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# Policy maps of national forest biodiversity conservation and restoration related policy and implementation in Europe

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# 1. Introduction

Over the last few years, several EU environmental policies based on hard law (regulations, directives) or soft law (strategies, guidelines) have been developed. They will very likely influence forest management for the next decades to come (see Table 1). In 2019, the newly appointed EU Commission adopted a Communication on the **European Green Deal**, where forest protection in the EU is deemed a political priority in pursuing the new EU's climate and biodiversity policy objectives (55% greenhouse gas emission reduction by 2030; nature protection of 30% of the EU land area, incl. 10% under strict nature protection by 2030). The European Green Deal together with the EU Climate Law, the new EU Biodiversity Strategy to 2030 and the new EU Forest Strategy to 2030 call for a transformative change aiming at tackling the biodiversity and climate crisis in an integrated way. These EU policies recognise that forest ecosystems are under increasing pressure and call for action to improve the quantity and quality of the forests for the EU and its Member States to reach climate neutrality by 2050 and a healthy environment by 2030 (EC, 2019).

In the framework of the new European Green Deal Policy, the new **EU Biodiversity Strategy** to 2030, adopted in May 2020, sets out three key objectives that are to be reached until 2030: (i) to legally protect at least 30% of EU land area (an extra 4% for land as compared to today) and integrate ecological corridors, as part of a true Trans-European Nature Network (Natura 2000); (ii) to strictly protect at least a third of the EU's protected areas representing 10% of EU land, including all remaining EU primary and old-growth forests; and to (iii) effectively manage all protected areas, defining clear conservation objectives and measures, and monitoring them appropriately. The new EU Biodiversity Strategy to 2030 contains a chapter on actions on forests, requiring the strict protection of all remaining EU primary and old-growth forests and increasing the forested area by planting at least three billion additional trees in line with biodiversity-friendly standards in the EU by 2030. It also aims at increasing the share of forest areas covered by management plans and developing guidelines on biodiversity-friendly practices on afforestation and closer-to-nature forestry. Furthermore, to counter the pressure of the increased demand for biomass on forests, the use of whole trees for energy production should be minimised, and bioenergy should focus primarily on wood waste and residues. An EU Nature Restoration Plan (see below) will set legally binding conservation targets to restore degraded terrestrial (forest) eco-systems, landscapes, and forest-related water bodies, to enhance sustainable management and resilience. The Plan demands measures to increase the quantity, quality and resilience of managed and protected forests in the EU-27. This refers to restoration measures such as biodiversity-friendly afforestation, reforestation and tree planting, closer-to-nature-forest management, integration of biodiversity and restoration objectives in management plans of forest owners. The Plan also aims at creating jobs, reconciling economic activities (e.g., forestry) and biodiversity objectives, and ensuring long-term productivity and value of the natural capital (EC, 2020).

As an initiative of the European Green Deal, and by building on the EU Biodiversity Strategy for 2030, the Commission adopted a new **EU Forest Strategy to 2030** (EU-FES). The main objectives of the EU-FES are effective afforestation and forest preservation and restoration in Europe, to help to increase the absorption of CO<sub>2</sub>, reduce the incidence and extent of forest fires, and promote the sustainability of forest-based bioeconomy in full respect for ecological principles favourable to biodiversity. It also aims to strictly and effectively protect all primary and old-growth forests in the EU. The EU-FES also demands that clearcutting practices in the EU countries should be approached with caution, generally avoided and used only in duly justified cases, for example when necessary for environmental or ecosystem health reasons and include environmental and ecosystem concerns (EC, 2021).

In June 2024, after a legal proposal made by the EU Commission in 2022, the EU Parliament and the Council of Member States adopted a new **EU Nature Restoration Regulation (NRR)**. Among others, the EU Nature Restoration Regulation (i.) aims to restore by 2030 at least 30% and by 2050 at least 90% of all habitats (also forest habitats) in need of restoration that are protected under the **EU Birds and Habitats Directives** and included in the **Natura 2000** network of protected areas (Art. 4), (ii.) request EU Member States to develop National Restoration Plans taking account of national circumstances (Art. 14), plant 3 billion additional trees in full respect of ecological principles such as priority for native tree species, tree diversity, age structure diversity (Art. 13). Importantly, the EU NRR also obliges EU countries to restore biodiversity in (managed) forest ecosystems. Member States shall achieve an increasing trend at national level of a set of biodiversity indicators in (managed) forest ecosystems until 2030, and every three years thereafter, until satisfactory levels are reached. The set of indicators include (a) common forest bird index; (b) standing deadwood; (c) lying deadwood; (d) share of forest with uneven-aged structure; (e) forest connectivity; (e) stock of organic carbon; and (f) share of forests dominated by native tree species. While Member States are encouraged to give initial priority to restoration measures in areas that are located in Natura 2000 sites until 2030, the NRR further stipulates the implementation of forest restoration measures outside of protected areas (EC 2024).

In short, the European Green Deal, the EU Habitats and Birds Directives, the new EU Nature Restoration Regulation, the EU Biodiversity Strategy to 2030 and the EU Forest Strategy to 2030 request from the EU countries to restore and conserve forest biodiversity, to increase the share of forest protected areas, effectively protect old-growth forests and increase deadwood in all forests, and to better conserve Natura 2000 forest sites. They also request countries to store more carbon in standing forests as well as to avoid clearcutting, foster close-to-nature forest management and biodiversity-friendly reforestation/afforestation in the EU-27, and beyond (Table 1). Further descriptions and more detailed analysis of the EU forest related policy and legal framework can be seen elsewhere (Wolfslehner et al. 2020; Sotirov et al. 2024).

*Table 1: Overview of EU biodiversity and climate policies and laws with relevance to national forest policies and laws (adapted from Sotirov et al. 2024).*

EU biodiversity policy targets with relevance to forests	EU biodiversity and climate policies
<ul style="list-style-type: none"> <li>Expanding forest protection and restoration by protecting at least 30% of the (forest) land in the EU by 2030, of which at least 10% should be strictly protected areas of high biodiversity and climate value (e.g., forest set asides), as well as by strict protection of remaining primary and old-growth forests (currently below 5%).</li> <li>Better conservation and restoration management in the EU-wide network of Natura 2000 sites (currently 50% of Natura 2000 is in forests).</li> <li>Increase in the quantity, quality and resilience of managed forests and protected forests in the EU-27 by biodiversity-friendly afforestation, reforestation and tree planting, closer-to-nature-forest management, integration of biodiversity and restoration objectives in forest management plans of forest owners.</li> <li>Restoration of degraded terrestrial (forest) ecosystems, landscapes, and forest-related water bodies (degradation due to climate change impacts and/or unsustainable</li> </ul>	<p>European Green Deal (Climate and Biodiversity Policy Focus)</p> <p>New EU Biodiversity Strategy to 2030</p> <p>New EU Forest Strategy to 2030</p> <p>EU Birds and Habitats Directives (Natura 2000)</p>



<p>intensive forestry practices, e.g., clear cutting, monocultures)</p> <ul style="list-style-type: none"> <li>• Sustaining biodiversity and ecosystem services while ensuring sustainable forest management.</li> <li>• Creating jobs, reconciling economic activities (e.g., forestry) and biodiversity objectives, and ensuring long-term productivity and value of the natural capital.</li> </ul>	<p>EU Nature Restoration Regulation to 2030, 2040 and 2050</p> <p>EU Guidelines for Defining, Mapping, Monitoring and Strictly Protecting EU Primary and Old-Growth Forests (2023)</p> <p>EU Guidelines on Biodiversity-Friendly Afforestation, Reforestation and Tree Planting (2023)</p>
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Ambitious EU biodiversity conservation and climate adaptation policy targets are important but they are not enough to secure effective implementation. Among others, critical success factors are supportive decision-making and behavioural practices by different (sub-) national policy-makers, enforcement agencies as well as private and public forest owners and forestry enterprises who have to implement these objectives. The implementation of forest restoration measures and indicators stipulated at EU level are not implemented in a policy vacuum but meet with often long established national forest policy and legal frameworks, which, to a certain extent, are likely to regulate forest management practices in different ways given national policy and socio-economic priorities (Winkel and Sotirov 2016). In addition, EU forest policy matters are frequently addressed outside of the forest policy domain due to a formal lack of competence at the EU level. This has resulted in a situation where for example EU funding for forestry measures is provided under EU agriculture and rural development policy as part of the Common Agricultural Policy (CAP), whereas regulatory aspects are increasingly taken up under the EU's nature conservation and climate policy (Winkel et al. 2013; Sotirov 2017; Sotirov and Storch, 2018; Sotirov et al. 2021; Fleckenstein 2024).

A higher certain degree of coherence with national forest legislation will be crucial to ensure an effective implementation of forest related EU nature conservation policy. Horizontal (across biodiversity and forestry policy sectors) and vertical (across EU and national levels of governance) incoherencies on the other hand are likely to pose a challenge to a successful implementation in the years to come (Sotirov and Storch 2018; Wolfslehner et al. 2020; Beland Lindahl et al. 2023). Effective forest biodiversity goal achievement hence presupposes cross-sectoral policy coherence and implementation at the forestry-biodiversity-climate nexus across EU, national and local levels. This raises questions regarding the degree of coherence between the national forest policy and legal frameworks governing forest management practices and the forest related biodiversity conservation and restoration goals of the aforementioned legally binding and non-legally binding EU environmental policies.

To assess the status-quo of horizontal and vertical policy coherence, this report analyses and discusses to what extent EU forest related biodiversity conservation and restoration policy goals and targets (see Table 1) are coherent with the regulations established in national forest policy and legal frameworks. This is based on an in-depth coding of national forest laws and related legislation and preparation of overview forest restoration policy maps for EU-27. The policy maps are developed to provide an overview on how selected forest ecosystem indicators and respective management practices included in the EU forest related biodiversity policy and legal framework are currently regulated in all EU-27 countries. These policy maps summarize to what extent and how national forest laws regulate the forest ecosystem indicators stipulated by EU policy and law. Depending on a policy and legal analysis of the similarities and differences among national forest regulations, country clusters are identified, shortly described

in cross-tables and on geographical maps along key variables and manifestations of their regulations. A comparison between the country clusters and EU policy goals and targets, conclusions are drawn on the status of horizontal and vertical coherence of EU forest restoration policy using the EU policy targets (e.g. NRR indicators) as point of reference and assessment benchmark.

In particular, the following five indicators for biodiversity related forest management practices were assessed in the present report: (1.) regulation of clearcutting, (2.) reforestation obligations, (3). deadwood management, (4.) forest set asides, and (5.) forest birds protection. To better inform the policy coherence analysis, a short summary of state-of-the art scientific and practical knowledge as regards these forest management practices and indicators is integrated into the report. Accordingly, five EU-27 policy maps, one for each of the aforementioned forest management practices and indicators are provided in this report.

The policy maps and the underlying policy analysis are meant to support a horizontal (biodiversity and forestry policy domains) and vertical (EU and national levels of governance) policy coherence assessment. This policy assessment helps explore horizontal and vertical policy trade-offs and synergies which has the potential to provide scientific evidence based support for decision makers in policy and practice for the implementation of forest biodiversity conservation and restoration in the EU-27. This current report is expected to inform the development of supportive forest biodiversity conservation and restoration policy and legal frameworks at the EU and national levels in the years to come.

## 2. Material and methods

In a first step, and in a close collaboration with the Horizon 2020 funded SUPERB project (<https://forest-restoration.eu/>), the legal provisions, including qualitative and quantitative regulations, governing key forest restoration indicators and forest management practices in national forest laws were coded and analysed. The relatively small number of BIOCONSENT (N=4) and SUPERB (N=12) countries was expanded to cover all current EU countries (N=27) and the UK as EU country before Brexit in 2020 (EU-28).

For those countries where an official English translation was not available or where the researchers were unable to read the respective language, DeepL Pro was used to translate national forest laws into English. In line with key EU policies and legislation (Table 1), literature review and in-house expertise, five forest biodiversity conservation and restoration related indicators and relevant management practices were identified. These include: i) deadwood management; ii) forest birds protection; iii) reforestation obligations; iv) regulation of clearcutting; and v) forest set-asides. The indicators and used definitions are summarized and described in Table 2.

*Table 2: Forest restoration indicators and practices covered in the legal analysis.*

Forest biodiversity restoration indicators and practices	Description
<b>Clearcutting regulation</b>	Provisions about the regulation of clearcutting as an intensive forestry practice that involves the complete removal of all merchantable trees in one operation, leading to changes in the composition of species and habitats in the affected area.



<b>Reforestation obligations</b>	Prescriptions and requirements about the conversion of previously forested land back to forest both through active measures (e.g. seeding and planting) and natural regeneration.
<b>Deadwood management</b>	Requirements about the amount of non-living standing and lying woody biomass in forest and other wooded land.
<b>Forest birds protection</b>	Refers to requirements about protection of common breeding forest birds across their European ranges over time. The index is based on a specific list of species in each Member State.
<b>Forest set-asides</b>	Provisions about strictly protected forests and other wooded land to conserve biodiversity, landscapes and specific natural elements, e.g. in order to implement strict biodiversity conservation objectives and effectively protect or create old-growth forests in line with global treaties, EU and national nature protection laws and strategies.

Through a content analysis of all national forest laws (within case analysis) and cross-country comparisons (cross-case analysis), groups of countries with similar qualitative and/or quantitative regulations were identified and described along their key features. The content analysis of legal text was carried out only as regards national forest laws and equivalent legislation due to their formal degree of legal obligation and primacy for regulating forestry matters across the EU countries in the absence of a common EU forest policy. National or subnational forest bylaw (e.g. ordinances, ministerial decrees etc.) or forest soft laws (e.g., forest strategies) or other sectoral laws, bylaws or soft laws (e.g., nature conservation, climate mitigation and adaptation, agriculture and rural development, bioenergy) were left out of the analysis for capacity constraints. Consequently, results of this policy coherence analysis should not be interpreted as comprehensive. It will be rather crucial to update and complement the findings based on provisions within forest bylaw and soft laws as well as in other forest restoration-related policy areas. Nevertheless, since national forest laws of the EU countries typically constitute the main and basic forest policy and legal framework for national action on forestry given the lack of formal EU forest policy, it can be assumed that these will be most relevant to analyse as regards policy coherence with the EU policies. In particular, a high degree of alignment of EU forest biodiversity indicators with matching targets and thresholds in national forest laws may indicate favorable vertical and horizontal policy coherence, whereas a lower degree of uptake and/or lack of matching targets and thresholds could be interpreted as a policy incoherence (Sotirov and Storch 2018; Beland Lindahl et al. 2023).

At the risk of oversimplification, five thematic European policy maps were illustrated to provide a user-friendly evidence based support to decision-makers in policy and practice. These policy maps contain geographical (e.g., individual countries, groups of countries with similar regulations) and policy attributes (e.g., annotated tables with brief descriptions of country and country group specific regulations). They aim to provide a better understanding of how the selected forest biodiversity conservation and restoration indicators and forest management practices, as promoted under the EU forest related environmental policy and legal framework (Table 1), are regulated across the different European countries (EU-27 and UK) and hence to assess vertical and horizontal policy coherence. This report acknowledges that the legal institutionalization of certain regulations in national forest laws (e.g. by command-and-control rules) is not the only policy tool to support on-the-ground practices. Other regulatory tools such as public and private funding, market instruments, informational tools, and institutional reforms can play also an important role. However, EU level policies and laws create a pull towards



legal compliance by European countries which is often monitored and enforced through command-and-control regulatory tools (e.g., EU monitoring and assessment, warning letters, infringement proceedings, financial sanctions), and pull by non-state actors' pressure (e.g., blaming and shaming campaigns, shadow reports and peer review/benchmarking). It is hence assumed that coherent national forest law provisions in support for EU forest biodiversity conservation and restoration indicators and forest management practices can facilitate the national implementation of EU policy and law. Conversely, an incoherent or incomplete support could pose a challenge to the implementation of the specific forest restoration indicators and related forest management practices.

The results of this desk-based content analysis of legal provisions were validated and discussed with experts from policy and practice at an earlier stage in an interactive workshop mainly organized by the SUPERB project, with a smaller contribution by the BIOCONSENT project. Organized in February 2024, a workshop on "One-day Expert Discussion on Forest Restoration Policy and Practice" addressed synergies and trade-offs across the key international, EU and (sub-)national forest restoration policies and across forest-related policy areas within the EU. The overarching aim of the workshop was to present and discuss desk-based research findings on restoration policy coherence with 35 representatives from EU institutions, national ministries, implementing agencies, and various stakeholders. The purpose of the event was to enable a practical validation and further development of project and research findings. Based on the aforementioned data collection and analysis methods, policy conclusions are drawn regarding the vertical and horizontal policy coherence at the forestry-biodiversity-climate nexus in Europe.

### **3. Results on policy maps and policy coherence assessment**

#### **3.1 Regulation of clearcutting**

##### **Overview of scientific and practical knowledge**

Opinions are divided between forestry scientists and ecologists on the ecological impact of clearcutting. While multiple studies highlight the detrimental effect of clearcut management on forest biodiversity, including tree species diversity (Torras and Saura 2008; Jokela et al. 2019) others emphasize the beneficial effects such as for eurytopic and open land species (Pykälä 2004; Česonienė et al. 2019). In general terms, the question of whether clearcut management has detrimental effects on forest biodiversity depends on the choice of animal and plant species under consideration, as well as the geographical context.

Nevertheless, the national regulations of clearcutting can be compared with the forest ecosystem restoration indicators outlined in the recently adopted EU-NRR and the EU Forest and Biodiversity Strategies that basically request avoiding clearcutting. The scientific literature also provides arguments for this policy direction. Large-scale clear-cutting (> 2 ha) can be an obstacle to the biodiversity restoration of forest ecosystems for several reasons and shall largely be avoided (Pawson et al. 2006; Nauburus et al. 2024). First, the substantial extraction of woody biomass through clearcutting as highly intensive forestry practice can lead to a depletion of both living and dead woody material (Rudolphi and Gustafsson 2007), which contradicts forest restoration efforts aimed at increasing the share of standing and lying deadwood for biodiversity protection and conservation. Second, clearcutting usually leads to

monocultures and even aged forests which have lower biodiversity values. The shifts towards mixed and uneven-aged forest stands in (large-scale) clearcut areas can be challenging due to the relatively homogeneous site conditions, which may hinder the re-establishment of a diverse species mix with varying light and nutrient requirements (Torras and Saura 2008). Third, clearcut management can impact the nesting and breeding habitats of forest bird species that rely on the structural features provided by old trees with habitat structures (Müller et al. 2007). Fourth, clearcutting extensive forest areas can create a barrier to enhancing forest connectivity and, therefore, reduce the permeability of forest habitats to the movement of certain species (Popescu and Hunter 2011).

**Within-case and cross-case analysis**

National forest laws and related legislation were analyzed in terms of their provisions and regulations governing clearcut management. Based on within and cross-case policy analysis, countries were categorized according to whether their regulatory frameworks allow or prohibit clearcut management or impose restrictions on the maximum allowable clearcut size (below 2 ha). This resulted in the identification of four country categories regarding the regulation of clearcutting (Figure 1; Table 3). Category 1 comprises the strictest regulations, imposing a ban on clearcut practices except for socio-ecological reasons. Category 2 comprises countries whose regulatory frameworks do not prohibit clearcutting per se yet impose small maximum allowable sizes of clearcut areas up to 2 ha. Category 3 countries principally allow clearcutting with maximum allowable size restrictions above 2 while Category 4 countries allow clearcutting without imposing general clearcut size limits with few specific exemptions.

*Figure 1: Policy map on the regulation of clearcutting in European countries. (Adapted from Sotirov et al. 2024 and Fleckenstein & Sotirov, 2024)*

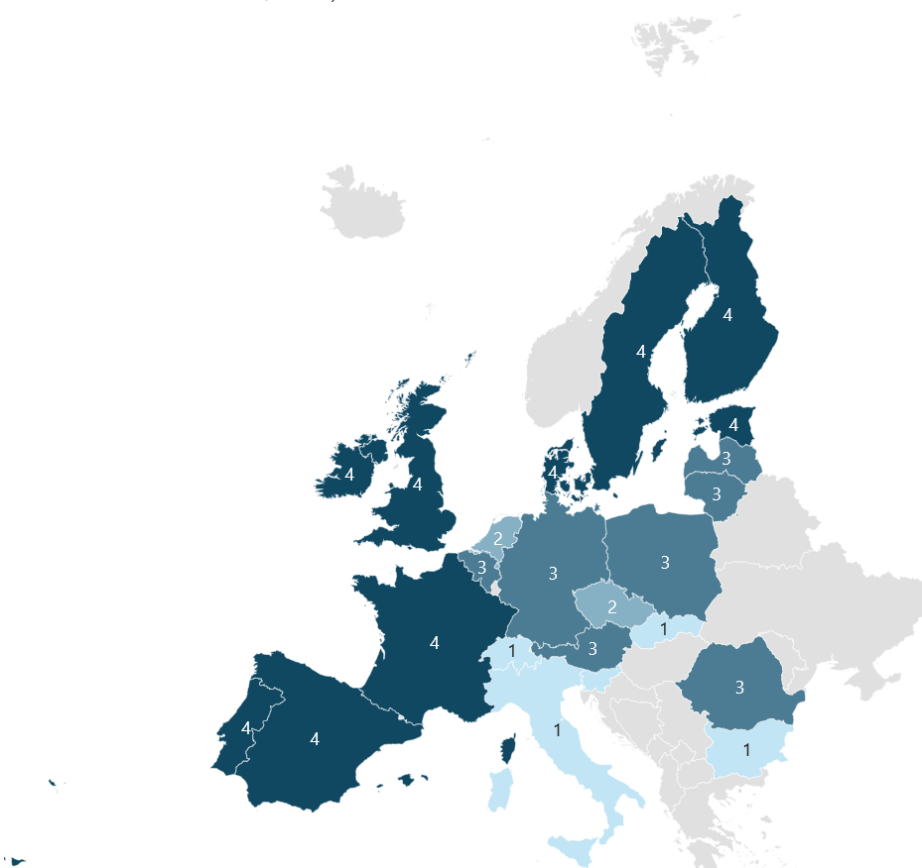


Table 3: Groups of European countries regarding the regulation of clearcutting.

Category 1:	Category 2:	Category 3:	Category 4:
National forest laws prohibit clearcutting with a few socio-ecological exemptions.	National forest laws allow clearcutting up to a maximum allowable clearcut size of 2 ha.	National forest laws allow clearcutting of areas larger than 2 ha.	National forest laws allow clearcutting with no general clearcut size limits (few specific exemptions).
Bulgaria, Italy, Slovakia, Slovenia	Czech Republic, the Netherlands	Austria, Belgium, Germany ( <i>federal level: no size restrictions, federal state level: from no restrictions to restrictions up to 2-3 ha</i> ), Latvia, Lithuania, Poland, Romania	Denmark, Estonia, Finland, France, Ireland, Portugal, Spain, Sweden, the UK

### **Concluding policy coherence assessment**

The EU Forest Strategy for 2030 highlights the environmental and ecosystem concerns related to clearcutting and its effects on above ground biodiversity and carbon storage. It calls for a use of this management practice only in duly justified cases. Moreover, large-scale clearcutting can undermine various forest ecosystem indicators outlined in Article 12 of the EU-NRR, including the accumulation of standing and lying deadwood and the creation of uneven-aged and mixed species forests. Therefore, the resulting degree of policy incoherence between groups 3 and 4 European countries and the EU level could signal the policy need for a review and an adaptation of the regulatory framework governing clearcutting if the vertical and horizontal forest restoration policy coherence and implementation of the EU-NRR and the EU-FES is to be promoted for the sake of forest biodiversity conservation and restoration.

## 3.2 Reforestation obligations

### **Overview of scientific and practical knowledge**

Mandatory reforestation obligations following final harvests in rotational forestry systems (e.g., clearcutting, shelterwood management) and/or forest disturbances (e.g., managed by salvage logging as another type of clearcutting), especially within a short time frame usually 2-5 years, are widely established in law and practice throughout the European countries (Bauer et al. 2004; McDermott et al. 2010; Sotirov et al. 2024). On the one hand, these traditional reforestation obligations, being core requirements in the sustained yield economic sustainability paradigm (Glück 1994), have effectively regulated against deforestation and contributed towards the (small but steady) increase of forest area in Europe (McDermott et al. 2010; FAO 2020). On the other hand, mandatory reforestation obligations, especially within a short time frame, are likely to influence the achievement of critical forest biodiversity restoration indicators and policy targets as outlined in the EU-NRR, the EU-BS and the EU-FES (e.g. the share of forests with an uneven age structure, the share of forests dominated by native tree species) and tree species diversity in general. For example, longer and more flexible time frames for mandatory reforestation obligations may favor natural regeneration processes, which could ultimately result in a more uneven-aged and mixed-species stand structure, at

least in the short to medium term (Meli et al. 2017). Mandatory short-term reforestation obligations may also require active reforestation measures (e.g., soil preparation, tree planting) which may favor single species and rotational age structures at least in the short to medium term resulting in even aged forests with lower biodiversity values (Bauer et al. 2004, Mason et al. 2018). Likewise, not existing or vague formulations with very general wording can leave much space for interpretations or exemptions resulting in a national forest policy and legal framework that eventually does not oblige forest owners and forest users to avoid or minimize the effects of intensive forestry or runs counterproductive against natural regeneration (Bauer et al. 2014; McDermott et al. 2010).

**Within-case and cross-case analysis**

Categorizing European countries according to mandatory regulations on reforestation obligations also revealed four different country clusters (Figure 2; Table 4). Category 1 includes countries where national forest laws do not stipulate a mandatory reforestation obligation or any specific time frames. Category 2 includes countries whose regulatory frameworks require mandatory reforestation after final harvest but do not specify time frame obligations. Category 3 countries have regulatory frameworks that mandate reforestation of harvested sites within 10 years following the harvest, whereas Category 4 countries require reforestation to occur within 1 to 5 years after the final harvest. Most of the European countries can be categorized into the latter category type.

*Figure 2: Policy map on reforestation obligations in European countries. (Adapted from Sotirov et al. 2024 and Fleckenstein & Sotirov, 2024)*

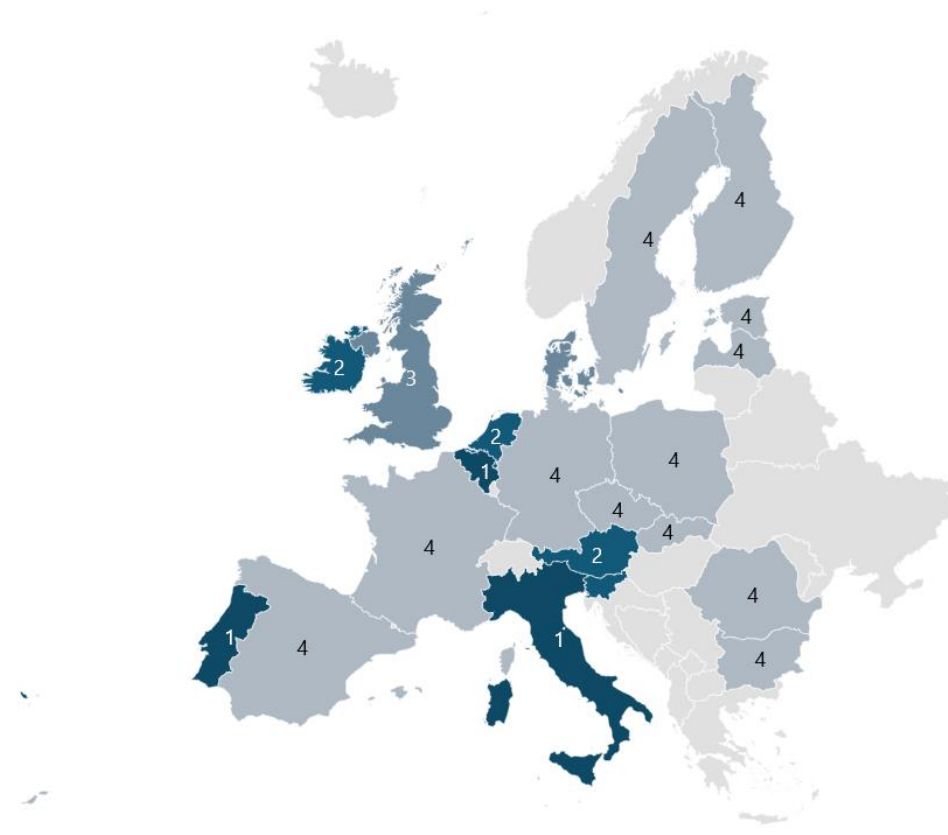


Table 4: Groups of European countries regarding reforestation obligations

Category 1: National forest laws do not request mandatory or any time frame obligations for reforestation.	Category 2: National forest laws request mandatory obligation for forest restoration yet do not specify concrete time frames.	Category 3: National forest laws request mandatory, medium-term obligations for reforestation within 10 years (<10 years).	Category 4: National forest laws request mandatory, short-term obligations for reforestation within 1-5 years (<5 years).
Belgium, Italy, Portugal	Austria, Ireland, the Netherlands, Slovenia	Denmark, the UK	Bulgaria, Czech Republic, Estonia, Finland, France, Germany (Federal level), Latvia, Poland, Romania, Slovakia, Spain, Sweden

### **Concluding policy coherence assessment**

To achieve the enhancement of forest restoration indicators, including the creation of uneven aged forest structure and tree species diversity to support forest biodiversity and foster climate adaptation, the EU-NRL, EU-FES and EU-BS suggest the diversification of forest structure in terms of species composition and age and through natural regeneration and succession of tree species as a concrete forest restoration measures. This represents a policy incoherence with group 4 countries whose short reforestation legal obligations may restrict possibilities for a diversification of forest structures through natural regeneration and tree species succession while pursuing good intentions, namely the maintenance of forest cover with all related benefits including carbon sequestration and timber provision. This policy incoherence may arise because national mandatory regulations may require active reforestation measures, as natural regeneration can take time that appears to be not accounted for in some regulatory frameworks.

For group 1, 2 and 3 countries, it still needs to be evaluated to what extent the more relaxed reforestation legal obligations would effectively favor or not natural regeneration. This assessment of policy (in-)coherence hints that in order to enhance the scope for reforestation management which can promote forest biodiversity restoration and respective indicators, a loosening and expanding the short-term reforestation obligations and a review of the more relaxed obligations may be needed if natural regeneration processes and the establishment of diverse forest stands both in terms of age structure and species composition are to be promoted. In this context, however, it is important to highlight that maintaining mixed-species and uneven-aged forest structures over the long term often requires active management practices due to variations in light demand and competition between tree species. In addition, there will be a need for biodiversity-friendly reforestation actions where natural regeneration is inhibited due to diversity of bio-geographical, climate and land use conditions, but a more longer time perspective is to be taken.



## 3.3 Deadwood management

### **Overview of scientific and practical knowledge**

Retaining sufficient standing and lying deadwood in different decay stages in forest ecosystems can play an important role in conserving and restoring forest biodiversity since many species depend on deadwood for larval development, foraging, or nesting (Löfroth et al. 2023). Deadwood volume is one of the most documented biodiversity indicators to date (Nauburus et al. 2024). Sufficient amounts of deadwood are considered especially relevant as regards the conservation of saproxylic beetles and wood-living fungi (Gao et al 2015; Oettel et al 2022), but also forest birds, bryophytes and vascular plants (Zeller et al 2023). However, while the correlation between deadwood volume (or other metrics such as number of dead trees) and biodiversity is generally positive (Kraus and Krumm 2013; Krumm et al. 2020), very few studies report thresholds for optimal conservation for these species (Nauburus et al. 2024). In their review, Müller and Butler (2010) analysed thresholds for deadwood and found peak values for species richness of several groups at 20-30 m<sup>3</sup>/ha in boreal coniferous forests, 30-40 m<sup>3</sup>/ha in mixed mountain forests and 30-50 m<sup>3</sup>/ha in lowland oak-beech forests. These are values above which the species richness does not increase very much anymore. Such values could be used as thresholds to assess forest management practices (Nauburus et al. 2024).

While deadwood has positive effect on other ecosystem functions, such as soil fertility (wood decomposition) or forest resilience (grounds for natural regeneration and works as a water sponge), conserving deadwood for biodiversity in forests prone to wildfire may in rare cases increase this risk (Larjavaara et al 2023). The biodiversity-friendly measures adopted should then be chosen carefully, for example more oriented towards other measures such as habitat trees (Nuburus et al. 2024). While many European countries have observed increasing trends in the accumulation of deadwood in forest ecosystems (State of Forest Europe, 2020), the deadwood volumes widely differ ranging from 1 m<sup>3</sup>/ha up to 28 m<sup>3</sup>/ha with an average of around 10 m<sup>3</sup>/ha. These volumes remain far lower than the conservation needs of species and the thresholds suggested by conservation biology knowledge, even in Natura 2000 forest protected areas (Winter et al. 2014; Sotirov 2017). Deadwood remains a crucial indicator for the health and diversity of forest ecosystems. This is also acknowledged in the EU-NRR, which stipulates a further enhancement of standing and lying deadwood in forest ecosystems of the EU-MS under Article 12. At the same time, deadwood management has shown to be a controversial point of debate since particularly Southern European countries fear an increase of forest fire outbreaks and intensities due to an increase of highly flammable woody biomass (Krumm et al. 2020). This resulted in the inclusion of a clause in the EU-NRR requiring Member States to take into account the risks of forest fires based on local circumstances. To see if and to what extent national forest regulatory frameworks address the management of deadwood, national forest laws were screened to derive key provisions on this forest ecosystem restoration indicator.

### **Within-case and cross-case analysis**

The country categorisation based on deadwood management provisions also revealed 4 overarching country categories (Figure 3; Table 5). Category 1 includes countries whose national forest laws directly promote the retention of deadwood and habitat trees for biodiversity and nature conservation purposes with some thresholds where legislative texts even stipulate deadwood amounts per hectare, suggesting concrete retention methods or stipulating quantitative thresholds (including diameter restrictions) on utilizable biomass. Category 2 comprises countries whose forest laws promote the retention of deadwood though without specifying retention methods or quantitative thresholds. Category 3 comprises

countries whose forest laws refer to deadwood rather from a forest (health) protection perspective and make recommendations and provisions to remove deadwood (e.g. through clearcuts called “sanitary fellings”) to prevent the spreading of forest pests and related security risks. Category 4 comprises those countries whose forest laws do not directly address deadwood management neither from a biodiversity conservation and restoration nor from a forest (health) protection perspective.

Figure 3: Policy map regarding deadwood management provisions in European countries. (Adopted from Fleckenstein & Sotirov, 2024)

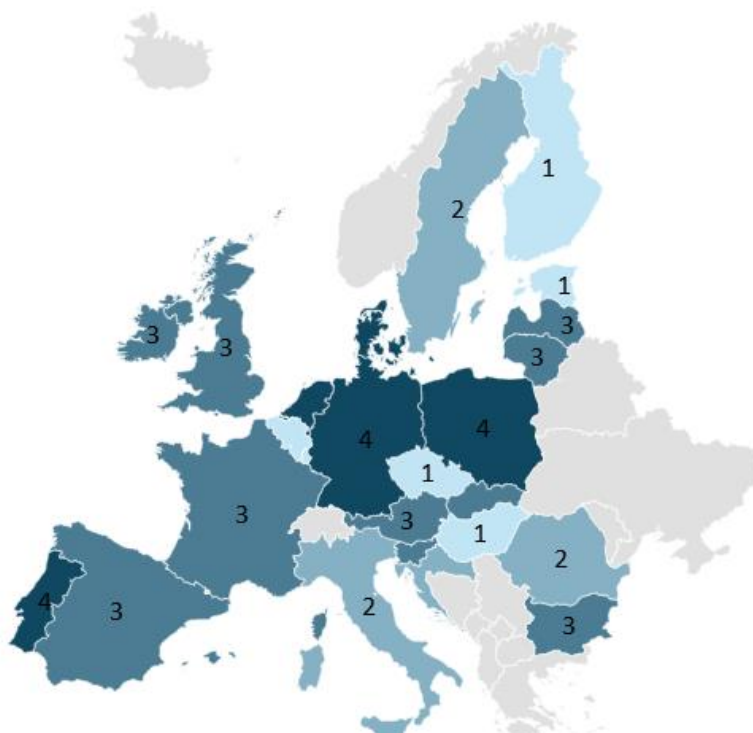


Table 5: Groups of European countries regarding deadwood management provisions.

Category 1:	Category 2:	Category 3:	Category 4:
National forest laws directly support the retention of deadwood for biodiversity conservation and restoration purposes (incl. provisions on deadwood amounts and minimum diameters of utilizable woody biomass).	National forest laws refer to deadwood management and retention for biodiversity purposes without providing concrete deadwood amounts or retention methods.	National forest laws specifically address deadwood management from the forest health and disturbance prevention perspective of forest.	National forest laws do not directly refer to the management of standing or lying deadwood neither from a biodiversity protection and restoration nor from a forest health or disturbance prevention perspective.
Czech Republic, Estonia, Finland, Luxembourg	Croatia, Italy, Romania, Sweden	Bulgaria, France, Ireland, Latvia, Lithuania, Malta, the UK (Scotland), Slovenia, Spain	Cyprus, Denmark, Germany (federal level), Netherlands, Poland, Portugal

### **Concluding policy coherence assessment**

The findings from the within and cross-case analysis of national forest laws shows that the majority of national forest laws in European countries address the role of deadwood management in forests, though from different perspectives. In addition, only very few national forest laws provide concrete recommendations, such as regarding biologically favorable amounts of deadwood or specific retention measures. In light of increasing forest disturbances in European forests and resulting damages, the role of deadwood management has taken a prominent role in policy and management debates. In particular, the role of extensive clearcutting through “sanitary logging” or “salvage logging” to minimize the further spread of pest infestations from damaged or infested timber, and to avoid economic losses resulting from an oversupply of (salvaged) timber on the market, which could lead to price declines, can be a detrimental choice at odds with the need to conserve more deadwood volumes. This has been a controversial topic of debate around European forests in recent years. Especially in group 3 and 4 countries, policy incoherence and policy tradeoffs between deadwood retention (EU obligations) and deadwood removal for sanitary reasons (national obligations) can be expected. General developments in European forests show increasing trends of deadwood yet the threshold of deadwood need to be further increased in most European countries. Still, mutually influencing incoherencies of deadwood accumulation and deadwood removal for forest disturbance management appear to be a crucial point in the review and potential adaptation of national forest policy and regulatory framework if/when the forest biodiversity restoration and conservation goals and commitments under the EU-NRR, the EU Nature Directives, the EU-FES and the EU-BS are to be achieved.

## 3.4 Protection and conservation of forest birds

### **Overview of scientific and practical knowledge**

Forest management practices and their impact on the diversity of forest structures from closed high forests to open woodlands areas is a critical influencing factor on the abundance and diversity of forest fauna, including forest birds (Basile et al. 2021). Therefore, the occurrence of common breeding forest bird species is frequently used as an important indicator to assess forest habitat structure and diversity such as under the regular reporting mechanism under the State of Forest Europe under Criterion 4: Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems – Indicator 4.10; Marchetti et al. 2017). The 2020 SoE report suggests stable developments of common forest bird species during the last 37 years yet highlights a limited knowledge on the influencing factors on bird species abundance apart from forest management practices (SoFe, 2020). In general, forest bird data is often used as a key biodiversity indicator because it is based on extensive data sources and benefits from skills among professionals and volunteer networks (e.g. Jiguet et al, 2012). According to some scientists, birds’ role as biodiversity indicator for other species is however not straightforward (Burrascano et al. 2018). Bird’s data may be used as a direct indicator only in connection to other forest management practices such as deadwood retention or tree-related microhabitats enrichment (Paillet et al 2018; Nauburus et al. 2024).

The EU-NRR requires Member States to achieve increasing trends on the common forest bird index, which includes several common European forest bird species. Member States are required to monitor and report on the developments from the enactment of the regulation until the end of 2030, and every six years thereafter. While the initial proposal from the European Commission included increasing trends for all forest ecosystem restoration indicators (EC 2022), the final regulation specifies the forest bird index as mandatory indicator (EC 2024).

**Within-case and cross-case analysis**

The forest regulatory frameworks of the European countries were analyzed according to the existing provisions on forest fauna, in particular forest birds, to assess potential regulatory gaps and synergies with EU legislation. This analysis revealed three overarching categories of European countries (Figure 4; Table 6). Category 1 comprises countries whose forest laws provide concrete provisions on the protection and conservation of forest bird species. In this context, some forest laws even make direct reference to lists of endangered species such as the IUCN Red List of European Birds and EU legislation, in particular the EU Birds Directive adopted in 2009. Countries falling under this category include Spain (national), Poland, Denmark, Bulgaria and the Netherlands, among others. Category 2 includes countries whose national forest laws implicitly address the protection and conservation of endangered forest bird species through regulations and recommendations for forest fauna in general. Countries in this category include, but are not limited to, France, Slovenia, Romania, and Croatia. The forest regulatory frameworks of countries included under Category 3 do not explicitly or implicitly refer to the protection and conservation of forests birds.

*Figure 4: Identified country categories regarding forest bird conservation. (Adopted from Fleckenstein & Sotirov, 2024)*

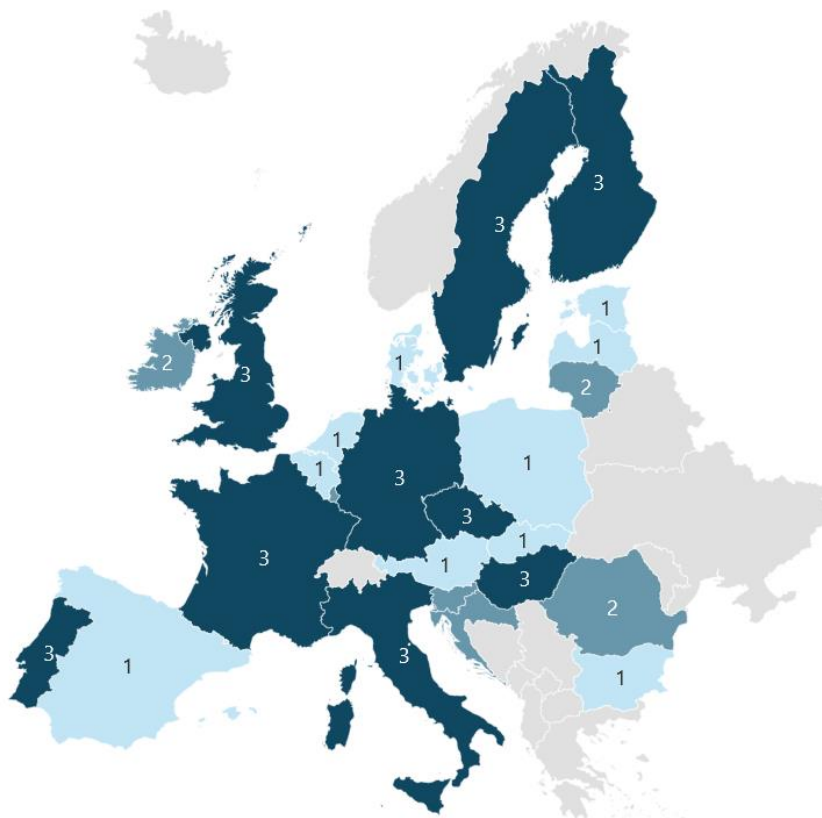


Table 6: Description of country categories for forest bird conservation provisions and recommendations and identified country groups.

<b>Category 1:</b> National forest laws explicitly refer to the protection and conservation of (endangered) forest bird species.	<b>Category 2:</b> National forest laws implicitly address the protection of (endangered) forest birds by stipulating the protection of forest fauna in general.	<b>Category 3:</b> National forest laws do not refer to the protection and conservation of (endangered) forest bird species not explicitly nor implicitly.
Bulgaria, Cyprus, Denmark, Estonia, Latvia, the Netherlands, Poland, Spain	Croatia, Ireland, Lithuania, Luxembourg, Malta, Romania, Slovenia	Czech Republic, Finland, France, Germany (Federal level), Italy, Latvia, Portugal, UK (Scotland), Sweden

### **Concluding policy coherence assessment**

The abundance of common forest birds in forest ecosystems depends on a range of factors including the forest stand and landscape connectivity and diversity which are governed by national forest laws that could specify management practices. Hence, group 2 and 3 countries without specific forest bird related legal provisions might face policy incoherency issues when implementing the EU obligations. In these countries, a review and adaptation of the applicable forest law might help reduce policy trade-offs. Still, a range of ecosystem indicators promoted under the EU-NRR and other EU policies, such as the increase in standing and lying deadwood and the creation of uneven-aged forest structures, may indirectly promote the conservation and enhancement of forest birds. Therefore, a lack of concrete provisions on the protection and conservation of common forest birds in national forest laws do not automatically mean that there are no other mechanisms in place that directly or indirectly favor or even hamper increasing trends of the common forest bird index. In addition, animal species protection might be regulated in related policy areas such nature and species protection policy, which were not covered in the present policy analysis.

## 3.5 Forest set-asides

### **Overview of scientific and practical knowledge**

Natural, primary, unmanaged and old-growth forests provide refuges for a large range of species, and have proved to be richer than managed semi-natural or plantation forests (Gustafson et al. 2010; Paillet et al 2010; McDermott et al. 2010; Krumm et al. 2020). Furthermore, since less than 1% of Europe’s forests can be regarded as primeval (Sabatini et al 2018), these forests host specific species that are often rare. However, due to the long history of human occupation and forest exploitation in Europe, not all protected forests show primeval or old-growth characteristics (Paillet et al 2015). A strict protection status as a forest set aside or any part or total exclusion of extractive activities (non-intervention management of forests) plays a number of key roles in biodiversity conservation and restoration. These include maintaining species and ecosystems that require natural or near-natural conditions for survival, providing an “ark” for threatened species whose surrounding habitats heavily disturbed and providing research opportunities for scientists and conservationists to learn



lessons about ecosystems that can be used to promote biodiversity conservation elsewhere (McDermott et al. 2010; Nauburus et al. 2020). However, the level to which a forest ecosystems should be (strictly) protected to guarantee biodiversity conservation is still under debate, not to mention the spatial configuration of the forest reserves (Krumm et al. 2020; Nauburus et al. 2024). Further, mosaic forested landscapes containing open forest patches can host specific species (Bouget and Parmain 2016; Miklin et al 2018).

Forest set asides that are not available for wood production or for any other land use is mostly assessed based on politically negotiated goals of strict protection (see below), and partly on administrative decisions (protected areas categories) and physical restrictions (forest lands not available for wood production or not economically interesting for timber use) (Nauburus et al. 2024). Still, Bouget and Parmain (2016) studied the influence of forest reserves area and configuration on the richness of saproxylic beetles in several landscapes in France and showed that, for lowland forests, the total beetle richness increased with increasing cover of forest reserves in the vicinity. They also show that 12%-20% of reserves within a total forest area increased richness and abundance in both managed forests and reserves. These results are in line with Schall et al (2020) who show, for different sites in Germany, that a certain share of unmanaged forest is necessary to preserve species but only affects specialist forest species of bats, birds, spiders, true bugs and vascular plants. These groups are favoured by 10% of unmanaged forests in the landscape.

From a policy view, these scientific results tend to resonate with the new EU-BS and EU-FS for 2030 goals to protect 30% of the land and sea, of which one third should be strictly protected with a special focus on remaining primeval and old-growth forests (EU, 2021e). These strategies also advocate for the strict protection of remaining primary and old-growth forests in the EU, supported by guidelines published by the European Commission in 2023 on how to define, map, monitor, and strictly protect these forest areas (EC, 2023).

Strict forest protection and forest set-asides (including primary, natural, old-growth and non-intervention management forests) have long been a cornerstone of biodiversity conservation and restoration efforts worldwide. The concept of preserving forests in their natural state dates back to the late 19th and early 20th centuries when the first protected areas, such as national parks and nature reserves, were established to safeguard critical habitats from human exploitation. Early scientific work highlighted the importance of undisturbed forests for maintaining ecological balance. As environmental science advanced, the recognition of forests as essential ecosystems for biodiversity conservation deepened (McDermott et al. 2010).

The introduction of more formal conservation policies, including the establishment of the International Union for Conservation of Nature (IUCN) in the 1940s and the adoption of the Convention on Biological Diversity (CBD) in 1992, further cemented the role of strict protection as a critical strategy. Over time, forest protection measures have shifted from a purely preservationist approach to more integrated models of conservation and restoration, emphasizing the restoration of degraded forests alongside the protection of intact ecosystems. This evolution reflects growing scientific consensus on the need for holistic, long-term approaches to biodiversity conservation. To date, forest set-asides and strict forest protection remain crucial methods for biodiversity protection and restoration (EEA 2020).

### **Within-case and cross-case analysis**

The analysis of provisions and recommendations for forest set-asides in (sub)national forest laws of the European countries revealed 4 Categories (Figure 5; Table 7). However, it must be emphasized once again that the focus of the analysis was solely on forestry laws, and the categories might differ if nature conservation laws and their respective by-laws, etc., are considered. Category 1 comprises countries and subnational jurisdictions whose forest(ry) laws make direct reference to forest set-asides and formulate quantifiable protection targets.

Only Luxembourg and Belgium (Wallonia) fall into this category. Category 2 comprises countries whose forest laws specifically reference different high conservation value forest types for set-aside, such as ancient forests in Italy or riparian forests in Finland, without providing quantitative protection targets. Category 3 comprises countries whose forest laws refer indirectly to forest set-asides with reference to different protected area types, particularly under other sectoral EU and national nature protection laws, without providing quantitative protection targets. Category 4 comprises countries whose forest laws do not refer to forest set-asides or the strict protection of forest areas at all. This category includes Germany (federal level), Ireland and the UK.

Figure 5: Policy map regarding provisions on forest set-asides in European countries. (Adopted from Fleckenstein & Sotirov, 2024)

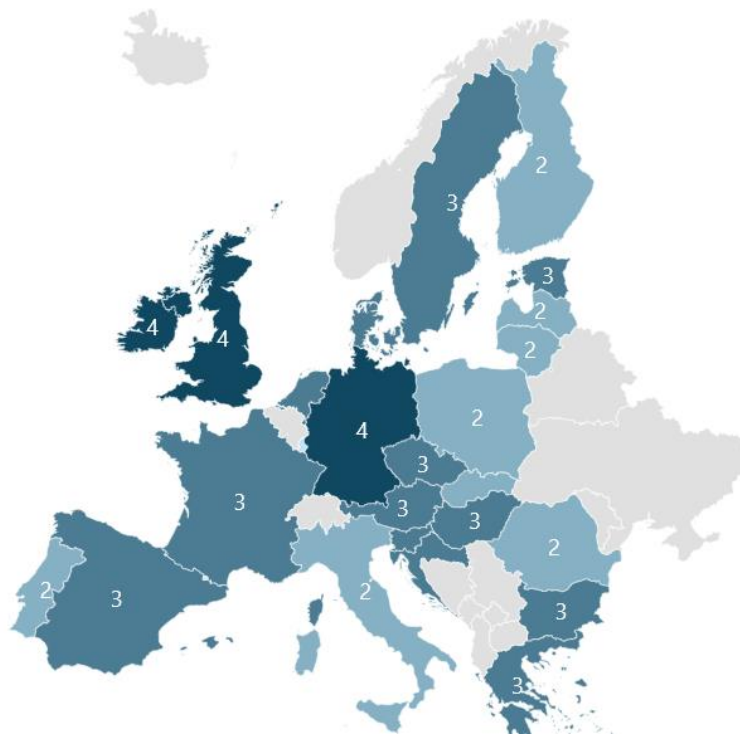


Table 7: Groups of European countries as regards forest set-aside provisions.

<b>Category 1:</b> National forest laws with specific reference to forest set-asides with quantitative thresholds (% of area, to be set-aside).	<b>Category 2:</b> National forest laws with specific reference to different types of forest set-asides without quantitative targets (% of area, or ha to be set-aside).	<b>Category 3:</b> National forest laws with reference to forest set-asides under different protected area types (usually under EU and national nature protection law), without quantitative targets (% of area, or ha to be set-aside).	<b>Category 4:</b> National laws without reference to forest set-asides; only implicit general reference possible via EU and national nature protection law.
Belgium (Wallonia, at least 3% forest set-asides in deciduous forest), Luxembourg (at least 5% of public forests as set-asides)	Italy (ancient forests), Finland (riparian forests), Latvia (micro-reserves), Lithuania (reserve forests), Poland (ecological forest complexes), Portugal (high conservation forests), Romania (virgin forests), Slovakia (primary forests)	Austria, Belgium (Brussels and Flanders), Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Greece, Hungary, Malta, the Netherlands, Slovenia, Spain, Sweden	Germany (Federal level), Ireland, the UK

### **Concluding policy coherence assessment**

While protected areas are often regulated by national conservation laws, it can be assumed that strong provisions and concrete targets for strictly protected forest areas in national forestry law can provide a solid framework for increasing the share of forest set asides, as called for by the EU Biodiversity Strategy for 2030. However, while the forest area reported as protected has steadily increased by 1.8% since 2011 (FoE 2020), no signs of further increase of forest set asides have been observed in recent years, making the achievement of the 30% target by 2030 uncertain. From the within and cross-case analysis can be concluded that the forest laws of many European countries (mainly groups 3 and 4) do not include particularly concrete or ambitious targets for forest set-asides. This represents a potential policy incoherency with EU policy and legal obligations. It is hence recommendable to review and adapt national forest laws in this regard. Nonetheless, forest set aside targets may be reflected in other laws (nature conservation laws), forest bylaw (ordinances, decrees), forest strategies (soft law) and management plans (e.g., forest management plans, Natura 2000 management plans). Hence, the policy mapping results for this forest restoration practice should be complemented by additional policy and legal assessments.

## 4. Discussion and conclusion

Forest biodiversity conservation and restoration policy in the European Union is embedded in a complex multi-sectoral and multi-level policy environment. With the adoption of the EU Green Deal and related key policies, in particular the recently enacted EU-NRR, the EU promotes a strong vision for the restoration of European forests in light of global biodiversity loss and rapidly changing climatic conditions. The fulfilment of the Commissions' and Member States' vision for forest biodiversity conservation and restoration will take place at the (sub-)national level as the European countries formally hold the competence in the field of forest(ry) policy and forest management but have the obligation to implement EU law (e.g., EU-NRL, EU Habitats and Birds Directives) and are exposed to normative pressure to adopt EU soft law (e.g., EU-BS, EU-FS). In this context, European countries often look back at a long history of institutional and policy arrangements for forests and their management, including for forest restoration. This results in a situation where EU forest restoration policies come upon different national priority settings in forest management which are reflected in national policies and instrument types. While the legal form of EU biodiversity law (EU-NRR, EU Nature Directives) exhibit compliance pressure on all EU countries, identifying vertical and horizontal policy incoherences between EU biodiversity law and national forest laws including regulatory gaps and potentially conflicting policy priorities - can support decision-making by informing the development of complementary policies and regulatory frameworks to facilitate the implementation of national forest restoration plans in the coming years.

The present study sheds light on some important cross-sectoral policy synergies (in terms of policy coherence) and potential policy trade-offs (in terms of policy incoherence) related to forest biodiversity conservation and restoration policy targets between the EU level and the (sub)national levels of the European countries forest policy and legal frameworks. This is done through a range of data collection and analysis approaches. They include a mapping and content analyses of key policies at the EU level and (sub)national levels and their direct and indirect provisions and recommendations on key forest restoration indicators with validation by experts and stakeholders.

The main study's findings, presented here in the form of policy maps and corresponding overview tables and policy assessments, show that several of the key forest biodiversity conservation and restoration indicators and related forest management practices are explicitly or implicitly addressed in national legislation with a great variation of legal provisions. For specific indicators and practices, such for the conservation and protection of forest birds, regulatory gaps were revealed. Substantial vertical and horizontal policy incoherencies seem to exist as regards traditionally well established indicators and practices such as (relaxed) regulation of clearcutting and (short term) reforestation obligations. For newer biodiversity-centred indicators and practices (deadwood, forest set aside, forest birds) explicit legal provisions, quantifiable targets, thresholds and recommendations are frequently missing. This may also be explained by the fact that the study's regulatory analysis focused exclusively on forest laws, while excluding bylaws and related regulatory instruments, such as nature conservation laws, as well as non-legally binding policy and governance instruments, including forest and nature conservation strategies and private forest certification requirements. These other instruments may also contain important provisions related to key forest ecosystem indicators and relevant management practices. In this context, the lack of explicit provisions in the forest legislation represents a policy incoherence as such. Policy coherence might increase if nature conservation laws and forest bylaw is considered, but the incoherent provisions in national forest laws add an additional hurdle as alignment with the EU law. An effective vertical policy coherence between the EU and national levels presupposes effective horizontal policy

integration on the national level, i.e. integration between forest and environmental legislation (Sotirov and Storch 2018; Beland Lindahl et al. 2023).

Nevertheless, and since national forest laws constitute the key regulatory framework for forest management, including for forest restoration practices, the results from the regulatory analysis certainly have an informative value and can provide evidence based support for decision makers in policy and practice.

To conclude, the study found a significant policy ambition for forest restoration both at the EU and the European countries' level. Restoration targets and goals appear to be well-aligned with EU nature conservation and climate protection policy while potential policy incoherences exist with those national policy areas that promote a more intensive form of forest management and use. Still, many open questions and differences among the European countries remain as regards the regulation of many of the forest restoration-related practices including clear-cutting provisions, reforestation obligations, forest set-aside, deadwood management, forest bird protection as well as other forest restoration practices and indicators.

In further implementing EU biodiversity hard and soft law, responsible EU institutions, national ministries, implementing agencies, and various stakeholders within EU and beyond are encouraged to thoroughly monitor and analyse the policy and legal framework for forest biodiversity conservation and restoration. This report provides a methodology, tools and exemplary results that help assessing EU and national policy and legal frameworks. These efforts are just one out of many other building blocks and decision support tools that can facilitate the effective implementation of forest biodiversity conservation and restoration measures at the forest-biodiversity-climate nexus.



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## Policy documents and legislative texts (selected)

### **EU policies and legislative texts**

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Codified version)

Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

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Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC).

Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU (Text with EEA relevance).

Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')