

# Integrating nature and people in European forest management: what is the state of nature conservation and role of participation?

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## HIGHLIGHTS

- Nature conservation has become a more prominent feature in forest policy development over the last twenty years in the countries studied.
- Integration of nature conservation in forests managed for wood production has become a dominant forest management paradigm in Europe.
- The percentage of forests covered by nature conservation areas increased across the study area, but also the felling to increment ratios in non-conservation forests.
- It is difficult to assess how the attention on nature conservation at the policy level translates into adjustments in forest management practices.
- The link between stakeholder participation and the integration of nature conservation in forest management at the European scale cannot be fully assessed without long-term, interdisciplinary research.

## SUMMARY

Forest biodiversity can be retained by setting aside protected forest areas for nature conservation or by integrating conservation measures in managed forests. Societal demands towards forest ecosystem services have changed in favour of conservation ideas, and there is a move towards more participatory forest policymaking. This paper investigated the relation between participatory decision-making and forest management developments within twelve European countries. We assessed a) the development of integration and segregation of nature conservation in forest management and the wider forest landscape, and b) how different groups participate in forest-related policy and management planning. Methodologically, we combined natural and social science to explore if the link between the two could be assessed by means of a multi-expert and multi-disciplinary assessment. We concluded that, in the twelve studied territories, integration of nature conservation in forest management was the dominating paradigm, while there is a simultaneous increase in both the areas set aside for nature conservation and the felling to increment ratio. At the same time, there was a noticeable increase in the attention given to nature conservation aspects in the formulation of forest policy. However, the relationship between participation in forest policy development/implementation and integrating nature conservation into forest management was found to be complex. We proposed directions for future research in this domain.

Keywords: nature conservation, segregation, integration, forest policy, participation, stakeholders

## BACKGROUND AND OBJECTIVE OF THE PAPER

Nature conservation in forests relies on two complementary policy and management approaches: 1) setting aside protected forest areas specifically for nature conservation, where management interventions detrimental to conservation goals are largely excluded (functional segregation), and 2) applying conservation measures within forests managed primarily or in part for wood production (functional integration) (Bütler *et al.* 2013, Edwards *et al.* 2014, Kremen 2015, Krumm *et al.* 2021, Larsen *et al.* 2022, Sotirov and Arts 2018). The potential to conserve forest biodiversity solely by strictly protecting old growth areas is limited by a number of factors including: (1) the historic loss of Europe's old-growth forests, with few remaining areas left, (2) the time lag between setting-aside and development of biodiversity associated with old-growth forest structure, (3) the management legacy of recent set-asides, (4) the high percentage of private forest ownership, and (5) the history and presence of various forest use demands in most European forests (Branquart *et al.* 2008, Sabatini *et al.* 2018). Forest biodiversity goals are hence often addressed by combining protection measures with nature conservation measures in actively managed forests (McDermott *et al.* 2010). When trying to satisfy conservation and production goals in forest landscapes with multiple use interests, conservation approaches can be enlisted at different positions along a spatial continuum of land-sharing (integration) and

land-sparing (segregation) (Bollmann and Braunisch 2013, Fischer *et al.* 2014, Kremen 2015). A central premise is that when used in combination to a sufficient extent, viable populations of forest-dependent species should be sustained (Lindenmayer and Franklin 2002, Seymour and Hunter 1992). The challenge is to balance the spatial extent and effectiveness of conservation actions with competing production goals, such as maximum sustained yield wood production within forest landscapes in different biomes (Angelstam *et al.* 2018, Felton *et al.* 2020, Naumov *et al.* 2018).

To date, 44 European signatory states and the European Union have voluntarily committed to the principle of “maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems” (Forest Europe 2022) as one of the six criteria necessary for achieving sustainable forest management (SFM). This includes maintaining tree species diversity and forest land naturalness, mandating regeneration, avoiding fragmentation, limiting clear-cut size, and restricting the use of non-indigenous tree species (Forest Europe 2022).

While a relatively small share of European forests is protected for nature conservation (Forest Europe 2020), the vast majority are managed under domestic SFM and/or national conservation policy regulations (e.g., national parks) and/or special protected/conservation areas forming the Natura 2000 network under the EU Habitats and Birds Directives (Sotirov 2017)<sup>1</sup>. For these forests, a wide range of

<sup>1</sup> During the work on this manuscript, the process of designing the 10% of EU land area to be put under strict legal protection as proposed by the EU Biodiversity Strategy for 2030 and EU Forest Strategy for 2030 has not been concluded. The guidelines for closer to nature forest management were published in 2023 (European Union 2023).

approaches for integrating conservation measures in forests managed partially or primarily for wood production has been developed (Angelstam *et al.* 2020, Bütler *et al.* 2013). The plethora of different social and biophysical conditions (Lazdinis *et al.* 2019), as well as variations in forest regulations and governance (Nichiforel *et al.* 2018) have, however, implications on their implementation in forest management practice (Konczal *et al.* 2023, Muys *et al.* 2022).

Forest management decisions do not occur in isolation from society. Debates about forest use and conservation are increasingly at the core of forest-related policymaking and planning in Europe (Angelstam *et al.* 2022, Wolfslehner *et al.* 2020). Environmental NGOs (ENGOs) and conservation experts, scientists, public forest administrations, forest owner organisations and industry representatives, as well as indigenous people, local communities and civil society, engage in these debates, with different worldviews and levels of influence (see Niedziałkowski and Chmielewski 2023, Sotirov and Arts 2018, Winkel and Sotirov 2016).

Societal participation has been emphasised as a major governance strategy to reconcile diverging demands on the environment. In Europe, the 1998 Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters is a key agreement regulating the right of participation. For forests and forestry, National Forest Programmes have been a prominent tool to implement more participatory policy approaches (Kleinschmit *et al.* 2018, Lindstad 2018, Schanz 2002, Weber 2018). The move towards more participatory forest policymaking was partly seen as a reaction to 'elitist' and technocratic approaches (Steelman 2001) that no longer suffice in pluralistic societies demanding multiple ecosystem services from forests. Yet, there are mixed findings on how far these participatory approaches in European forest policy have lived up to those expectations (see Winkel and Sotirov, 2011 and Johansson, 2024 on National Forest Programmes), and there are no recent comparative studies that have systematically analysed participatory approaches across Europe.

Against this background, this study aims to explore the link between participation in forest policymaking and management (*integrating people*) and nature conservation in forest management (*integrating nature*) in a Europe-wide perspective, covering a wide range of bio-physical and societal conditions. Specifically, we ask:

- a) Are nature conservation and wood production increasingly segregated in European forests?
- b) How do different groups participate in forest-related environmental policy and management planning?
- c) Is it possible to assess how participation is linked to integration or segregation in forest management practices

To answer these questions, we propose a methodological approach connecting insights from forest ecology and forest management, more broadly – from natural science, and from participatory and policy studies, more broadly – from social science.

## STATE OF KNOWLEDGE AND CONCEPTUAL FRAMEWORK

Forests designated specifically for biodiversity and landscape conservation, with different levels of ambition, cover 49.3 Mha in Europe (23.6% of the total forest area in reporting countries covered by MCPFE classes 1 and 2; Forest Europe 2020). These areas include the three highest levels of forest biodiversity conservation: 'No active intervention' (1.8% of the forest area), 'Minimum intervention' (3.2%) and 'Conservation management' (MCPFE class 1.3 – 10.5%) areas (Ministerial Conference on the Protection of Forests in Europe (MCPFE) classes 1.1, 1.2 and 1.3, Forest Europe 2006). The total area of MCPFE classes 1.1-1.3 in Europe increased considerably between 1990 and 2020 (Forest Europe 2020) and there are indications of subsequent increase. Within these areas, nature conservation is a primary management objective, which limits the potential of using these lands for at least some other management goals, thus qualifying as an indicator of functional segregation. Next to these categories, class 2 'Protection of Landscapes and Specific Natural Elements' covers 9% per cent of Europe's forests (18 168 000 ha). There is a significant overlap between this category and forested areas of Natura 2000, the EU network of areas designated for the protection of species and habitats. Natura 2000 covers more than 25% of the EU's forests (Sotirov 2017) and is meant to combine conservation objectives with other management goals, including timber production. The implementation of this conservation regime varies strongly, and in many EU nations effective on-the-ground management of these sites for conservation is doubtful, if not missing (Sotirov 2017, Sotirov *et al.* 2015, Winter *et al.* 2014, Winkel *et al.* 2015). Wood production forestry is found to be one of the primary pressures on Natura 2000, with 85% of such forest habitats assigned a poor or bad conservation status (European Environment Agency 2020). Therefore, neither MCPFE class 2 nor Natura 2000 areas can be used as adequate indicators of functional segregation.

Beyond this, conservation measures directly targeting forest species or structural features, e.g., large trees, deadwood, habitat trees, can also be incorporated in forest management planning and practices in the entire forest area (Gustafsson *et al.* 2012, 2020); for instance in response to species protection regulation, forest management certification schemes, or based on voluntary commitments. This results in a continuum extending from small proportions of strictly protected areas to larger areas of forest with some level of conservation management but with a prioritised focus on other management purposes.

According to official statistics, in most European regions, overall felling levels – i.e., wood cut in the forest – are below the net increment in forests available for wood production (Levers *et al.* 2014). Yet, felling as a proportion of net annual increment per hectare increased from 62.4% in 1990 to 70% in 2015 (Forest Europe 2020). This increase is an important indicator of increasing harvesting intensity (Levers *et al.* 2014), i.e., wood extracted from the forest and harvesting

losses, which can be expressed as the Felling/Increment (F/I) ratio<sup>2</sup>.

Recently, the scientific debate on increased felling in European forests has underlined the importance of reliable felling and harvesting data. While the mean standing volume per hectare has increased over the past few decades (Forest Europe 2020), there has been a sharp upturn in amount of forest area felled in recent years (Ceccherini *et al.* 2020). Palahí *et al.* (2021). Picard *et al.* (2021) criticise the assumption that the prime causes driving this recent increase in fellings are socioeconomics and policy. They point instead towards the use of finer resolution remote sensing, revealing commercial thinnings, and increased forest disturbances, e.g., in Finland, Sweden and Germany (Breidenbach *et al.* 2022, Schuldt *et al.* 2020). This debate shows the difficulty of untangling felling data and drivers without specifying the role of different types of wood felling, and the use of remote sensing versus field survey data. It also shows how felling levels can respond quickly to acute changes, e.g., forest disturbances or market prices for wood. We do not aim to fuel this debate by defining the drivers but wish to discern any changes along the integration-segregation axis. There is some evidence that intensive forest management in Europe undermines political objectives such as forest multifunctionality (Angelstam and Manton 2021, Eyvindson *et al.* 2021, Pohjanmies *et al.* 2021), which is interpreted here as an integration of forest functions.

Felling an increased proportion of the net annual increment over extended periods of time is among the most tangible parameters impacting forest related biodiversity (Verkerk *et al.* 2014), which is one of many indicators identified for forest biodiversity assessment (Brukas *et al.* 2013, Oettel and Lapin 2021) and simultaneously used for defining intensification in forest management (Angelstam and Manton 2021). Under some conditions, Gamma-(landscape) diversity might be positively affected by forest management systems that create a wide range of contrasting stand types and developmental stages (see Bruun and Heilmann-Clausen 2021, Schall *et al.* 2020), yet there will certainly be negative effects if remnants of high conservation value forests are transformed into intensively managed production systems (Angelstam and Manton 2021, Svensson *et al.* 2019). Specific felling effects on biodiversity depend on many factors including the area's baseline biodiversity, the specific set of species, felling operations, retention methods, and harvesting intensity at both the forest stand and landscape level, and the subsequent consequences these previous factors have on forest stand structures and habitat network functionality (Angelstam *et al.* 2020, Angelstam and Manton 2021, Biber *et al.* 2015). A number of relevant direct and indirect indicators are used when assessing

the state of forest biodiversity in Europe, related to aspects of forest composition, structure and functionality (Ćosović *et al.* 2020, Lindenmayer *et al.* 2000, Paillet *et al.* 2018). Forest and biodiversity policy uses a subset of indicators depending on the policy goal to be obtained. There are recent calls to harmonise these various indicators and definitions, i.e., from Natura 2000 and Forest Europe, and strengthening stakeholder consultation has been advocated (Sotirov 2017, Trentanovi *et al.* 2023).

Our aim is then to establish whether some indicators for segregation in European forest management are increasing. We therefore use an increase in the proportion of areas designated for nature conservation (MCPFE Classes 1.1-1.3), or a change in mean felling as a proportion of net annual increment over time as indicators of segregation.

Participation in policy design and implementation has many facets and dimensions, including participation formats, scales and stakeholders/societal groups involved, as well as aspects of information flow, power and related decision-making competences (Buchy and Hoverman 2000, Lawrence 2006). Rationales offered for taking a participatory approach are generally two-fold: first, an ethical/normative dimension refers to the ambition to better legitimise decision-making processes and outcomes through democratic involvement (Blondet *et al.* 2017, Pellissier *et al.* 2013, Winter *et al.* 2014). Second, a more technical/political dimension refers to broadening the knowledge base for decision making, e.g., to include local knowledge of specific conditions (Lawrence 2010), or to anticipate and deal with potential societal conflicts. Decision makers' reasons for choosing participation are not always made explicit. Mirroring the dichotomy introduced above, participation rationales can relate to processes (goal to involve people) or outcomes (goal to increase acceptance of results) (Reed 2008). Intended benefits are, however, not always realised (Kallas 2002). In some cases, 'participation' may be (mis)used to hide power differences, strengthen existing disparities, delay decision making or allow certain stakeholders to dominate (Agarwal 2001, Blühdorn and Deflorian 2019, Niedziałkowski *et al.* 2012, Winkel and Sotirov 2011).

Participation is usually considered on a scale from top-down to bottom-up, with different typologies developed in the literature. Building on Lawrence (2006) and Reed (2008), here we distinguish three main types: (1) *consultation* – the governing body/forest manager consults stakeholders/citizens, but holds the final decision-making power; (2) *collaborative decision-making* – the governing body/forest manager forms a partnership with stakeholders/citizens, and outcomes reflect a common understanding; (3) *empowerment* – decisions are 'handed over' to stakeholders/citizens.

<sup>2</sup> FOREST EUROPE (2020): In order not to adulterate the proportion of increment extracted through fellings by forests that are not utilised for timber production, the following information refers to forests available for wood supply (FAWS) only. The increment is presented here as a net annual increment (NAI), which is defined as the average annual volume over the given reference period of the gross increment (i.e., the total increase of growing stock during a given time period) minus natural losses on all trees. The increment, natural losses and fellings are reported over bark, as well as the growing stock. If felling is lower than the net increment, the growing stock is increasing (Figure 3.1-1). A part of the fellings remains in the forest as logging losses (e.g., stem sections with defects) and is not utilised for energy or wood products."

Institutional frameworks regulate how participation in forest management policy planning and implementation is carried out. This often includes the (pre-)definition of methods of participation in policy processes, and the question of who are perceived as eligible participants (Lazdinis *et al.* 2009). For the latter, again three types can be distinguished: (1) *stakeholder participation* – including those considered to have a particular interest in the topic (includes expert participation); (2) *public participation* – including citizens, usually considered non-experts; and (3) *community participation*. Community participation often aims to mobilise local knowledge or demands. Stakeholder or expert participation is more common in Europe than community and public participation (Kleinschmit *et al.* 2018), except in some specific cases of forest commons and community forest ownership (Lawrence *et al.* 2021).

## RESEARCH METHODS

Research on complex sustainability problems requires input from various communities of knowledge to increase its legitimacy, ownership and accountability for the problem (Lang *et al.* 2012), and to ensure “the restructuring of disciplinary knowledge and/or the creation of new shared knowledge” (Jakobsen *et al.* 2004). To avoid simplistic interpretations, we gathered an interdisciplinary team representing forest ecology, silviculture and ecosystem management, forest policy and economics, and environmental anthropology, and drew on different types of data to answer our research questions (Buchanan 1992).

As our research questions require local knowledge of information sources and observations of practice, multiple European scholars were invited to collaborate as co-authors in an iterative process of information searching, interpretation, reflection and conclusion. Specifically, twelve European countries (Austria, Belgium, Bulgaria, Denmark, France, Germany, Poland, Romania, Scotland (UK), Spain, Sweden and Switzerland) were chosen to represent different biogeographical zones, forest cover percentages, landownership structures, historical land-uses, and political cultures in Europe. For each country, two complementary scientists were approached – one representing forest management and ecology research, the other social science research on participatory forest governance (see Annex 1). The scientists were identified as senior researchers or professors through the established networks of the lead authors. In some cases, additional expertise was requested from additional scientists, resulting in the participation of 30 scholars.

Because participation is related to legislation and policy, researchers chose the most relevant scale at which to respond, meaning the most relevant level at which local autonomy for forest policy is executed. Within four of the European countries, this corresponds with a specific part of the country, Flanders (Belgium), North-Rhine-Westphalia (Germany), and Basque Country (Spain), or constituent country within a sovereign state [Scotland (UK)]. For reasons of simplicity,

in cases where we referred to both the countries and these geographical areas within them, we used the term ‘territories’.

For the forest management side, some relevant data could be extracted from publicly available databases, particularly country statistics provided by Forest Europe, which are self-reported by the national ministries responsible for forest affairs. Because of their abstraction level and the reporting interval, they might not always provide the level of detail needed to answer our research questions, especially where country data represents an average of a large range of locally varying biophysical and societal circumstances. Self-reported data might further be subject to political biases. For the assessment of participation across Europe, no pre-existing data set exists, hence preparing this paper needed expert judgements and some new data gathering for that part.

Overall, we followed an iterative and reflexive approach to help diverse participants develop consensus, requiring multiple meetings and drafts to discuss findings and develop shared interpretations (Fazey *et al.* 2014, Lang *et al.* 2012). The core group developed an approach that ensured the involvement of each co-author in cross-cutting analyses and syntheses. We developed a parallel process that explores the ‘nature’ and ‘people’ dimensions first separately and then jointly. Annex 2 provides a comprehensive overview of consecutive steps both groups of scientists undertook during the process of data gathering and analysis. Annexes 3 and 4 provide the templates used for data gathering.

## RESULTS

### Participation in forest policy and forest management

#### *Legal requirements for participation in forest policy development and forest management planning across territories*

In several territories, forest and/or nature conservation laws require a participatory process for forest-related decisions (Table 1). The scope of these laws varies between specific policy areas and decisions, e.g., the declaration of a protected area, the development of a new management plan etc.

Most territories mandate participation for the development of new policies with potential environmental impact. In France, participation is required by law for any new environmental policy developed under the Ministry of the Environment; there is no such requirement for forest policy, which falls under the jurisdiction of the Ministry of Agriculture. At the federal, national, and regional level (constitutional and legislative levels), participation is required in some territories when developing a new forest programme, forest strategy, or forest act. At the local, operational level, participation is required by some territories during the preparation of a forest management plan (FMP). This is understood here as a document describing, organising and steering management, and hence policy implementation, in a forest or forest enterprise.

When developing new public FMPs, participation is mandatory in Eastern European territories with mostly publicly

TABLE 1 Overview of the basis for participation in forest policy development and forest management planning in 12 European territories. Responses based on a menu of options

Territory	Participation is required in . . .				
	new policy development	state FMP (forests owned by state/region)	other public FMP (local municipality etc.)	private FMP	nature-protected forests (Natura 2000, etc.)
<i>Austria</i>	mix of legal requirements and voluntary commitments, hard to disentangle	no requirement	no requirement	no requirement	no requirement for participation
<i>Basque Country (Spain)</i>	mandated by law (only at the highest level /Spain not in Basque country)	mandated by law for public utility forest	required for grants/subsidies	required for grants/subsidies	insufficient information
<i>Bulgaria</i>	mandated by law	mandated by law	required only if managing the forest	required only if managing the forest	mandated by law
<i>Denmark</i>	mandated by law	no requirement	no requirement	no requirement	no requirement for participation
<i>Flanders (Belgium)</i>	mandated by law	mandated by law	mandated by law	required for Natura 2000 forest	mandated by law
<i>France</i>	mandated by law <sup>i</sup>	no requirement	no requirement	no requirement	required for Natura 2000 forest
<i>North Rhine-Westphalia (Germany)</i>	mandated by law	no requirement	no requirement	no requirement	established but not required practice
<i>Poland</i>	mandated by law	mandated by law	mandated by law	mandated by law	mandated by law
<i>Romania</i>	mandated by law	not mandatory for the elaboration but for Strategic Environmental Assessment	not mandatory for the elaboration but for Strategic Environmental Assessment	not mandatory for the elaboration but for Strategic Environmental Assessment	mandated by law
<i>Scotland (UK)</i>	mandated by law	mandated by law	local public forests have the same requirements as private forests	required for grants AND certification	no different requirements – depends on ownership
<i>Sweden</i>	mandated by law and voluntary commitments	no requirement <sup>ii</sup>	no requirement <sup>ii</sup>	no requirement <sup>ii</sup>	mandated by law
<i>Switzerland</i>	mandated by law	no requirement <sup>iv</sup>	no requirement <sup>iv</sup>	no requirement <sup>iv</sup>	mandated by law for certain forms of protected areas, e.g., regional nature parks

<sup>i</sup> Mandatory only for the development of environmental policies

<sup>ii</sup> Only when certain measures are planned and under particular circumstances

<sup>iii</sup> Refers to the elaboration of draft legislation in the pre-parliamentary process

<sup>iv</sup> Participation required in the elaboration of regional forest developments plans, which are a frame condition for FMP

owned forests, in Scotland and Flanders. In the Basque Country, an environmental impact evaluation, including mandatory public consultation, is required as part of the environmental regulations for ‘public utility’ forest FMPs; public participation is not mandated in FMP elaboration in forest regulations,

although community-level, multi-stakeholder consultations are not uncommon. Similarly in Romania, FMPs are designed based on a normative procedure that does not require public participation. Yet, the demand for a public consultation process during the preparation of the FMPs comes from

environmental legislation, e.g., with preparation of the strategic environmental assessment and applies to all FMPs, regardless of the ownership forms. In addition, for the FMPs overlapping with Natura 2000 sites, an adequate environmental assessment is required, which opens more participation possibilities. Participation is not required for FMPs in North Rhine-Westphalia and France. In Denmark, participation is not mandatory, but participatory processes are organised to reduce conflict. Similar processes are used in North Rhine-Westphalia.

In Switzerland, participation is not required for FMPs at the enterprise level, and there is no differentiation made between private and public FMPs. However, participation is mandatory for regional forest development plans, which are a framework condition for the enterprise-level plans. In Poland and Romania, participation in FMPs on private forest land is obligatory, but in practice is often limited to consultation. For Austria, Denmark, France, the Basque Country and North Rhine-Westphalia, there are no participation requirements for FMPs in private forests. In the remaining territories, participation is either indirect or not obligatory except when obtaining certification, subsidies, or in relation to Natura 2000 (see below).

For establishing and managing protected areas, participation is mandatory in Bulgaria, Poland, Romania, Switzerland and Sweden, and at least for Natura 2000 areas in France and Flanders. In Austria and Denmark, there are no participation obligations. In North Rhine-Westphalia it is not mandatory, but partially practised. In Switzerland, the requirement for participation depends on the form and type of protected areas, e.g., it is mandatory for the establishment of regional nature parks.

Choosing to join a particular forest certification system is a voluntary decision for forest owners. In most of the studied territories, to obtain and maintain FSC certification, participatory processes are required in dispute resolution, management planning, monitoring and evaluation, and the identification of High Conservation Value Forest (HCVF). The exact format differs between territories. For Bulgaria and Scotland, public consultation participation is obligatory for developing FMPs for certified forests. The national certification standard might include and clarify the role of locally driven initiatives, for instance, relating to the recognition of forest areas as HCVF (Bulgaria, Poland<sup>3</sup>, Romania, Switzerland), or consultations with indigenous people and local communities affected by forestry activities (Sweden). Especially, in Romania (Buliga and Nichiforel 2019), certification is mentioned as a driver of participatory processes.

A country's particular forest policy culture and tradition is an important factor affecting participation patterns (Deuffic *et al.* 2018, Winkel and Sotirov 2016). In France, North Rhine-Westphalia and Poland, a historically rooted, relatively strong state forestry culture where professional forest expertise is seen as the most legitimate source of forest management

guidance, might constrain participatory approaches (Winkel and Sotirov 2016, Scott 1998). These have, nevertheless, partly developed following increased conflicts and societal demand for participation. In France and North Rhine-Westphalia, private forest owners hold the largest land share; they might be afraid of restrictions resulting from participation. Participation seems more widespread in Switzerland, Flanders and Sweden due to a more inclusive political culture. In Bulgaria, Poland and Romania, the history of centralised state planning has evolved towards institutionalised participation, where there is a strong 'attachment' to laws mandating participation, frequently organised as top-down consultations in both public and private forests (Konczal 2020, Schulz *et al.* 2014).

#### *Participation methods within policy processes, management planning and practices*

Policy development at the national/federal and regional/sub-national level, in the case of both forest and biodiversity policy and land use legislation in some of the study territories, mostly uses top-down consultation processes. These processes are typically expert oriented. If the wider public is included, it is usually organised in the form of public hearings and sharing of data or public presentations. In some territories, e.g., Scotland, Austria, policy consultations are open to all and attract contributions from individuals, communities and a range of interest groups.

While the empowerment type of participation was not reported for the territories analysed, collaborative decision-making was reported during the preparation of National Forest Programmes or Strategies in, e.g., Austria, Bulgaria, Denmark, France, Poland, Romania, Switzerland, Sweden, and North Rhine-Westphalia. However, these processes frequently have a non-binding character with limited impact on the ground (Johansson 2024, Winkel and Sotirov 2011).

Looking into specific territories, Sweden generally has a participatory policymaking approach that includes sharing data in the case of new governmental propositions, multi-stakeholder consultations and dialogue within various governmental projects (Wallin *et al.* 2016, Johansson 2024) that could, in some cases, classify as collaborative decision making. Participation is required through written referral rounds before the parliament passes a new law. Certain circumstances require inviting the Sami to participate (Sandström and Widmark 2007).

Similarly, Austrian forest policy processes were interpreted as largely inclusive and dialogue-orientated, including both top-down and bottom-up approaches; yet forest management planning is usually not done in a participatory way. Both Sweden and Austria are characterised by a collaborative policy culture and the influential role of the traditional forest sector in the national debate on the economy. This might explain participatory policy arrangements at higher policy levels (collaborative decision-making) but less participatory arrangements (consultation) when it comes to concrete forest management planning and forestry practices.

<sup>3</sup> In October 2023 the Polish National Forest Holding "State Forests" decided to discontinue FSC Certification in the forests it manages. This decision is being reconsidered following a change of the government in Poland in December 2023.

Nevertheless, in Austria and Sweden – as well as in several other territories – collaborative methods are reported at the level of forest management planning and forestry practices. These are however often presented as ‘best practices’, meaning they are the exceptions rather than the rule. Collaboration includes roundtables, working groups, joint projects, consultation exercises and data-sharing, which are mostly voluntary and restricted to short-term project-related activities. The large variety of activities among territories is affected by the forest ownership structure, administrative organisation, local community role, indigenous presence (Sami in Sweden), and the attitudes of forest owner and wood producer associations. At the local level, participation is sometimes characterised as a tool to prevent and mediate conflicts concerning clear-cuts, large-scale afforestation, harvesting, game management and planned protected areas.

There are differences between participation methods used at the local level in the studied territories, most of which are not systematically applied. In Denmark (mainly in public forests), tools include online meetings and platforms, public events, data sharing with scientists, debates, and cooperation of foresters and local communities. This approach can be summarised as ‘including people and preventing conflicts’. Similarly, in Flanders and Switzerland several participation methods are listed. In North Rhine-Westphalia local uses of participation methods seem more reactive, usually in response to conflicts with citizens. In France and the Basque Country, and partially also North Rhine-Westphalia, participation is oriented towards specific issues such as negotiations over management plans for Natura 2000 areas or joint preparation of the Territorial Forest Plans or Management Plans. In Poland, Bulgaria and partly in Romania, participation occurs around FMPs at the Forest District level. These consultations are rather formal and top-down and are seen as having limited impact; but they do mobilise NGOs, scientists and interested citizens, e.g., to collect data for FMP remarks. For instance, in Poland, NGOs have addressed the European Commission about the limited consideration of their complaints in FMPs<sup>4</sup>. They have also criticised the planning process in forest certification governance as dominated by public forest organisations and lacking participation (Niedziakowski and Shkaruba 2018). In Romania, the forest certification process provides examples of good practices in participation at the local level around forest districts, especially in HCVF identification (Nichiforel *et al.* 2021). In Sweden, participatory landscape approaches of many kinds are applied with research, development and networking projects (Axelsson *et al.* 2013, Elbakidze *et al.* 2010, Wallin *et al.* 2016), and include the Model Forest concept, Biosphere Reserves, and activities in some of the national parks.

#### *Stakeholders involved in participation*

Experts such as private forest owners, private forest owner organisations, public forest managers, forest industries,

NGOs, public sector/administrations, and scientists are perceived to be relatively more influential than non-specialists, such as other civil society groups, local communities and the general society. There are, however, variations across the two levels of decision making considered here. Figures 1 and 2 present overviews of stakeholder influence in participation processes at the territory and local levels, respectively. Forest managers (non-industrial private, private industry, public) are seen as more influential at the local level, whereas forest owners, forest industry associations and NGOs are perceived as more influential at the territory level. Other civil society groups and local communities are considered as having limited influence in participation processes particularly at the territory level.

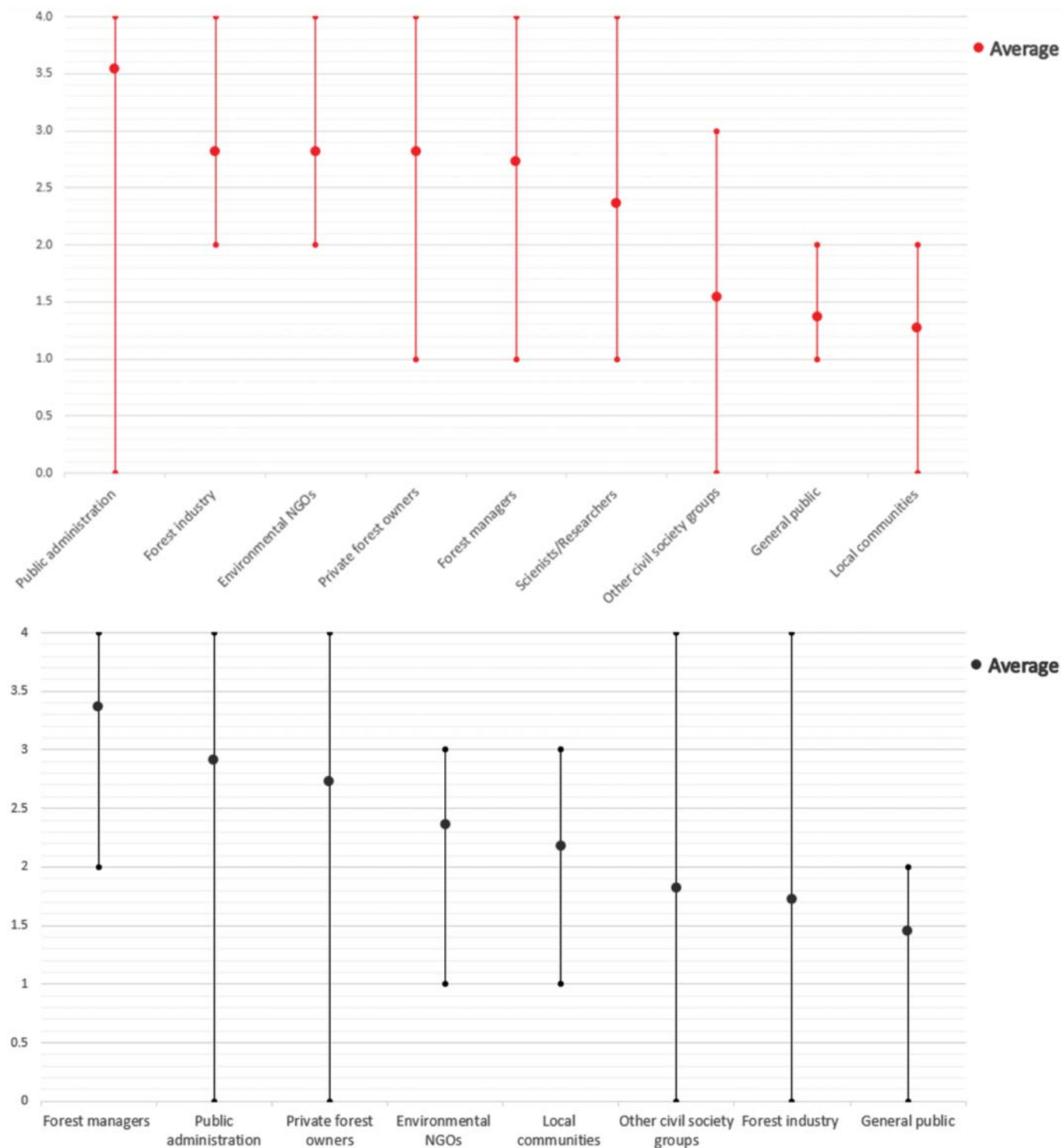
In Flanders, Denmark, France, North Rhine-Westphalia, Poland, Bulgaria, Romania, Scotland, Sweden, and Switzerland, NGOs are perceived as well organised and able to communicate their opinions to policymakers and the general public within and outside participation processes (Schulz *et al.* 2018). In Poland, Romania and Bulgaria, limited capacity and resources as well as strategic considerations can result in NGOs focussing on a few *emblematic* forests, e.g., the Białowieża Forest in Poland, although since the Covid-19 pandemic there has been a rapid growth in bottom-up initiatives seeking participatory options regarding local forests (Niedziakowski and Chmielewski 2023). Forest industry associations are considered to have a significant impact at the territory level, particularly in Scotland, Sweden and recently Romania. In Sweden, unclear mandates and vague forms of accountability associated with participatory processes have favoured better networked and more resourceful stakeholders, such as the state, forest owner, and forest industry associations (Beland Lindahl *et al.* 2017). In other European territories, at least in public forests, the trend away from production-oriented management, combined with such factors as increased environmental awareness among the public and forest managers, can be linked to an increasing impact of NGOs.

The general public is considered to have a low, direct influence through participation. However, in France, Denmark, Romania, Scotland, Switzerland, Flanders and North Rhine-Westphalia, public opinion matters – either indirectly by giving advantage to some stakeholders through public pressure, or directly when the public becomes organised, e.g., through citizen initiatives or local protest groups.

In Denmark, North Rhine-Westphalia and France, territory-level influence varies according to the policy agenda. Foresters and forest owners are more influential when it comes to participation in forest sector policies, whereas NGOs are more powerful in biodiversity policies. This difference indicates challenges of cross-sectoral linkages in participation and a related risk of sectoral *participation silos* (Winkel and Sotirov 2016). In Scotland, participation and influence

<sup>4</sup> On the 2<sup>nd</sup> of March 2023, the European Union Court of Justice ruled that Poland must ensure that environmental organisations are able to apply to a court for effective review of the substantive and procedural legality of forest management plans.

FIGURE 1 and FIGURE 2 Ranking of stakeholders' influence in participation processes in 12 territories. Answers to the question: "Which stakeholders are involved at: (1) territory; (2) local level and how important are they?". Rankings are the personal assessments of contributing researchers based on perceived influence in participatory processes relating to forest policy and forest management in their territories. Next to their expert assessment, the contributing researchers based their ranking on existing publications and/or consultations with additional experts. To reduce subjectivity, the suitable criteria for assessing power was discussed with the expert team before the exercise. The figure indicates the highest and lowest answers on a scale of 0–4, where the following meaning was assigned to numbers: 1 – no or very little influence; 2 – minor influence; 3 – moderate influence; 4 – strong influence



depend on which component of forest policy is under discussion: reforestation is the most significant and controversial component of forest policy impacting local communities and it is this topic around which most public participatory activity happens, both in terms of consultation and conflict.

Perceived stakeholder influence varies according to forest ownership structure. In Bulgaria, Poland and Romania, where a large share of the forest land is state owned (Table 2), private forest owners and their associations are considered less influential compared to those in territories where private ownership is widespread, such as Austria, Sweden or France. In turn, strong, hierarchical public forest management organisations in territories with dominant public forest ownership, e.g., in Poland, Bulgaria, are assessed as having a significant influence in forest policy processes at both local and territory levels (Konczal 2020, Winkel and Sotirov 2011). Stakeholders

seem to engage more, and are more influential, in cases where their interests are at stake; thus, private forest owners are described as more powerful at the local level.

### Forest management and integration of nature conservation across territories

Socioeconomic and forest-related characteristics vary across participating territories. For most territories, non-industrial private forest owners and industry hold the majority of forest area, with the exception of Bulgaria (12%), Poland (19%) and Romania (36%). Amongst those non-industrial private forests, most holdings are below 10 hectares in Belgium, France and Poland, whereas most private holdings in Sweden are between 10–500 hectares, with a mean of 34 ha and the median of 12 ha in 2020. Territories also vary with respect

TABLE 2 Socio-economic and forest-related characteristics per country

a	b	c	d	e	f	g	h	i
Country	Population density (per km <sup>2</sup> )	Forest cover (1000 hectare) <sup>1</sup>	Forest cover (% of country area)	Forestry sector contribution to GDP (%) <sup>2</sup>	Public/Private (%) of column c)	Protected forests (MCPFE class 1.1., 1.2 & 1.3% of column c) <sup>3</sup>	N2000 (% of column c)	Certification (% of column c)
Austria	108	3869	47	0.40	19/81	12.9	15.0	80
Belgium	377	689	23	0.03	47/53	3.9	31.2	47
Bulgaria	63	3893	36	0.54	88/12	4.0	57.5	21
Denmark	138	628	15	0.13	26/74	7.2	12.2	49 <sup>3</sup>
France	106	17253	32	0.15	28/72	19.7	16.7	33
Germany	235	11419	33	0.09	52/48	29.0	23.8	69 <sup>3</sup>
Poland	124	9483	31	0.35	81/19	32.6	36.1	75 <sup>3</sup>
Romania	83	6929	30	0.40	64/36	6.2	38.4	33 <sup>3</sup>
Scotland <sup>4</sup>	70	1457	19	-	32/68	6.6	0.9 <sup>5</sup>	60
Spain	94	18572	37	0.11	29/71	15.2	31.7	8 <sup>3</sup>
Sweden	25	27980	69	0.99	22/78	7.7	12.2	30 <sup>3</sup>
Switzerland	215	1269	32	0.06	30/70	6.6	-	55

<sup>1</sup> Forest as defined by Forest Europe; Process to update the pan-European set of indicators for sustainable forest management; relevant terms and definitions used for the updated pan-European indicators for sustainable forest management (2015)

<sup>2</sup> As defined by Eurostat; Statistical classification of economic activities in the European Community (2008)

<sup>3</sup> Minimum percentage of forest cover under certification, either FSC or PEFC, assuming there is full overlap between the two certification schemes

<sup>4</sup> For Scotland [b], [c], [d], [f], [i] data provided by contributing authors; [g], [h] extracted from supporting data for the UK contribution to the State of Europe's Forests (2020); [j] extracted from past National Forest Inventory data by contributing authors

<sup>5</sup> Natura2000 does not apply in Scotland post-Brexit, but the SPA and SAC are legally protected to the same extent

[a]: The numbers in this table are for the entire country as mentioned in [a]

[b]: Eurostat 2019, 2020

[c], [d], [e]: State of Europe's forests (2020), except for Scotland, in which case the data was extracted from the UK contribution to SoEF by the contributing authors and was unavailable for 'e'

[f], [g]: calculated based on the available data range for each of the countries, in State of the European Forests 2020, except for Austria, Germany and Romania for which additional data was provided by contributing authors; for Romania [g] is based on the data reported in State of the European Forests 2005

[h]: calculated from the EEA dataset on forest area within N2000 areas (<https://www.eea.europa.eu/data-and-maps/data/natura2000-clc-by-nuts>), except for Austria, for which additional data was provided by contributing authors

[i]: Measano *et al.* (2018) except for Scotland, in which case the data was provided by the contributing authors

to the legal framework regulating private forestry, which imposes different levels of restrictions on private forest owners (Nichiforel *et al.* 2018). The selected territories show large variation in forest cover, ranging from 15% for Denmark to 69% for Sweden (Table 2).

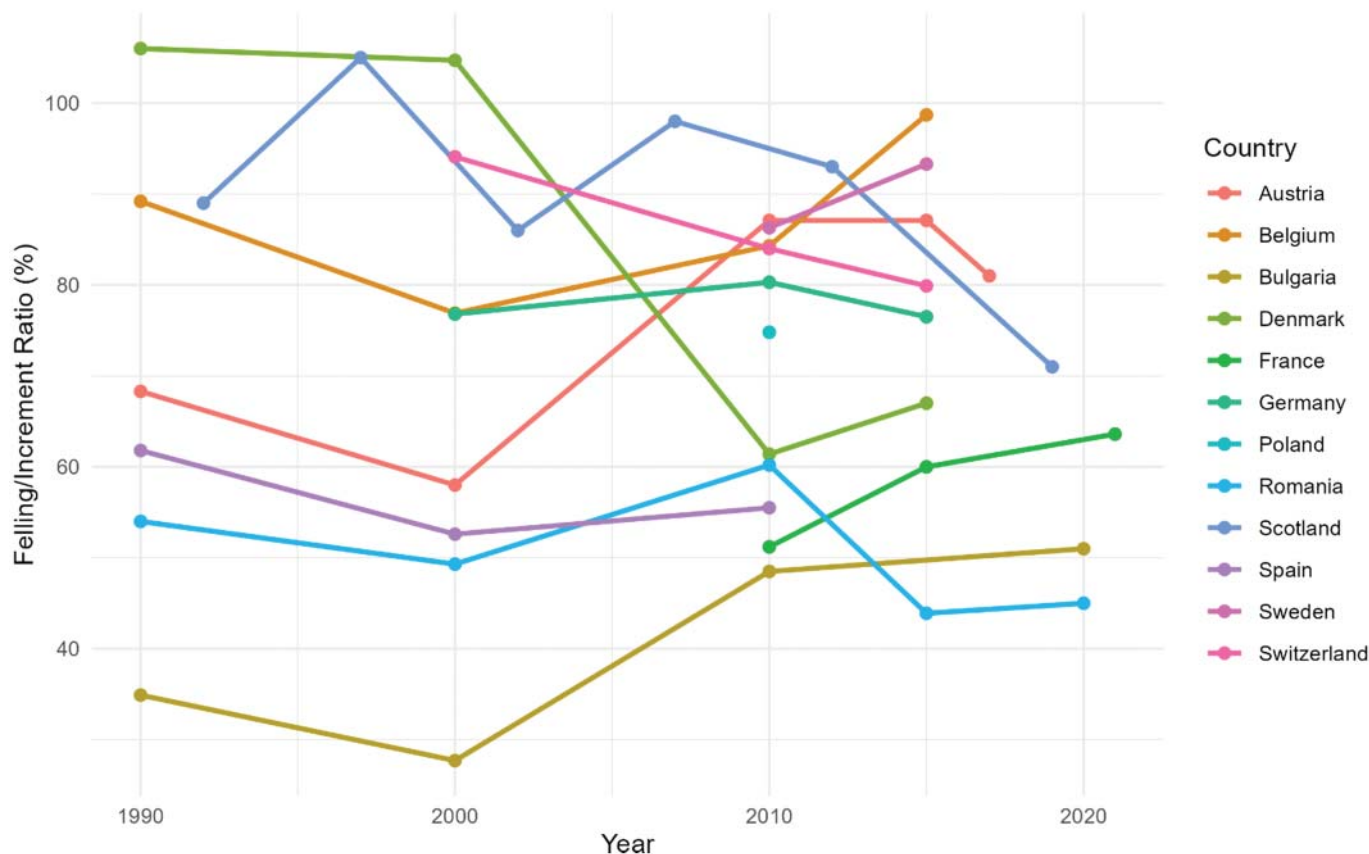
F/I ratio varies considerably between territories and between years. Bulgaria reports on average fellings below half of their net annual increment, whereas Belgium, Denmark, Scotland, Sweden and Switzerland are at or above 85%. A closer look at F/I ratio over time shows that the percentages change considerably between intervals within territories. We cannot discern an overall trend regarding felling levels over the past 25 years (data not shown) although the F/I ratio increased for seven of the twelve territories between the two most recent available data points (Figure 3). This figure should be interpreted with caution since validity is low given the few data entries available. In addition, for Bulgaria, the increment assessment methodology is not harmonised with the other territories. For several territories, large regional differences were mentioned that are not visible in country figures. In one case, the increase over the previous 15 years was reported to be largely due to salvage logging after disturbances. Moreover, in some territories (e.g., Romania, Bulgaria) the results of National Forest Inventories and/or expert assessments show higher felling rates compared to official statistics (WWF

Romania 2019), e.g., Bulgarian authors regard the actual F/I ratio to be near 65%.

The share of protected forest for nature conservation varies considerably, with some territories focusing on an unmanaged approach, and others relying more heavily on active management for nature conservation. In nearly all cases, the forest area in MCPFE classes 1.1-1.3 has increased steadily over the years (Figure 4). According to the contributing researchers, the share of protected forest areas for nature conservation is expected to increase in Belgium, Denmark, Germany, Switzerland and Sweden, but remain stable in Austria, Bulgaria, France, Scotland and Spain. Following a government change in Poland in December of 2023, there is an expectation that the share of protected forest areas will increase considerably. In Romania the National Forest Strategy 2030 has been approved in October 2022. According to this programmatic document the share of strictly protected forests needs to increase to 10% by 2030.

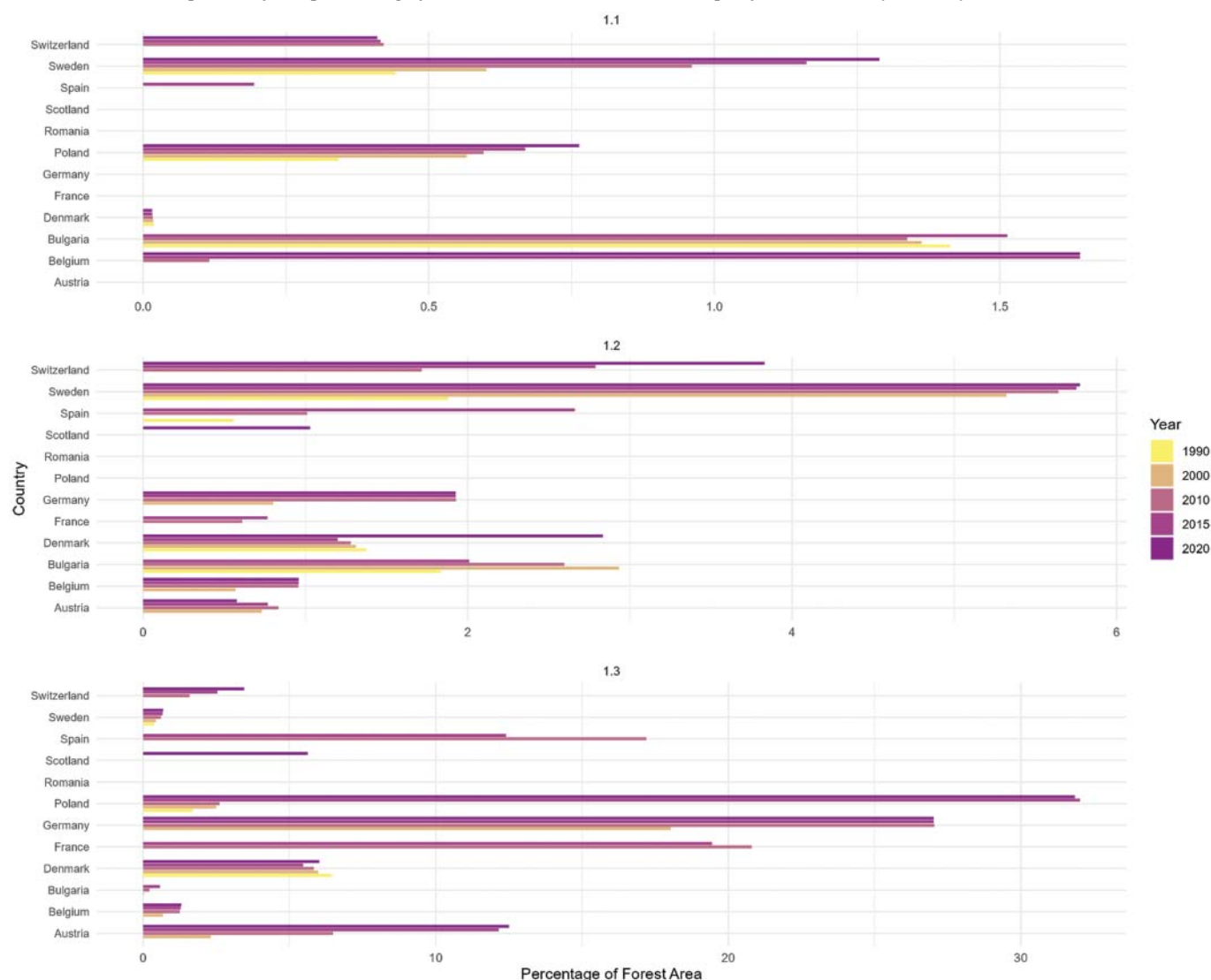
Current developments in Germany illustrate the ongoing increase of forest areas in MCPFE classes 1.1-1.3, where the area of strictly protected forests (class 1.1.) recently increased to 3.1% whereas the aim was for 5% (NW-FVA 2021). Changing political regimes can have pronounced impacts on the outlook of forest area included into MCPFE classes 1.1.-1.3; as in countries like, e.g., Poland, where the expectations of our

FIGURE 3 Development of felling/increment ratio (%) per country (1990–2021). Dots indicate available data points



Data sources: State of Europe’s forests (2020), verified by co-authors with national focal points responsible for NFI or equivalent. For Scotland, data was provided by contributing authors

FIGURE 4 Development of the percentage forest area in MCPFE 1.1-1.3, per forest cover by country (1990–2020)



Data sources: State of Europe’s forests (2020), adjusted in case of more recent information, verified by co-authors with national focal points responsible for NFI or equivalent. Data for Scotland were extracted from supporting data for the UK contribution to The State of Europe’s Forests (2020), and are not available for 1991–2015

\* For Romania, the latest reported data regarding the share of forests by MCPFE classes are from 2005; since then, many natural protected areas have been provided with management plans and the area of forest included in different management plans is expected to be substantially increased. There is no national centralised set of data of the conservation status assigned by the management plans of natural protected areas

contributing authors reflect the recently elected government ambition to now increase forest protection.

Regarding future forest felling trends, increased felling intensities are expected for most territories except Belgium, Germany and Spain. Recent data from Sweden mark an increase with the latest numbers showing 98% of total volume increment felled within productive forest areas (Skogsdata 2023). For Scotland there is no evidence to suggest that felling intensity will change significantly (Table 3). Notably, small percentage changes can represent very different changes

in absolute numbers; likewise, a national change in the proportion of increment felling might be unevenly distributed over production forests<sup>5</sup>.

Segregation is reported to be part of the forest management landscape, to some degree, in Bulgaria, Romania, Spain and Sweden, and for Sweden, specifically through the management of several large private forest companies. For Austria, Belgium, Denmark, France, Germany, Poland, Scotland and Switzerland, an interesting picture emerges indicating integration as the dominant overall paradigm.

<sup>5</sup> Data for this paper was collected in 2020 and the first half of 2021 and it reflects the status priori publication of the EU Biodiversity Strategy for 2030 and EU Forest Strategy for 2030.

TABLE 3 Expected change in A. ratio of MCPFE Class 1.1-1.3/total cover of protected forest and other wooded land and in B. H/I ratio in forests available for wood supply

	A. MCPFE Class 1.1			A. MCPFE Class 1.2			A. MCPFE Class 1.3			B. harvest/increment ratio		
	No change	Increase	Decrease	Don't know	No change	Increase	Decrease	Don't know	No change	Increase	Decrease	Don't know
Austria	x				x						x	
Belgium		x				x			x			x
Bulgaria		x		x					x			
Denmark		x			x				x			
France		x			x						x	
Germany		x			x				x			
Poland		x			x							x
Romania		x			x				x			
Scotland		x			x							
Spain		x			x							x
Switzerland		x				x			x			
Sweden		x									x	

Asked for any ‘new’ silvicultural approaches regarding integration of nature conservation in forest management, the contributing scientists provided us with the answers presented in Table 4.

In several territories, management systems such as close to nature forest management or continuous cover forestry are partially practiced, especially in public forests and to varying degrees in private forests, and/or have increased in importance. In Austria, Poland and Sweden, no substantial trend towards such approaches are reported over larger areas, although for all, the integrated paradigm is reported to be present or even dominant.

In sum, the analysed data indicate the following developments:

- Most contributing authors expect a proportionally stable or increasing area of forest to be set aside for nature conservation in their country. For Sweden, only categories 1.2 and 1.3 are expected to decrease.
- Official statistics of fellings are consistently below 65% in some Southern and Eastern European territories (Bulgaria, France, Romania, Spain). Northern and Western European territories report higher F/I ratios, although they are very volatile, sometimes fluctuating by dozens of percentage points between reporting periods. Contributing researchers from five territories expect the percentage of net increment felled to increase in the next decade; four expect it to remain the same, and for three the percentage is expected to fall. For Bulgaria and Romania, it is indicated that official statistics do not represent real fellings; numbers could be higher, yet by how much is unclear.
- Most contributing researchers expect an increase in at least one of the indicators in our approach. Where the F/I ratio will increase, further intensification would take place. For several territories where both indicators are expected to increase, segregation may increase.

**The link between (1) participation in forest policy and management and (2) integration of biodiversity objectives and measures in forest management**

The link between participation in forest policy and the uptake and application of nature conservation objectives in forest management was reported as highly context dependent. Territory and local characteristics played a role here, as did the history and tradition of forest management, ownership structure, power relations between stakeholders, political and economic drivers, just to name a few. Researchers found it difficult to trace participation impacts, which depend on the process, including participation type and involved stakeholders. They also reported a lack of research and evaluation criteria at the local, territory, national and European levels. Generalisations at the national or European levels are not easily formulated, as the effects of participation on the integration of biodiversity in forest management depend critically on who is participating, their particular interests, and current agendas.

In Austria, Belgium, Denmark, France and Scotland, a clear link was seen between participation in forest policy and

TABLE 4 *New silvicultural approach projected/introduced addressing biodiversity in production forests (e.g., close to nature forest management, continuous cover forestry, retention forestry, reduced impact logging, mimicking natural disturbances, etc. (expertise)*

Austria	Biodiversity is a weak driver for changes in management practices
Belgium	A gradual switch to integrated management occurs even in plantations, accompanied by a shift from stand-based management towards uneven aged, mixed species tree-based management systems
Bulgaria	Traditional forest management is practiced, indirectly pushing towards segregation, but close to nature forestry is increasingly being introduced
Denmark	Close to nature forest management as guiding principle for state forests and encouraged for private forest owners
France	Slow increase in close to nature forest management, especially in public forests
Germany	<i>Naturnahe Waldwirtschaft</i> (close to nature forestry) and continuous cover forestry is the management paradigm in many public forests, diversity of management practices in private forests
Poland	While some new silvicultural approaches aimed at close to nature forestry, and “multifunctional” forestry were implemented in the 1990s, there has been a lack of innovation in the recent years, accompanied by increasing social conflicts concerning nature conservation in forests
Romania	Traditional approaches to close to nature forest management are de jure promoted (e.g., natural regeneration and long production cycle), while new approaches addressing biodiversity are sceptically regarded in practice
Scotland	Gradual rise of continuous cover forestry in public forests and on traditional private estates
Spain	Slow rise towards more nature friendly management
Switzerland	Close to nature forest management for all forests
Sweden	Despite ongoing debates no clear trend towards close to nature forestry on the ground. A survey by the forest agency showed that clear-felling dominates (97%). Closer-to-nature forest management has been introduced as concept but has very limited application.

\*Data was derived from the contributing researchers’ responses to question 11

positive biodiversity effects in managed forests; in Bulgaria, Germany, Poland, Romania, Sweden, and Switzerland, researchers had reservations regarding this link. While participation in policy formulation was reported as effective (particularly strong formal integration), the effects of participation for nature conservation at a practical level are reported as much harder to assess due to insufficient monitoring.

There were important variabilities described for the link between participation and the integration of biodiversity measures. ENGOs were reported as pushing for more conservation in both policy formulation and policy (FMP) implementation on the ground. However, the quantifiable impact of their activities differed between territories (if the suggestions regarding nature conservation submitted to the FMPs are taken into consideration), and their engagement in the consultation processes was reported as a way to increase awareness of nature conservation in forest management. The activities of the ENGOs on the ground were listed as important for public awareness of biodiversity and more general forest issues. It was also stated that wider societal participation has shaped policies in recent years by engaging citizens in public policy debates on biodiversity issues.

## DISCUSSION

### Reflections on results and existing knowledge

All 12 territories reported increased attention given to nature conservation aspects in the formulation of forest management

paradigms at the policy level. This goes together with an institutional framework that emphasises nature conservation as one objective of forest management (see Nichiforel *et al.* 2020, Schulz *et al.* 2014). This framework is frequently connected to the EU’s biodiversity policy (especially the Birds and Habitats Directives) as an institutional driver of national and subnational policies (Aggestam *et al.* 2020, Borrass *et al.* 2015, Konczal *et al.* 2023), and includes protected areas where conservation objectives are combined with other forest management goals. Our results confirmed this integration focus: when specifically asked, researchers agreed that for most territories the dominant paradigm is the integration of nature conservation in forest management aimed at wood production.

It was challenging to assess how and to what degree this attention for nature conservation at the policy level translates into actual adjustments in forest management practices. Where both percentages of forest areas for nature conservation and F/I ratios in forest areas are increasing, segregation is indeed increasing in some territories or expected to do so in the near future. However, our results also confirm that, regarding harvesting intensity, official felling levels have been below the net yearly increment in the case territories for the previous 25 years; Levers *et al.* (2014) confirm this for most European regions. However, at the stand level, increasing increment harvesting and retention of green trees and deadwood can indicate the integration of conservation in forest management or the lack thereof, yet either interpretation requires caution for several reasons. First, the setting-aside of

especially intensively managed forests for nature conservation or the adoption of an integrated management policy precedes the actual development of biodiversity even in the best of cases, since it takes considerable time for biodiversity associated with unmanaged forests to develop from especially intensively managed forests (Langridge *et al.* 2023). Second, the F/I ratio may not be the most suitable indicator of habitat-availability for forest-related biodiversity, since it does not seem to correlate well with important indirect biodiversity indicators at the stand level, e.g., deadwood amount or tree ages. Third, our results show several territories with a strong focus on integration, simultaneously having a high F/I ratio. Factors that could explain such a seemingly paradoxical situation are i) a focus on harvesting for biodiversity purposes, ii) a substantial increase in harvesting intensity within a subset of forest areas focusing primarily on wood production, and iii) an increasing forest age in which a higher F/I might combine with nature conservation, since few trees would be harvested in stands with a comparatively low increment. For example, in an uneven-aged forest, the annual harvest may equal increment while keeping a rather high growing stock indefinitely (Schütz 2001). A more accurate indicator of the relationship between fellings and forest-related biodiversity is urgently needed (Bauhus, *et al.* 2017), for which Brukas *et al.* (2013) and Oettel and Lapin (2021) provide suggestions, related to stand level structural parameters. So, while the F/I ratio cannot alone predict the success of nature conservation, it does, especially together with the increasing setting aside of forest areas, provide us with tentative indications that an ongoing segregative trend may be occurring or expected to occur in forest management.

There are concerning reports for some territories that felling trends might undermine increment retention and increase overall pressure on forest ecosystems (Felton *et al.* 2020). Where increased fellings occur, these might in part be explained by increasing disturbances with subsequent salvaging or sanitary felling (Seidl *et al.* 2014, Wysocka-Fijorek *et al.* 2022), which would not warrant their interpretation as policy- or market-driven increase. In response to such situations, economic and forest sanitary considerations may drive salvage logging while retention of disturbance legacies can both support biodiversity restoration and expedited forest recovery (Taerøe *et al.* 2019). We infer a geographical grouping from our results: the Northern and Western European territories show higher levels of increment harvesting, and the Southern and Eastern European territories in this study show relatively lower levels. This may indicate a certain challenge for the application of integrated forest management approaches in the first named regions. However, based on the previous paragraph, we would add that any conclusions about how this result affects forest-related biodiversity should consider the impact of a sustained harvesting intensity on ecological thresholds, taking into account the specific context of the biome in question. Furthermore, for Romania and Bulgaria,

official statistics underestimated fellings that result from illegal logging (WWF Romania 2019, WWF Bulgaria 2018) and for some other territories, the availability of official data necessary for our analysis was limited. These results highlight that despite the importance of accurate felling statistics as a foundation for public debate and policymaking, there are many remaining limitations in official databases.

Regarding segregation, a relatively small but growing forest area was found designated primarily for nature conservation in all the territories that we studied, although the focus on a strategy to do this through active management, unmanaged set-asides or both, varied greatly between the territories. Researchers from most territories expected a further increase of forest areas specifically designated for nature conservation over the next decade, but did not specify if these increases will be in highly productive or less productive forest areas. In Europe, only 5% of forest land is under strict protection (Forest Europe 2020). In addition to the country percentages shown in our results, these numbers are well below the 10% objective for strictly protected areas recommended in the EU Biodiversity and Forest Strategy for 2030<sup>6</sup>. While the meaning of ‘legal’ and ‘strict’ protection varies between territories, the relatively low percentages across European territories indicate, congruent with our assessment, that segregation has not been the dominant nature conservation strategy thus far.

Forest management is expected to intensify in Austria and Sweden, with economically important, relative to the national economy, and/or powerful forest and wood sectors. This also holds true for Bulgaria, Denmark, and France, where this intensification is expected to be accompanied by an increase in the area of protected forests. For Belgium, Poland and Spain, a decrease is expected in the F/I ratio, while protected forest area is expected to increase. In case of an expected increase in F/I ratio, the question is how much of an increase in protected forests is required and how targeted this protection needs to be to compensate for forestry intensification (Felton *et al.* 2020). Although there is no established strict causal relation between harvesting intensity and the integration of nature conservation in forest management, there is a need to assess the net effect of conservation and intensification in the long term (Angelstam and Manton 2021). A significant increase of strict forest reserves satisfying evidence-based conservation targets might allow for increased harvesting intensity in managed forests (Nabuurs *et al.* 2001). Current levels of set-asides do not reach the threshold levels needed at the country level to sustainably support all forest biodiversity (see Felton *et al.* 2020, Angelstam *et al.* 2020), especially when a simultaneous trend towards harvesting a larger share of the increment in managed forests might negatively affect biodiversity (Verkerk *et al.* 2014). This is particularly concerning for territories where harvesting levels are already close to increment levels, such as Sweden where the most recent data show that 98% of the available growth

<sup>6</sup> Romania has translated this into its National Forest Strategy 2030, approved in 2022. The target for 2030 is to strictly protect 10% of the forests. The criteria and methodology to be used are to be developed.

is either harvested or subject to storm and insect damages (Angelstam *et al.* 2023).

In territories with economically less important forest and wood sectors and/or high population densities/highly urbanised societies such as Belgium, Germany, Spain, Switzerland, to some extent France, Scotland, Denmark, an integration of biodiversity in forest management was widely reported, as is, for most, the expectation that strictly protected areas will increase. Such approaches as close-to-nature forestry were reported to be widely practiced in these territories or expected to increase in importance.

When it comes to participation in forest policy and management, our study showed that this plays a role in all twelve territories, but in different legal settings, mandatory to voluntary, with different societal groups involved such as professional stakeholders to the general public, and with different purposes such as policy co-design to ex-ante or ex-post conflict resolution. How participation was included in forest policy and management in practice varied across political and cultural contexts. For example, in Sweden and Switzerland, the general political and administrative culture emphasised collaborative decision making and participation, whereas in France, Germany and Poland, experts instead described the prevalence of a state forestry culture which underlines the importance of professional expertise and expert decision making. Assessments of implementing institutional requirements for participation also depend on stakeholder perspectives. Private woodland owners, for instance, might perceive the participation of other groups, such as ENGOs, in decisions regarding their land as problematic. How well-established participation schemes are perceived to be, and how their performance can be assessed, depends strongly on the context and the respective stakeholder interests and perspectives (see Winkel and Sotirov 2011, Johansson 2024).

At higher governance levels, the participation and policy involvement of stakeholders such as forest owners, industry organisations, ENGOs, was more widespread than that of citizens. In all case territories, stakeholders were consulted in forest policymaking processes. Citizen involvement is mostly related to information exchange but is evolving in response to societal pressures and conflicts, frequently related to forest use and conservation issues. Stakeholder involvement is applied 'in prevention' or ex-post to mediate conflicts related to forest management, sometimes in informal ways.

Participation was widely reported to enhance learning amongst forest policymakers as well as stakeholders and society. Yet, learning does not necessarily result in position adjustments or increased consent. This is especially true of professional stakeholder groups who do not easily change their positions but instead might learn through participation how to better advance their interests ('Instrumental learning', see Sabatier 1998).

Finally, the link between stakeholder participation and the integration of nature conservation in forest management is not straightforward and cannot be clearly assessed based on the data presented in this study. One might assume that involving different societal groups and accounting for their different

demands for the same forest area is likely to result in an integrated management approach. Yet, in practice this depends on many factors such as, a) which groups are participating and are most powerful in voicing their interests, b) the position of these groups, whether they are arguing for more integration or more segregation, c) the mutual trust, empathy and willingness of all participating groups to learn, compromise and adapt, d) the respective country's institutions and legal culture, including ownership rights, which affect how forest management is developed and implemented, and e) the political power and land power legacies of participating groups.

While 'balanced' participation of diverse groups might result in integration if some important conditions are met, some researchers indicate that policy-level participation is partially occurring in sectoral silos, e.g., conservation actors are strong participants in biodiversity policy but weak in forest policy, vice versa for forestry actors. This might result in significantly different policy objectives and instruments between sectors, and associated conflicts and challenges involving the application of both integration and segregation approaches, which could translate into conflicts at the practical forest management level. The participation of different interest groups can lead to increased polarisation if there are differing views regarding who is entitled to participate, and which knowledge claims are valid (Angelstam *et al.* 2023).

## CAVEATS AND LIMITATIONS

This paper connects natural and social science methods and data. This ambition resulted in limitations related to, a) the natural, b) social science methodology, and c) the linking of the respective findings. Specifically:

- We used felling as a percentage of net annual increment for each country as a proxy for harvesting intensity. For simplicity, we focus on this major factor that has a large impact on the ability to integrate nature conservation at the stand level. We accept that other forest management interventions or methods, e.g., tending and thinning intervals, use of foreign tree species in monocultures, harvesting method, whole tree harvesting versus bole-only harvesting, mean size and distribution of harvested area, deadwood volume, could offer additional information relating to (de-)intensification to assess the share of 'segregation' relating to nature conservation. This assumes that in classes 1.4, 2, and Natura 2000 areas, while certainly contributing to forest nature conservation, the integration of management goals other than nature conservation is allowed and regularly practiced, and that these areas are therefore not well suited to assessing a possible increase in segregation.
- Several experts, backed up by literature, noted that actual fellings differ from formal statistics, with actual fellings usually being higher than what is reported. This undermines forest use intensity approximations;

hence we stress the need for reliable and harmonised statistics for future research. In cases where such doubts were specified, in Romania and Bulgaria, we stress reservations in the results presented.

For both parts of the results and the link between them, a specific challenge relates to the inevitable involvement of personal perceptions and biases stemming from expert assessments. There is no objective way to estimate the future of forest management. However, contributing researchers were asked to formulate expectations for the next decade, which is only a short time with regard to changes in forest management. Furthermore, by ensuring that scientists from two distinct disciplinary perspectives, forest management/conservation and social science, collaborated when delivering the country information, we aimed to reduce disciplinary biases. This gives us confidence that researchers' congruent expectations are reflective of real patterns, e.g., an increase in the harvest of biomass from managed forests in several territories, and a stable or slight increase in the strictly protected areas across Europe.

Finally, it was challenging to assess factors that go beyond the simple description of the institutional framework for participation in forest policy and management, e.g., the influence of specific stakeholders in participatory forest policy and planning processes and, importantly, the impact of the policy framework and participation on forest management. First, there is currently no systematic research evidence available that assesses such questions across territories; expert estimations had to be grounded on existing case study research, exploratory interviews conducted by the contributing authors in the respective territories, and the co-authors' experience/knowledge. Second, exploring interconnections between social and natural sciences, and between territories, inevitably involves simplification. In the absence of systematic comparative research at the European scale, we did not find a better alternative. To address these limitations, a) we made them explicit by transparently indicating how findings were generated, b) we formulate the identified interlinkages as hypotheses, and c) we conclude with a call for further systematic comparative assessments across territories to test and solidify our exploratory findings.

This paper's methodology has been challenging regarding both its scope (multiple territories) and ambition (linking natural and social sciences). Important experiential learning took place for the advancement of interdisciplinary science, where contributing scientists from different disciplines have envisioned possible methodological connections between natural and social science methodologies. While the limitations addressed above need to be emphasised, we argue that the multi-expert and multi-disciplinary assessment provides evidence of relevance to politically important and topical questions. Combining the available qualitative and quantitative, expert-based data and knowledge is valuable for dealing with complex issues, and can guide both policy deliberations and further systematic interdisciplinary research.

## CONCLUSIONS AND FUTHER RESEARCH

Although a certain trend towards intensification and segregation seems likely, further investigations are needed to establish the sensitivity of measures applied to integrate nature conservation into forests managed at an increased harvesting intensity. Further empirical research in the natural sciences is needed to provide an increased understanding of how European forest systems respond to management intensification (Naumov *et al.* 2018) and how set-aside forest areas of different sizes and distributions deliver on the promise of nature conservation (Jonsson *et al.* 2019). Special attention might be given to biodiversity indicators that are immediately influenced by increased harvesting intensities, e.g., amounts and quality of retained green trees and deadwood, set-aside areas and habitat network functionality at the landscape (gamma diversity) level (Felton, *et al.* 2017, Roberge, *et al.* 2018). When seeking to do so, the distribution range of within country variation needs to be taken into account, as harvesting intensities may vary greatly within the same country, and country level indicators do not correlate well with the stand-level biodiversity indicators mentioned above (see Bauhus, *et al.* 2017, Verkerk, *et al.* 2011). Effects might differ for each conservation measure, and they depend on baseline values and local conditions; the implications of a more detailed assessment are beyond our scope (see Angelstam and Manton 2021).

If Europe's forests are to provide an increasing amount of wood while simultaneously conserving forest biodiversity, we subscribe to the need to thoroughly investigate the relationship between fellings and forest related biodiversity. Evidence suggests that a triad approach, a mix of intensively managed forests, set asides and areas managed integratively, in combination with sufficient areas of representative and functionally connected habitat networks may be effective for pursuing both goals simultaneously (Angelstam *et al.* 2020, Betts *et al.* 2021, Côté *et al.* 2010).

Depending on the local situation, several other intensification dimensions interplay with increasing harvesting levels to determine effects on forest biodiversity: notably, harvesting in high conservation forest areas, changes in tree species composition and diversity, drainage, increasing stem density and canopy cover (Felton *et al.* 2020), as well as the spatial distribution of set-asides in the forest landscape and their relative size to the production dominated landscape (Angelstam and Manton 2021). Using the collected data, we conclude that, in the studied territories, the patterns of participation of different groups in forest-related environmental policy and management planning, 1) varied to a high degree, 2) are shaped and impacted by the mix of local, regional, national and European drivers, including policy developments, market demands and historical relations, as well as interactions between them, and 3) are largely unexplored with respect to aspects of stakeholder inclusion and their real impact on the environmental policy development and the implementation of the policies on the ground. In the light of increasing social interest in environmental policy and forest management

planning as well as increasingly diverse societal expectations towards forests, understanding the patterns of societal participation processes is crucial.

Hence, we suggest empirical social science research, possibly systematic cross-country comparative studies involving various stakeholders, to solidify the indicative findings of this paper and ground them beyond an exploratory assessment. This calls for an ambitious research programme at the European level to allow for comparison, benchmarking and learning among social-ecological systems in multiple regions and territories.

Lastly, and probably most importantly, more thoroughly investigating the interface between both ‘worlds’, the level of forest and conservation policy and planning and forest management and nature conservation practices on the ground, is of critical importance. Natural resource management is facing major challenges, with both changing societal demands and a changing environment. Recognising trade-offs, organising dialogues between distinct scientific communities and a diversity of forest interested societal groups, and providing policy and management directions that are based on scientific evidence and societal support, will be crucial. This paper has only explored possible critical interlinkages, which can and need to be tackled by systematic interdisciplinary research looking into policy implementation and its effects. Existing research indicates rather loose connections between participatory policy or management planning and actual management practices (Blondet *et al.* 2017, Winkel and Sotirov 2011), and often surprising and diverse patterns in forest management practices that may in some cases contradict set policy goals (Maier and Winkel 2017, Winter *et al.* 2014). More systematic interdisciplinary research is needed to further understand such patterns, and scientists from different disciplines and forest and conservation practitioners are challenged to continue collaborations and further investigate and understand the interlinkages.

We suggest the following aspects that should be taken into consideration while designing future collaborations between natural and social scientists:

1. Complexity of interactions: Natural systems and social systems are highly complex and interconnected. Understanding and managing these interactions requires interdisciplinary collaboration and an integrated approach. However, it can be challenging to navigate the complexity and identify the relevant factors from both natural and social sciences;
2. Different methodologies and languages: Natural and social sciences often employ different methodologies and approaches to study and analyse phenomena. They also use different terminologies and languages, which can make communication and collaboration between experts from different disciplines difficult. Bridging these gaps and establishing a common ground for understanding and collaboration is a challenge, that should be considered and reflected upon by scholars;
3. Time and resource constraints: Integrative research and management processes that consider both natural and social sciences require significant time, resources, and expertise. Conducting interdisciplinary studies, analysing complex data, and coordinating multiple disciplines can be time-consuming and resource-intensive. A lack of funding, institutional support, and coordination among various stakeholders can impede the integration of natural and social sciences in nature management. Universities, research institutions and grant schemes’ providers should recognise these obstacles and address them by developing institutional support and collaboration tools;
4. Uncertainty and limited data: Natural and social sciences grapple with uncertainties, but the nature of uncertainty can differ. Natural sciences often deal with uncertainties related to ecological processes, while social sciences face uncertainties associated with human behaviour and societal dynamics. Integrating these uncertainties and limited data from both disciplines can be challenging, as it requires developing robust models and decision frameworks that account for the inherent complexity and unpredictability of natural and social systems. Recognising and addressing the challenges as well as opportunities linked to interdisciplinary efforts should enable future policy-makers to make more informed decisions, thereby positively advancing both forest and biodiversity policy in Europe.

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## ANNEX 1.

The list of participating scholars

Country	Social science scholar	Natural science scholar
Austria	Gerhard Weiss	Manfred Lexer
Belgium	Rik De Vreese	Kris Vandekerckhove
Bulgaria	Metodi Sotirov	Tzvetan Zlatanov
Denmark	Bo Jellesmark Thorsen	Palle Madsen*
France	Marieke Blondet	Yoan Paillet
Germany	Georg Winkel	Christian Ammer
Poland	Krzysztof Niedziałkowski	Bogdan Jaroszewicz
Romania	Liviu Nichiforel	Laurențiu Rozyłowicz
Scotland	Anna Lawrence	Victoria Stokes Bill Mason
Spain	Inazio Martinez de Arana	María Calviño-Cancela
Sweden	Ida Wallin Therese Bjärstig Johanna Johansson	Per Angelstam
Switzerland	Tobias Schulz	Thomas Wohlgemuth

\*The scholar asked to not be listed as a co-author of the publication

## ANNEX 2.

An explanation of the steps in an approach developed by the core group of authors that ensured the involvement of each co-author in cross-cutting analysis.

## A. "People" stream:

1. Development of a framework for analysing the role of participation in integrating conservation and production by social science; core team members: Konczal, Dolriis, Winkel and Lawrence (see Annex 3);
2. Development and testing of a semi-structured interview schedule; distribution to co-authors. Iterative review of responses, one-to-one telephone interviews to add depth and understanding. The data collected during the interviews were organised in interview templates (a separate template for each territory). In the next step, the analysis matrix was developed to summarise data and to allow for the detection of the main themes, patterns, and tendencies. The core group members populated the matrix with the data from interview templates. The analysis matrix was shared with the co-authors for checking data accuracy. After cross-checking by the co-authors, the data were analysed in five main blocks: 1. Rules for participation, 2. Policy processes where participation takes place, 3. Stakeholder involvement in participation, 4. Effects of participation, 5. Evaluation of the statements. For 'Rules for participation', the answers were assigned according to the governance level (national, local), the process (e.g., new policy development, public forest management plan), and with regard to participation being legally obliged or voluntary. When participation was mandated by law, the legislation source was indicated. In this section, answers were analysed for both policy planning and management planning, with regard to both forest management and nature conservation. For 'Policy processes where participation takes place', thirteen categories were developed, and for each of them it was described if/how participation took place. Furthermore, nine groups of stakeholders involved in participation were distinguished and their involvement in the participation processes at either national/subnational level and/or a local level was described. Subsequently, the effects of participation were described, distinguishing effects for finding consensus, the integration of nature conservation in forest management, the economic performance of forestry, and learning by foresters vis-a-vis learning by society.
3. Subsequently, the reported findings were for each of the sections qualitatively analysed and reported in the paper which was repeatedly shared and commented/ revised by the co-authors. Findings were also critically compared with the existing literature, and placed within the wider context of participation and nature conservation.

**B. “Nature” stream:**

1. Identification of relevant data on forest ecology and management to describe differences and similarities between the countries;
2. Identification of a suitable proxy for management intensity;
3. Development of a questionnaire (by natural science core team members De Koning, Felton and Larsen) for participating scholars from the ecology/forest management side regarding current characteristics of the integration of nature conservation into forest management, including influencing factors, projections of future development and novel developments affecting or potentially affecting uptake (see Annex 4);
4. Presentation of a summary of results to participating scholars;
5. Iterative revision and elucidation of findings based on scholar’s feedback.

**C. Combined streams:**

1. Subsequent to the analysis performed, additional questions were included in a further analysis, the answers to which provided new insights into the links between participation and biodiversity protections and allowed the identification of still missing links, which were addressed by C2;
2. From these answers, the core group developed three hypotheses describing the relationship between participation and integration. These were circulated to all co-authors and ‘nature’ and ‘people’ experts from each territory were invited to provide a score to each on the Likert scale, and to elaborate on this score;
3. A draft report was prepared with a preliminary interpretation of the relationships between participation and integration, and geographical patterns and trends; this was made available to co-authors for shared comment;
4. A synthesis of comments, was then used for a revision of the report and analysis;
5. The draft of the manuscript was shared with the national focal points of the Integrate Network. The Science-Policy Support approach was applied – meaning authors needed to respond to comments by the Integrate Network, but they were free to change or not change the text depending on the available scientific evidence; additional data regarding mean felling obtained from the national focal points of the Integrate national focal points and Forest Europe national contact points.

The final version of the manuscript was made available to co-authors for comments.

## ANNEX 3.

Guide topics for “people” questionnaire

\*Forest legislation includes acts, decrees, strategies, policy programmes and guidelines

\*\* Secondary data includes statistics, research reports and evaluations

\*\*\* Scholar expertise includes interviews, and fact-checking communications

Context dependent elements	Topic addressed	Type of questions	Options for responses	Data sources
Unit of response	Q1. name of the political-geographic unit for which are you responding?		Choice of nation, or subnational policy level unit (e.g., Land in Germany, devolved nation in UK)	Forest legislation
Rules and requirements for participation at different scales and property rights	Q2. What are the requirements for participation in: ... new policy development ... <b>state</b> FMP (forests owned by state/region) ... other <b>public</b> FMP (local municipality etc.) ... <b>private</b> FMP ... nature-protected forests (etc. Natura2000)	Closed Plus option to comment	<ul style="list-style-type: none"> <li>• mandatory by law</li> <li>• no requirement for participation</li> <li>• required for certification</li> <li>• required for grants / subsidies</li> <li>• required for grants/subsidies AND certification</li> <li>• required when new building/road</li> <li>• required when new building/road AND certification</li> <li>• required for Natura 2000 forest</li> <li>• established but not required practice</li> <li>• local public forests have same requirements as private forests</li> <li>• local government forests have same requirements as state forests</li> <li>• no different requirements – depends on ownership</li> <li>• insufficient information</li> <li>• required by law in particular cases AND required for certification</li> <li>• mandatory by law for public utility forest</li> <li>• mix of legal requirements and voluntary commitments, hard to disentangle</li> </ul>	<ul style="list-style-type: none"> <li>• expert knowledge plus reference to legislation</li> </ul>
Legislative drivers	Q3. What are the main drivers for participation in: ... state FMP ... private FMP ... planning nature-protected areas	Closed	<ul style="list-style-type: none"> <li>• NFP</li> <li>• EU RDP</li> <li>• International – Biodiversity Convention</li> <li>• Forestry Act</li> <li>• Biodiversity Act or Strategy</li> <li>• Certification standard</li> <li>• Land Use Planning</li> <li>• none</li> <li>• environmental impact assessment legislation</li> <li>• insufficient information</li> </ul>	expert knowledge plus reference to legislation

Context dependent elements	Topic addressed	Type of questions	Options for responses	Data sources
Participatory processes used	<p>Q4. What kinds of processes are used for participation in the following:</p> <ul style="list-style-type: none"> <li>• National/regional forest policies and programmes</li> <li>• Biodiversity policy (strategy/nature conservation act)</li> <li>• Agricultural/rural development programme, subsidies, grants</li> <li>• Certification standard</li> <li>• Citizen engagement/ citizen science</li> <li>• Public education (walks, talks)</li> <li>• Forest owners partnerships (between forest owners only)</li> <li>• Stakeholder partnerships, roundtables</li> <li>• community-landowner partnerships</li> <li>• Land reform (change of forest ownership/ change of land status)</li> <li>• Conflict resolution between stakeholders</li> </ul>	Open	<p>Co-authors were invited to consult with other experts to access relevant legislation, reports and data</p> <p>Co-authors were invited to provide information on whether such processes were mandated by law or arose on a voluntary, case-by-case basis</p>	<p>Relevant legislation</p> <p>Secondary data analysis</p> <p>Expert expertise***</p>
Stakeholders involved in participation	<p>Q5. Which stakeholders are involved at:</p> <ul style="list-style-type: none"> <li>• national</li> <li>• local</li> </ul> <p>level and how important are they?</p>	Closed	<p>Stakeholders:</p> <ul style="list-style-type: none"> <li>• Private forest owners</li> <li>• Forest managers</li> <li>• Forest industry</li> <li>• Environmental NGOs</li> <li>• Other civil society groups</li> <li>• Local communities</li> <li>• General public</li> <li>• Public administration / governmental authorities /policy makers</li> <li>• Science/ academia/ research</li> </ul> <p>Coded for N (national), L (local)</p> <p>Scored as:</p> <p>1= no or very little influence</p> <p>2=minor influence</p> <p>3=moderate influence</p> <p>4=strong influence</p>	<p>Expert expertise, consultation with colleagues, and open commentary to illustrate regional differences</p>
Effects of participation	<ul style="list-style-type: none"> <li>• Improved consensus</li> <li>• Integration of nature conservation in forest management</li> <li>• Economic performance of forestry</li> <li>• Learning by forest (policy and management) experts</li> <li>• Learning in society/amongst stakeholders</li> </ul>	Open	<p>Co-authors were invited to provide examples and case studies</p>	<p>Researcher knowledge of specific examples</p> <p>Access to secondary data e.g., evaluation reports</p>

Context dependent elements	Topic addressed	Type of questions	Options for responses	Data sources
Attitudes to participation	Agreement / disagreement on a Likert scale with the following statements: <ul style="list-style-type: none"> <li>• participation in forest planning is limited to stakeholder consultation</li> <li>• participation is required in public forest planning but not in private forest planning</li> <li>• participation is required in private forest planning but not in public forest planning</li> <li>• participation is not considered desirable because ordinary people don't know about forestry</li> <li>• after consulting the planners go ahead and do what they originally intended</li> <li>• participation is only useful when there is a conflict that needs to be resolved</li> <li>• participation is expensive but it has improved forest planning</li> <li>• in this region, we see quite a lot of examples where statutory requirements for consultation turn into more innovative partnerships or roundtables for joint decision-making</li> <li>• the most useful examples of participation are led from the grassroots- where local communities insist on having a say in forest management</li> <li>• citizen science has led to genuine participation in forest decision-making</li> </ul>			

## ANNEX 4.

Guide topics for “nature” questionnaire  
Questionnaire shared with forest management experts

The main purpose is to assess how measures to integrate nature conservation in managed forests are practiced across Europe. The paper takes the approach that scientists engage in responding to these questions, but that the “Integrate countries” (member countries of the European Network Integrate, LINK) support the initiative by sharing feedback on the draft manuscript. Scientists remain however free to add their own ideas and issues they are questioning in relation to the topic. The selected 12 countries aim to cover Europe in its biogeographical extend.

Question 1: What is the percentage of forest cover in your country?

Question 2: What percentage of current forest area is strictly protected (set aside) primarily for nature conservation?

Question 3: What percentage of current forest area is protected under the Natura 2000 network?

Question 4: What percentage of current forest area is used primarily for wood production?

Question 5: How are the terms “integration” versus “segregation” (in relation to conservation actions) defined in your country, and which do you think is the dominant paradigm in relation to nature conservation in forests and production?

Question 6: What is the projected direction of change for protected forest areas (decrease, stable, increase) and the intensity of production forestry (decrease, stable, increase) over the coming 20 years?

Question 7: What is the intensity of management in the production forests (proportion of semi-natural to plantation and is this proportion under change)?

Question 8: Is there any link between the intensity of production and requirements for conservation actions? E.g., if the intensity of production is higher, are additional compensatory actions for nature conservation required?

Question 9: List the conservation concessions made in production forests (e.g., retention trees/patches, dead wood provision, natural regeneration, species mixtures, cutting regime/size of clear-cuts, restoration of natural hydrology, creating buffer zones, forest glades and edges? Please provide amounts if possible and add others if not listed here.

Question 10: Are there other measures and tools in your country developed and used to address nature conservation concerns in forests?

Question 11: Are any “new” silvicultural approach projected/introduced addressing biodiversity in production forests in a more general way (e.g., Close to nature forest management, Continuous Cover Forestry, Retention Forestry, Reduced Impact Logging, Mimicking Natural Disturbance, etc.), and if so how wide are these approached implemented in your country (public land, private forests).

Question 12: Are the climate change mitigation/adaptation approaches currently being advocated/applied in production forests consistent with or in contrast to goals for nature conservation in forests? Please explain your answer.