforests.org/>

detected in Romania, in the region of Retezat and Domogled - Valea Cernei National Parks and the Tarcu mountains. Due to ongoing logging and the subsequent loss of natural forests, the IFL area was removed from the list in 2015.

Today, no thorough inventory exists in the public that provides robust figures of the total area of remaining “virgin and quasi-virgin” forests and other “close-to-nature forests” that deserve protection for the natural values they possess.

In 2017, Greenpeace published a remote sensing-based inventory about “Potential virgin forests in Romania”, based upon assessment of satellite imagery and a sophisticated algorithm-based identification methodology (Greenpeace CEE Romania 2017). This inventory revealed 295,601 hectares of potential primary forests for the Romanian Carpathians.

In 2016, the interim technocrat government of Romania created a fund to conduct an up-to-date map of Romania’s “virgin and quasi-virgin” forests. Three years later, at the time of publication of this report (September 2019), this map still does not exist.

According to a public announcement by the Romanian Ministry for Water and Forests (May 14, 2019), the national forest protection program *National Catalogue of Virgin and Quasi-virgin Forests* includes only 29,063.58 hectares of forests under more or less strict protection. This represents only 0.4% of Romania’s total forest cover (approximately 7 million hectares) and only around 13% of the virgin and quasi-virgin forest surface identified by the *Pin Matra* inventory in 2005.

The *National Catalogue of Virgin and Quasi-virgin Forests* only considers forests for protection which meet rather strict criteria as defined by various Ministerial Orders (latest version by Ministerial Order 2525/2016). Several NGOs and scientists complain that the application process of virgin forest areas for this catalogue is “quite slow and cumbersome” (Biris 2017).

Experts also argue that there could be much more unidentified natural and primary forests which are still intact or only marginally degraded and thus still rich in biodiversity.

Ongoing calls by many NGOs (including Greenpeace, Agent Green and EuroNatur) for a logging moratorium of virgin forests have not yet led to any effective corresponding action by the Romanian government. In addition, in the absence of a detailed and contemporary map of Romania’s old-growth and virgin forest areas, it remains unclear exactly where these highly valuable habitats are located.

2.2. Forest cover and history

Europe’s primary forests developed after the last ice age, when forests slowly returned to the post-glacial tundra. For approximately 5,000-6,000 years, central Europe had been dominated by forests of European beech (*Fagus sylvatica*), before humans started to almost completely turn

the original forest cover into planted forests, farmland, settlements and other uses. At higher elevations of the Alps and the Carpathians (montane and subalpine zones) coniferous forests dominated by Norwegian spruce (*Picea abies*) have been largely shaping the landscape. The original forest cover of Europe has largely disappeared from central Europe. The largest remains of European old-growth and primary forests (outside Scandinavia and Russia) can be found today in the Carpathians, the Balkans, the Dinaric Alps and - as an isolated treasure - in the large forest complex of Bialowieza at the border between Poland and Belarus. Romania and Ukraine host the biggest shares of this important natural heritage.

Romanian forests cover about 30% (approximately 7 million hectares) of the country's territory. In particular, the entire arc of the Carpathian and Apuseni Mountains is covered by dense forests. The dominant species in the sub-alpine and alpine areas are beech forests (31%) followed by coniferous trees (26%), namely spruce and fir towards the mountain and high mountain ridges. The foothills forests consist mainly of hornbeam, acacia, ash and maple (20%), oak (16%) and finally poplar, willow and lime forests in the floodplains⁴ and lowlands (7%). Regarding age class, around 1 million hectares (15%) falls in the class > 100 years old (Biris 2017).

Most of Romania's old-growth and primary forests consist of pure beech forests (in the hills and in the southwest) and beech forests mixed with fir, spruce and deciduous trees (such as oak, ash and maple). In the montane and subalpine regions of the Carpathians also old-growth and primary spruce forest complexes have survived.

The forestry history, in particular the development within the past 150 years, has been analysed and discussed in detail (Biris 2017). Biris lists several scientific publications from the late 19th and early 20th century describing the special value of Romania's unexploited and virgin forests present on large surface areas.

An initial large deforestation event occurred back in the 18th century, when the Habsburg empire took over Transylvania from the Ottomans. Due to exclusive ownership of the majority of tillable land by the state and nobility, peasants were forced into the woods, to procure land for their subsistence. Romanian serfs lived under harsh circumstances, which also led to increased pressure on the formerly rarely used forests. In the late 18th century the Transylvanian forest surface (as well as wetlands and meadows) was drastically reduced. In the late 18th and the first half of the 19th century over 2 million hectares of forests were logged in Transylvania, Bucovina, Banat and Maramureş (Biris 2017).

The State's Forest Statistics issued by the Ministry of Agriculture, Commerce, Industry and Propriety (1906), stated, that "in the year 1905, only 22.7% (208,984.95 ha) of the surface of public domain forests has been exploited, the surface of the unexploited forests amounting to 709,840 ha" (Biris 2017). At that time, Romania was a much smaller country than it is today so this figure

⁴ http://www.mmediu.ro/app/webroot/uploads/files/2016-06-08_Rezultate_IFN.pdf

relates to an area that is less than one quarter of the size of Romania's territory today. Therefore, it can logically be expected that there was significantly more intact forest left at that time.

Biris points out "in the interwar and communists periods, the main factor which contributed to the preservation of large surfaces of virgin forests to this day was the lack of access available for man". In isolated and pathless mountain areas, "the forests were fortunately preserved, even though man-made management has included them in the economic circuit". Other important factors for the preservation of natural forests were "biodiversity preservation needs" or protective functions, such as:

- "old-growth forests of incommensurable value;
- forests whose purpose was to preserve rare species of indigenous fauna;
- forests situated on areas with a slope bigger than 30 (35) degrees, on cliffs and rocks;
- forests that can be found in higher altitude areas, on the superior border of forest vegetation;
- forests in river bed areas;
- forests found near avalanche-prone areas and their respective originating areas." (Biris 2017)

During the communist regime forestry was driven by economic objectives and cultivation of softwood species (such as spruce and pine) outside their natural growth areas and of exotic species (such as Douglas fir and Weymouth pine) as well as cultivation of cloned Euro-American poplars expanded. As a result, large areas of primary forests were lost. Only in the 1990s the vast old-growth and primary forests in the Carpathians received more attention and conservation efforts gained strength.

Biris also depicts an irritating picture of the forest debate in Romania, contributing to the unfortunate situation that these types of arguments disqualify these forests for protection under the Romanian *National Catalogue of Virgin and Quasi-virgin Forests*:

- "There are some voices, in the country and outside it, which are trying to advocate the fact that the Carpathians don't have any virgin forests left;
- all forests have been explored by woodcutters in the past and we are dealing exclusively with man-managed forests;
- the forests that do contain arboretum that is 140-160 years old are actually forests where trees have been selectively picked out;

- Such affirmations are coming either from an ignorance of the forest's history and implicitly of Romanian silviculture, either from the intention of questioning their preservation process that are currently being developed. " (Biris 2017)

2.3. Inventories of potential "virgin" forests in Romania

Since the year 2005 several inventories of primary ("virgin and quasi-virgin") forests in Romania have been prepared following different approaches and details:

- The Dutch funded *Pin Matra* inventory (Biris and Veen 2005) revealed 218,000 hectares (210,503 hectares⁵ used for the analysis) of virgin and quasi-virgin forest. The inventory was based on previous and fresh mapping as well as field validation in the years before 2005.
- A remote sensing analysis, funded by Greenpeace and conducted by University Eberswalde and University Iasi (Greenpeace CEE 2017), identified almost 300,000 hectares of potential primary forest.
- Data from the second cycle of the Romanian National Forest Inventory (NFI 2018) indicates the potential existence of 84,000 hectares of virgin and quasi-virgin forest (based upon forest age estimations and other information from official forest management plans).

In addition to this, WWF Romania has been evaluating numerous forest stands from the *Pin Matra* inventory and submitted some of these forests for inclusion in the *National Catalogue of Virgin Forests*⁶.

Independent scientific projects such as REMOTE forests project (led by Czech University for Life Sciences) or a primary forest mapping project (coordinated by German Hochschule für Forstwirtschaft Rottenburg / funded by Deutsche Bundesstiftung Umwelt) have been assessing numerous forests and collecting large volumes of data about intact primary forest areas in different regions of Romania.

Repeatedly, there have been debates among forest experts that significantly more old-growth and primary forest might exist in Romania than defined so far. This is especially the case if the very strict criteria for identification of "virgin and quasi-virgin forests" as defined by Romanian law would be opened to a more inclusive way, corresponding with international nature conservation approaches like the CBD and Natura 2000 framework.

⁵ Measured GIS data for provided data set

⁶ <https://wwf-ro.maps.arcgis.com/apps/webappviewer/index.html?id=31831d9db12c4e32ab5456c13952bfef&>

2.4. Legal framework for primary forest protection in Romania

Virgin and quasi-virgin forests are supposed to be fundamentally protected by the national Forest Code of Romania (Law 133/2015 for the modification and completion of law 46/2008) where it is stated that “Virgin and quasi-virgin forests will be strictly protected and included in the National Catalogue of Virgin and Quasi-virgin Forests”.

The Ministerial Order 3397/2012 by the Ministry for Environment, Water and Forest has defined a set of criteria and identification indicators for virgin and quasi-virgin forests and banned logging of intact virgin and quasi-virgin stands which had been identified by the *Pin Matra* inventory in 2005. It has been the responsibility of the provincial forest guards to determine whether a forest parcel was still intact or degraded. However, logging of formerly registered virgin and quasi-virgin stands continues all across the country and this legal regulation has more or less not been implemented.

The Ministerial Order 1417/2016 (also issued by the Ministry for Environment, Water and Forest) approved the setup of the “National Catalogue of Romanian Virgin and Quasi-virgin Forests”. This created a tool for registration and management of the virgin and quasi-virgin forests of Romania.

The Ministerial Order 2525/2016 modified the Order 1417/2016, as a series of deficiencies and incongruences had been criticised by experts and NGOs because they were blocking the process of identification and mapping of forests and creating bureaucratic burdens preventing the voluntary contributions (mainly from NGOs) to assist in populating the catalogue. Previously, the mapping work for this state protection program was largely left to the efforts of civil society organisations and experts commissioned by them.

Another big obstacle for effective forest protection was the lack of public compensation funds for private forest owners. This is despite the fact the Forest Code (2015; page 97 line 1) stipulates economic support from the annual state budget (public central authority’s budget for silviculture) for “compensations representing the equivalent of products that are not harvested by owners due to protection functions established by forest landscapes, which determine some restrictions concerning wood gathering.” In 2017, the EU confirmed that such compensations were not violating the “internal market” and a budget of 63 million EUR was provided by the Romanian Government for the period 2017 - 2020.

Romania ratified the Convention on Biological Diversity (CBD) in 1994, which commits the country to action preserving and restoring its natural heritage.

The EU Biodiversity Strategy 2020⁷ aims to halt the loss of biodiversity and ecosystem services in the EU. It was set up to reflect the commitments accepted by the EU in 2010, based upon the aims and objectives of the CBD. The strategy calls for “growing of agricultural and silvicultural

⁷ https://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

contribution in order to maintain and enrich biodiversity”. Action 11 includes the activity of “Encouraging forest owners towards protecting and enriching forestry biodiversity” and Action 12 defines the “Integration of measures concerning biodiversity in forest management plans”, which features measures for protecting wild areas (Action 12) and adoption of new mechanisms (e.g. payments for ecosystem services) in order to finance the maintenance and reconstruction of ecosystem services provided by the multifunctional forests (Action 11b).

Target 3b of the EU Biodiversity Strategy 2020⁸ aims to “Increase the contribution of forestry to maintaining and enhancing biodiversity”. In detail it states “By 2020, Forest Management Plans or equivalent instruments, in line with Sustainable Forest Management (SFM), are in place for all forests that are publicly owned and for forest holdings above a certain size (to be defined by the Member States or regions and communicated in their Rural Development Programmes) that receive funding under the EU Rural Development Policy so as to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by forestry and in the provision of related ecosystem services as compared to the EU 2010 Baseline.”

Most of Romania’s old-growth and virgin forests are located within Natura 2000 sites, which have been established under the provisions of the EU’s Habitats and Birds Directives. These two directives require that Member States prevent the further deterioration of listed habitat types and species and to undertake positive management measures to ensure a favourable conservation status of habitats and that populations of protected species are prospering (in both quality and extent/population) and have good prospects to do so in future as well.

In detail, the first two paragraphs of Article 6 of the Habitats Directive require Member States to:

- “Establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites (Article 6(1))”;
- “Take appropriate steps to avoid the deterioration of natural habitats and the habitats of species as well as the disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive (Article 6(2)).”⁹

All plans or projects which are likely to have a significant effect on protected habitats and species shall be subject to an appropriate assessment of the implications for the site in view of the site’s conservation objectives.

⁸ <https://biodiversity.europa.eu/mtr/biodiversity-strategy-plan/target-3b-details>

⁹ Habitats Directive 92/43/EEC: https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

However, the Nature Directives themselves do not explicitly refer to the need for conservation of old-growth or primary forests nor do they distinguish between natural/primary forests from secondary/production forests, as scientists have done whilst calling for prioritisation for protection of the world's primary forests (Mackey et al. 2015).

But, old-growth and primary forests are undoubtedly representing natural habitats in a very "good conservation status". Thus, any significant deterioration (such as logging) should be considered as not compatible with the provisions of the Nature Directives.

The disappearance of old-growth and primary forests is an indication that national legislation, commitments given under the CBD or the legal obligations deriving from Natura 2000 are not being implemented properly.

A significant proportion of Romania's old-growth and primary forests are included in Romania's 13 national parks. They cover around 317,000 hectares, which is the equivalent of 1.3% of the Romanian territory. Romania hosts approximately 7 million hectares of forests (according to the latest National Forest Inventory¹⁰). Approximately 240,000 hectares of forests are within national parks, equivalent to around 1% of Romanian territory and about 3.5% of Romanian forests. In the core zones of Romanian national parks approximately 120,000 hectares are under strict protection along with a bit less than 50,000 hectares of alpine grass and rocky terrain.

In the majority of national parks, *core zones* ("special conservation zones" which usually comprise: "zona de protectie stricta" and "zona de protectie integrale") and *buffer zones* (so called "sustainable use zones", comprising: "zona de conservare durabila" and "zona de conservare durabila parcele limitrofa") have been defined. Today a relatively small fraction of forests in national parks are actually under sufficient protection within non-intervention core zones of national parks. Only one park - Defiul Jiului National Park - meets the IUCN (International Union for the Conservation of Nature) guidelines of strict protection of at least 75% of the park's territories. In the other parks, numerous old-growth and primary forests stands have been the subject of commercially motivated *progressive* and *conservation* cutting in so called *buffer zones*. These parks have smaller *core zones*, some with even less than 50% of the park actually protected (see Image 3 below).

¹⁰ <http://roifn.ro/site/rezultate-ifn-2/>

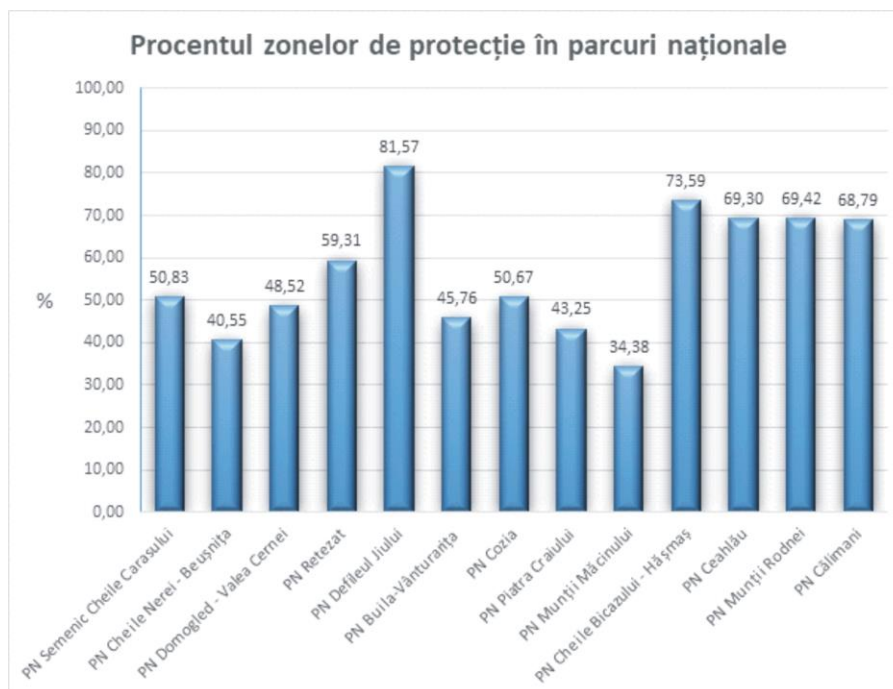


Image 3: Percentage of park surface within strict protection across Romania's 13 national parks. Only one park meets the IUCN principle of 75% strict protection. Source: Data according to latest available management plans for national parks.

IUCN defines national parks as “large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.”¹¹ The primary objective is “To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation.” Economic activities should be limited to tourism and “subsistence resource use” by local communities, “in so far as these will not adversely affect the primary management objective.”

NGOs have long reported that Romania's national parks are far from meeting these requirements. A recent video series and dossier produced by Agent Green and EuroNatur reveals that commercial logging is often prioritised over conservation objectives¹².

Besides national parks and Natura 2000 sites, there are also nature parks and nature reserves which should provide protection for old-growth and primary forests.

¹¹ <https://www.iucn.org/theme/protected-areas/about/protected-areas-categories/category-ii-national-park>

¹² <https://www.saveparadiseforests.eu/en/video-2/>

According to the Global Forest Watch online map¹³ logging is affecting almost the whole territory of Romania. Some of the hot spots of logging are Maramures Nature Park and Natura 2000 site, Apuseni Nature Park and Natura 2000 site and Fagaras Mountains Natura 2000 site. The volume of forest which has disappeared in these protected areas since 2005 - including forest which has been mapped by the *Pin Matra* project in 2005 - is causing strong concern among civil society organisations and international scientists¹⁴.

In 2018, leaked data from the second cycle of the Romanian National Forest Inventory, revealed that more than 50% percent of the annual wood harvest in Romania is not based upon approved management plans and is therefore not happening within the legally approved harvest¹⁵.

In summary, Romania's legal frameworks and protected area management appear to be not capable of meeting national and international obligations and commitments with regard to ecosystem conservation, including the protection of old-growth and primary forests.

2.5. The “National Catalogue of Virgin and Quasi-virgin Forests”

In 2012, Romania announced and introduced a new protection system, the so-called *National Catalogue of Romanian Virgin and Quasi-virgin Forests* (first mentioned in Ministerial Order 3397/2012) which aimed to ensure the comprehensive protection of its remaining primary forests. This legislation was in response to a popular forest protection campaign organised by WWF Romania. The National Catalogue is a unique and pioneering instrument in Europe.

However, this catalogue is being populated at an extremely slow rate, it is based upon disputed criteria and Romanian experts report many bureaucratic obstacles and hurdles from authorities and the Ministry for Water and Forests in the course of the approval process for submitted forests areas. The latest published available datasets includes 1,430 forest parcels with a total surface of 29,063.58 ha (May 2019)¹⁶.

The Ministerial Order 2525/2016 defines criteria for the identification of virgin and quasi-virgin forests to be included in the catalogue. These criteria are disputed among experts (Biris 2017) because they mainly describe the climax phase of natural forest development with high volumes of dead wood and large number of tall and old trees. Thus they are restrictively limiting the scope for forest protection. The criteria defined by the Ministerial Order require, among other strict

¹³ <https://www.globalforestwatch.org/>

¹⁴ https://www.euronatur.org/fileadmin/docs/Urwald-Kampagne_Rumaenien/Scientists_Memorandum_Save_Primary_Forests_of_Romania_S_Final_.pdf

¹⁵ <https://www.saveparadiseforests.eu/en/kept-secret-data-from-romanian-forest-inventory-reveals-catastrophic-level-of-illegal-logging/>

¹⁶ <http://apepaduri.gov.ro/paduri-virgine/>

attributes, “the frequent presence of dead wood, standing and on the ground, in different decay classes”.

A life cycle of a natural forest runs through different age stages over a course of several hundred years. The time span for the complete renewal of a primary beech forest stretches up to 600 years. Depending on the forest’s disturbance history and actual forest dynamics, these stages can be present more or less simultaneously and neighbouring each other in a forest complex.

Mainly in the mature phases - *climax* and *decay* phases - natural forests do show large numbers of large and old trees and a high level of dead wood. If an unmanaged, natural forest stand was affected by a larger disturbance, for example, more than 100-200 years ago, the forest might appear today as even aged stand without complex structures and probably with only small amounts of dead wood. Furthermore, very old trees may not necessarily be very large, because the size depends strongly on the tree history and the availability of light. Old-growth and primary forests in extreme expositions also might not show large trees or high levels of dead wood on extreme stands such as dry and rocky slopes or at high altitudes.

Furthermore, Romanian experts report that these criteria have been applied by the Technical Commission of the Ministry for Water and Forests (CTAS) in a strict and rather discriminatory way, utilising criteria such as “frequent presence of dead wood” and the “age of trees” to exclude natural forests from protection. Authorities are reported to have argued there was “not enough dead wood” in applications for the catalogue and therefore forests were rejected on these strict grounds.

Other factors such as the extraction of single trees can also result in exclusion of forests from inscription into the catalogue, even if the majority of the forest patch is in a very close-to-nature status - rich in biodiversity and showing domination by natural, not human-induced, processes.

As Romanian experts report, authorities often oppose the inclusion of old-growth or primary forest parcels because forest plots were marked in management plans as less than 150 years old (on average). The age figures in forest management plans are normally not based upon thorough scientific research (e.g. dendro-chronological measurements) but are often an estimation by foresters. There is a tendency to underestimate the average age of forests or just take into consideration the tree size, which can be strongly misleading, as explained above. Several studies prepared by experts for the *National Catalogue of Virgin and Quasi-virgin Forests* were rejected by CTAS because the information given by the forest management plans was in contradiction to the results of the experts’ study.

The Romanian approach to forest protection exclusively refers to the criteria for the *National Catalogue of Virgin and Quasi-virgin Forests*, where the measure of whether a forest is “virgin” or not is the only key criteria for protection, and not its wider biological values. There are verbal

reports by experts, that forest parcels were rejected by authorities and not included in the catalogue because there were more than five tree stumps per hectare visible, even if the rest of the forest patch is still an intact natural forest. So, the intended effect of the law becomes unclear and questionable. As a result, many of Europe's most valuable forest ecosystems in Romania have been lost during the last 15 years.

This limitation to such strict criteria will most likely result in a loose collection of rather small strict forest reserves, surrounded by vast degraded forests, lacking ecological connectivity and thus ending up as isolated islands of rich forest biodiversity.

Therefore, it is the intention of the PRIMOFARO inventory to help identify as much as possible all forest areas with high biodiversity value.

Forests that have not been touched for a very long time or where the effects of human interventions are negligible, can show very close-to-nature features or have the immediate capacity to develop into a close-to-nature state in near future, if left to naturally recover.

This approach is underpinned by EU legislation which commits Member States to ensure the preservation of natural habitats in a favourable conservation status or ensure the conservation status is restored by appropriate ecologically oriented management, which excludes intensive commercial forest exploitation. Neither the EU Natura 2000 regime nor international nature protection systems such as the World Heritage Convention or IUCN categories for protected areas restrict forest protection to "virgin and quasi-virgin" forests only.

Forests with high conservation, biodiversity and science value have been identified as comprehensively as possible in order to inform and ensure full implementation of Natura 2000, CBD objectives, World Heritage Convention and IUCN Guidelines.

3. Methodology of PRIMOFARO

3.1. Definitions of "old-growth" and "primary" forest

What are old-growth, primary or virgin forests exactly? Basically, forests can evolve naturally (primary and old-growth forests) or they can be heavily impacted by humans (secondary forests):

- Primary and old-growth forests have no major impact from anthropogenic activities during their entire history or have recovered from interventions a long time ago into a close-to-nature status.
- Secondary forests are cultivated or managed by humans, generally for wood production purposes.

The Swiss forest scientists Hans Leibundgut, who gave major contributions to primary forest research and protection, defines virgin forests (Urwälder) as follows: “Primary forests are original forests, whose structure has always been characterized by natural living conditions. Their soil, their interior climate, their entire living environment and their life processes have not been changed by the use of wood, littering or grazing, nor by other direct and indirect human influences” (Leibundgut 1982).

Natural forests (Naturwälder) can show direct or indirect anthropogenic influences, but they have kept most of their natural structure and mainly consist of types of trees specific to the area.

Josef Fanta introduced the following definition of virgin forests (Biriş and Veen 2005):

“Virgin forest is a natural woodland where the tree and shrub species are in various stages of their life cycle (seedlings, young growth, advanced growth, maturity and old growth) and as dead wood (standing and laying) in various stages of decay, thus resulting in more or less complex vertical and horizontal structures as a product of a dynamic process, which 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 to the impact of abiotic factors related to substrate, climate and to the complex of topography and water table (e.g. wind, snow, flooding). Part of this dynamics is the temporary occurrence of gaps or larger tree-less stages.

Virgin forests differ within the given phytogeographic zone, forming specific types of 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.”

Biris goes on to explain that “the concept of virgin forest can’t limit itself only to the climax forest because there are also virgin forests in other developing stages apart from the climax one (e.g. the forests constituted of pioneer species which represent a pre-climax and which, with few exceptions, are born without any anthropogenic influence)” (Biris, 2017).

This relates to a debate about the strict criteria for identification of “virgin” forests in Romania which are mainly describing forests in a climax phase (large number of very old trees, large loads of dead wood etc.) and thus exclude other old-growth forests from protection.

However, the different terms “virgin”, “primary” and “old-growth” forest (and others) are used in various and sometimes confusing ways.

The following definitions and classifications were therefore referred to:

a. Definitions by the Convention on Biological Diversity (CBD)¹⁷

- “A primary forest is a forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age. It is referred to "direct human disturbance" as the intentional clearing of forest by any means (including fire) to manage or alter them for human use.”
- “Old growth forest stands are stands in primary or secondary forests that have developed the structures and species normally associated with old primary forest of that type have sufficiently accumulated to act as a forest ecosystem distinct from any younger age class.”

b. Framework by Erik Buchwald (2005)¹⁸

Based on Sabatini et al. (2018) the classification framework proposed by Buchwald (2005) was followed which uses the term *primary forest* to comprise all those forests of high conservation value described as primeval, virgin, near-virgin, old-growth and long-untouched (classes n10 to n5 in Buchwald, 2005).

In detail, *primary forests* (n10-n5) are defined as: “Relatively intact forest areas that have always or at least for the past sixty to eighty years been essentially unmodified by human activity. Human impacts in such forest areas have normally been limited to low levels of hunting, fishing and harvesting of forest products, and, in some cases, to historical or pre-historical low intensity agriculture.”¹⁹

Primary forests in relation to the PRIMOFARO inventory include the following classes (presuming that the classes n8-10 are not existing anymore in long time populated and cultivated Europe), as defined by Erik Buchwald:

n7 Very high degree of naturalness – Near-virgin forest – “Forest ecosystems (forest scale) untouched long enough to have attained structures, dynamics and species composition similar to virgin forest, even though they may have been significantly modified, e.g. by clearcutting or agriculture at some time in the past. They are distinguished by a mixture in time and space between different seral stages, e.g. between old-growth stages and younger stages. Human impact on the forest structures is not obvious to see. The time necessary in untouched development before this level can be reached depends on how modified the situation was at the start. It is at least several hundred years if the starting point is a plantation-like forest.”

n6 High degree of naturalness – Old-growth forest – “Ecosystems (stand scale) distinguished by old trees and related structural attributes. Old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include

¹⁷ <http://www.fao.org/3/Y4171E/Y4171E11.htm>

¹⁸ https://forestsandco.files.wordpress.com/2015/11/buchwald_2002_definitions.pdf

¹⁹ <https://forestsandco.wordpress.com/2015/11/05/old-growthprimevalvirgin/>

tree size, accumulations of large dead woody material, number of canopy layers, species composition, and ecosystem function. The age at which old-growth develops and the specific structural attributes that characterise old-growth will vary widely according to forest type, climate, site conditions, and disturbance regime. [...] However, old-growth is typically distinguished from younger growth by several of the following attributes: 1) large trees for species and site, 2) wide variation in tree sizes and spacing, 3) accumulations of large-size dead standing and fallen trees that are high relative to earlier stages, 4) decadence in the form of broken or deformed tops or bole and root decay, 5) multiple canopy layers, and 6) canopy gaps and understory patchiness. Old-growth is not necessarily “virgin” or “primeval.” Old-growth can develop following human disturbance. [...]”

n5 Quite high degree of naturalness – Long untouched forest – “Relatively intact forest (stand level) that has been essentially unmodified by human activity for the past sixty to eighty years or for an unknown, but relatively long time. Signs of former human impacts may still be visible, but strongly blurred due to the decades without forestry operations. The time limit depends on how modified the forest was at the starting point. [...]”

In summary, the definitions below are used, following the most common use of these terms to facilitate understanding and communication with the interested public:

- **“Old-growth forests”**: relatively intact forests with a very high degree of naturalness, which have been essentially unmodified by human activity since a long period of time and which have developed the structures and species normally associated with old primary forests. This refers to Buchwald classes n5 and n6.
- **“Primary forests”**: virgin forests or near virgin forests which have been developing untouched long enough to have attained structures, dynamics and species composition equal or similar to virgin forests. Human impact on the forest structures is not obvious to see. This refers to Buchwald classes n7 and higher.

3.2. Overview of the analytical methods of PRIMOFARO

This inventory data was compiled and validated in several steps:

1. All the polygons of the *Pin Matra* inventory (Biris and Veen 2005) were analysed for signs of human interventions using satellite/aerial imagery as provided by Google Earth and other providers (such as ARC GIS). Only polygons without visible signs of logging or degradation and showing structures of close to nature forest habitats were considered as old-growth or primary forests. Homogenous, even-aged areas, areas with high tree density (young forests) or areas visibly impacted by logging activities were excluded.

Where available, older satellite/aerial images of deciduous forests in autumn/winter/spring without foliage were used to gain an insight into suspect forest stands. The images were checked for forest structure, presence of deadwood and large trees as well as for roads and traces of cuttings. Only forests with a very natural forest image and without visible forest roads were included.

The method of visual desktop analyses clearly has limitations, such as uncertainties about forest naturalness due to provision of image of poor visual quality (due to clouds or shadows) or outdated images (e.g. three year old images do not show logging activities in the recent past). As data from approved forest management plans was not accessible, it was not exactly possible to determine forest age or logging activities in the past.

2. The polygons of the Greenpeace inventory (Greenpeace CEE Romania 2017) were analysed. Polygons with clear visual appearance of decreased naturalness or traces of forest interventions (e.g. high tree density of younger secondary forests, homogenous stands, visible logging activities) were not considered as potential old-growth or primary forests.
3. Other forest areas outside the marked polygons of the two previously mentioned inventories were then visually analysed in all Romania, applying the criteria described in chapter 3.3 (see below).
4. Information gathered at field trips was considered as well as results from mapping projects:
 - “Virgin Forests in Romania. Safeguarding European Biodiversity Heritage”, led by Hochschule für Forstwirtschaft Rottenburg / Deutsche Bundesstiftung Umwelt²⁰
 - WWF Romania online map of verified virgin forests²¹
 - Primary forests researched by REMOTE project (University for Life Sciences Prague)²²
5. 12 focus regions with an increased concentration of potential old-growth forest and primary forests were selected (mainly in the Carpathians) to be characterised by additional analyses (see below).

²⁰ The project is not concluded yet (Sept. 2019); we gratefully have been provided with results and maps by project team members.

²¹ <https://wwf-ro.maps.arcgis.com/apps/webappviewer/index.html?id=31831d9db12c4e32ab5456c13952bfef&>

²² <http://www.remoteforests.org>

Focus region name	Abbreviation	Size in hectares
Alba Julia, Apuseni Mountains	AJA	655,688
Bacau, Neamt, Calimani, Bistrita Mountains	BNC	971,460
Covasna, Bucegi, Siriului Mountains	BCS	416,221
Danube Southwest, Almajului Mountains	DAS	97,238
Făgăraș, Piatra Craiului	FPC	276,362
Maramures, Rodna Mountains	MAR	336,362
Vrancea, Nemira Mountains	EAC	240,086
Parâng, Cozia	PAC	483,583
Poiana Rusca	POR	108,774
Semenic, Cheile Nerei- Beușnița	SCN	85,427
Suceava	SUC	96,848
Tarcu, Retezat, Vâlcan, Jiu	TRV	373,447
Total		4,141,496

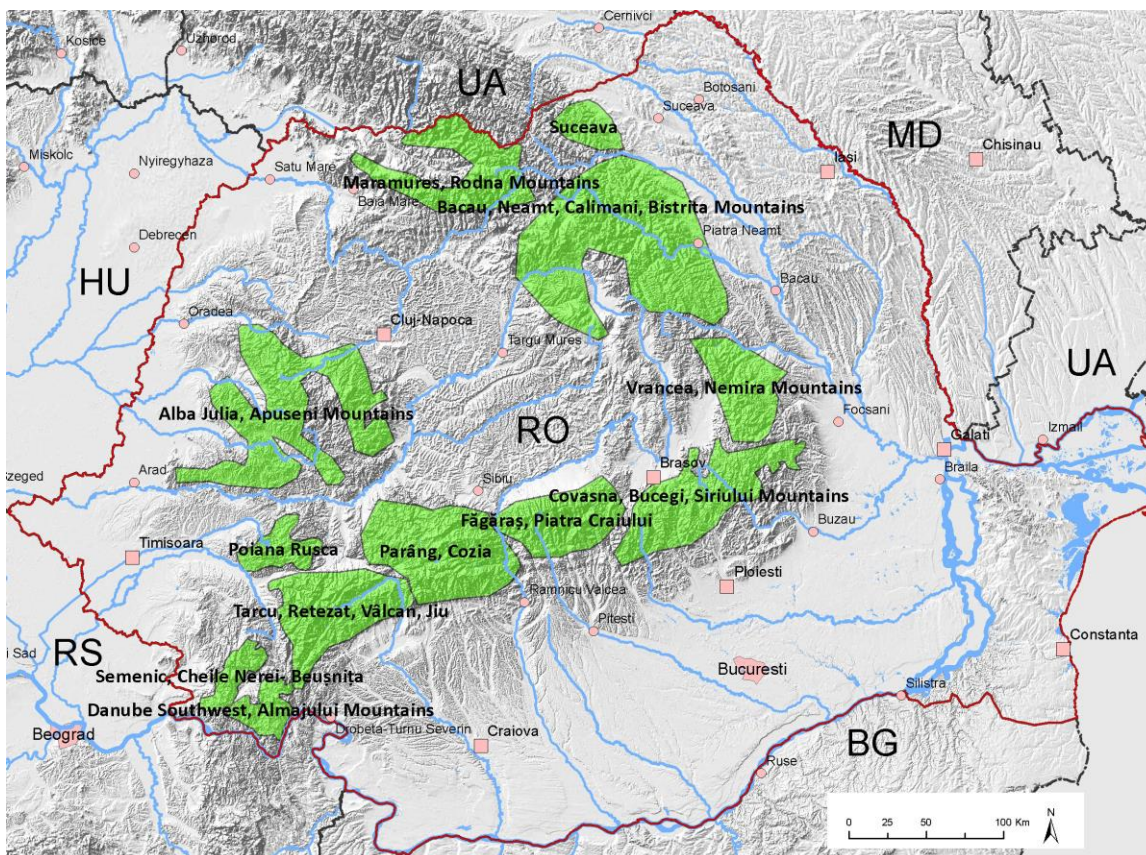


Image 4: 12 focus regions with a high density of potential old-growth and primary forests were selected for further analyses.

6. PRIMOFARO polygons were then overlaid with data from the CORINE²³ land cover (forest / forest types, no forest) to check if the PRIMOFARO inventory contains gross errors and to roughly determine which forest types are affected (deciduous forest / mixed forest and coniferous forest).
7. The results of the 12 focus regions were then validated using the historic CORONA satellite images (USGS 2018, 1964-1970). These images are declassified satellite imagery from a 1960s military project - the CORONA mission. The CORONA images (digitalised film strips) were geo-calibrated, overlaid with the polygons from the PRIMOFARO initial mapping exercise and analysed one by one. All areas showing human impacts such as visible clear cuts and significant human alteration (changes in form of rectangular areas - buildings/meadows - or wire/pipeline traces) were excluded, assuming that these forests are affected by human interventions.

²³ The CORINE Land Cover (CLC) inventory was initiated by European Commission in 1985 (reference year 1990). CORINE stands for: Coordination of Information on the Environment . Updates have been produced in 2000, 2006, 2012, and 2018. Websource: <https://land.copernicus.eu/pan-european/corine-land-cover>

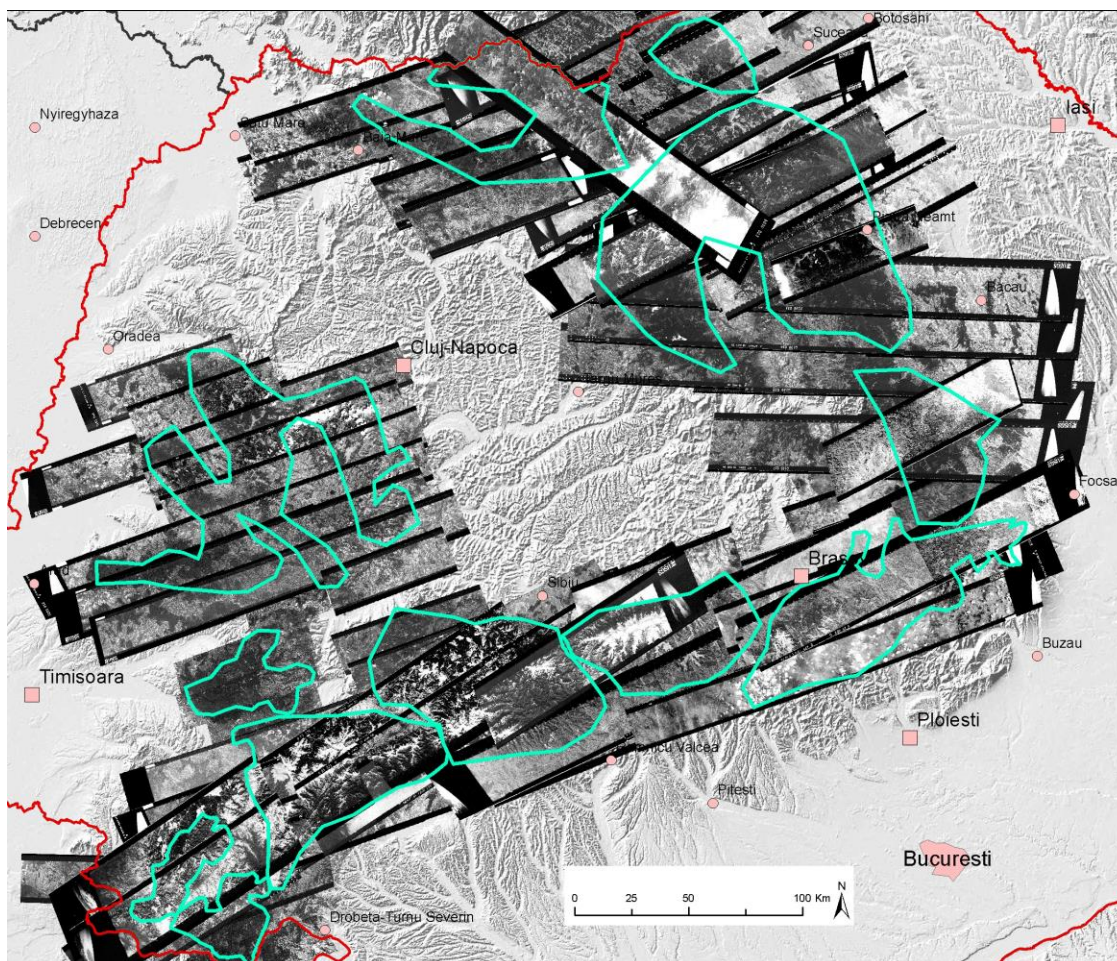


Image 5: Overview of the 137 declassified CORONA film strips, carefully assembled together to create a cloud-free layer with high resolution images from the 1960s. Emerald lines show borders of focus regions.

8. To further characterise the identified areas, a layer of different forest types was created: Overlay with general forest type (deciduous (CLC 311) / mixed forest (CLC 313) and coniferous forest (CLC 312), based upon the current European Corine Land Cover data set (CLC 2018).
9. In order to find out about the legal protection status of the identified forests an overlay was created with existing protected areas: EU Natura 2000 sites (EU data sets) and national parks.
10. As an add on, a layer was created to identify areas with a statistically increased/ decreased likelihood of impacts by human use based on buffer masks of settlements and roads, steepness of slopes and forest types. This is intended to help define areas with a higher wilderness potential and to highlight areas with an increased risk of logging activities.

3.3. Criteria for visual identification of potential old-growth and primary forest

The identification of potential old-growth and primary forests on the various satellite and aerial images was based upon the following criteria, which have been defined after consultation with scientists and literature review (Biris and Veen 2005, Biris 2017):

- Potential natural forest type present at the site.
- No visibility of elements showing human influences (human induced openings, signs of thinning, clear-cut, roads, areas of likely cattle grazing close to pastures etc.).
- Complex and diverse structures (if image quality allows).
- Adequate tree density - according to forest type and exposition.
- Texture of canopy to determine whether the forest is uneven aged and shows diversity of sizes/ages and species.
- Occurrence of very old/very large trees (if image quality allows).
- Presence of deadwood (if image quality allows). If available, autumn/winter images of deciduous and mixed forests were used to assess the “interior” of the forest and check it for natural structure (diversity of trees and ages), presence of dead wood, size of trees - and signs of human interventions.
- Geographical context of the forest stand: Remoteness and accessibility of the forest. Vicinity of settlements and intensively used land. Natural context of tree species, ruggedness/steepness of terrain and exposition.
Spruce dominated forests in flat terrain are more likely to be altered by forest management than deciduous forests on steep or rocky slopes in mountains regions or steep valleys in hilly areas.

3.4. Calibration of visual analyses

In order to be able to distinguish production forests with intensive management from old-growth and primary forests the following calibration method was used:

- A set of 269 polygons was used showing representative example forests in different regions of Romania. These polygons include verified virgin forests from the *Pin Matra* inventory²⁴. These polygons include different forest types in different regions and in different expositions.

²⁴ Data sets gratefully selected and provided by Professor Iovu Biris based on digital maps from Pin Matra project 2005.

- Several field visits were conducted in Romania which identified old-growth and primary forests patches. The areas were delineated in polygons on satellite images. These polygons were then used to inform the search for similar forest stands in the region.

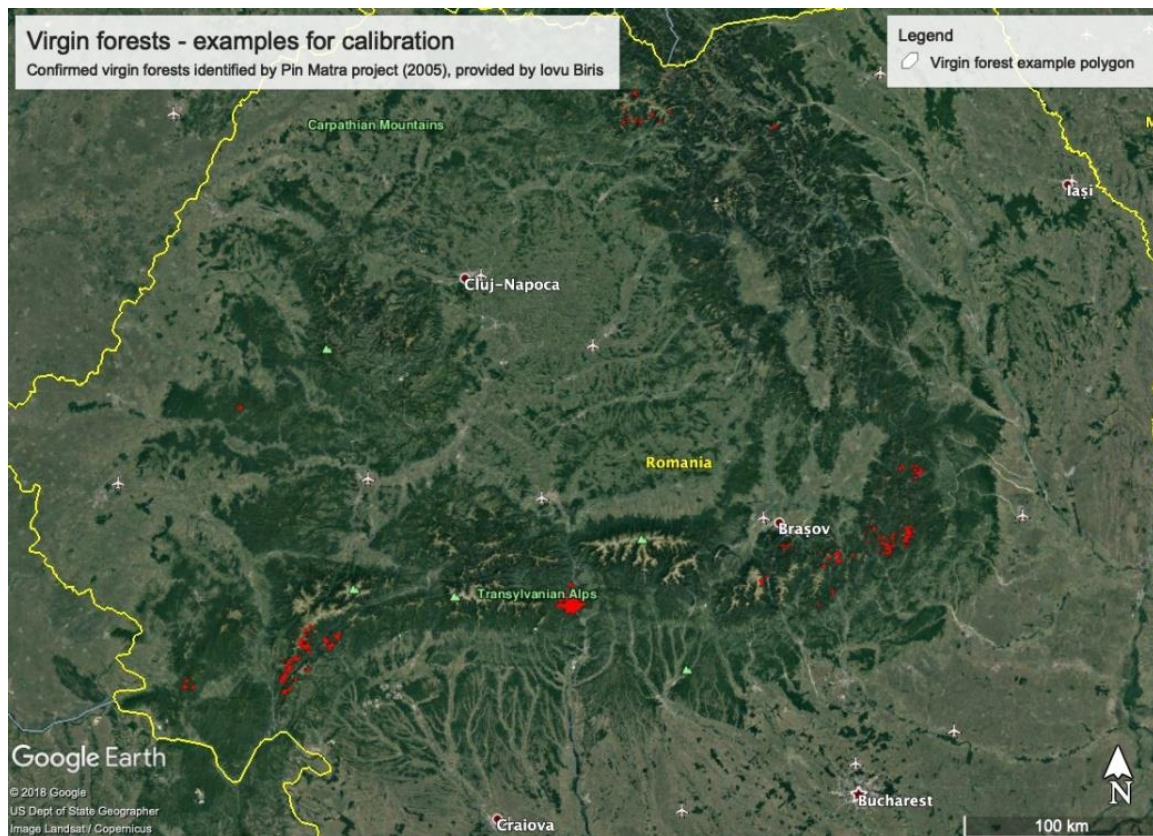


Image 6: Example polygons used for calibration of the visual analyses. Background image source: 2018 Google; US Dept of State Geographer, Landsat/Copernicus.

The field visits took place at the following areas: Poiana Rusca, Tarcu mountains, Semenic - Cheile Carasului National Park, Retezat National Park, Valcan mountains, Cerna valley, Olt valley, Parung mountains and Fagaras mountains.

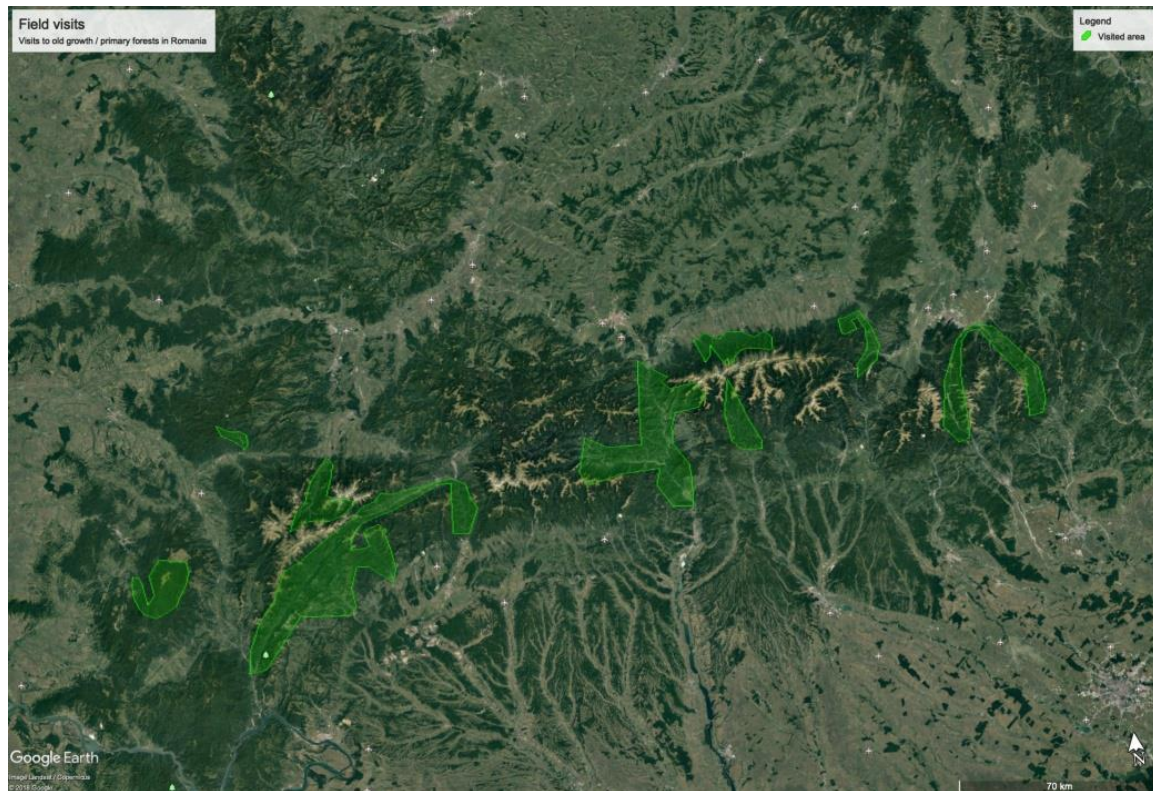


Image 7: Areas with field visits (2016-2019). Background image source: 2018 Google Earth; Landsat/Copernicus.

3.5. Validation of the preliminary analyses results

3.5.1. Validation based on in-field surveys

The PRIMOFARO polygons are based on visual analyses and thus depend highly on image quality and image age as provided by web based services (such as Google Earth or ArcGIS maps).

In order to minimise errors several analyses for validation of the naturalness of the areas included in the polygons were conducted.

Information and research data from field visits and field work of other research projects about natural forest sites was incorporated:

- Collection of information about naturalness of forest stands during several field trips in the areas mentioned above. These areas were explored through extensive walking exercises and through the use of drones. Promising stands were checked for their naturalness (see criteria above). Afterwards these forest complexes were delineated digitally with polygons. Information about appearance of forest stands from the site visits was also used as sample images for calibration of the desktop mapping exercise (forest type, exposition).

- Use of sample data collected during field work of the primary forest mapping project “Virgin Forests in Romania. Safeguarding European Biodiversity Heritage” led by Hochschule für Forstwirtschaft Rottenburg and funded by Deutsche Bundesstiftung Umwelt. The project sent several teams of experts to various primary forest areas (mainly Poiana Rusca, Semenica-area, Fagaras, Neamt, Bacau, Maramures) to confirm whether these areas met the legal criteria for “virgin” forests and then to develop expert reports about them. They gratefully provided this project with data about primary forest stands.
- Incorporation of information about primary forest stands gathered by the primary forest research project “REMOTE” led by the Department of Forest Ecology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences (Prague). The REMOTE project is conducting “spatial and temporal analyses focusing on various aspects of disturbance regimes in primary forests” and doing “dendrochronological studies”. Several hundred permanent study plots have been established in Romania and are evaluated over a long period of time. They have built one of the largest dendroecological database in the world including data for thousands of individual trees. The REMOTE team was joined for field visits in the Fagaras mountains.

Consideration was given to primary forest areas mapped based on field work (or selected based on forest management plans) by WWF Romania²⁵ and of areas which already have been included in the *National Catalogue of Virgin Forests* and published on the website of the Romanian Ministry for Water and Forests. These polygons were also used as example areas for calibration of the desktop mapping work.

3.5.2. Validation based on declassified CORONA satellite images

In order to validate the polygons of the PRIMOFARO inventory 137 film strips of declassified CORONA satellite images, provided by USGS (2018) were acquired. The images are mainly from 1968, with some from 1964 and 1970 substituting for clouded areas. This gave an opportunity to learn about human interventions that had occurred prior to this date, because the historical images showed visible traces of human land use such as rectangular open meadows, evidence of forestry interventions, traces of settlements or pipelines in the forest. Indications of natural forest succession, for example on alpine meadows, were not excluded from the final data set.

The CORONA mission was launched from Vandenberg Air Force Base in 1960. The satellite acquired photographs with a telescopic camera system and loaded the exposed film into recovery capsules. The capsules were de-orbited and retrieved by aircraft while the capsules parachuted to earth. The exposed film was developed and the images were analysed for a range of military applications. The digitalised film strips are now available for the public.

²⁵ <https://wwf-ro.maps.arcgis.com/apps/webappviewer/index.html?id=31831d9db12c4e32ab5456c13952bfef&>

In order to obtain a cloud free layer of images, several digitalised film strips were overlapped.

The analysis of the potential old-growth and primary forest stands against historic satellite images from the 1960s can be used to gain further clarity about the following:

- Identify and exclude areas with visible human interventions up to and including the 1960s.
- Before World War II, numerous remote areas in Romania were not accessible for industrial or large-scale forestry activities, in particular in many upstream sections of valleys in the higher Carpathians. If the CORONA satellite images did not indicate forest roads and openings caused by logging, there is a high likelihood that these valleys had still been in a rather pristine condition in the 1960s. In some cases, such as some side valleys of Cerna valley in Domogled - Valea Cernei National Park or southeastern Fagaras mountains, the CORONA images show large areas of untouched forest landscapes, even without any signs of roads.
- The CORONA analyses helped to find forest interventions in potential old-growth and primary forests before the 1960s. Interventions in forests after the late 1960s can be identified on contemporary satellite and aerial images, because they show structures of younger forest with increased density and a more homogenous appearance.

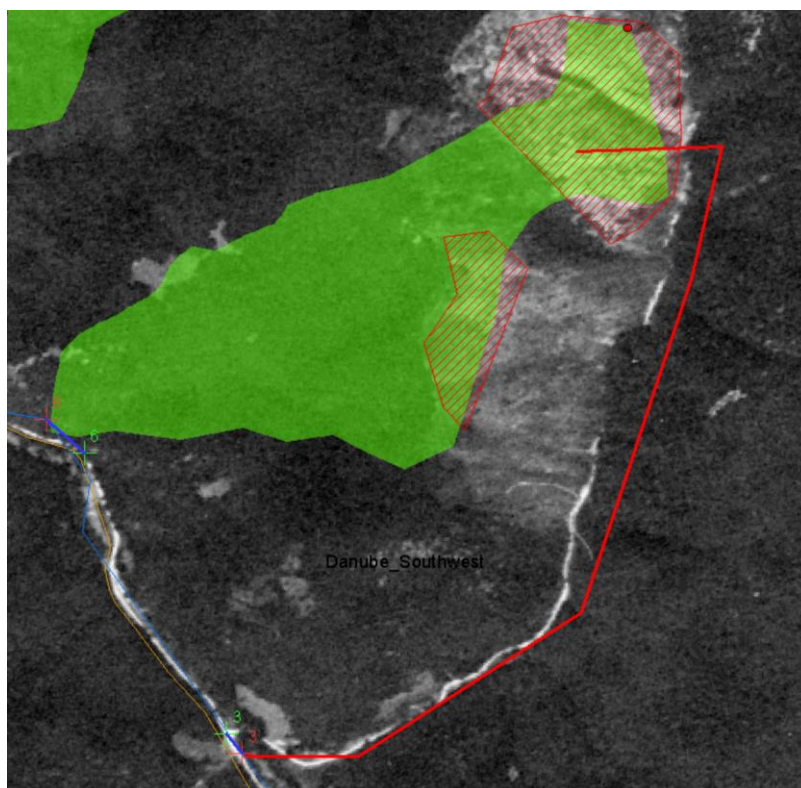


Image 8: Example of the validation of a polygon with potential old-growth and primary forest based upon CORONA images: the images shows historic human interventions (clear cuts and forest roads). Green area: PRIMOFARO polygon. Red hatched area: signs of historic interventions. Red line: Forest road. The area was removed from the PRIMOFARO digital map. Background image source: USGS (2018).

3.6. Likelihood of naturalness of forests - and of threats

This project also wanted to learn about the overall likelihood of human caused disturbances on Romania's forests deriving from the proximity of settlements and roads/transportation routes, gradient of slopes and forest types. Therefore, additional layers of likely human disturbances were created which were the subject of subsequent statistical calculations.

1. This exercise was conducted using datasets of settlements and roads. This data was taken from open street map data sets to determine the vicinity of areas mapped by the PRIMOFARO inventory with forest roads identified on the CORONA images. Settlements (in close proximity to the potential old-growth and primary forest areas, only villages and some small towns can be found) were buffered with a 2 km surrounding layer. All types of roads were considered by using a 1 km buffer,

assuming that roadless areas show a higher degree of naturalness. To identify areas of the PRIMOFARO inventory with potential human caused disturbances, the buffer was combined with the inventory.

2. The resulting reduced set of PRIMOFARO polygons were then analysed regarding steepness of slopes ($> 30^\circ$) using EU hill slope data provided via Copernicus. Those areas were also excluded from the dataset remaining after step 1, assuming a less intensive forest use on steep sloped hills and mountains.

3. The remaining PRIMOFARO map was finally overlaid with data about forest types. Deciduous and mixed forests show less signs of intensive use. Human interventions in these forests were probably to a higher degree confined to local firewood and charcoal production, and only to a lower degree to intensive and large scale clear cuttings. PRIMOFARO polygons in areas with deciduous and mixed forest are most frequently located in remote valleys, on ridges and hills and on steeper slopes. The likelihood of intensive forest management in these areas is decreased, considering the history of forestry in Romania. Coniferous forests were more frequently the subject of clear-cuts, resulting in vast areas with even aged, homogenous spruce forests in several mountain regions today.

This assumption is also backed by observations during field visits (eg. in the Fagaras Mountains), where the upper slopes and ridges were often overgrown with secondary forests of the same age, while the steeper slopes below in most cases showed mixed forests with significantly greater naturalness. One reason for the more intensive use of spruce stands was their ease of transport: spruce trees float better than beech or sycamore, so they could be more easily shipped via river transportation.

However, this is a statistical exercise and does not determine the real conditions in a specific forest area, because there might be other influences which were not considered with this exercise (eg. ownership determinations, hunting grounds, watershed protection etc).

The final figures of of this statistical exercise only indicate the likelihood of increased or decreased human influence in the past and potentially increased pressure by human use interests in the future (eg. in easily accessible forests in the vicinity of settlements)

The results of this statistical calculation exercise were used as an add-on analysis only and did not influence the final dataset of PRIMOFARO.

This final “likely human intervention” layer can be used to identify areas with potentially increased logging pressure and to learn where there are areas with a higher likelihood of intact naturalness in order to inform future conservation efforts.

4. PRIMOFARO - the findings

This chapter provides the overall results of the PRIMOFARO inventory and displays detailed maps of the final selection of potential old-growth and primary forests for the 12 focus regions of Romania.

4.1. Overview of the main results of the inventory

The PRIMOFARO inventory identified a large total surface of potential old-growth and primary forests in Romania. Our visual analyses indicate the potential existence of 525,632 hectares of old-growth and primary forest in the whole of Romania.

The countrywide data set of PRIMOFARO inventory identified 5,921 single patches with a mean size of 89 hectares. The polygons range between a minimum of 1 hectare and a maximum of 4,861 hectares.

The data sets are based on visual evaluations of existing inventories (Biris and Veen 2005; Greenpeace CEE Romania 2017) and also areas which were not included in these two inventories.

The PRIMOFARO figure roughly compares to numbers quoted by Romanian forest experts and representatives of the Romanian state forestry company, Romsilva (personal communications with an author in 2018 during a field visit in Romania's Domogled - Valea Cernei National Park). In conversations, other experts have also indicated the existence of about "half a million hectares of natural forest" in Romania.

Based upon the country-wide forest data analyses, 12 focus regions with a total of 4,141,496 hectares were selected in order to be validated using CORONA satellite images. Within these 12 focus regions the initial mapping results were analysed in detail against the historic satellite imagery and as an add-on likelihood of naturalness.

A validation of these 12 focus regions using declassified CORONA images led to exclusion of 781 patches (4,521 hectares) with visual signs of historic human disturbances from the initial data set. The PRIMOFARO polygons included in the 12 focus regions cover 480,054 hectares of potential old-growth and primary forests, which stretch over 12% of the surface of the focus regions.

In addition to the 480,054 hectares in the 12 focus regions validated by use of historic CORONA images, another 45,578 hectares of potential old-growth and primary forest (814 patches, mean size 56 hectares, range between 2 and 2,258 hectares) outside these focus regions were identified. These forests are mainly located outside the Carpathians, in the lowlands and hills. They are dominated by deciduous forests.

Although these polygons have not been validated by CORONA images, these forests should be considered worthy of permanent protection, as they are likely to contain biodiversity-rich forest ecosystems that have become very rare in the rest of Europe.

This analysis resulted in a final figure of 525,632 hectares for the whole country (480,054 hectares in the 12 focus regions and 45,578 hectares outside those areas).

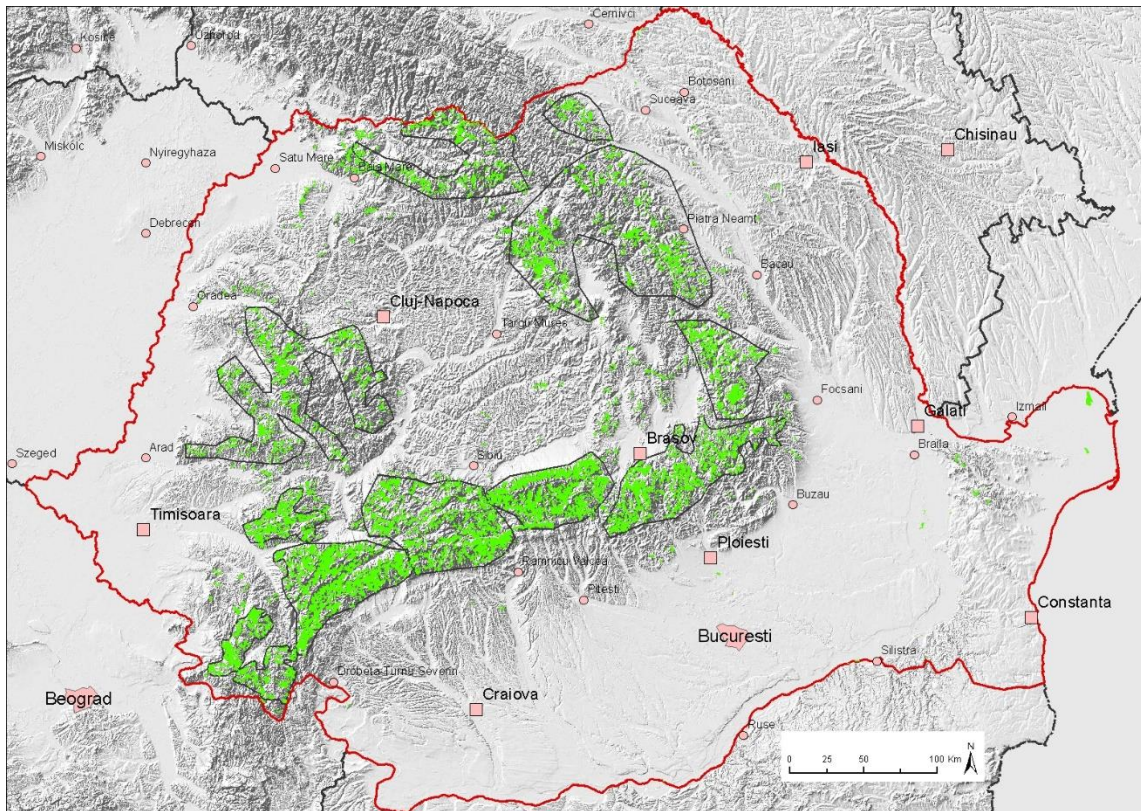


Image 9: Overview of the entire PRIMOFARO inventory and its distribution over the 12 focus regions.

4.2. Forests and land use in Romania

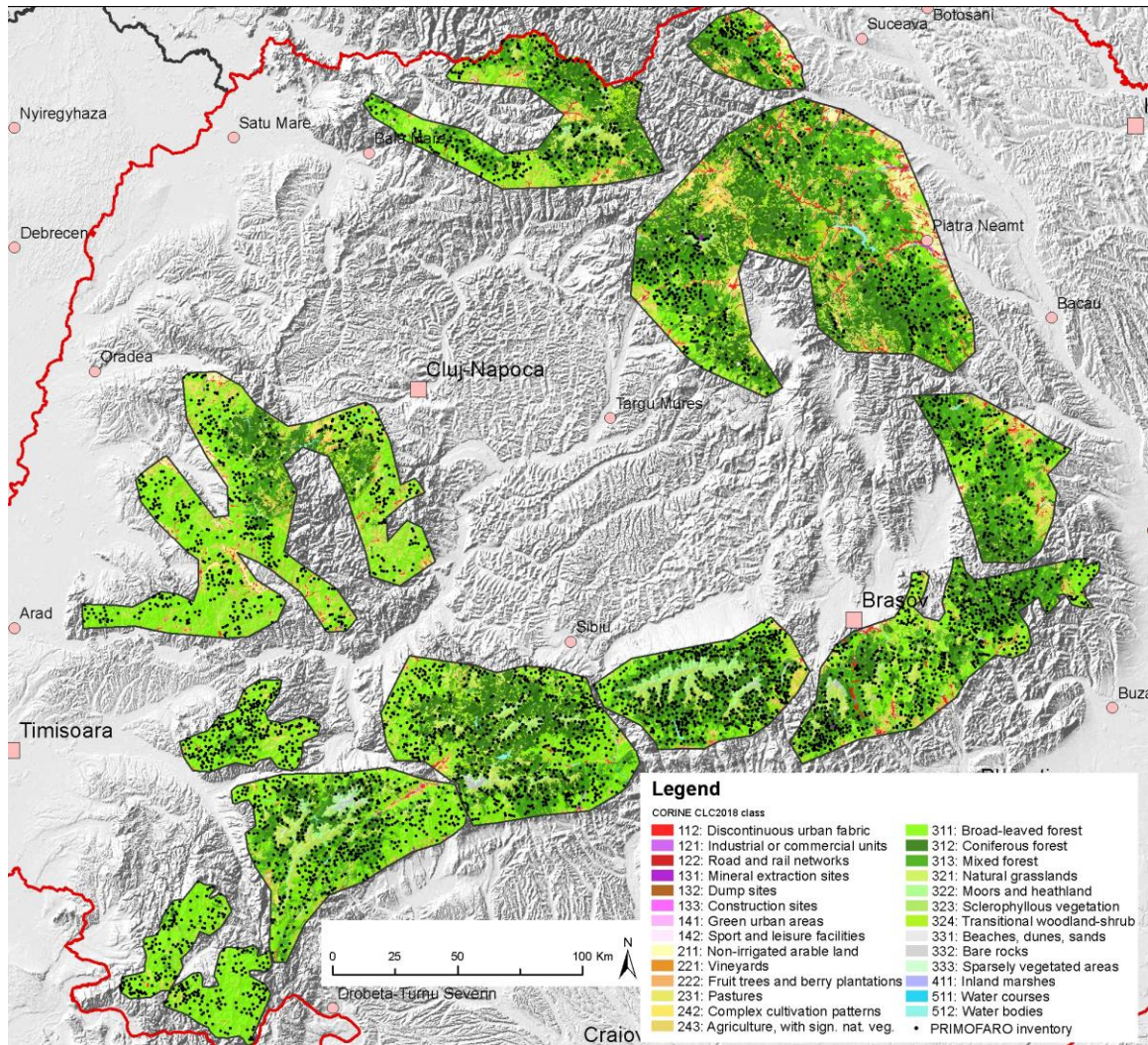


Image 10: PRIMOFARO inventory (dark green dots) and CORINE land cover showing coniferous forests (darker green areas) and deciduous forests (light green).

The exercise revealed that 98% of the (initial) PRIMOFARO inventory polygons were located within the CORINE forest layer. The other 2% are placed in mountainous mires (open bog forests), barren forested grasslands and wetlands, which are not classified as “forest” by the CORINE system, but include important forest and shrubby transition habitats, therefore we did not remove them from the PRIMOFARO inventory.

4.3 Indications of human interventions prior to 1970, based upon CORONA satellite images (1960-1970)

The analysis of PRIMOFARO polygons against the CORONA images yielded 781 “compromised” polygons with visible traces of prior human interventions. In total, 4,521 hectares were excluded from the initial PRIMOFARO data set.

After excluding all areas with signs of human influence and removing very small residual polygons (<1 ha), 480,054 hectares remained for the validated PRIMOFARO dataset. In total, only about 1% of the initial inventory was excluded due to certain or probable human impacts which occurred between 1960 and 1970.

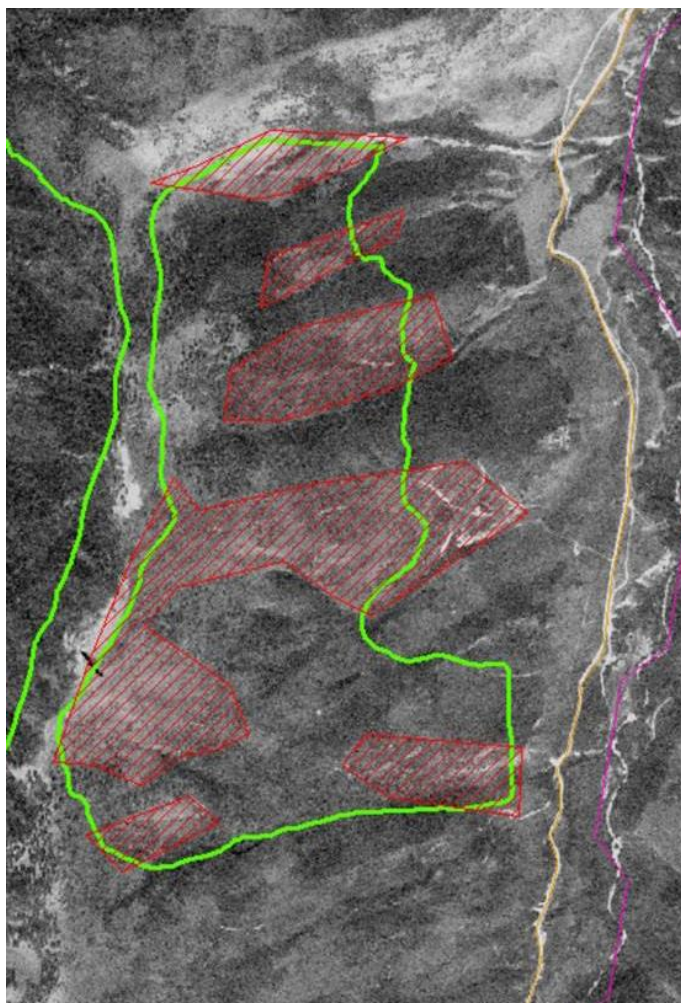


Image 11: Example for exclusion of forest areas likely being harvested in the 1960s (green lines: PRIMOPFARO polygons; red areas: potentially logged forest stands, which were excluded from PRIMOPFARO inventory). Background image source: USGS (2018).

4.4 Evaluation of *Pin Matra* virgin forest inventory

Within the 12 focus regions, where the CORONA check was applied, the *Pin Matra* data from 2005²⁶ indicated a total area of 199,757 hectares of virgin forests. This represents 95% of all Romanian virgin forests mapped under the *Pin Matra* project.

A large part of the primary forest areas that were recorded in the course of the *Pin Matra* inventory have been destroyed / degraded or were probably not mapped accurately (Biris and Veen 2005). After superimposing the final PRIMOFARO inventory polygons (after the CORONA validation) with the *Pin Matra* polygons, 116,589 hectares can be confirmed today as still potentially intact primary forest. In other words, only 55% of the *Pin Matra* areas within the PRIMOFARO study area still represent intact old-growth or primary forests (example of overlay; see Image 12). Most of these lost natural forest areas have been logged partially or completely since 2005.

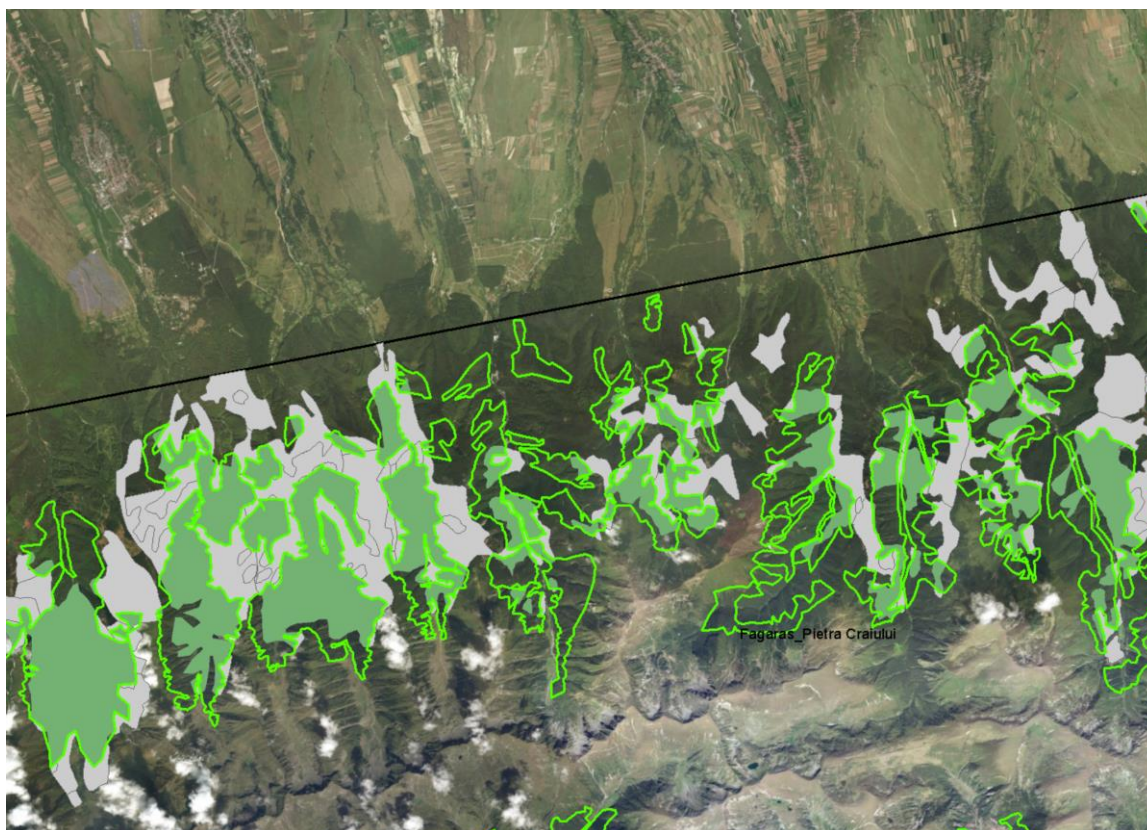


Image 12: Overlay of *Pin Matra* (grey) and PRIMOFARO (green lines) inventories indicates a significant loss of potential virgin forests between 2005 and 2018 (remaining overlaps are in dark green). Background image source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

²⁶ Retrieved from <http://www.mmediu.ro/articol/proiect-pin-matra-padurile-virgine-din-romania/2068>

4.5 Potential old-growth and primary forests and protected areas in Romania

The extent to which the final PRIMOFARO data set is included in different protected areas, namely Natura 2000 sites and national parks, was measured.

The EU's Nature Directives commit member states to maintain or restore a "favourable conservation status" of habitats and species in all Natura 2000 sites. Old-growth and primary forests undoubtedly represent habitats in a very favourable conservation status.

However, in most of the Natura 2000 sites and in all "buffer zones" of national parks visible signs of intensive (recent or active) logging were found in valuable forest stands.

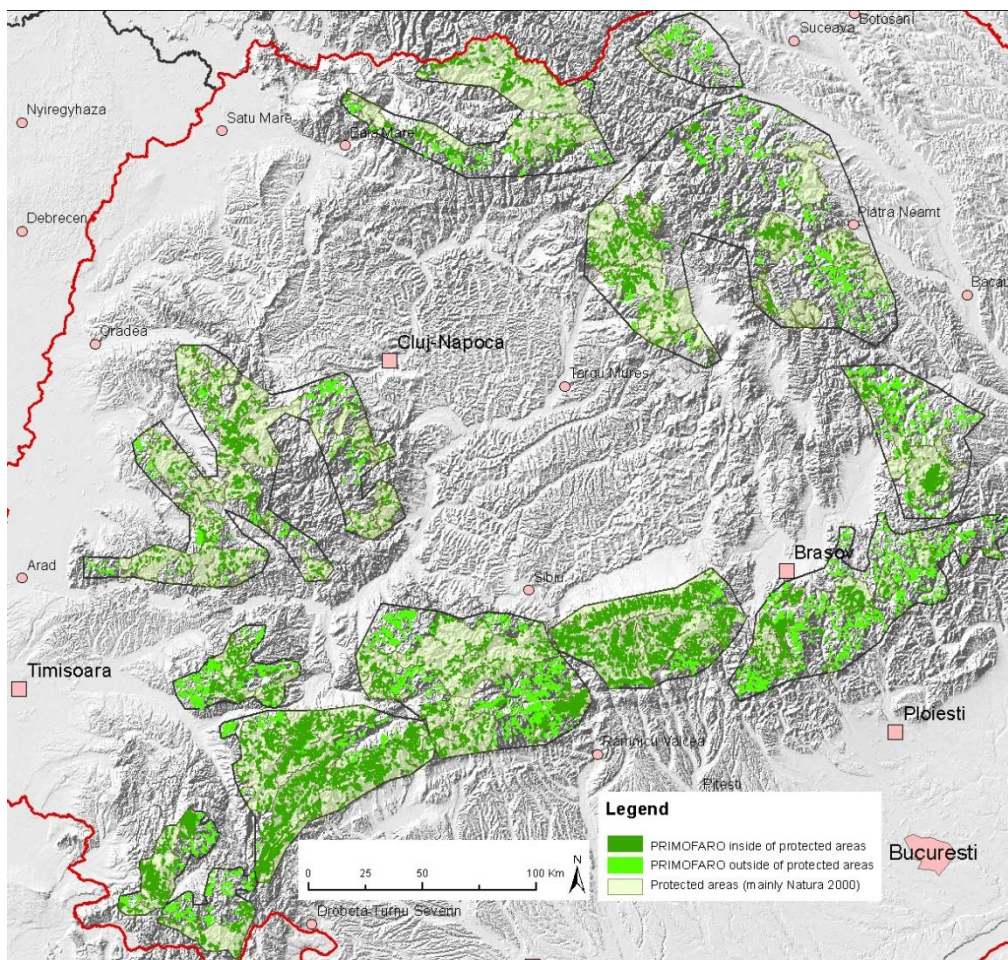


Image 13: Match of Natura 2000 and national parks with PRIMOFARO polygons in the 12 focus regions (314,107 hectares). Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community. 4.6 Forest types and old-growth/primary forests

Image 14 shows the forest distribution for the main overall forest types (deciduous, mixed and coniferous forests) for the entire 12 focus regions. Image 15 shows the forest type distribution for 480,054 hectares mapped for the PRIMOFARO inventory.

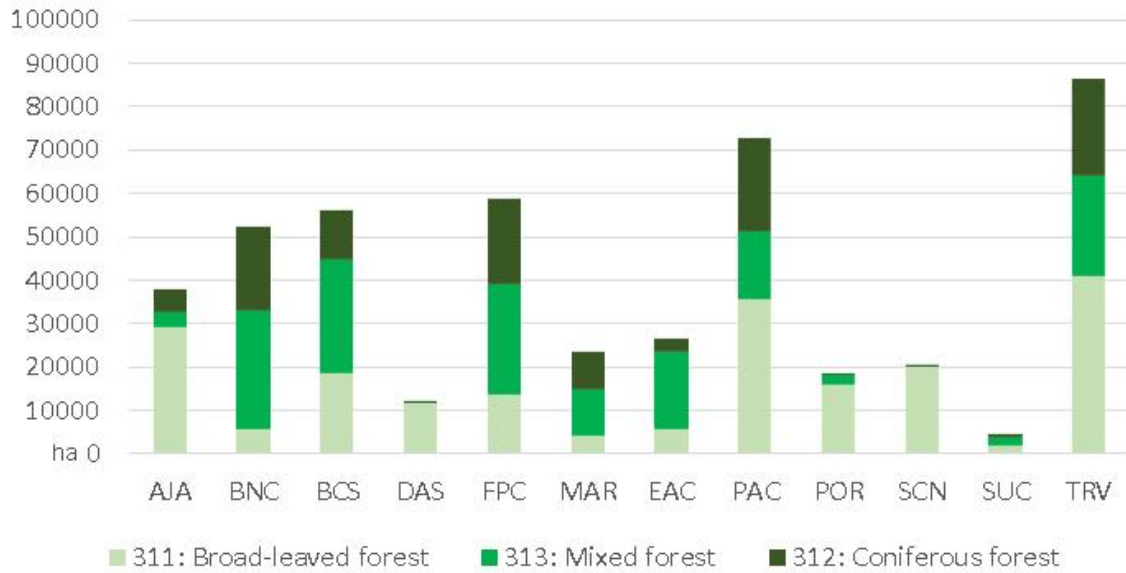


Image 14: Forest type distribution (in hectares) within the PRIMOFARO inventory polygons (480,054 hectares) for the 12 focus regions.

While for some focus regions the distribution of the PRIMOFARO inventory is similarly shared and distributed among forest types, in other areas, the forest type distribution varies significantly.

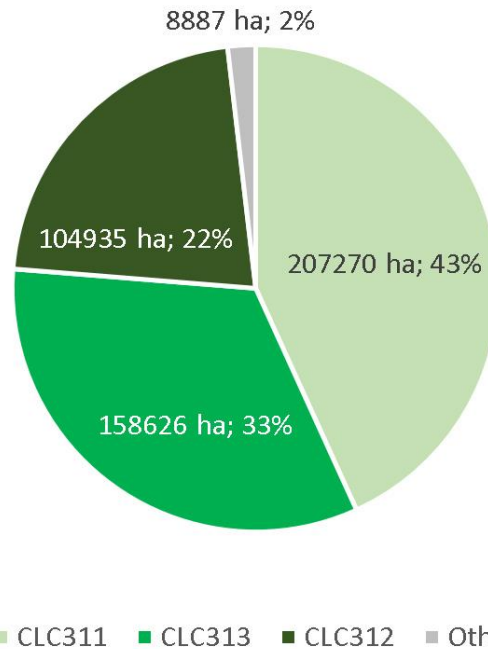


Image 15: Distribution of forest types in the PRIMOFARO inventory: 43% deciduous forest, 22% mixed forest and 33% coniferous forest.

4.7. Likelihood of naturalness of forests and of associated threats

The additional analysis to identify the least influenced forest landscape areas in Romania will help identify areas of greatest potential for the establishment of larger protected areas, such as wilderness areas or new national parks.

In order to identify these areas of large and only slightly disturbed "forest wilderness", zones with a higher probability of human intervention were identified and overlaid with the PRIMOFARO dataset. The remaining primary forest areas show lower human influence and can be considered as areas with an increased wilderness potential.

This exercise was done in several steps and yielded the following results:

Step 1:

Proximity of settlements and roads: The overlay of the PRIMOFARO old-growth and primary forest polygons with the buffers indicating increased human influence shows a statistically increased human impact on 337,582 hectares or 70% of the PRIMOFARO areas due to the proximity of settlements and roads.

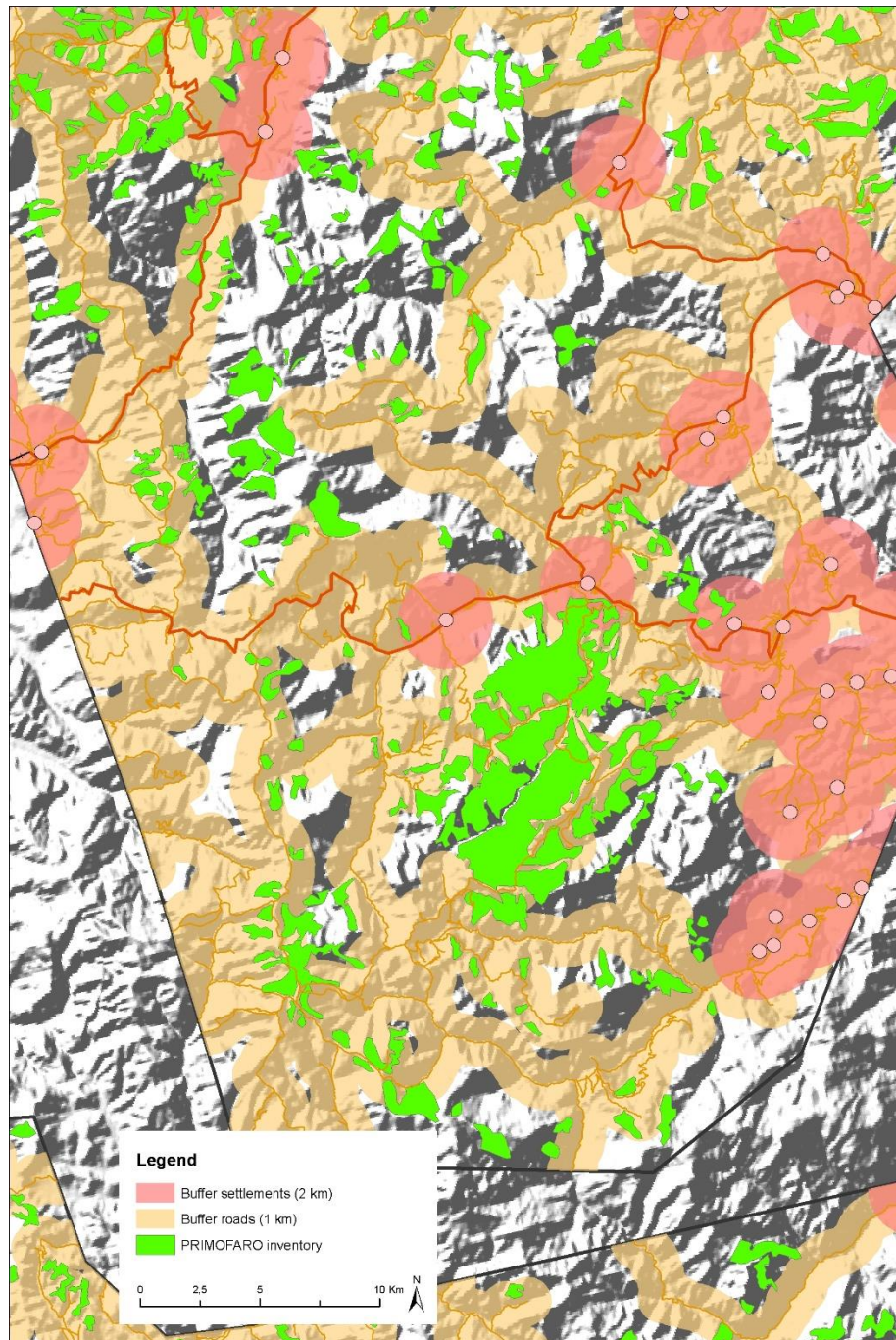


Figure 16: Example for likely human influence buffers (roads and settlements). Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

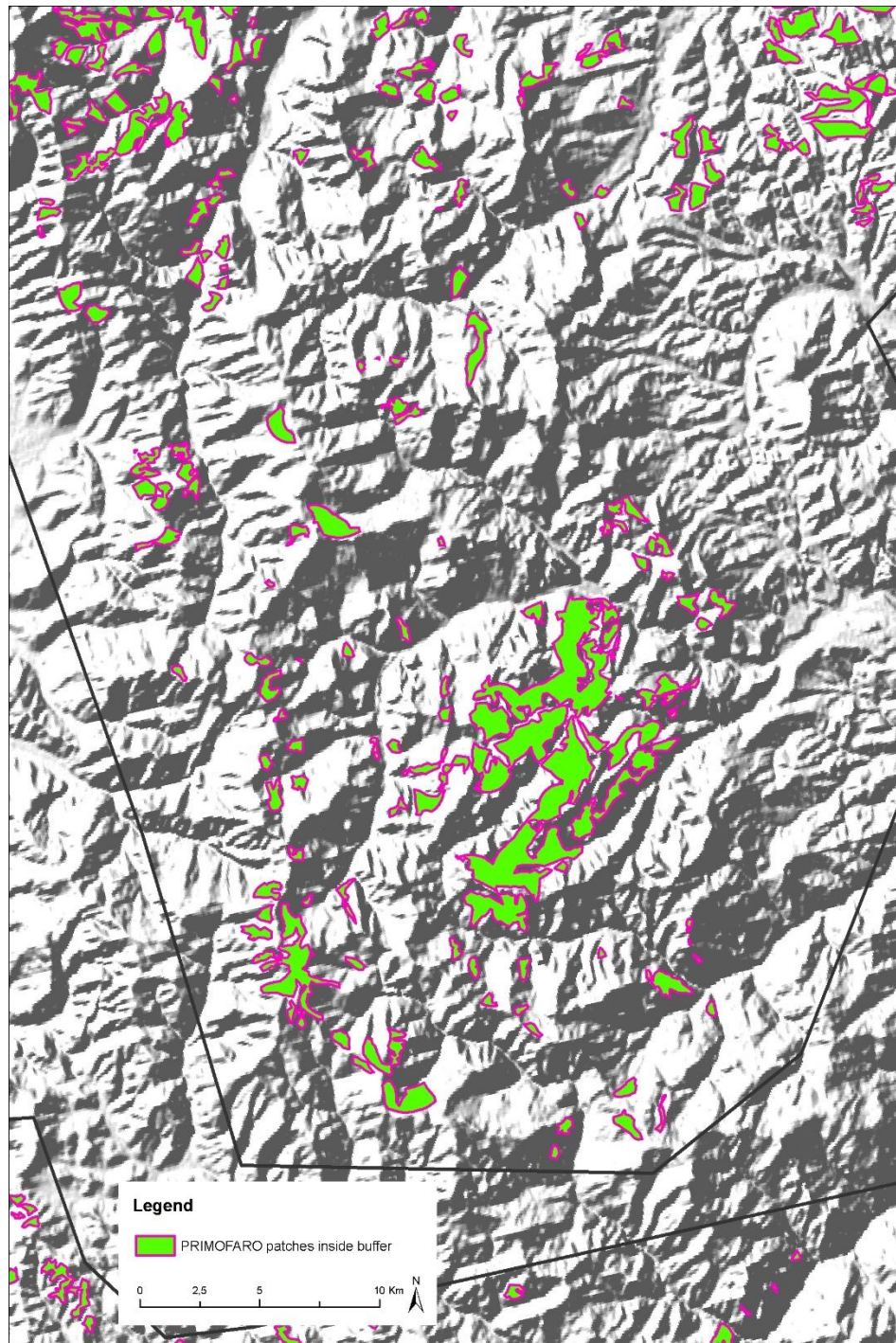


Figure 17: After excluding the PRIMOFARO areas using the settlement and road buffer areas (see Figure 12), those areas which remain show a higher likelihood of disturbance. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

Step 2:

After excluding the steep slopes from the likely human intervention buffer, 95,521 hectares (20% of the PRIMOFARO inventory) remain in the zone with likely increased human influence: forests on gently sloping territories ($<30^\circ$), close to settlements and roads.

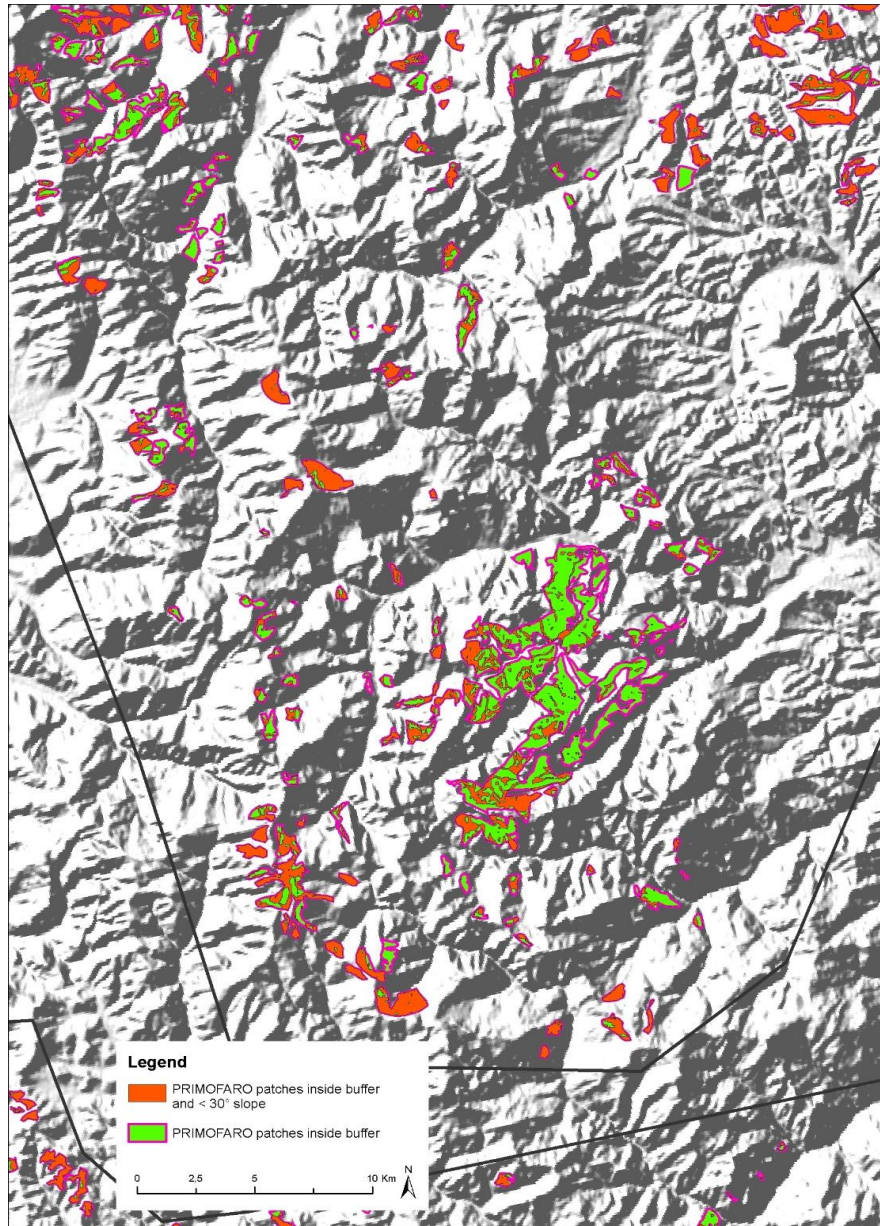


Figure 18: In the next step the areas generated in Step 1 (Figure 13) inside the disturbance buffer were overlaid with a slope gradient layer. All areas with a gentle slope ($< 30^\circ$) were further extracted. The remaining areas show a higher likelihood of human (roads / settlements), are gently sloped and easily accessible. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

Step 3:

Finally, the forest type in the remaining (gently sloped or plain) areas with likely higher disturbance were checked. The resulting zone with a likely higher level of human interventions includes 19,533 hectares or 4 % of the PRIMOFARO inventory (Figure 15). This basically reflects coniferous forest stands on gentle slopes in near proximity to settlements and road infrastructure.

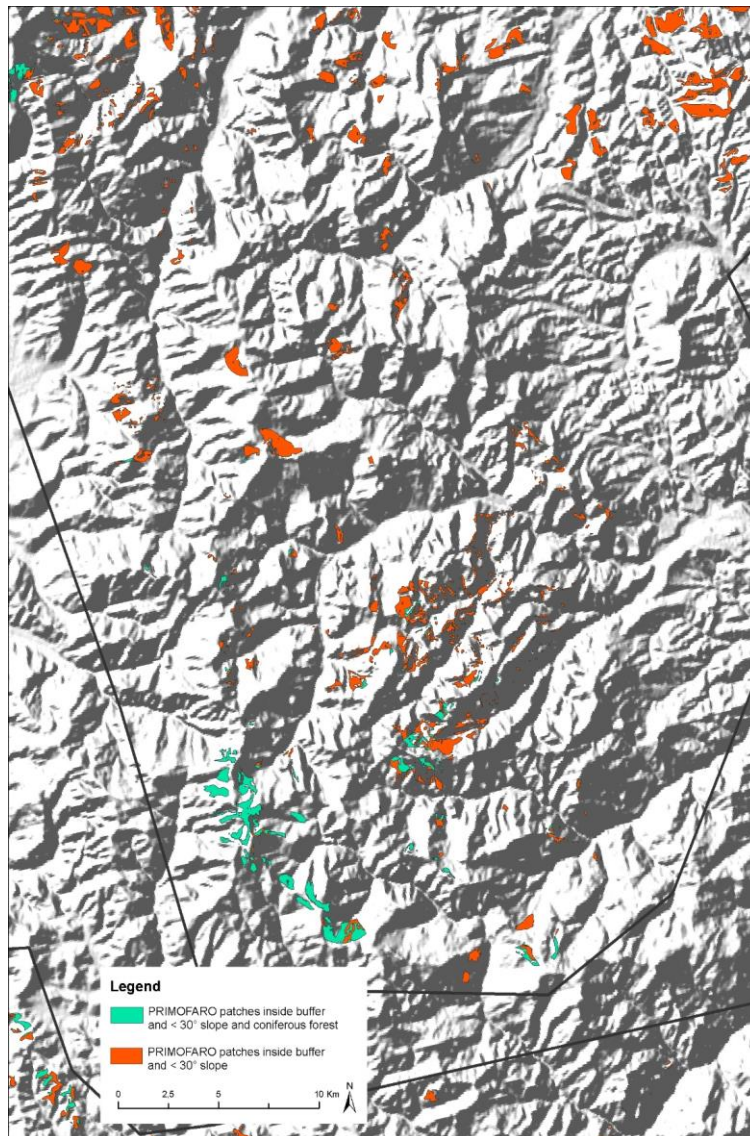


Figure 19: In the last step, the dark orange areas (from Figure 14), defined as areas inside the human disturbance layer with gentle slope, were analysed by forest types resulting in the cyan layer - areas remaining in the buffer with gentle slope and coniferous forest. Those areas are likely to suffer the strongest pressure from potential human interventions. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

This exercise indicates that 460,521 hectares or 96% of the forests identified by PRIMOFARO inventory show an increased likelihood of naturalness.

In general, areas within protected areas (301,340 hectares or 63% of inventory in the focus regions) but outside the likely human disturbance layer could be considered as potential core areas for protection of “forest wilderness”. Most of these forests are part of the Natura 2000 network.

5. PRIMOFARO: Old-growth and primary forest areas in the focus regions

This chapter gives an overview of the potential old-growth and primary forests in the 12 focus regions and highlights some area specifics. The potential old-growth and primary forests in these regions have been validated by overlay with historical CORONA images. This chapter does not include the potential and old-growth areas we identified outside the 12 focus regions.

Region	Total forest area (ha)	PRI-MOFARO (ha)	PRIMOFARO share of total cover (%)	PRI-MOFARO overlay with Pin Matra (ha)	PRIMOFARO overlay with Greenpeace ²⁷ (ha)	PRIMOFARO overlay with Natura 2000 (ha) (incl. 81,716 ha national parks)
AJA	460,643	42,473	9 %	7,979	3,999	28,513
BNC	650,414	54,208	8 %	3,092	4,503	30,855
BCS	324,677	54,413	17 %	15,864	17,872	21,068
DAS	90,608	12,990	14 %	1,070	1,243	5,762
FPC	197,397	61,846	31 %	20,322	42,642	57,055
MAR	234,143	23,432	10 %	2,515	4,001	16,793
EAC	190,977	25,957	14 %	2,306	1,855	11,824
PAC	364,142	74,754	21 %	21,406	20,272	38,012
POR	95,631	19,306	20 %	2,774	2,649	8,913
SCN	77,218	20,807	27 %	5,975	6,875	16,594
SUC	67,400	4,438	7 %	0	815	578
TRV	274,162	85,430	31 %	28,657	19,694	74,950
Total	3,027,412	480,054	16 %	111,960	126,408	310,917

²⁷ <https://maps.greenpeace.org/project/potential-primary-forests-map-of-romania/>

5.1. Alba Julia, Apuseni Mountains

This focus region comprises 460,643 hectares of forests including 42,473 hectares (9%) of the PRIMOFARO areas. There is an overlap of 7,979 hectares with the *Pin Matra* inventory (Biris and Veen 2005) and 3,999 hectares with Greenpeace's digital map (Greenpeace CEE 2017). 28,513 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

This region was subjected to more intensive usage because of the historical existence of several small mines and industries which had an increased timber demand. During the last 15 years, the Apuseni Mountains suffered from large-scale clear-cuts leaving behind huge treeless areas. Due to the massive size of the cuttings, regeneration is troublesome. However, various high conservation value old-growth and primary forest areas still remain.

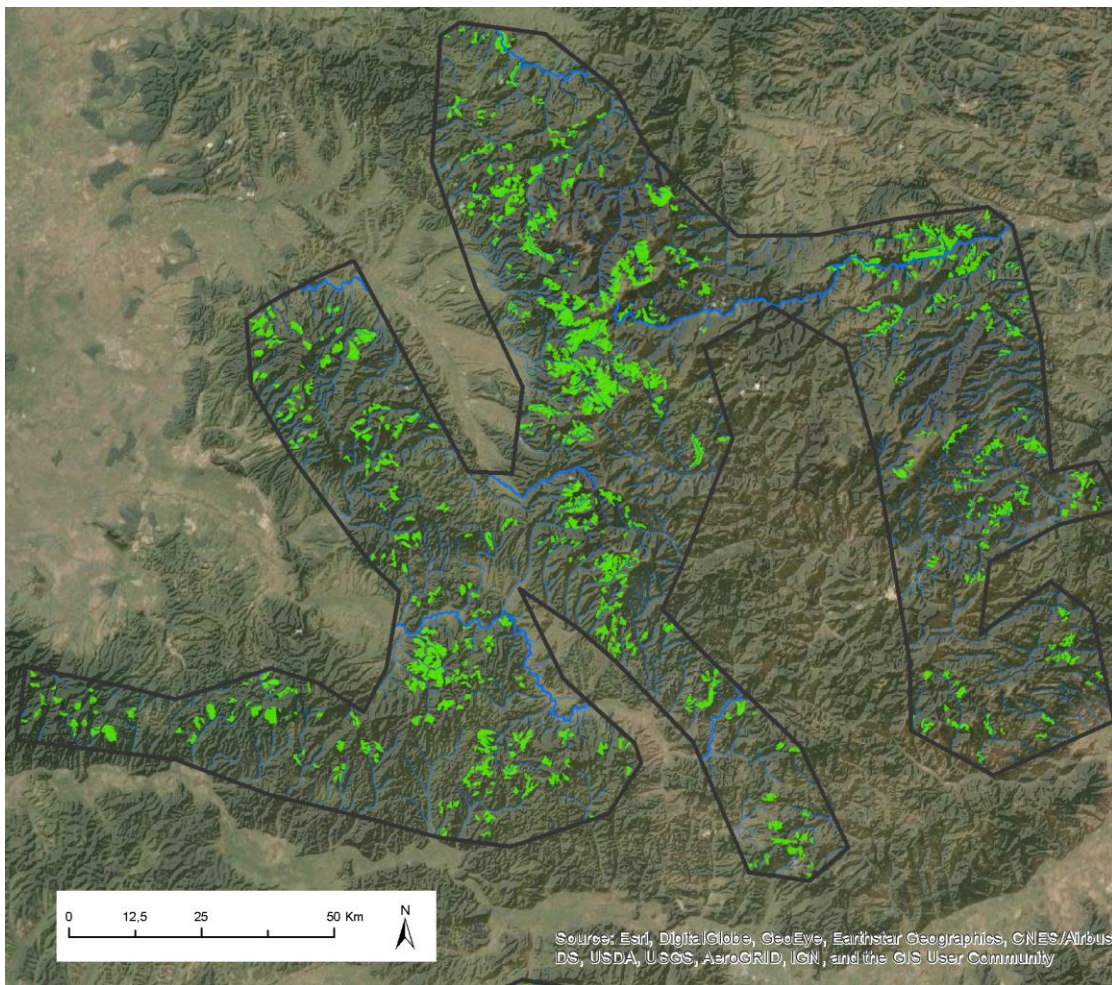


Image 20. Potential old-growth and primary forests in Alba Julia and Apuseni Mountains focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.2. Bacau, Neamt, Calimani, Bistrita Mountains

This focus region has the highest total coverage of forests with 650,414 hectares. But only 54,208 hectares (8%) are included in the PRIMOFARO inventory. There is an overlap of 3,092 hectares with *Pin Matra* and 4,503 hectares with Greenpeace inventories. 30,855 hectares of the PRIMOFARO inventory are located within protected areas (Natura 2000).

The area contains large stands of forests but which have been partly subject to strong forestry impacts. Numerous fresh cuttings were found in forest stands with a rather close-to-nature appearance. However, still several distinctive areas of old-growth and primary forests can be determined. None of them are listed as part of the official inventory so far. This is the region with the highest share of coniferous forests.

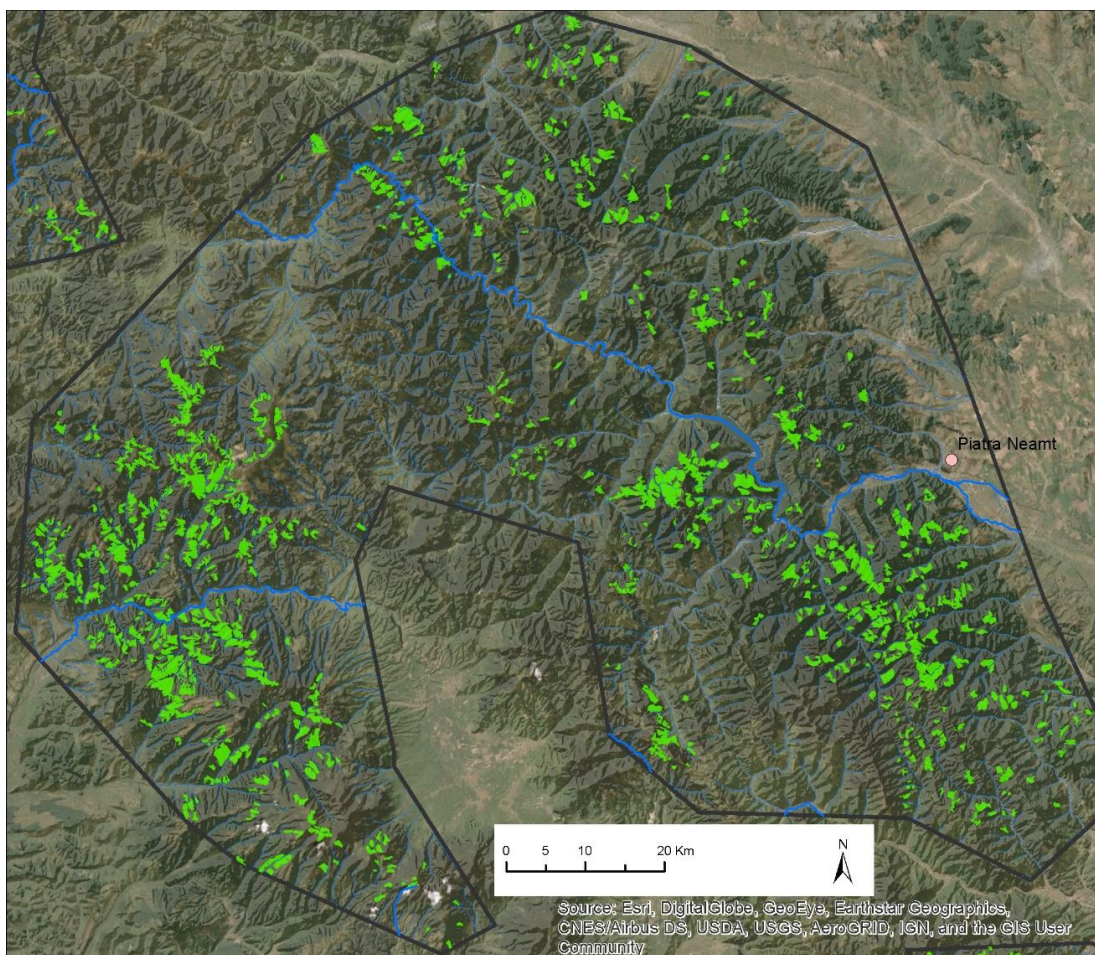


Image 21: Potential old-growth and primary forests in Bacau, Neamt, Calimani, Bistrita Mountains focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.3. Covasna, Bucegi, Siriului Mountains

The focus region is covered by 324,677 hectares of forests including 54,413 hectares (17%) of PRIMOFARO areas. There is an overlap of 15,864 hectares with *Pin Matra* and 17,872 hectares with Greenpeace inventories. 21,068 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

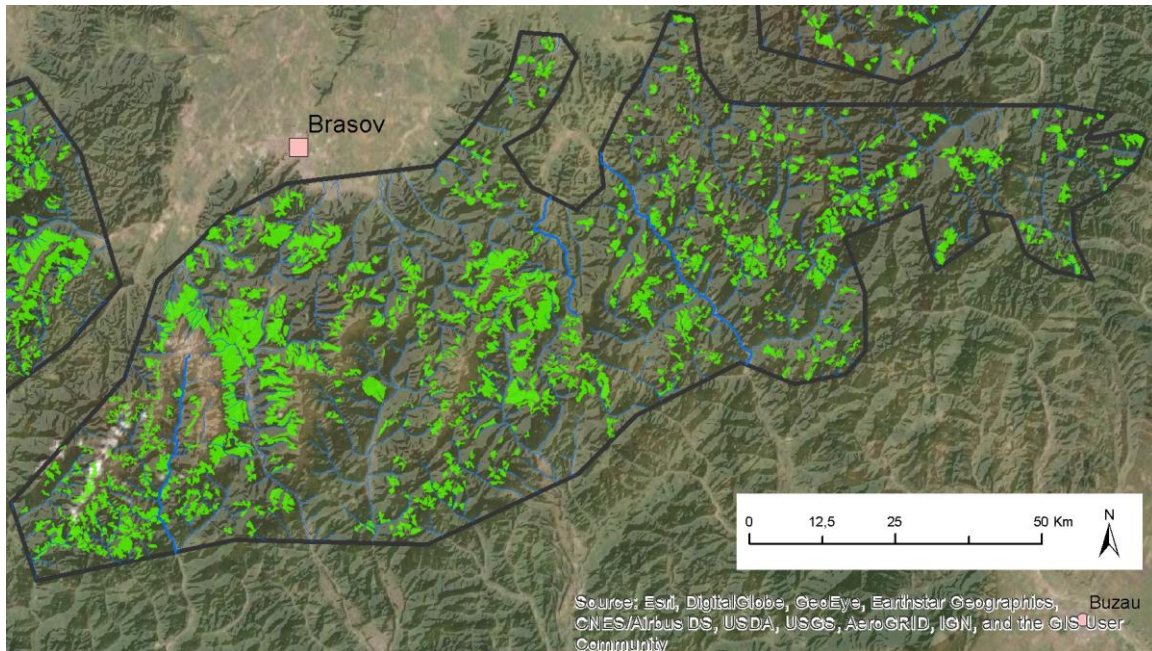


Image 22: Potential old-growth and primary forests in Covasna, Bucegi, Siriului Mountains focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.4. Danube Southwest, Almajului Mountains

The focus region comprises 90,608 hectares of forests including 12,990 hectares (14%) of PRIMOFARO areas. There is an overlap of 1,070 hectares with *Pin Matra* and 1,243 hectares with Greenpeace inventories. 5,762 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

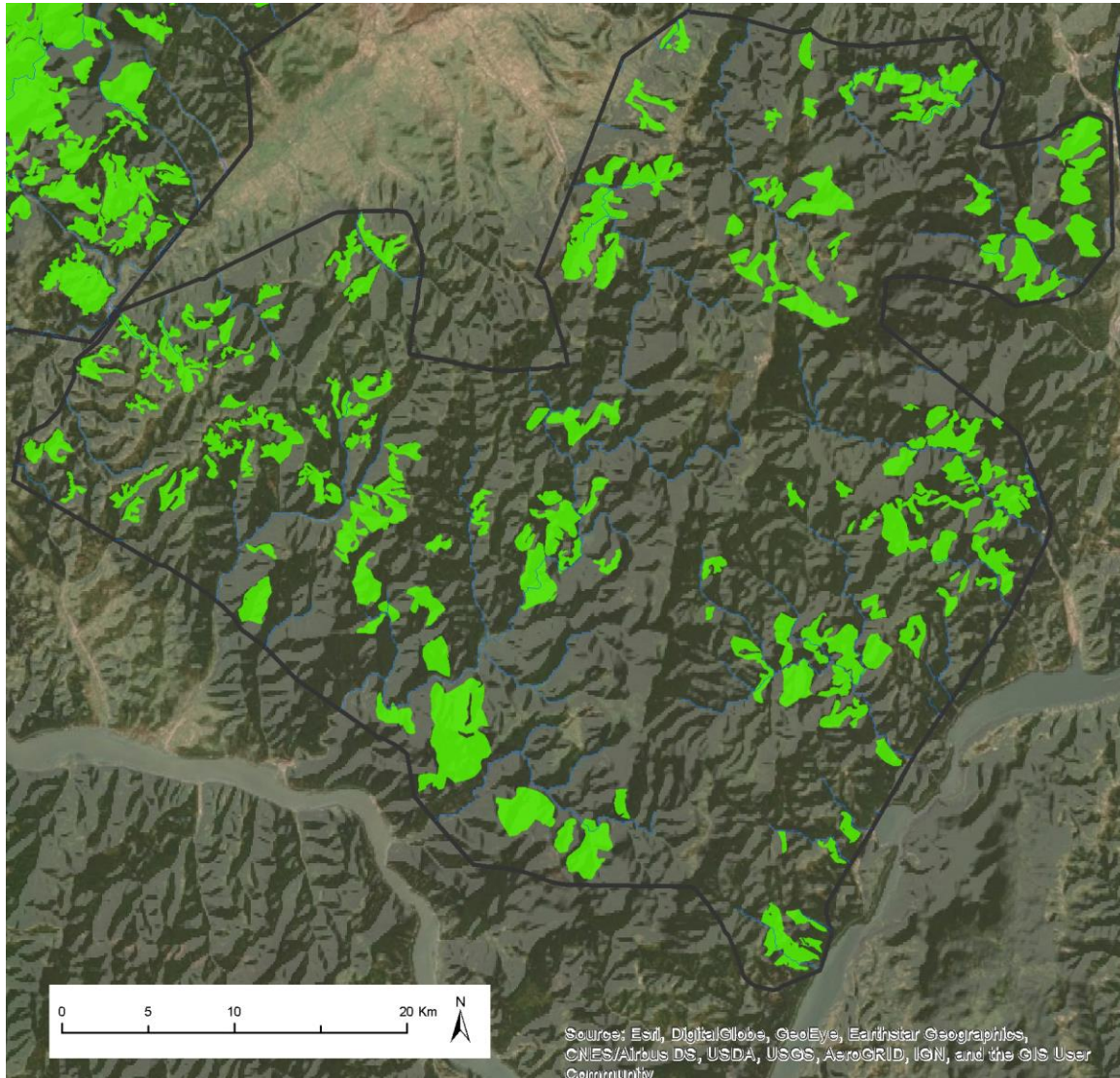


Image 23: Potential old-growth and primary forests in Danube Southwest, Almajului Mountains forest region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.5. Făgăraș, Piatra Craiului

This focus region comprises 274,162 hectares of forests including 61,846 hectares (31%) of PRIMOFARO areas, which is together with the Tarcu/Retezat/Vâlcan/Jiu region the highest share of total forest coverage. There is an overlap of 20,322 hectares with *Pin Matra* and 42,642 hectares with Greenpeace (largest overlap within all 12 areas) inventories. The coverage of protected areas (mainly Fagaras Mountains Natura 2000 site) spreads over 57,055 hectares of the PRIMOFARO inventory. However, numerous, partly very large clear-cuts were identified, potentially posing an increased threat by flooding to lower settlements and agriculture fields.

This focus region shows a very high density of potential old-growth and primary forests, even for most of central Europe: Făgăraș mountains harbour some of the wildest and most remote mountain valleys in middle Europe and host several very large and widely untouched primary forest complexes (such as Boia Mica, Arpasul, Arpaselu, Ucea Mare or Laita valleys). Unfortunately, due to intensive logging, many forest areas with high scientific and biodiversity value have already been degraded (Mikolas & Kameniar 2018). The vast intact natural ecosystems of this extraordinarily wild mountain range deserve the highest possible level of protection.

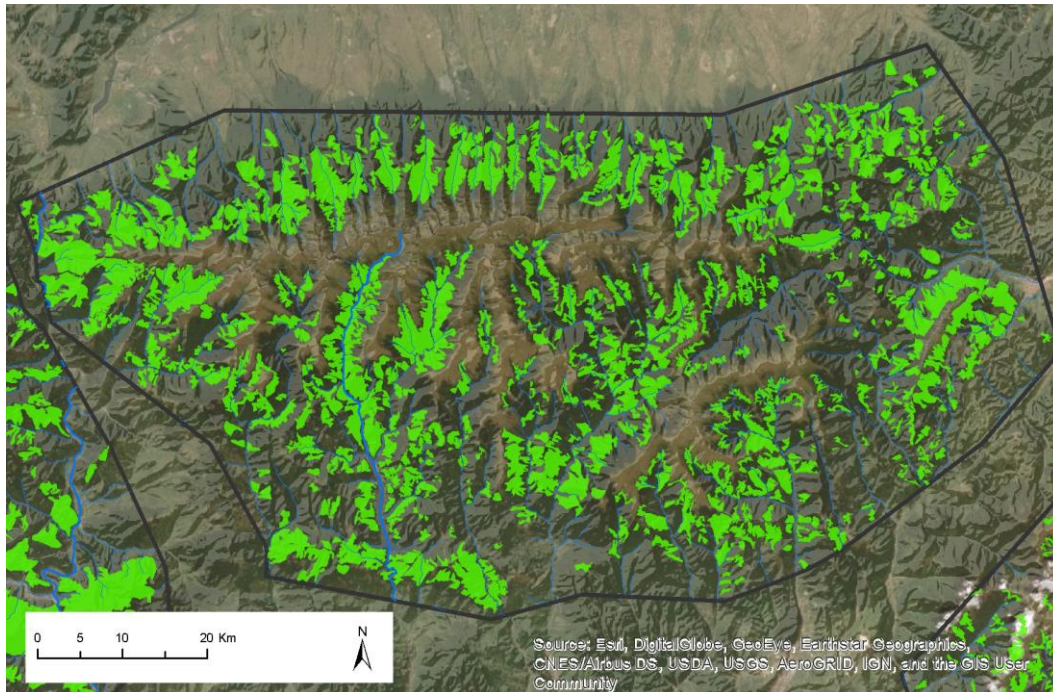


Image 24: Potential old-growth and primary forests in Făgăraș, Piatra Craiului forest region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.6. Maramures, Rodna Mountains

The focus region comprises 234,143 hectares of forests including 23,432 hectares (10%) of PRIMOFARO areas. There is an overlap of 2,515 hectares with *Pin Matra* and 4,001 hectares with Greenpeace inventories. 16,793 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

This focus region has been suffering significantly from intensive logging. Some valleys are more or less completely clear-cut, especially within Maramures and Rodna Natura 2000 sites. Thus, the natural forest remains are of particular importance for conservation efforts.

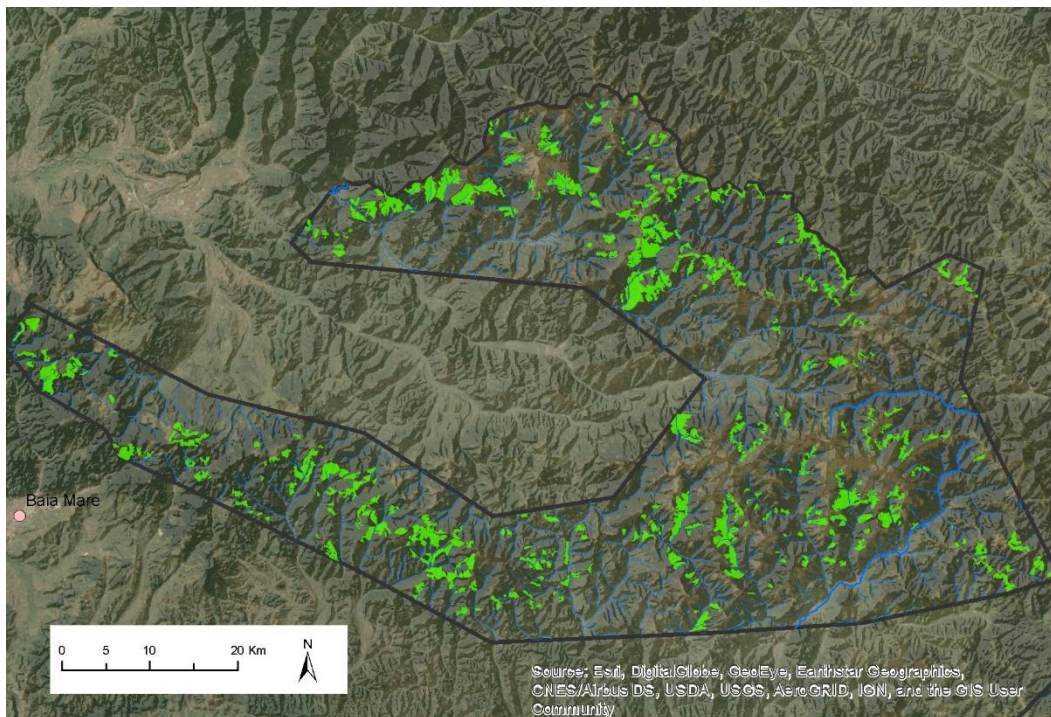


Image 25: Potential old-growth and primary forests in Maramures, Rodna Mountains focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.7. Vrancea, Nemira Mountains

The focus region comprises 190,977 hectares of forests including 25,957 hectares (14%) of PRIMOFARO areas. There is an overlap of 2,306 hectares with *Pin Matra* and 1,855 hectares with Greenpeace inventories. 11,824 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

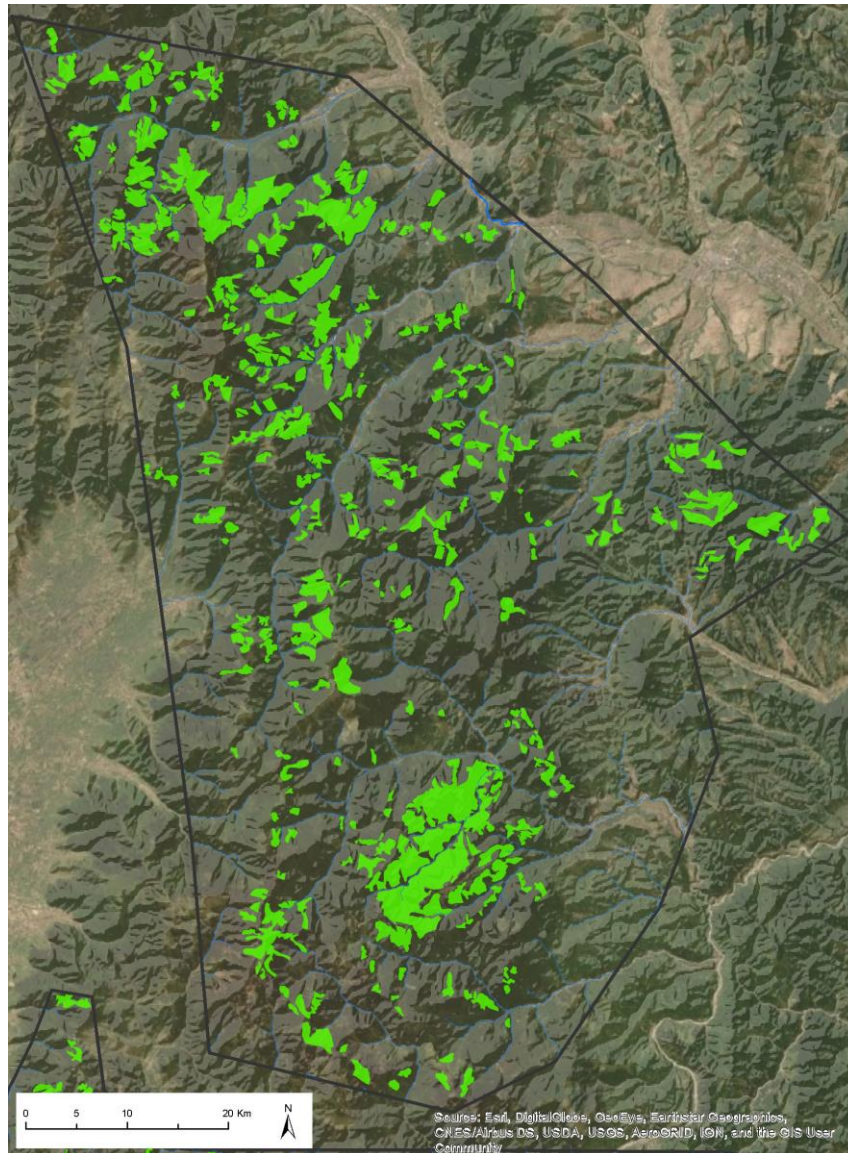


Image 26: Potential old-growth and primary forests in Vrancea, Nemira Mountains focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.8. Parâng, Cozia

The focus region comprises 364,142 hectares of forests including 74,754 hectares (21%) PRIMOFARO areas. This is the largest total extent of PRIMOFARO areas among all 12 regions. There is an overlap of 21,406 hectares with *Pin Matra* and 20,272 hectares with Greenpeace inventories. 38,012 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

We identified a high density of potential old-growth and primary forests including some large patches of forest wilderness.

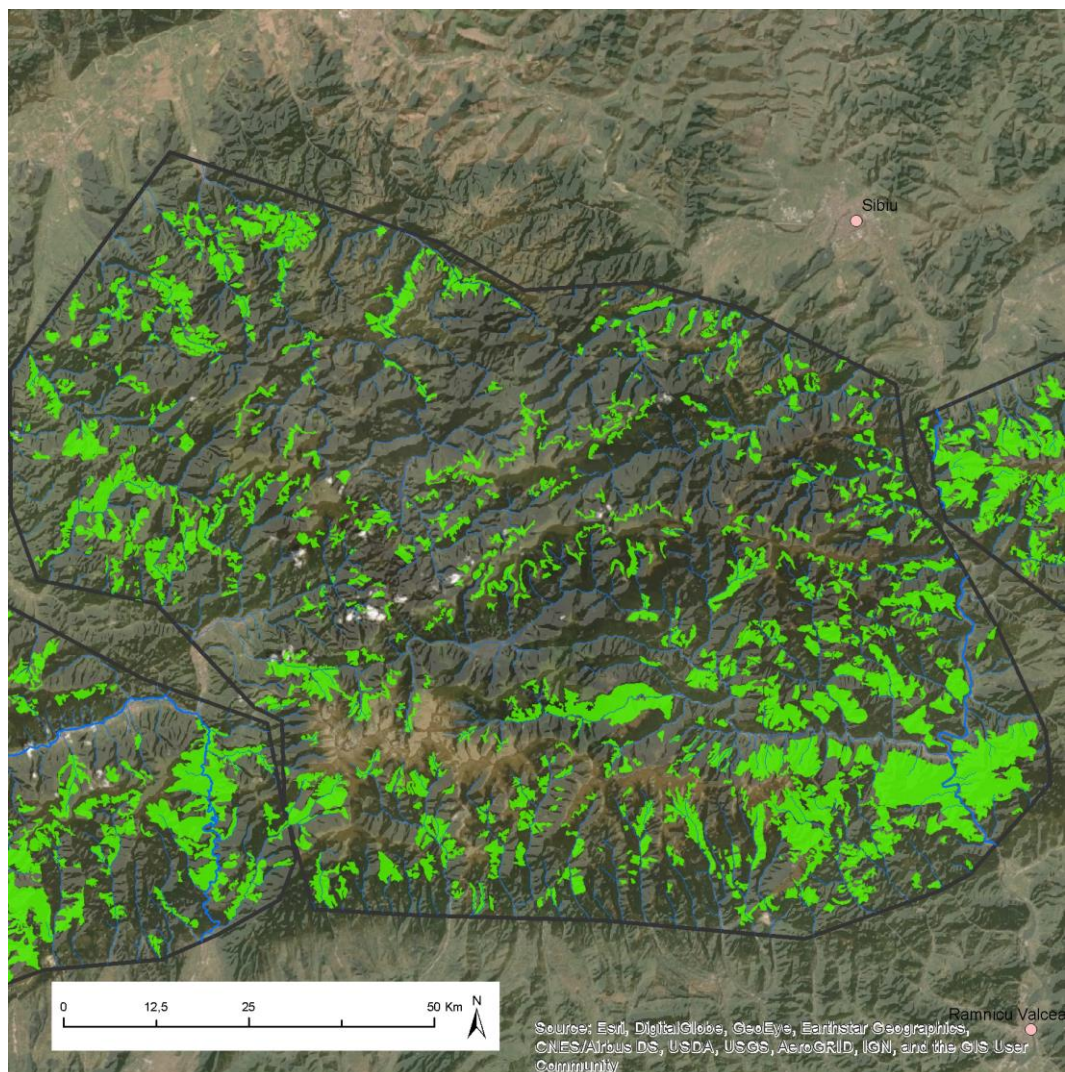


Image 27: Potential old-growth and primary forests in Parâng, Cozia focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.9. Poiana Rusca

The focus region comprises 95,631 hectares of forests including 19,306 hectares (20%) of PRIMOFARO areas. There is an overlap of 2,774 hectares with *Pin Matra* and 2,649 hectares with Greenpeace inventories. 8,913 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000). PRIMOFARO identified several potential old-growth and primary forests areas in this large forest landscape. Several of them have not yet been detected by other inventories.

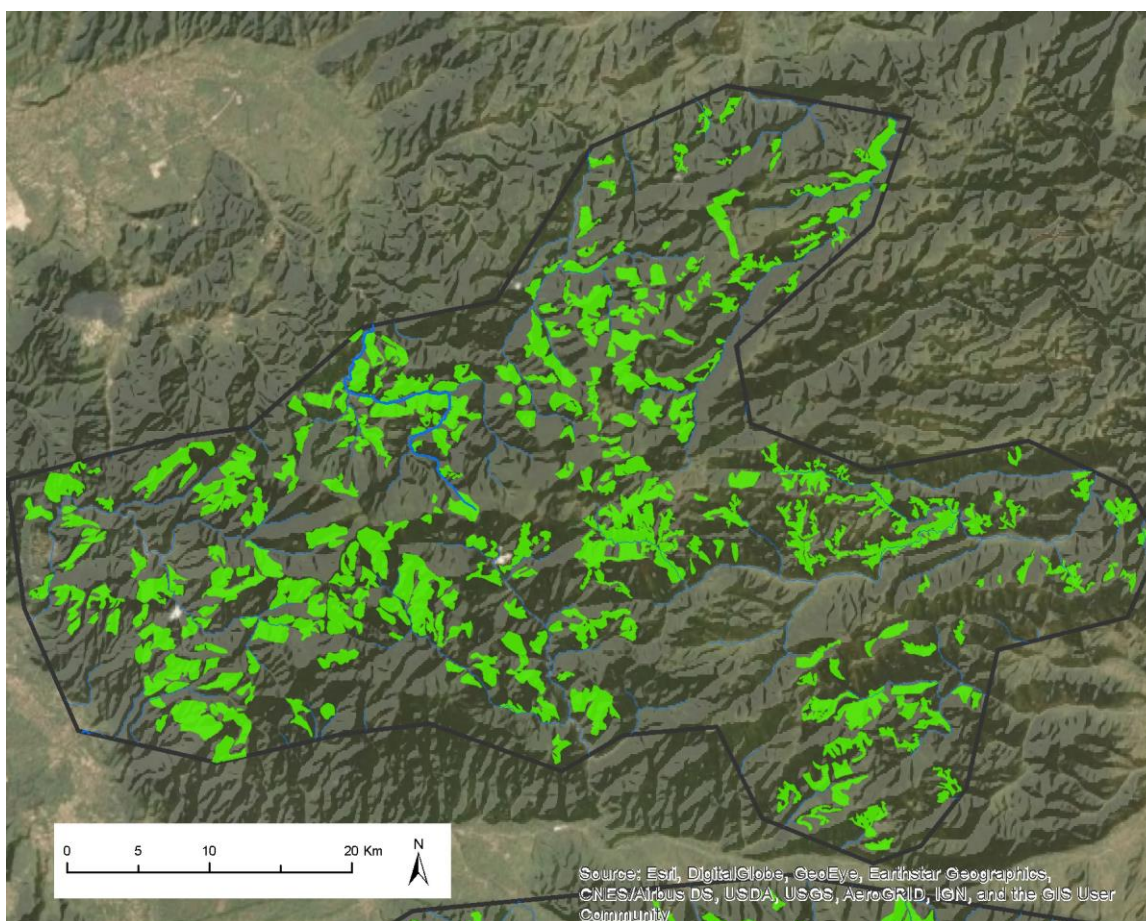


Image 28: Potential old-growth and primary forests in Poiana Rusca focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.10. Semenic, Cheile Nerei-Beușnița

The region comprises 77,218 hectares of forests including 20,807 hectares (27%) of PRIMOFARO areas. There is an overlap of 5,975 hectares with *Pin Matra* and 6,875 hectares with Greenpeace inventories. 16,594 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

Izvoarele Nerei reserve (depicted below in the large green polygon at top right) is the largest single primary forest complex in Romania and it is the biggest stand of primary beech forest in the whole EU. However, we noticed that outside protected areas many high conservation value forests have recently been logged, in particular close to the eastern boundary of Semenic National Park (eastern boundary of the large green polygon). Logging also affects old-growth forests within the Semenic - Cheile Nerei national park.

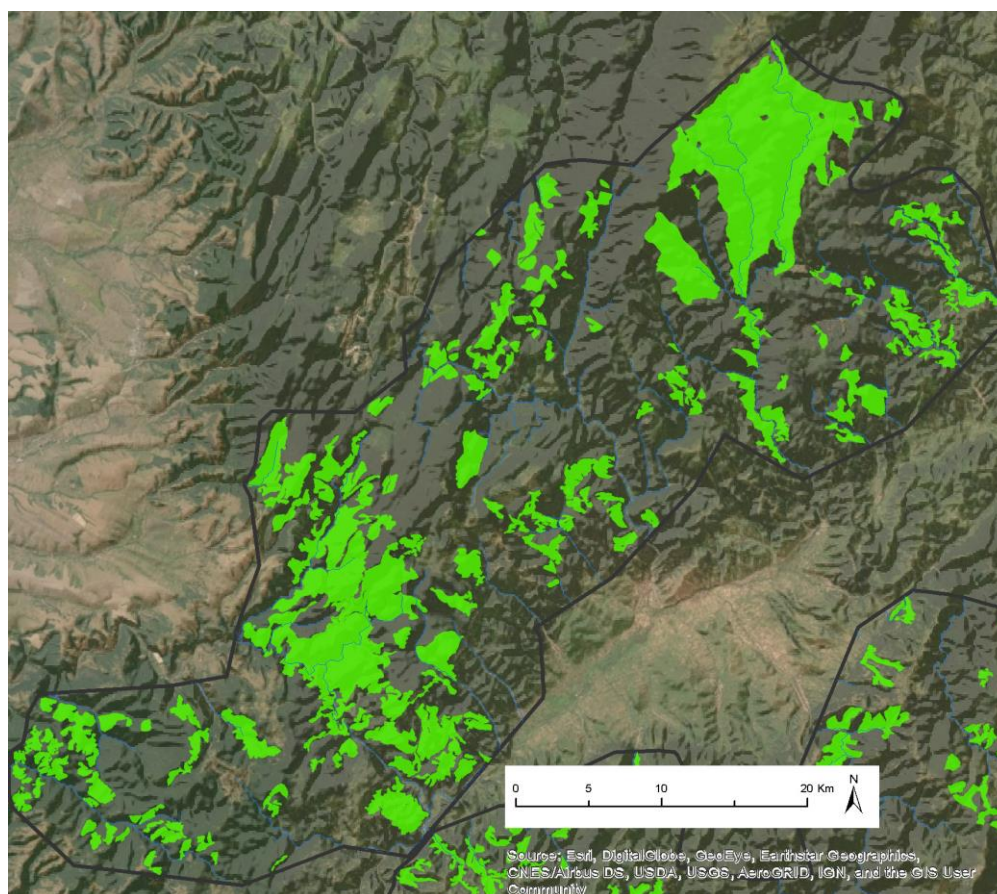


Image 29: Potential old-growth and primary forests in Semenic, Cheile Nerei-Beușnița focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.11. Suceava

The smallest focus region comprises 67,400 hectares of forests and includes 4,438 hectares (7%), the smallest share of the PRIMOFARO inventory. There is an overlap of 815 hectares with Greenpeace inventory (no overlap with *Pin Matra*). 578 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000).

Many potential old-growth and primary forests areas are located outside of protected areas.

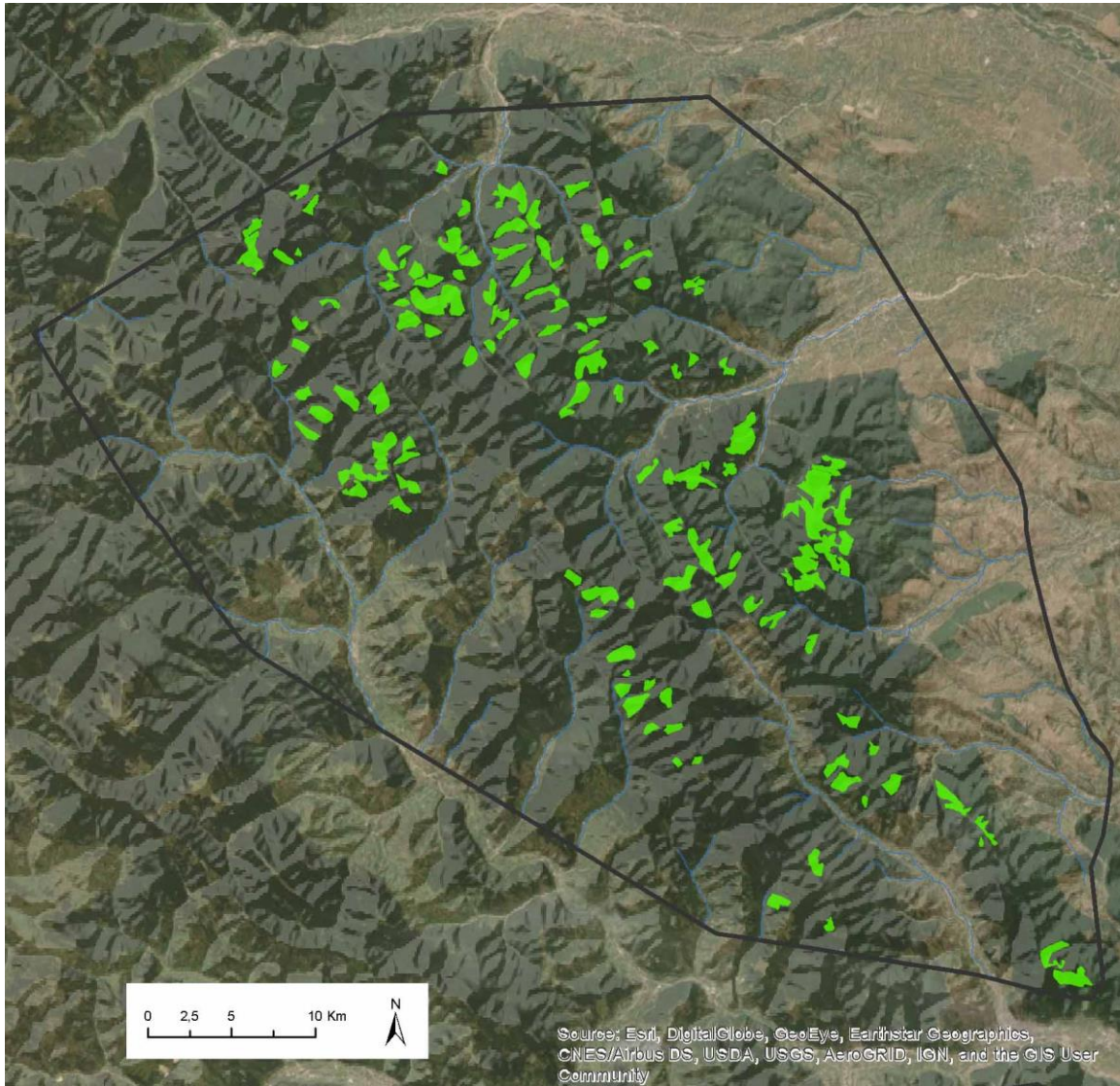


Image 30: Potential old-growth and primary forests in Suceava focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

5.12. Tarcu, Retezat, Vâlcan, Jiu

The focus region comprises 274,162 hectares of forests including 85,430 hectares (31%) of PRIMOFARO areas, which is together with the Fagaras - Piatra Craiului region the highest share of total forest coverage. There is an overlap of 28,657 hectares with *Pin Matra* (the largest overlap for all 12 regions) and 19,694 hectares with Greenpeace inventories. 74,950 hectares of the PRIMOFARO inventory are within protected areas (Natura 2000). This is the highest total value for protected areas within all focus regions.

However, satellite image analyses revealed that logging pressure in the Natura 2000 sites Domogled Valea Cernei, Nordul Gorjului de Vest and Tarcu mountains, including in the buffer zone of Domogled Valea Cernei national park and UNESCO World Heritage Site, is very high.

Retezat and Domogled - Valea Cernei National Parks together with Tarcu mountains were recognised as one of the few remaining “intact forest landscapes” (IFL) in Europe. Due to intensive logging, this classification had to be removed again. However, in Tarcu and Vâlcan mountains Natura 2000 sites there are vast remains of natural beech forest which deserve strong protection.

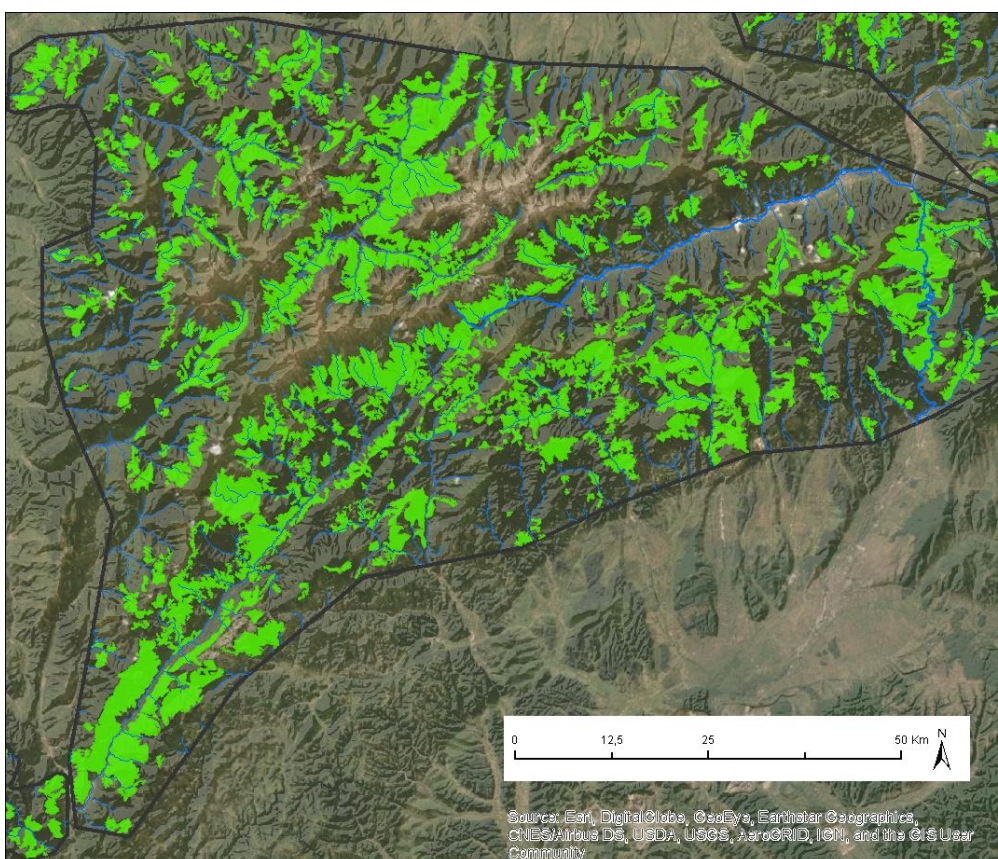


Image 31: Potential old-growth and primary forests in the Tarcu, Retezat, Vâlcan, Jiu focus region. Background image source: Esri, Digital Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User community.

6. Discussion of final results of PRIMOFARO

6.1. Discussion of methods

The visual analyses approach, like all remote sensing methods, has limitations:

- Date of images: Some images might have been outdated by the time of the analysis due to them having been logged in the meantime. The polygons were rechecked finally in July and August 2019 but several areas were only covered by images from 2015 or 2016. Considering the rapid progress of logging in Romania, some of the polygons might have been compromised by recent logging activity. It is hoped that the PRIMOFARO polygons can be re-evaluated in the future by others who will gain contemporary access to latest high resolution imagery.
- Image quality: Google Earth is using a mosaic of good resolution and, as much as possible, cloud-free images which have been taken at different seasons and daytimes. This determines to what degree the images can be used for identification of natural forest structures. Especially if the images showed no or only little shadow it was difficult to detect clusters of large trees and typical irregular structures of natural forests. Also, if there were very dark shadows, it was hardly possible to analyse the forest canopy texture. In this case, older images were used (provided by Google Earth) or the very specific location was searched for on web images provided by ArcGis with better visibility of the actual terrain.
- Using digital algorithms for remote sensing analyses has the advantage of a more precise description of the methodology. However, it is difficult to consider complex geographical context information (e.g. from ground-truthing visits) or a big complexity of regionally differing variables with computer algorithm based analyses of satellite images. Thus, purely digital analyses result in certain degrees of errors. Conducting such an inventory visually is much more time consuming, but allows the possibility to dig deeper into the context of specific locations and, for example, to also consider older images with better lighting or forest insight in older autumn/winter situations.
- Field surveys: Numerous trips to potential old-growth and primary forest sites were conducted to check their ecological integrity. Findings from these trips were also used for calibration of the search process. However, field visits give limited insights as they cannot be pursued everywhere.

To clarify the real conditions on the ground, field checks and consultation of management plans (e.g. for average age data of forest parcels) should be considered as next steps. It

is suggested that PRIMOFARO digital maps are evaluated by overlays with forest management plan data, data from National Forest Inventory and by field checks conducted by forest ecology, forestry and/or biology experts.

6.2. Discussion of results

- The PRIMOFARO inventory reveals more than 525,000 hectares of potential old-growth and primary forests in Romania. The inventory intentionally includes close-to-nature forests which have been used by humans in the past, but have developed again to a very high degree of naturalness. In the past, the focus of forest protection in Romania has been on rather untouched “virgin” forests only. This created a situation where forests were over-critically checked for signs of human use. If officials found more than five stumps per hectare, the very forest parcel often was not accepted for inclusion within the *National Catalogue of Virgin and Quasi-virgin Forests* and the forest could be logged and lost.

Earlier forest inventories, such as *Pin Matra* in 2005 and the Greenpeace digital map of potential primary forests in 2017 had been devalued by opponents of forest conservation because they detected some errors in the final datasets. To be clear: PRIMOFARO also includes forests which have had minor human use in the past.

These old-growth forests very likely harbour a rich diversity of protected species and natural ecosystems in a very good conservation status. Even if some of them have experienced selective cuttings some time ago, they have the potential to develop structures and biodiversity of primary forests much quicker than most other forests in Europe. Therefore they are considered as worthy to be identified - and preserved - in particular when they already exist in a protected area such as Natura 2000 site or a national park.

- Due to the limitations of a desktop analyses, it is not possible to determine exactly how much “near virgin” forest without any forest management in the past is left intact in Romania and where these forests are located. What can be said is that the intact remains of *Pin Matra* polygons are likely to represent unmanaged primary forests. How much of the rest of PRIMOFARO inventory is in a “near virgin” status and how much is “old-growth” forest (including long untouched forest) can only be determined by independent field research by forest ecology experts. However, considering the fact that also long untouched forests deserve conservation (see above) this question is probably not the most relevant one.
- The existence of large tracts of “virgin” forests in Romania has been disputed heavily between different groups in Romania over the past years. Representatives of forestry

authorities, some forest managers and officials from ministries have repeatedly expressed in public discussions that most of the “virgin” forests in Romania are not as untouched as some experts and NGOs claim. They state, that all these forests have been cut in the past centuries, even over 150 years ago.

Data collected from our field missions and the various desktop analyses does not confirm this picture. Romania undoubtedly still hosts very large areas of intact, close-to-nature forests.

Vast areas of old-growth and primary forest were identified which by far exceed any similar remains in all other EU member states except Scandinavia. These forests show natural structures typical for old-growth and primary forests.

- Also, recent research results from the REMOTE project (University of Life Sciences, Prague) and a mapping project led by the University of Rottenburg have underpinned the existence of large primary forests with exceptionally old trees, rich biodiversity and even the existence of pathless mountain valleys.
- Forests like these are almost non-existent in most of Europe (Sabatini 2018) and old-growth and primary forests are treated in several EU countries almost as holy places today where access is granted only for scientists and a very limited number of visitors due to their outstanding biological value.
- Therefore, the identification of this large surface of potentially intact natural forests in Romania is a very positive surprise. However, during field missions it was confirmed that most of these forests are not safe from degradation or liquidation by logging. This includes old-growth forests, which are not covered by the Romanian forest protection program, the *National Catalogue of Virgin and Quasi-virgin Forests*.
- More than 330,000 hectares of old-growth and primary forests are already included in Natura 2000 sites. It is important to stress that whether or not a forest is classified as “virgin” cannot be the only criterion for forest protection. Neither the EU’s Natura 2000 legislation nor international conventions or standards (such as Convention on Biological Diversity or IUCN guidelines) limit the need of forest conservation to untouched “virgin” forests. Therefore, all these forests should be the subject of immediate enhanced conservation efforts.
- The need for improved protection efforts is underpinned by reports about a very high level of illegal logging in Romania. According to leaked data from the Second National Forest Inventory²⁸ the annual wood harvest exceeds the legally allowed cut by more than

²⁸ <https://www.saveparadiseforests.eu/en/kept-secret-data-from-romanian-forest-inventory-reveals-catastrophic-level-of-illegal-logging/>

100%. This is an indication that the unique forest treasure of Romania is under acute threat.

- Romanian officials argue that Western countries cut all their natural forests in the past and therefore, Romania should be allowed to do the same. This issue, which is also raised in other parts of the world, touches on the bigger context of the global commons and ecological responsibility. At its heart, the idea of sustainability aims to deliver intact and fully functional ecological systems to future generations. Since the Global Assessment Report by IPBES in May 2019, humanity knows that it is facing a combined, strongly interconnected climate and biodiversity crisis. Every natural forest that is logged adds to this crisis situation.

The large-scale breakdown of production forest (mainly plantations) in Germany and other European countries shows clearly that Europe's natural and semi-natural forest remains should be preserved as a whole, as a pool of genetics and species for the reforestation of Europe with better climate resilient forests.

- Germany, Switzerland, Sweden and other countries have adopted biodiversity strategies with clear benchmarks of the share of forests left unmanaged and allowed to naturally develop. They have even turned industrial forests into secondary "wilderness" areas due to a lack of intact stands of close-to-nature forest. Luckily, Romania is not (yet) facing such a shortage of high biodiversity value forests.

7. Summary:

1. EuroNatur Foundation commissioned an inventory of potential old-growth and primary forests to help with the identification of this unique natural heritage of Europe.
2. This inventory was pursued based upon available free access online satellite imagery. Existing inventories were evaluated and also additional areas outside their scope were analysed for intact remains of old-growth and primary forests.
3. This resulted in the identification of **525,632** hectares of potential old-growth and primary forests in Romania.
4. Out of this total number, **480,054** hectares of potential old-growth and primary forests in 12 focus regions have been confirmed as intact after validation by historical satellite images (declassified CORONA images).
5. Outside the 12 focus regions, **45,578** hectares of potential old-growth and primary forests were identified. These forests were not validated by historical satellite images (CORONA).

Although these forests are more likely to have suffered a higher degree of human interventions in the past due to their vicinity to settlements, industry and transport infrastructure, they very likely contain high levels of biodiversity and constitute rare refuge areas for threatened species and natural ecosystems, surrounded by more intensively used agriculture and silviculture land. Thus, they deserve special conservation efforts.
6. To exclude forest stands with historic silvicultural interventions, 137 CORONA aerial images from 1960 to 1970 were analysed. 781 patches were found covering 4,521 hectares with visible human impacts. After removal of the “compromised” polygons (1% of the initial data set), the final inventory data set covers **480,054** hectares (within 4,961 polygons). This is the first time such an analysis was pursued in Romania.
7. The comparison between PRIMOFARO and the *Pin Matra* inventory (Biris and Veen 2005) results in 55% overlap (116,589 hectares). This means that almost half of the virgin forest stands identified in 2005 cannot be confirmed as intact primary forests anymore, mainly due to logging since that time.
8. Nearly two-thirds or 332,844 hectares of the polygons of the PRIMOFARO inventory are located within Natura 2000 sites of which 83,937 hectares are additionally included in Romania’s 13 national parks (Natura 2000 sites and national parks overlap). However, Romania’s protected areas are obviously under strong logging pressure, as our analyses have revealed. Active or recent logging was discovered in natural (or recently

- natural) forest stands in most of the Natura 2000 sites and national parks.
9. In general, potential old-growth and primary forests located within protected areas should be considered as priority areas for conservation. This is highly relevant for 332,844 hectares (63% of the PRIMOFARO inventory), which are already located within national parks and Natura 2000 sites. The remaining almost 200,000 hectares of high biodiversity value forest currently lack any protection and thus urgently need efforts to be included in enlarged or additional Natura 2000 sites, national parks or strict nature reserves (according to IUCN protected area category I).
 10. Only 19,533 hectares of potential old-growth and primary forests identified by PRIMOFARO (4%) could be considered as likely to have had stronger human impacts in the past. Thus, for the overwhelming majority of the PRIMOFARO polygons there are statistical indications of an increased likelihood of close-to-nature status

8. Conclusions

by EuroNatur Foundation and Agent Green

Romania's extraordinary forest treasure must be preserved as one of Europe's key contributions to global biodiversity protection

The PRIMOFARO inventory identified 525,632 hectares of potential old-growth and primary forest including 480,054 hectares validated as showing no significant signs of human use since at least the 1960s. This includes 116,589 hectares of the “virgin and quasi-virgin” forests identified in 2005 by the *Pin Matra* study (Biris and Veen 2005).

It is not possible to determine exactly how much of this high biodiversity value forest can be considered as “virgin” forest. However, we think the share of “virgin” forests is not the most important question because conservation of forest ecosystems needs to reach beyond this restrictive definition. Factors such as rich biodiversity, conservation value at a local and regional level, connectivity, potential for natural recovery, carbon storage and ecosystem services need to be considered as well.

Romania's remaining primary forests are unique, not just for their large expanse, but also for still being well connected at a landscape scale. This high connectivity is a unique feature of Romanian forest landscapes and deserves special conservation efforts.

These more than half a million hectares of potential old-growth and primary forest represent around 8% of Romania's forest cover. It is an enormous contribution to Europe's unique natural heritage and deserves EU-wide conservation efforts.

The 2019 release of the Global Assessment report of IPBES²⁹ emphasised clearly how serious the impacts of the accelerating biodiversity crisis have already become. The report leaves no doubt that biodiversity loss and global warming are closely interlinked. Deforestation and our current systems of agriculture, including livestock production, account for about a quarter of greenhouse gas emissions, but are also significantly responsible for biodiversity decline.

According to the IPBES report, there is agreement among scientists that one of the most urgently needed actions is to stop further loss of biodiversity and global heating. The IPBES findings underline that deterioration of intact natural forests must be halted across the whole globe. This includes the protection of old-growth and primary forests everywhere on this planet. This certainly includes Europe, which is the continent with the highest degree of land conversion from natural to industrial landscapes.

²⁹ <https://www.ipbes.net/news/ipbes-global-assessment-summary-policymakers-pdf>

The PRIMOFARO inventory provides a comprehensive overview about the extent and geographical location of Romania's potential old-growth and primary forest remains.

The PRIMOFARO inventory reveals that Romania hosts the largest natural forest treasure within the EU outside Scandinavia. Furthermore, this unique treasure is far bigger than previously reported, when a wider scope regarding naturalness is applied.

Misleading debate about forest protection in Romania

Earlier Romanian forest inventories including the *Pin Matra* project (Biris and Veen 2005) and Greenpeace's more recent primary forest map (Greenpeace CEE Romania 2017) were heavily focused on "virgin and quasi-virgin forests". The Romanian state issued a set of criteria for the identification of these kind of forests, which is strictly bound to climax types of primary forests and does not allow the comprehensive protection of all important - biodiversity rich and high conservation value - forests.

This has been used by Romanian state institutions, authorities and forest managers to restrict forest protection to a smaller number of more or less isolated forest stands. As a result, many important natural forests have been lost, including highly valuable stands in protected areas, which would have been under strict forest protection in many other EU member states.

The Romanian criteria for identification of forest naturalness strongly relate to the measure of whether a forest is considered "virgin" or not and defines how much human impact is allowed in order to include a forest stand in the *National Catalogue of Virgin and Quasi-Virgin Forests*.

The whole public debate in Romania about forest protection has been fixed focused on this catalogue and whether a forest is untouched enough to allow protection.

This has triggered counterproductive and destructive developments. It is reported that forest owners and state forest agencies, in response to the catalogue, have hurried to cut some trees in their natural forests so that the forest is no longer considered "virgin" and thus the forest no longer qualifies for protection. Ironically, the strict criteria for protection of forests have been used as an opportunistic tool against conservation.

The strict Romanian criteria for "virgin" forests and their discriminatory application by some representatives of forest authorities have contributed to deterioration and degradation of many important natural forests in Romania.

Focusing on the *National Catalogue of Virgin and Quasi-Virgin Forests* has completely excluded other protection regimes and approaches such as national parks, nature reserves and Natura

2000. All these approaches are focused on the biodiversity value of ecosystems and do not use “virgin” forest criterion as discrimination against protection. They strive to be as inclusive as possible and also consider aspects such as threatened species or size of natural landscapes as criteria for the protection of a given area.

The debate has largely ignored the existence of large forest landscapes in Romania that have a high degree of biodiversity and naturalness beyond the criterion of “virgin” forest. Therefore, there are serious implementation deficits regarding the legally binding EU Nature Directives and IUCN guidelines in Romania.

Lack of implementation of nature protection laws and commitments

Almost two-thirds of the areas identified as old-growth and primary forests in this study are found within Romania’s protected areas, mostly in Natura 2000 sites. Due to overlap among Natura 2000 sites and national parks, some of these areas are additionally located within national parks. However, most of these forests are not protected at all and are under permanent threat of intensifying logging.

Romanian NGOs claim that the main drivers of the destruction of Romania’s natural forest heritage are:

- a widespread culture of greed, corruption and bad governance,
- the huge demand for timber deriving from the giant wood manufacturing capacities of international companies present in and sourcing from Romania.

As most of the logging in Romania occurs as so-called “progressive cutting” (relevant for deciduous forests - the stepwise removal of all trees of a forest parcel over a course of 10 to 15 years) and by clear cutting (coniferous forests), the ecological value of these forests is liquidated after relatively short logging cycles.

12 of 13 Romanian national parks are managed by the state forestry manager, Romsilva. In many cases, strictly protected “core zones” are smaller than 50% of the national park surfaces. Forests within the national park but outside these zones are treated by Romsilva like ordinary, commercial logging sites outside of the parks. Thus old-growth and primary forests continue to disappear, even within national parks. This is in clear contradiction to IUCN guidelines for national parks, which call for preservation of large natural ecosystems on at least 75% of the park surface.

Furthermore, only a very small fraction of old-growth and primary forests within Natura 2000 sites is under secure protection. The EU Habitat and Birds Directives³⁰ oblige EU member states

³⁰ <https://ec.europa.eu/environment/nature/legislation/>

to avoid “the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated”. Therefore an “appropriate assessment” of “implications for the site in view of the site's conservation objectives” has to be conducted before any “plan or project is approved at the very site.”

These legal requirements appear to not be respected sufficiently in Romania: old-growth and primary forests in Natura 2000 sites - including numerous protected habitat types and species - are vanishing. “Appropriate assessments” (environmental impact assessment in Natura 2000 sites) mostly appear to be bureaucratic exercises where the appropriate assessments of the ecological impacts of plans or projects such as logging and forest road construction are not considered.

Where are Romania’s large wild forest landscapes?

Outside Scandinavia, most of the EU’s large remains of natural or wild forest landscapes can be found in the Carpathians, especially in Romania, Slovakia and Poland. The largest share of this natural treasure is located in Romania.

There are several reasons why protection of larger natural landscapes is of high importance: In order to preserve rare and highly threatened species which depend on larger areas of undisturbed forest ecosystems (such as bats, owls, woodpeckers and saproxylic beetles), it is important to ensure the preservation of their last larger habitats. The full range of natural processes can only unfold when larger natural landscapes are designated as non-intervention areas. Natural forests also store and continuously absorb huge amounts of carbon. Thus, they play a key role in climate protection efforts.

Therefore, protection of connected large natural forest landscapes in addition to a network of smaller forest reserves is key to ensuring the proper protection of species dependent on mature and natural forests.

These larger areas of “forest wilderness” have a particularly high need for protection because it is very important for many specialised species. Many of these demanding species are listed as conservation objectives of Natura 2000 sites already, so their comprehensive protection is a binding legal obligation. Larger protected areas may also include forest parcels which have been degraded already by logging but can be regenerated and re-wilded.

In order to find out where appropriate forest areas with a high degree of naturalness and less human impact are located, we commissioned a specific additional analysis with the PRIMOFARO project, to identify the most promising areas for the creation of larger forest reserves and reserves networks. Areas with an outstanding potential of vast wild forest landscapes, including large surfaces with potential old-growth and primary forests, particularly can be found in:

- Romania's existing national parks; which urgently need enlarged "core zones" to comprehensively preserve all old-growth and primary forests and
- Natura 2000 sites (according to Birds and Habitat directives).

The biggest concentrations of potential old-growth and primary forests of the PRIMOFARO inventory which are already included in the Natura 2000 protection regime can be found in the following sites (SCI):

- Munții Făgăraș (ROSCI0122)
- Ciucaș (ROSCI0038)
- Penteleu (ROSCI0190)
- Nordu Gorjului de Vest (Valcan mountains, ROSCI0129)
- Munții Țarcu (ROSCI0126)
- Frumoasa (ROSCI0085)
- Podișul Lipovei - Poiana Ruscă (ROSCI0355)
- Rusca Montană (ROSCI0219)
- Putna - Vrancea (ROSCI0208)
- Munții Goșman (ROSCI0156)
- Masivul Ceahlău (ROSPA0129)
- Călimani - Gurghiu (ROSCI0019)
- Munții Maramureșului (ROSPA0131)
- Obcinele Bucovinei (ROSCI0328)
- Valea Izei și Dealul Solovan (ROSPA0171)
- Apuseni (ROSCI0002)
- Munții Bihor (ROSCI0324)
- Defileul Crișului Alb (ROSCI0298)
- Coridorul Rusca Montană - Țarcu – Retezat (ROSCI0292)
- Munții Almăjului - Locvei (ROSPA0080)

Recommendations

The PRIMOFARO inventory identified more than 525,000 of potential old-growth and primary forest - this is a unique natural treasure, not just of critical significance to Romania, but to all of Europe.

EuroNatur Foundation and Agent Green recommend the following measures to be implemented as soon as possible to avoid further loss of these forests:

- Romania's old-growth and primary forests need to be protected properly, as comprehensively as possible.
- In order to implement the obligations from the Convention on Biological Diversity (CBD), other countries including Germany³¹ and Switzerland have committed to permanently protecting 5-10% of their forests without further forestry use. In Germany, previously intensively managed forests have been designated for natural development to reach the 5% "forest wilderness" goal, simply because there are not enough close-to-nature forests left in the country. In Romania, approximately 8% of the forest cover is still in a very natural state. But Romania has not yet defined measurable goals in conjunction with its CBD obligations. Romania should follow the lead of Switzerland and Germany. EU funds should be provided and used to support the implementation of such a goal.
- The PRIMOFARO inventory identified 332,844 hectares (63%) of potential old-growth and primary forests in Natura 2000 sites, including 83,937 hectares located within national parks. These forests need to be protected comprehensively, applying a non-intervention approach and very extensive, close to nature forest management, only to serve immediate subsistence needs of local population.
- Potential old-growth and primary forests on Romanian state property need to be turned into non-intervention zones. This needs to happen quickly, therefore a moratorium for logging of potential old-growth and primary forest on state property must be applied by the Romanian government. Eventually these forests need to be included in strictly protected zones of enlarged national parks, UNESCO World Heritage sites, strict nature reserves or Natura 2000 sites to ensure permanent and safe protection.
- Private owners need to be compensated for loss of income as a result of strict protection of their forests. This should be supported by public funding including EU funds.
- Old-growth and primary forests are important carbon storages and sinks, and as such they also deserve conservation for the sake of climate protection.

³¹<https://www.cbd.int/financial/2017docs/germany-commitment2016.pdf>

Appropriate funds should be mobilised to compensate private and municipal forest owners for loss of income. There is an intensifying debate on EU level about forest protection and related funds. Recently, the EU Commission issued a statement on protection and restoration of forests³². Romania could be a model region for forest carbon capture and sequestration.

Natural forests have become extremely rare in Europe. However, the EU Habitats Directive does not explicitly distinguish between primary and secondary forests in terms of conservation objectives and measures. It has become clearer that the EU is unlikely to meet its 2020 goal of halting the loss of biodiversity, and that the implementation of the Natura 2000 conservation targets in the forest sector across the EU is deficient. Therefore, Europe's old-growth and primary forests need enhanced protection efforts.

The need for their full protection (ie. the application of a non-intervention approach) should be the subject of future EU political and strategic processes (eg. in the framework of the post-2020 Biodiversity Strategy). An explicit initiative by the European Commission to ensure the proper conservation of intact natural forest habitats would also contribute significantly to their protection, both within and outside of existing Natura 2000 sites.

- Romania should implement its legal obligation under the Natura 2000 regime:
 - Detailed ecologically focused identification of old-growth and primary forest stands in all Natura 2000 sites (map habitat types and conservation status);
 - Research and map presence of key species relevant for Natura 2000;
 - Pursue appropriate assessments (or strategic environmental assessments) for both forest management plans and local logging plans;
 - Prohibit logging plans for potential old-growth and primary forests based upon existing forest management plans and change forest management plans accordingly.
- Old-growth and primary forests outside existing Natura 2000 sites should be included in new or enlarged Natura 2000 sites in Romania.
- Establish some larger and strict protected areas as “forest wilderness” for those areas with the highest concentration of old-growth and primary forests. This could be done by creating large nature reserves (IUCN 1b “wilderness area”) or new national parks. These reserves could foster the local economy by contributing to the development of nature tourism (hiking on cautiously installed trails, provision of guided tours with local

³² https://europa.eu/rapid/press-release_IP-19-4470_en.htm

guides, accommodation in villages and farm houses) and the sale of local traditional agricultural products in the surrounding rural areas.

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