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► To cite this version:

Liviu Nichiforel, Philippe Deuffic, Bo Jellesmark Thorsen, Gerhard Weiss, Teppo Hujala, et al.. Two decades of forest-related legislation changes in European countries analysed from a property rights perspective. *Forest Policy and Economics*, 2020, 115, pp.102146. 10.1016/j.forpol.2020.102146 . hal-02545533

HAL Id: hal-02545533

<https://hal.inrae.fr/hal-02545533>

Submitted on 17 Apr 2020

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1 Version auteur publiée dans

2 Nichiforel L. ; Deuffic P. ; et al. (2020) Two decades of forest-related legislation changes in
3 European countries analysed from a property rights perspective. *Forest Policy and Economics*, vol.
4 115, p. 102146.

5 <https://doi.org/10.1016/j.forpol.2020.102146>

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7 **Two decades of forest-related legislation changes in European** 8 **countries analysed from a property rights perspective**

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56 **Acknowledgements**

57 The study was conducted in the framework of the FP1201 FACESMAP COST Action (Forest Land Ownership Change
58 in Europe: Significance for Management and Policy) which is supported by the EU Framework Programme Horizon
59 2020. BJT acknowledges the support of the Danish National Research Foundation for the Centre for Macroecology,
60 Evolution and Climate (DNRF96). MH and VJ were supported by NAZV (QK1820041) and grant EVA4.0, No.
61 CZ.02.1.01/0.0/0.0/16_019/0000803 financed by OPRDE. ZS and ZD have been supported by the Slovak Research and
62 Development Agency under the contract no. APVV-15-0715. JN and DN were supported by the Ministry of Education,
63 Science and Technological Development of the Republic of Serbia. DF acknowledges to Rosario Alves (FORESTIS).
64 SKO acknowledges the Croatian Union of Private Forest Owners' Associations. TS acknowledges Mr. Oikonomou,
65 president of the Greek Private Owners' Association.

66

67 **Abstract**

68 In the last two decades, attention on forests and ownership rights has increased in different domains of international
69 policy, particularly in relation to achieving the global sustainable development goals. This paper looks at the changes in
70 forest-specific legislation applicable to regular productive forests, across 28 European countries. We compare the legal
71 framework applicable in the mid-1990s with that applicable in 2015, using the Property Rights Index in Forestry (PRIF)
72 to measure changes across time and space. The paper shows that forest owners in most western European countries
73 already had high decision-making power in the mid-1990s, following deregulation trends from the 1980s; and for the
74 next two decades, distribution of rights remained largely stable. For these countries, the content and direction of
75 changes indicate that the main pressure on forest-focused legislation comes from environmental discourses (e.g.
76 biodiversity and climate change policies). In contrast, former socialist countries in the mid-1990s gave lower decision-
77 making powers to forest owners than in any of the Western Europe countries; over the next 20 years these show
78 remarkable changes in management, exclusion and withdrawal rights. Nevertheless, with the exception of Baltic
79 countries which have moved towards the western forest governance system, most of the former socialist countries still
80 maintain a state-centred approach in private forest management. Despite this diverse setting of property rights, there is
81 no longer a clear line between western and former socialist countries with respect to the national governance systems
82 used to address private forest ownership. Overall, most of the changes we identified in the last two decades across
83 Europe were recorded in the categories of management rights and exclusion rights. These changes reflect the general
84 trend in European forest policies to expand and reinforce the landowners' individual rights, while preserving minimal
85 rights for other categories of forest users; and to make use of financial instruments when targeting policy goals related
86 to the environmental discourse.

87 **Keywords**

88 Forest governance; Institutional changes; Property rights; PRIF; Private ownership.

89

90 **Highlights**

91 - Changes in forest legislation in the last two decades are assessed using the property rights index.

92 - Important changes were recorded in the categories of management rights and exclusion rights.

- 93 - Western Europe has maintained the high level of owners' rights that already existed in mid-1990s.
- 94 - Baltic countries have followed the deregulation trend in private forest governance.
- 95 - Most former-socialist countries still rely on a highly restrictive regulatory framework.

96

97

99 Over the last two decades, the emerging political agendas of biodiversity conservation, climate change and
100 bio-economy has increased political attention on sustainable forest management (Winkel, 2017). During the
101 same period, European forest policy was challenged by forest ownership changes, which are the result of
102 the changes in lifestyle, attitudes and behaviours of forest owners, the forest land restitution in Eastern
103 Europe, the support for afforestation, and the incidence of new forms of ownership (Weiss et al., 2019a). As
104 a result, a complex system of political, social and scientific interactions from inside and outside of the forest
105 sector is increasingly influencing forest policies (Klapwijk et al., 2018). This is reflected in country specific
106 governance frameworks, with different combinations of mandatory or voluntary, public or private policy
107 instruments (Nichiforel and Hujala, 2020; Pülzl et al., 2013).

108 Considering that more than 60% of European forests are privately owned (UNECE, 2020), property rights
109 arrangements are critical institutions defining the relations between the private forest owners (PFO), forest
110 managers, resource users and forest authorities (Siry et al., 2015). Property rights refer to particular actions
111 authorised by specific operational rules (Schlager and Ostrom, 1992). The “de jure” property rights are
112 guaranteed and implemented by the state. They are reflected in national or regional regulatory frameworks
113 defining what a forest owner may or may not do in relation to her/his forest. While some property rights are
114 defined directly in the text of laws, some other „operational rules” with impact on the exercise of the property
115 rights are defined at the level of different other regulative acts, such as Ministerial resolutions or
116 administrative decisions/guidelines. In the European context, the forest-focused regulations impacting on the
117 de jure distribution of PFOs rights include forest codes, forest acts, forest-related acts, technical
118 prescriptions, and operational guidelines (Pülzl et al., 2013).

119 Even though the form of forest ownership (Schmithüsen and Hirsch, 2010) and the relevance of property
120 rights in forest management (Glück, 2002) are given high importance in the literature, there is little
121 analytically derived empirical knowledge on the differences in property rights across countries and how these
122 differences evolved over time (Weiss et al., 2019b). To address this issue, Nichiforel et al. (2018) developed
123 the Property Rights Index in Forestry (PRIF) as an analytical tool to measure property rights distribution
124 among private forest owners across Europe. The PRIF provides a structured overview of the power of
125 decision-making that forest owners have across a variety of national or regional legal contexts. The PRIF
126 index makes possible the characterisation of “de jure” property rights, in a specific jurisdiction at a certain
127 point in time (Nichiforel et al., 2018). This paper adds to this emerging research agenda by documenting and
128 analysing the trends of change in the PRIF across Europe. This is achieved by comparing the legal
129 provisions that applied in the mid-1990s with those that applied in the year 2015. This allows the systematic
130 identification of the property rights changes in a time frame of two decades and provides a sound method to
131 highlight and discuss the geographical patterns of changes.

132 The design of the institutional framework that governs the forest production system is subject to changes and
133 influences by stakeholders. The actors in the forest production system are guided by the “rules of the game”
134 (North, 1990), which are created in time and space by the interaction between “rule makers” and “rule takers”
135 (Möllering, 2007). This means that the actors of the system can expend different efforts in order to modify or
136 preserve the structure of the property rights according to their interest (Nichiforel and Schanz, 2011). This is
137 reflected in examples such as lobbying policy makers and legislators by PFOs in some former socialist
138 countries with a view to increasing their management and withdrawal rights (Bouriaud et al., 2013) or the
139 political efforts made by PFOs in some western countries to defend the current structure of rights against
140 demands for forest conservation (McCauley, 2008). Thus, property rights arrangements are created,
141 maintained or redistributed as an outcome of the interactions between stakeholders who resist or propose
142 changes that benefit themselves, as well as law makers, who receive political benefits from making rules
143 (Ostrom and Hess, 2008; Sikor et al., 2017). The property rights allocation pertaining to forest ownership is
144 therefore part of a continuous socio-political negotiation process, involving the PFOs and other stakeholders
145 under the specific authority structure of the state (Vatn, 2001).

146 The diversity of pressures and challenges faced by the forest sector may require institutional adaptation in
147 order to direct PFOs’ management towards desired policy outcomes. However, stable property rights are an
148 important prerequisite for enhancing entrepreneurship in the forest sector (Bouriaud et al., 2011), to increase
149 the adaptive capacity required to respond to natural disturbances (Coleman, 2011) and to implement
150 successful payment schemes designed to promote forest conservation (Larson et al., 2013). Thus, there is a
151 dilemma of governance with respect to the role of the state in assigning property rights. On one hand, the

152 state can use its authority to assure the stability of the property rights system and thus maintain a firm
153 institutional environment. On the other hand, the state can also exercise its authority to revise the content of
154 the property rights so as to comply with international norms, initiatives and agreements or to create
155 opportunities to enhance the social welfare and resolve social conflicts.

156 For example, in Western European countries, changes seem to comprise at least two opposing trends. First,
157 the de-regulatory discourse during the 1980s challenged the efficiency of the existing top-down regulation
158 system and resulted in a liberalisation trend in forest legislation promoting self-regulation and voluntary
159 policy instruments (Arts et al., 2010; Pülzl et al., 2014). Since the early 1990s, this led to an increased role of
160 Corporate Social Responsibility in the forest sector (Toppinen et al., 2012) and of various voluntary
161 certification systems, standards, and guidelines operating at different points across the supply chain to
162 address the sustainability of biomass utilization (Stupak et al., 2011). Second, the implementation of
163 environmental/nature conservation legislation such as the European Natura 2000 policy resulted in
164 increasing restrictions (Sotirov et al., 2017; Weiss et al., 2019a) which have been frequently questioned by
165 PFO associations who opposed the changes in property rights (Alphandéry and Fortier, 2001; Primmer et al.,
166 2014). At the same time, following the fall of the socialist bloc during the 1990s, significant changes to forest
167 legislation were made in the former socialist European countries (Weiland, 2010; Weimer et al., 1997).
168 Developments in those countries, however, are not homogeneous (Bouriaud and Schmithüsen, 2005). For
169 example, this is illustrated by the difference in the manner in which the process of forest restitution in the
170 Czech Republic and the Slovak Republic was carried out despite their common background: i.e. the two
171 states that for a long time formed a single state (Jarský et al., 2018). The changes in the forest ownership
172 structure in former socialist countries were associated with different patterns of changes in regulation of
173 private forest management (Bouriaud et al., 2013; Brukas et al., 2013).

174 In general, the changes in the European legal framework in forest sector have been studied by the research
175 community (e.g. Winkel and Sotirov, 2016). However, the use of PRIF for comparative legal assessments
176 provides a homogenous and unitary methodology for the quantitative analysis of legal changes. By
177 comparing the PRIF and its components at two points in time we are able to identify how the changes in the
178 forest-specific legislation influenced the distribution of the property rights, and which are the spatio-temporal
179 differences among European jurisdictions.

180 The next section introduces the methods used for the calculation of the PRIF at two points in time. In the
181 results section, we first give an overview on the relevant legislative changes (covering the period 1990-
182 2015), followed by the analysis of their impact on the property rights (comparing the changes of the PRIF
183 between mid-1990s and 2015). Finally, the results are discussed and the concluding section highlights the
184 key points of this assessment.

185 **2. Methods**

186 The cross-country analysis of the identification of property rights changes uses the PRIF methodology as
187 presented in Nichiforel et al (2018). The PRIF is based on 37 indicators (table A1-appendix) grouped into five
188 property rights categories associated with forest production: access, withdrawal, management, exclusion and
189 alienation (Schlager and Ostrom, 1992). The indicators were designed to assess the rigour of the legal
190 framework and the scope for freedom of decision-making attributed to forest owners. Thus, the indicators are
191 assessed based on the rule of law (*de jure* situation) and do not consider perceptions regarding their
192 practical implementation (*de facto* situation).

193 The study was conducted by use of a questionnaire sent to national experts in forest policy who had
194 participated in the COST Action FP 1201 FACESMAP or were selected based on their scientific contribution
195 in the field of forest policy analysis. Data collection took place in 2015-2017 and consisted of two main parts.

196 Firstly, the national experts were asked to document the legislative changes in the period between 1990 and
197 2015. The calculation of PRIF and the identification of property rights changes focuses on “regular
198 productive forests”. Thus, legal provisions referring to forests in protected areas (e.g. Natura 2000 sites) or
199 forests that are subject to plant health or quarantine measures, are not included in the analysis. All of the
200 other forest-relevant legislative policy areas that can impact a PFOs’ scope of decision making were
201 considered. After an initial exploration of policy tools affecting the five property rights categories, three types
202 of legal acts emerged: 1. Forest laws (sometimes named Forest Codes, Forest Acts), 2. Hunting laws and 3.
203 Land use laws (figure 1). We documented the changes that affect forest owners which occurred to these
204 legal acts in the period 1990-2015 for each country. The legal changes were classified either as major

205 changes (a law revision representing a change that affected the constitutional level of rules) or as minor
206 changes (an amendment to the law affecting mostly the operational-level of rules). The sequence of these
207 changes provided the legal background that is used to assess the indicators which are in turn used to
208 identify the changes to property rights.

209 Secondly, the questionnaire asked for an expert assessment of the 37 indicators based on the rules of law
210 applicable to private forests at two distinct points in time:

- 211 - The “mid-1990s legislation” refers to the legislation applicable in the period 1993-1999, which was
212 chosen as a reference, because the former socialist countries in Europe underwent important
213 institutional changes during this time. Almost all of the countries included in the analysis have as a
214 reference point the end of 1999, with the exception of Slovenia (reference year 1993), Czech
215 Republic (reference year 1996), Poland (reference year 1997) and Estonia (reference year 1998).
- 216 - The “current legislation” refers to the status of applicable legislation on the 1st of October 2015, as
217 detailed in the data collection protocol.

218 The assessment of the indicators was based on the qualitative questionnaire that was distributed to the
219 experts, with each question representing an individual indicator. The role of the national experts was to
220 identify the legal provisions applicable for each indicator in their jurisdiction, for each of the two points in
221 time. Three situations were identified in relation to changes to the laws and the changes to PRIF indicators:

- 222 - the changes to the legal acts resulted in changes to the indicators; in this case, a description and
223 interpretation of the situation in both timeframes was provided to gauge the alterations to the
224 restrictions imposed on PFO.
- 225 - an indicator had more than one change in the time frame from mid-1990s to 2015; in such cases all
226 the changes are discussed, but only the legal provisions corresponding to the two points in time are
227 used for the PRIF calculation.
- 228 - the changes in the legal acts did not result in changes to the indicators; thus, the legal changes did
229 not impact on PRIF calculation.

230 The methodological foundation of PRIF (Nichiforel, et al, 2018) presents the steps used for data processing,
231 data weighting and the aggregation of indicators in the calculation of PRIF (Appendix A2). According to the
232 PRIF methodology, each indicator contained a set of predefined alternatives. The identification of the
233 predefined alternatives was carried out on the basis of the legal texts in the “current” 2015 legislation. This
234 set of alternatives proved to be applicable also for the “mid 1990s legislation”, which allowed the calculation
235 of PRIF and its sub-components, in the two time frames, using the same initial methodology. For the
236 predefined alternatives, under each indicator, the scale for assessing the rigour of the law ranged from 0 –
237 meaning “the right is fully restricted” to 100 meaning “no legal restrictions are imposed”, with intermediary
238 values being possible. The scale is designed so as to approach the property rights from the perspective of
239 PFOs. Thus, a change to an indicator that brings more restrictions to PFO freedoms results in a decrease in
240 the value assigned for that indicator.

241 The PRIF is calculated as the mean of the values for each indicator for the set of 37 indicators. The value of
242 the index can range from 0 – when full restrictions apply for all the indicators to 100 – when owners have a
243 full degree of freedom for all the indicators. For example, the assessment of the legislation applicable in
244 2015 resulted in PRIF ranging from 38.4 in FYR Macedonia to 84.7 in the Netherlands, implying considerably
245 greater freedom for the forest owner in the Netherlands (Nichiforel et al., 2018).

246 We have analysed the property rights changes on a European scale comparison based on the data provided
247 by 28 countries (abbreviations of the jurisdictions are identified using the ISO 3166). In five countries the
248 legal framework was analysed considering the jurisdiction at the regional level: Wallonia – Belgium (BE-
249 WAL), Bavaria – Germany (DE-BY), Aargau – Switzerland (CH-AG), Scotland – United Kingdom (GB-SCT)
250 and Catalonia –Spain (ES-CAT). For Austria, the hunting legislation was analysed at the level of Styria. In
251 terms of geographical distribution, the countries analysed cover all the regions identified by the Forest
252 Europe (2015) group of countries (figure 1): North-Europe (NE), Central-West Europe (CWE), Central-East
253 Europe (CEE), South West Europe (SWE) and South East Europe (SEE). Amongst the countries analysed,
254 13 of them have a former socialist political background while 15 are categorised as having a “western”
255 political background. In the display of the results, the North-Europe is divided between “western” Nordic
256 countries (NWE) and former socialist Baltic states (NEE).

257 3. Forest relevant legislative changes

258 3.1. Changes to forest-related legislation

259 In a timeframe of 26 years (1990-2015), the legal acts regulating forest management were adapted in the
260 majority of the countries analysed (Figure 1). In the decade 1990-1999, 16 new forest acts entered into
261 force, 11 of which were issued in former socialist countries. The years where most of changes occurred in
262 this decade are 1993 (four new acts) and 1996 (three new acts). In the next decade (2000-2009) 12 new
263 forest acts entered into force out of which seven in former socialist countries and five in western countries.
264 The last six years of the analysis included four new acts, all of them elaborated in former socialist countries.

265 We generally can distinguish between three patterns:

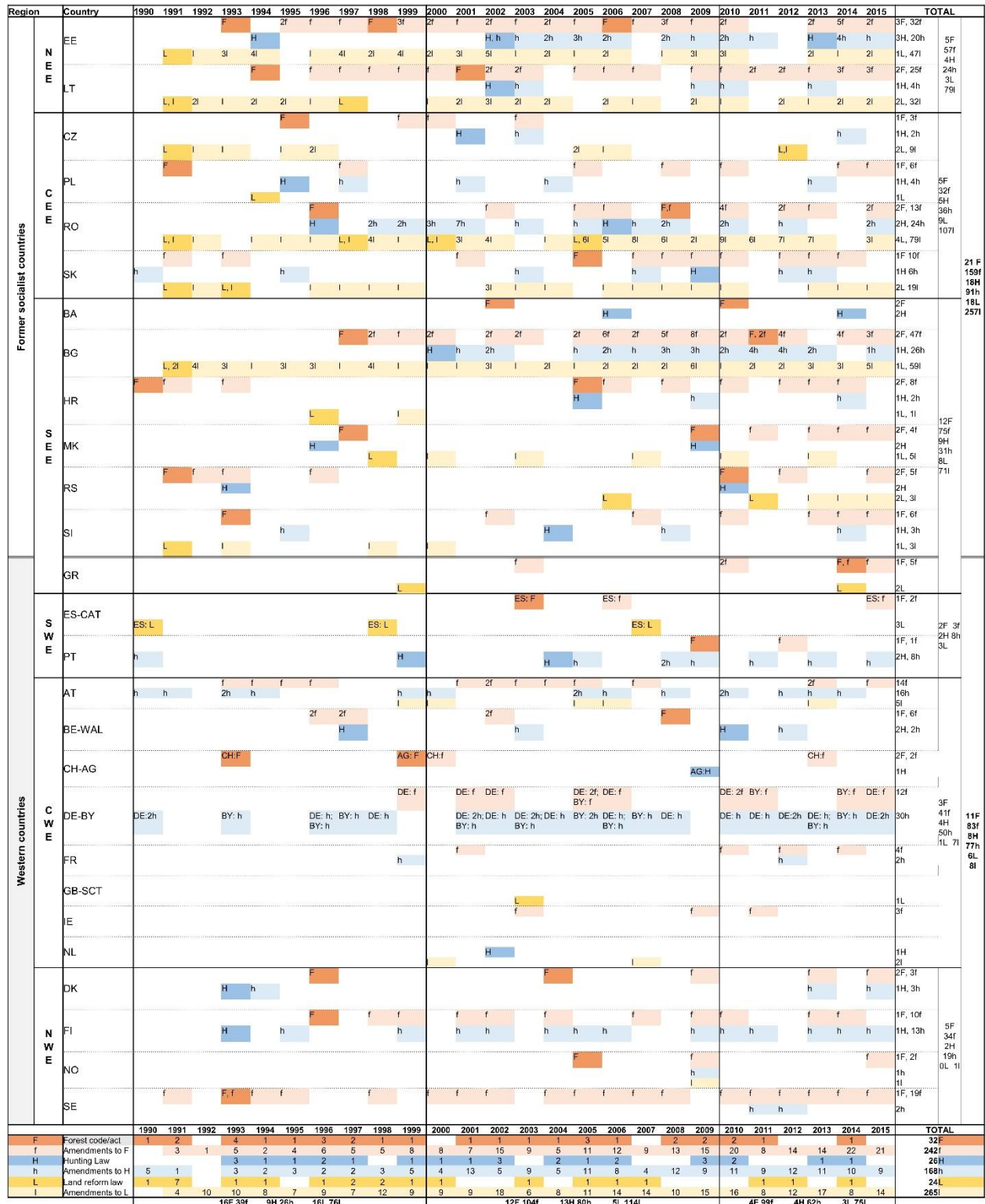
- 266 i) countries who kept to a minimum the number of changes to forest-related legislation and thus no
267 new forest act was legally endorsed in the period analysed: Austria (AT), France (FR), Greece
268 (GR), Germany (DE), Ireland (IE), Netherlands (NL) and the United Kingdom (GB);
- 269 ii) countries that legislated only one new forest act in the time span analysed: Belgium (BE), Czech
270 Republic (CZ), Finland (FI), Norway (NO), Poland (PL), Portugal (PT), Slovenia (SI), Slovakia
271 (SK), Spain (ES), Switzerland (CH) and Sweden (SE);
- 272 iii) countries that legislated at least two new forest acts between 1990 and 2015: Bosnia-
273 Herzegovina (BA), Bulgaria (BG), Croatia (HR), Denmark (DK), Estonia (EE), Hungary (HU),
274 Lithuania (LT), Macedonia (MK), Romania (RO) and Serbia (RS).

275 The first group of countries, characterized by limited changes in the forest-related legislation, are mainly from
276 CWE. In the Netherlands, the Forestry Act (originating from 1961) has not changed for decades and in the
277 period analysed only minor administrative changes occurred. A similar situation is found in the UK (Scotland)
278 where no amendments affecting property rights have been made to the Forest Act. In Ireland, several minor
279 amendments were made to the 1946 Forestry Act, which were not really of concern to PFOs, except a
280 change from 2001 involving indicators regarding forest lands selling and what price the owner can get. In
281 Austria, despite the fact that the Forest Act (originating from 1975) was amended 13 times, only the 2002
282 amendment had an impact on PFOs property rights. For German Federal Law (originating from 1975) and
283 Bavarian Forest Law (originating from 1974) only in 2005 did some provisions of Germany's nature
284 protection regulations have an impact on the PRIF. In France, there was a significant revision to the French
285 forest code (originating from 1827) in 2001 (introduction of the notion of multi-functionality), but no real
286 impact to PFO's rights occurred. In 2010 alone, an important amendment was added to the forest code that
287 influenced the matter of requirements for forest management plans (FMP). Additional to the CWE group of
288 countries, in Greece two legal acts from 2014 amended the Forestry Law from 1979, validating and
289 supplementing a series of scattered legislative provisions in respect of the definition of forests and utilisation
290 of forest lands.

291 In the second group of countries, that legislated one new forest act in the timeframe analysed, both the
292 geographical distribution and the former socio-political background is diverse. In Portugal, the Forest Code
293 from 1996 defined the basis for the national forest policy. A legal change with impact in PRIF occurred in
294 2009 with a Law-decree which approved forest management and forest intervention plans foreseen in the
295 Forest Code of 1996. In Spain, the autonomous communities received the right to rule on natural resource
296 management during the 1980s (including forests and hunting). The Spanish Forest Act of 2003 put in place a
297 common framework for all regional laws. Catalonia introduced pioneering forest legislation in 1988, and the
298 subsequent new Spanish Forest Act (2003) and its amendments (2006, 2015) which apply to whole of Spain
299 were already implemented in Catalonia. Consequently, while the forest law formally changed in Spain, it had
300 no impact in changing PFOs property rights in Catalonia though it had in other Spanish regions. In
301 Switzerland, a Federal Act on Forests entered into force in 1993 setting out the principles to be implemented
302 by cantonal forest legislation. For the Aargau canton, a new Forest Law entered into force in 1999 and was
303 amended in 2013 but the changes had no impact on the indicators used for this assessment. In Belgium, the
304 Forest Code (originating from 1854), has been replaced in 2008 with a new Forest Code applicable in the
305 Walloon region. Additionally, a specific law regarding the protection of forests belonging to PFOs has been in
306 force in Belgium since 2008, impacting on the management rights of PFOs.

307 Among the Nordic countries, the Norwegian Forest Act (originally enacted in 1932) was replaced in 2005
308 with a new Forestry Act but kept the similar level of PFOs rights. On the contrary, in the analysed period
309 Sweden and Finland had important changes with respect to the legal acts regulating the activity of PFOs. In

310 Sweden, a major change occurred in 1993, with the introduction of the “freedom with responsibility” principle
 311 in the text of the Forest Act but since then, the amendments made to the law had no impact on PFOs rights.
 312 In 1996, Finland introduced a major update to the Forest Act, by introducing biodiversity protection explicitly
 313 in regulatory statutes. However, a noteworthy change took place in 2014 when a major update to the forest
 314 legislation bestowed more freedom upon forest owners with relation to decision making in forest
 315 management.



316 **Figure 1: Timeline evolution of changes occurring in the forest-related legal acts.** Enactment year of a new Forest
 317 Act/Forest Code is identified with „F“ (dark orange), for a new Hunting Law with „H“ (dark blue) and for a new Land Use
 318 Act with „L“ (intense yellow). Amendments to these laws, that represent changes to the content of the law, are identified
 319 with equivalent small letter: „f“ (soft orange), „h“ (light blue) and „l“ (light yellow)“. The numbers before the letters
 320 represent the quantification of the number of changes in a specific year and for the total per country and groups of
 321 countries. (Source: compiled by the authors)
 322

324 Poland (1991), Slovenia (1993), Czech Republic (1996) and Slovakia (2005) are the former socialist
 325 countries that legislated for only one new forest law designed to cope with the new challenges of the
 326 transition from a centrally-planned to a market economy. In Poland, no change occurred to the forest
 327 ownership patterns after the change from the socialist system, thus fewer rules were introduced envisaging
 328 PFOs. Czech Republic and Slovakia included, in their revisions of the Forest Code, specific regulations for
 329 the newly established private forests.

330 The third group of countries, characterised by at least two new Forest Acts in the period analysed, is
 331 represented mostly by the former socialist countries, thus illustrating the process of institutional adaptation in
 332 these countries, needed to assure the transition to a market economy. In general, the former socialist
 333 countries adopted one new forest act at the beginning of the transition period and the second after a number
 334 of years (e.g. Serbia in 1991 and 2010, Croatia in 1990 and 2005, Lithuania in 1994 and 2003, Romania in
 335 1996 and 2008, Hungary in 1996 and 2013, Bulgaria in 1997 and 2011, FYR Macedonia in 1997 and 2009).
 336 In these countries, the laws issued in the beginning of the transition period are the reference point for the
 337 analysis of the “mid-1990s” legislation. Estonia records the highest number of changes to its forest laws, with
 338 three versions of the Forest law being issued in 1993, 1998 and 2006. In the Estonian case, the analysis for
 339 the “mid-1990s” period refers to the legislation applicable in 1993-1998, while the “current legislation” is the
 340 outcome of changes to the forest law from 2006. The legal changes in former socialist countries resulted in
 341 changes for all of the five property rights categories. The patterns of changes are not homogeneous (as
 342 detailed in section 4). Denmark with two new Forest Acts (in 1996 and 2004) was the only western country in
 343 this group. However, for forests outside nature protection areas, legal changes recorded in Denmark did not
 344 result in a major impact on the ability of a PFO to exercise their private property rights.

345 **3.2. Changes to hunting legislation**

346 Changes to the hunting laws were in general less frequent when compared to forest-focused legislation i.e.
 347 in 18 out of 28 countries included in the analysis hunting laws were enforced from 1990 to 2015 (Figure 1).
 348 Similar differences were observed between western and former socialist countries as in the case of
 349 legislation that focuses on forests. Most of the western countries had only amendments to the existing
 350 hunting laws. For example, there was no change to hunting legislation affecting landowner’s decisions in
 351 Catalonia since 1970. On the contrary, in Austria, patterns of changes to the hunting legislation are diverse
 352 at the regional level, some regions having issued new hunting laws while others only made amendments to
 353 existing laws. In France, a very important amendment occurred in 1999 and was confirmed by the European
 354 Court of Human Rights. According to this amendment, a PFO can prohibit access to hunters for ethical
 355 reasons. A decision of the same court led to a similar amendment to German Hunting Law. In the
 356 Netherlands, the Hunting Law (originally from 1954), became part of the Flora and Fauna Act in 2002 (i.e. no
 357 specific hunting law since 2002); yet, the hunting rights remained with the forest owners, but stricter rules
 358 were observed. In Portugal, the 1999 Law regulated hunting practices but had no impact on PFOs rights.

359 All the former socialist countries, except Romania and Estonia, have issued one new hunting law in the
 360 period analysed. Romania passed two hunting laws, one in 1996 and one in 2006. Estonia passed three new
 361 hunting laws (1994, 2002, 2013) and numerous amendments to regulate hunting activities.

362 **3.3. Land reform laws**

363 Land reform laws constitute major legal changes especially in the context of former socialist countries. These
 364 laws are highly relevant to our analysis because they significantly impacted the ownership patterns.

365 Former socialist countries had different approaches to forest land restitution (i.e. giving nationalised forest
 366 lands to owners) (table A3 –appendix). In Poland, the land reform took place in 1994, but the forest land was
 367 not returned to the previous forest owners. Many of the former socialist countries dealt with forest land
 368 restitution by means of a single land reform act, usually enforced shortly after the collapse of the socialist
 369 regime (in 1991 in Bulgaria, Czech Republic, Lithuania, Estonia, Slovenia) even though many amendments
 370 were added over time. In Croatia, the Law on restitution and compensation of property nationalised by the
 371 socialist state was passed in 1996 and this law also allowed PFOs to claim ownership. Until the year 2002,
 372 the law was restricted only to Croatian citizens (preventing others from making claims). Slovakia promptly
 373 issued two new laws, one in 1991 and one in 1993. In Serbia, the restitution process officially started in 2006
 374 with the Law on the restitution of property to churches and religious communities and this was followed in
 375 2011 with a law regulating property restitution to physical persons. In Romania, land reform took place

376 gradually and was implemented by three different land reform laws that returned a maximum of 1 hectare
 377 back to PFOs (in 1991), 10 hectares (in 2000) and then (in 2005) the entire area owned prior to
 378 nationalisation.

379 Land law reforms in western countries, with an influence on PFOs property rights, are rare. In Spain, three
 380 laws addressing land use did not result in changes to the PFO's freedom of decision making on land use
 381 change and the sale of forest lands. In the Netherlands, amendments to the Estates Act (1928) in 2002
 382 brought changes to the ownership requirement: the estate has to remain in the possession of the owner for
 383 at least 25 years, otherwise the owner must pay taxes. In Scotland, the 2003 land reform law clarified that
 384 access for pedestrian recreation in private forests could not be restricted. On the other hand, in Greece,
 385 many changes occurred, resulting in a clarification of property ownership and forest cadastre. The forest
 386 cadastre legislation tries to clarify the situation relating to forests which have either been long considered
 387 non-forest and had to be definitively declassified as forests or have been managed as forests and had to be
 388 designated as forests. For example, since 2012 in Greece it is considered for public interest reasons, that
 389 the forestry areas cleared before the year 2007 for farming purposes without the competent forestry
 390 authority's permission, can remain in use for agricultural or horticultural cultivation and exploitation.

391 4. Property rights changes

392 4.1. Changes to the content of property rights

393 The property rights distribution in regular commercial forests was influenced to different degrees by the
 394 legislative changes occurring in the last two decades. Of the 37 indicators analysed in 28 countries, we
 395 identified 124 situations where changes occurred (figure 2), which represented 12% of the overall combination
 396 of countries and indicators analysed.

Property Rights Categories:		Access	Withdrawal rights for										Management rights for forest										Exclusion rights for					Alienation rights for			Sum of changes														
Region	Country		timber	NWFPs										land use	planning					operations					public	NWFPs use				land	timber		↑	↓											
		I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20	I21	I22	I23	I24	I25	I26	I27	I28	I29	I30	I31	I32	I33	I34	I35	I36	I37							
Former Socialist	NEE	EE		↑	↑			↑				↑			↑		↑	↑	↑	↑					↑																13	0			
		LT		↑	↑			↑							↑	↑	↑	↑	↑	↑									↑	↑	↑												12	1	
	CEE	CZ		↑	↑												↑	↑	↑	↑																							9	0	
		HU			↑			↑								↓																										2	1		
		PL																↑	↑																								2	0	
		RO		↑									↑	↑				↑	↑								↑	↑	↑	↑	↑	↑	↑										13	0	
		SK																	↑	↑																							3	0	
	SEE	BA		↓					↓	↑					↑	↑																											3	3	
		BG																↓																									0	1	
		HR		↓		↑	↑								↑	↑			↑	↑					↑	↑		↓	↑	↑	↑													11	2
MK			↓														↑																									2	2		
RS								↑													↑							↓	↑														5	2	
Western	SWE	SI						↓	↓						↓													↓															4	4	
		GR																																									0	0	
	CWE	ES-CAT																																									0	0	
		PT																↓								↑																	1	1	
	NWE	AT													↑											↑																		2	0
		BE-WAL																↓	↓																									0	3
		CH-AG																																										0	0
		DE-BY																																										1	3
		FR																↓	↓																									1	3
		GB-SCT																																										0	2
NWE	IE																																										2	3	
	NL																																											0	1
	DK																																										1	1	
	FI		↑																																								4	0	
Changes	NO																																											0	0
	SE																																											0	0
Total	↑	3	2			1	1		1	1		1		1	3	4	1	1								2	4	1	2	1													33		
	↓		5	3	1	1	4	1			1	1		3	3	4	6	4	6	6					4	5	2	6	1	2	3	3	4	6	2	1	1	1	1			91			
	Total	3	7	3	1	1	0	5	2	0	1	1	2	3	4	7	10	5	7	6	0	0			4	5	2	8	5	3	5	4	4	6	0	6	1	1	1	1			124		

397

398 **Figure 2: Changes in property rights assessed according to the legislation applicable in 2015 compared with**
 399 **mid-1990s** (“blue arrows pointing upward” indicate that the change to the indicator was in the direction of increased
 400 freedom for decision making for the PFO in 2015 compared with mid-1990s, while “red arrows pointing downward”
 401 means that the change in the indicator was more restrictive for PFO in 2015 compared with mid-1990s) (Source:
 402 compiled by authors based on empirical data)

403 The changes represented a liberalisation of PFO's rights in 91 cases (73%), while in 33 cases (27%) the
 404 changes meant more restrictions to the PFOs' rights. Most of the changes to indicators occurred in the
 405 former socialist countries (95 changes, representing 76% of the total changes). With regard to the property

406 rights categories, most of the changes occurred to those indicators characterising management rights with
407 61 changes identified for the 13 indicators, meaning an average of 4.7 changes per indicator. The next
408 category is exclusion rights with 27 changes for seven indicators (average 3.9), access rights with three
409 changes per indicator (average 3), and withdrawal rights with 23 changes for 11 indicators (average 2.1).
410 The category least influenced by legislative changes is alienation rights with only 10 changes recorded for
411 five indicators (average 2).

412 **Changes to access rights** were assessed by one indicator (i1), which identified whether the forest owners'
413 access to their own forest lands was restricted to some extent. Temporary restrictions were introduced in the
414 legislation concerning access in areas contaminated by mines (Bosnia-Herzegovina, Croatia) or affected by
415 forest fires (FYR Macedonia). Thus, in these three countries the level of restriction increased in the 2015
416 legislation compared with the mid-1990s.

417 **Changes to withdrawal rights for timber** were identified in 11 countries consisting of 17 changes for the
418 six indicators used. In five countries the freedom for decision making regarding the amount of timber to be
419 harvested (i2) increased. In Estonia, Lithuania, Czech Republic and Romania, the 1990s legislation required
420 that all private forests had to be covered by FMP, which specified the amount of timber to be harvested.
421 Currently, in Estonia and Lithuania, the amount of timber to be harvested is decided based on inventory data
422 while in Romania and Czech Republic, small scale owners can harvest a certain volume of timber without a
423 FMP. In Finland, the 2014 Forest Act revision discontinued the minimum requirements for mean diameter
424 and age in final felling thus bestowing more freedom upon owners to decide the amount of timber to be
425 harvested. On the contrary, the withdrawal rights for timber became slightly restricted in two countries. In the
426 Netherlands, since 2002, it is not allowed to do any regular forest management activities (including
427 harvesting) in the bird breeding season in deciduous and mixed forests. In Bavaria, since 2005, harvesting
428 rights limitations may come from the enactment into the forest law of the recommendation that clear cuts
429 should be avoided.

430 With respect to the approval for timber harvests (i3), there were changes in three countries in which the right
431 to harvest had become less regulated. In Hungary, any type of harvest was previously based on a licence
432 from the authorities, while now if the harvest is assigned in the FMP, the forest manager needs only inform
433 the authority, who has 30 days to issue restrictions. In Estonia and Lithuania, during the 1990s, permission
434 was required for all cuttings. According to 2015 legislation, exceptions applied for up to 20 solid m³ of wood
435 per estate per year in Estonia and for different types of cuttings in Lithuania (e.g. cuttings of young stands,
436 selective sanitary cuttings or in cases of natural disasters of forests and harvesting solid timber up to 3 m³/ha
437 per year for personal consumption). The authority issuing the permit changed in many former socialist
438 countries (e.g. Croatia, FYR Macedonia and Romania) reflected in the fact that before, the state forest
439 company issued permits, whereas in accordance with the 2015 legislation an advisory service can issue the
440 permits. For some countries, this was reflected in a decreased level of bureaucracy required to issue
441 harvesting permits (i7), changes to this indicator being recorded for Estonia, Lithuania, Hungary and Serbia,
442 while for Bosnia and Herzegovina the level of bureaucracy increased.

443 **Changes to withdrawal rights for non-wood forest products (NWFPs)** are assessed using five
444 indicators, but changes to these indicators were identified in only five countries. Regarding the PFO's right to
445 pick up mushrooms from their forests (i8), changes are recorded in two countries. In Bosnia-Herzegovina,
446 the owners are currently allowed to harvest up to 1 kg of mushrooms per day, while previously this was only
447 allowed if specified in the forest management plans. In Slovenia, the 1998 decree on the protection of wild
448 fungi states that a maximum limit of 2 kg per person per day of mushrooms can be collected, without
449 differentiating whether the picker is the owner or a visitor. In Portugal, there were no regulations for the
450 collection of mushrooms until 2009 when the law limited the collection of mushrooms for personal
451 consumption to 5 kg per day per person. Nevertheless, the section covering mushroom picking was repealed
452 in 2012 and consequently the current legal situation returned to the one existing before 2009. The 2003
453 Spanish Forest Act clarified that the owner of wild/spontaneous forest fruits is the landowner; yet, this has
454 had a very limited impact in Catalonia, given that there are no specific regional regulations on the matter.

455 There are no recorded changes in the hunting rights in the period analysed with the exception of Slovenia
456 and Estonia. In Slovenia, the ownership of game (i10) has legally changed, the hunting regulation from 2004
457 stating that the game belongs to the state and not to the hunting associations as was previously the legal
458 case. Since the new Estonian hunting act of 2013, owners have more freedom to decide on the hunting
459 quota (i11), but only for the small game. With respect to the right to use forests for grazing (i12), the 2015
460 version of the Danish forest act brought a slight limitation to this right as it currently specifically states that a

461 maximum of 10% of the area of a forest property can be grazed. On the contrary, the changes to the
462 Romanian forest code from 2008 set conditions to permit grazing take place in private forests, while
463 previously this was totally forbidden.

464 **Changes to management rights regarding the forest land use** are recorded in 11 countries. In three of
465 these countries, the right of the PFO to change the forest land use (i13) has been liberalised, in the sense
466 that previously a land use change was possible only if deemed to be in the public interest, while in the 2015
467 legislation, the change is possible also if it is solely in the interest of the owners, subject to authority approval
468 (Austria) or for limited areas and subject to compensation (Lithuania and Romania). The obligation to assure
469 the reforestation of forest lands after final cutting (i14) was less arduous on PFOs in three countries as the
470 state supported fully or partially the cost of reforestation (Estonia, Bosnia-Herzegovina, Croatia). In Hungary,
471 the situation was the opposite: previously there was a forest fund where forest managers paid and received
472 support on behalf of the owner at the time of reforestation, while currently there is no payment and no
473 support for reforestation. In eight countries, the indicator referring to the need to assure forest regeneration
474 after natural catastrophes has changed (i15). In four countries, the owners have currently more financial
475 means available to support the reforestation, either from national funds (Croatia, Bosnia-Herzegovina, FYR
476 Macedonia) or EU subsidies (Lithuania). The implementation of windthrow insurance in Denmark and France
477 lead to divergent assessments on the impact to the changes to PFO's rights. In Denmark, the national
478 windthrow scheme implemented in 2000 created the possibility for the PFO to access public reforestation
479 support conditional on having signed the insurance prior to the event. This insurance was also introduced in
480 France in 2015, but this is assessed as a reduction in PFOs rights since during the 1990s, a PFO had
481 access to public reconstitution grants after a catastrophic windthrow without the need for windthrow
482 insurance. Similar slight reduction in PFOs rights for this indicator are noticed in Ireland and Slovenia, where
483 previously, reforestation was systematically supported through a special state fund while currently this can
484 be supported by way of an application for EU and national funds (Slovenia) or by way of national forest
485 reconstitution grants (Ireland).

486 **Changes to rights regarding forest management planning** occurred in 15 countries and generally
487 represent an increase in the freedom of decision making for the PFO (in 22 out of 28 cases). In seven out of
488 the 13 former socialist countries the need to have a FMP (i16), which applied to all types of forests during the
489 1990s, was changed to take account of the forest size. Thus, the obligation to have an FMP only exists for
490 forests above 10 hectares (Poland and Romania), or above 50 hectares (Czech Republic). In Estonia only
491 forest inventory data are needed and only for forests above 2 hectares. In Lithuania, FMPs were previously
492 obligatory for PFOs if they intended to do a final felling, while today it is the same, but FMPs are not required
493 for private holdings of less than 3 hectares and for final felling of grey alder, aspen and other low value
494 stands. In FYR Macedonia, since 2013 changes were made with respect to the size of forest areas which
495 must include various types of planning documents; previously FMPs were required for forests larger than
496 100 hectares and simplified FMPs for areas less than 100 hectares. Nowadays, PFOs with more than 30
497 hectares need an FMP, owners with 10 to 30 hectares need a simplified FMP and owners with less than 10
498 hectares have to adhere to simplified rules for forest management. On the contrary, in Bulgaria, there was a
499 reverse trend following liberalisation. From 1997 to 2011 in forests below 2 hectares, there was no need for
500 an FMP. Currently, all Bulgarian forests must have an FMP. For properties less than 2 hectares the FMP is
501 formulated in conjunction with the neighbouring state enterprise FMPs and it is paid for by the state. In three
502 western countries restrictions were added with respect to the need of FMPs. In France, before 2010, an FMP
503 was compulsory for every forest owner who owned at least 25 hectares in one land parcel. Since 2010, FMP
504 has been compulsory if the PFO owns 25 hectares in total (taking into accounts all the parcels she owns
505 larger than 4 hectares). In Wallonia, since 2008 the public authority has the right to oppose any type of
506 excessive harvesting if it is deemed that such harvesting is contrary to the public interest, as defined in the
507 law. While before 2008, the forest law had limits in terms of the size of clear cuts and no FMP or similar was
508 required, today an FMP is required for spatially contiguous clear cuts larger than 3 hectares in deciduous
509 stands and 5 hectares in conifer stands. In Portugal, with the approval in 2005 of the Zone of Forest
510 Intervention legislation, all PFOs covered by the approved and established zones have to jointly prepare a
511 FMP and cooperate in the management of the forests.

512 Options to include the PFO's management objectives into the planning procedure (i18) have increased in
513 five former socialist countries, where during the 1990s their interests were generally not considered. In
514 Croatia, Slovakia and Romania the changes are mainly formal as the owners can express their interest in the
515 course of the planning procedure, without having the capacity to influence the decisions. In the Czech
516 Republic and Estonia, PFOs can currently choose management goals within some technical limitations. In

517 the western context, one important change occurred in Finland, where in 2014 uneven-aged (continuous
518 cover) forest management formally became a legally viable option as a forest management regime, meaning
519 owners can choose selective cuttings and upper-crown harvestings as a forest management option. Pulling
520 in the opposite direction, higher restrictions were introduced in the Bavarian Forest Law of 2005, which
521 specifically states that clear cuts should be avoided, while previously only vague provisions were given in the
522 law regarding “sustainable” and “professional” management.

523 Finally, in many of the former socialist countries, the right to design an FMP (i19) does not belong anymore
524 to the state, and owners can now contract authorised experts (Czech Republic, Croatia, Estonia, Lithuania,
525 Serbia and Slovakia).

526 **Changes to rights regarding the implementation of forest operations** were measured by four indicators,
527 which recorded changes in 12 countries. The requirement for the administration of private forests (i22) has
528 become less restrictive in four countries. In Austria, an amendment from 2002 requires all forest holdings
529 between 1,000 and 3,600 hectares to hire a forester and above 3,600 ha an academic, while previously the
530 limits were 500 and 1,800 hectares. In Czech Republic, Romania and Serbia during the 1990s, the
531 administration of private forests was imposed by the authorities, but in accordance with the 2015 legislation,
532 PFOs may hire out the administration of the forest to private entities. In FYR Macedonia, since 2011 private
533 licencing bodies were responsible for performing administrative services for PFOs, but amendments made to
534 the law in 2014 restored the situation to what it was before 2011, with officials from the state forest enterprise
535 now being in charge of these administrative services. With respect to the right to decide which trees are to
536 be harvested (i23), in many of the former socialist countries, in mid 1990s, the state forest district
537 representatives selected and measured the trees and calculated the volume of the forest to be harvested in
538 private forests. In the Czech Republic, Croatia, Romania and Serbia there is a slight liberalisation of this
539 requirement, since according to the 2015 legislation the owner can hire a private licensed forester for this
540 operation. In Estonia and Latvia, the owners were granted the right to select trees for harvesting from the
541 mid-1990s. On the contrary, in FYR Macedonia the PFO has this service provided only by the public forest
542 enterprise thus no change is recorded compared to mid-1990s. Regarding the possibility to decide on the
543 rotation length (i24) changes occurred in two countries. In Estonia, the owner can currently decide it based
544 on general technical provisions provided (i.e. minimum imposed age) whereas previously this was
545 determined by the forest management planner. In Finland, the Forest Act revision of 2014 removed the
546 average diameter and age requirements for final felling, and explicitly enabled selective cuttings and the
547 possibility that a PFO can decide the rotation length with no constraints, thus there is no official forest
548 supervision at final felling site’s maturity as there was previously. Regarding the selection of species to be
549 used for reforestation (i25), six situations arose as a result of the evolving trends. In Portugal, the 2013 "Law
550 of the Eucalyptus" simplified the bureaucratic requirements for the establishment of eucalyptus plantations
551 and gave more freedom to PFOs to plant this tree species. In Estonia, Lithuania and the Czech Republic,
552 forest legislation currently provides for a spectrum of species to be used for afforestation and the owner can
553 decide which species to use, while previously this was integrated into the management planning procedure.
554 Similarly, in Croatia and FYR Macedonia the owners have greater freedom in deciding on the species to be
555 used. On the other hand, in Wallonia (Belgium), the choice of species has become more restrictive
556 especially with regard to the reforestation of clear cut areas. Furthermore, in Wallonia the PFO must choose
557 species based on an ecological guide for any parcels greater than 0.5 hectares. In Bavaria (Germany), an
558 amendment of the national nature protection law in 2002 includes the obligation to use a certain amount of
559 native species in afforestation.

560 **Changes to exclusion rights for public access** were assessed by three indicators and resulted in the
561 identification of 13 changes in seven countries. In four countries, the owners have nowadays less rights in
562 restricting public access into their forests for recreational purposes (i26). In Scotland, before the Land
563 Reform Act of 2003 the situation was quite unclear. Traditionally there were no specific regulations restricting
564 public access to forests, but owners often used various means to prevent public access to the land.
565 Currently, the law stipulates that the owner cannot restrict pedestrian public access for recreational
566 purposes. In Ireland, the owner was allowed to restrict access of any private individual onto their forest
567 property, but since 2008, public access for recreation must be provided along the forest road for pedestrians
568 in private forests where government subsidies have been paid for forest road construction. In Croatia, Serbia
569 and Romania there were no regulations during the 1990s for public access into private forests. According to
570 the 2015 legislation, in Croatia and Serbia the public have access, but visitors are not allowed to extract
571 material benefits from private forests or cause damage to the forests. Only in Romania, starting with 2008,
572 PFOs gained the legal right to exclude the public from accessing private forests. The right to restrict access

573 on forest roads when they cross private forests (i27) is currently within the power of a PFO in Estonia and
574 Romania while previously it was not regulated. For Ireland the same change was recorded as for the
575 previous indicator i.e. public pedestrian access must be provided along the grant aided forest roads.
576 Regarding camping in the forest (i28), rights to camp have been formalised in Scotland, whereas since 2003
577 the owner cannot refuse responsible and short-term camping on unenclosed land; previously camping was
578 permitted under what was widely perceived as 'common law'. In Slovenia since the introduction of the 2006
579 Protection of Public Order Act, camping is only allowed in especially designated places. In Croatia, Serbia
580 and Romania the owner can now legally restrict camping whereas beforehand camping was legally
581 unregulated.

582 **Changes to exclusion rights for NWFPs** occurred in nine countries for four indicators. The patterns are
583 similar with regard to the PFOs capacity to exclude the public from collecting mushrooms for recreational
584 (i29) and for commercial purposes (i30). In Croatia and Romania, the owners acquired this legal right
585 whereas previously it was unregulated. In Lithuania, the previously accepted "everyperson's right" was
586 modified i.e. the harvesting of mushrooms in private forests closer than 100 meters from the owner's
587 household being permitted only with the owner's agreement. In Bosnia-Herzegovina the collection of
588 mushrooms was previously restricted while currently owners must permit the collection of a maximum limit of
589 1 kg per person per day.

590 **Changes to exclusion rights for hunting** on PFO's property (i31) have occurred in six countries. In France,
591 since 1964, PFOs were obliged to grant access to hunters if a collective municipal hunting association
592 existed at a local scale. However, according to the "*Chassagnou*" amendment in 1999, a PFO can restrict
593 hunter's access to their forest for ethical reasons (ethical opposition to hunting). In Germany, every private
594 forest land is part of a hunting district. Since 2013, the hunting authority has had the power to prohibit
595 hunting if the PFO refuses hunting on ethical grounds as long as other public interests are not impeded. In
596 Estonia, Lithuania, Romania and Slovakia during the 1990s the owners had to accept hunting activities
597 taking place in their forest subject to compensation. Nowadays, in Estonia and Lithuania the PFOs have the
598 legal right to forbid hunting in their forests but if they do they lose eligibility to apply for compensation if game
599 damages the forest. In Slovakia and Romania nowadays forest owners can form hunting associations if they
600 own, individually or in association, more than half of the area of the hunting ground. In the Czech Republic
601 owners have had this legal right since 1992 so there is no change in the rights corresponding to this
602 indicator.

603 **Changes to alienation rights** mainly refer to restrictions on the sale of forest lands (i33 and i34) as
604 identified in six countries. The sale of forest land has become more restrictive in four countries. In France,
605 the changes to the Forest Code from 2012 introduced a pre-emption right in favour of the state or the closest
606 neighbours whereas previously the owner was free to decide whom to sell the forest to. The pre-emption
607 right was also introduced in Lithuania, Serbia and FYR Macedonia in favour of the "neighbours", whereas
608 beforehand the law did not regulate this during the 1990s. On the contrary, in the Czech Republic there was
609 a liberalisation in the law: previously sales of forests were permitted only to Czech citizens whereas currently
610 there are no restrictions on who can purchase forest land, except in national nature reservations and parks
611 where the state has a pre-emption right. In Ireland, starting 1990 the Government had the right to execute a
612 compulsory purchase of forest land, but this power was repealed in 2001, thus owners are free to decide to
613 whom and at what price to sell their forest land.

614 Only in Slovenia were changes recorded to the rights of PFOs to decide to whom they choose to sell their
615 timber to (i35), the form of sale (i36) and at the sale price (i37). Slovenia is a country that had an important
616 share of private ownership even in socialist times. Nevertheless, the state had monopoly over the trade of
617 timber from private forests. This situation completely changed in 1993, when the transition to the market
618 economy started and owners got the right to solely decide on the selling methods for timber.

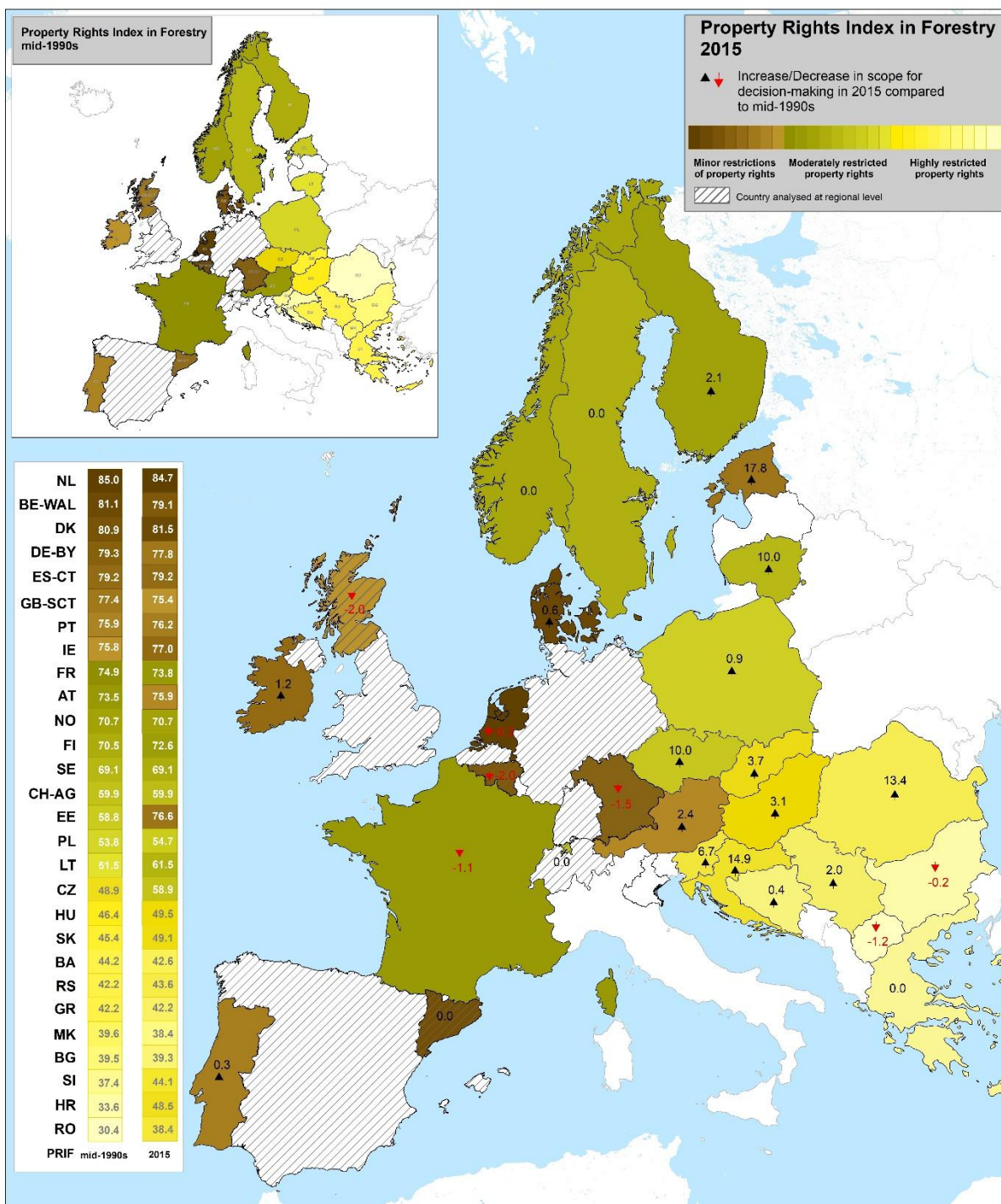
619 **4.2. Pattern of property rights changes between the mid-1990s and 2015**

620 Looking at the distribution of PRIF according to the legislation applicable to the mid-1990s, the map shows a
621 clear difference between the western and the former socialist countries, distinctions which are less evident
622 nowadays (figure 3). In the mid-1990s, the western countries (with the exception of Greece) had higher
623 PRIFs than any former socialist country. Furthermore, 10 out of the 13 former socialist countries included in
624 the analysis of the mid-1990's had a highly restrictive legal framework (PRIF < 50) and only Poland, Estonia
625 and Lithuania had a PRIF slightly above 50 (moderately restrictive legal framework).

626 Comparing the PRIF values computed for the mid-1990s legislation with those calculated for the end of 2015
627 we can derive the following patterns of changes (table 1):

- 628 - there is an overall increase in the PFO's scope for freedom in decision making, the average PRIF
629 value across the 28 analysed countries is 59.4 in mid-1990s compared with 62.3 in 2015;
- 630 - for the 15 "western" countries included in the analysis the average PRIF value remained the same
631 (73.0), which confirms the stability of the property rights distribution in most of these countries;
- 632 - for the 13 former socialist countries included in the analysis there was a significant increase in the
633 average PRIF from 43.7 in mid-1990s to 50.0 in 2015, which means that the institutional changes in
634 the former socialist countries had an important impact on the distribution of property rights;
635 nevertheless, there were greater differences amongst them in the approach of rights liberalisation;
- 636 - the 2015 legal framework remains highly restrictive for 10 countries, but with a modest increase in
637 the average PRIF values compared to the mid-1990s; Czech Republic moved up into the group of
638 countries with moderate restrictions while Estonia moved up into the group of countries with a high
639 degree of freedom in decision making, having the largest absolute increase in PRIF from 53 degrees
640 of freedom in 1998 to 76.6 in 2015.

641 Looking at the changes from the perspective of property rights categories (table 1), we see that the average
642 for the 28 countries increased for management and exclusion rights (both, with an increase of 3.9 degrees of
643 freedom in 2015 compared to the mid-1990s), withdrawal rights (with an increase of 2.0 degrees of freedom)
644 and a slight increase in alienation rights (1.3) Access rights had a slight decrease of degrees of freedom
645 (1.1).



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647 **Figure 3: Geographical distribution of the Property rights index in forestry (PRIF) in mid-1990s and in 2015 with**
 648 **the identification of the changes in the scope of decision making from mid-1990s to 2015 (Source: compiled by the**
 649 **authors)**

650 Considering the geographical distribution of jurisdictions (table1), we observed that overall increases in PRIF
 651 were found for the NWE countries, but these increases were modest, while reductions in PRIF occurred
 652 mainly for CWE countries, but these changes were also small. Aargau (Switzerland) and Greece are the
 653 western jurisdictions that have maintained a restrictive framework in private forest management recording no
 654 changes in the distribution of rights. Among the former socialist countries, we saw a clear decrease in the
 655 average change from North to South East Europe. NEE countries recorded the highest increased in absolute
 656 values of PRIF (13.9 points). From the CEE region Poland, Hungary and Slovakia had only small increases
 657 in PRIF values. Former socialist countries with marginal changes to property rights are mainly from the SEE
 658 region, with the exception of Croatia and Slovenia.

659 **Table 1. Calculation of changes in the property rights categories and PRIF between mid-1990s and 2015**

Region	Country	PRC mid-1990s					PRIF mid-1990s	PRC 2015					PRIF 2015	PRIF 2015 - PRIF mid-1990s			
		Acc.	Withd.	Mgt.	Excl.	Alien.		Acc.	Withd.	Mgt.	Excl.	Alien.					
Former Socialist	NEE	EE	100	57	39	65	96	58.8	100	72 ↑	65 ↑	89 ↑	96	76.6 ↑	69.1	17.8	13.9
		LT	90	56	42	24	96	51.5	90	66 ↑	53 ↑	49 ↑	85 ↓	61.5 ↑		10.0	
	CEE	CZ	90	55	21	51	96	48.9	90	57 ↑	47 ↑	51	100 ↑	58.9 ↑	10.0	6.2	
		HU	100	40	21	68	85	46.4	100	55 ↑	18 ↓	68	85	49.5 ↑	3.1		
		PL	100	52	24	72	100	53.8	100	52	27 ↑	72	100	54.7 ↑	0.9		
		RO	80	22	7	39	85	30.4	80	30 ↑	16 ↑	81 ↑	85	43.8 ↑	13.4		
		SK	90	48	18	49	96	45.4	90	48	24 ↑	58 ↑	96	49.1 ↑	3.7		
	SEE	BA	100	44	19	44	85	42.2	90 ↓	44	24 ↑	37 ↓	85	42.6 ↑	0.4	3.2	
		BG	90	31	25	39	85	39.5	90	31	25 ↓	39	85	39.3 ↓	-0.2		
		HR	100	25	14	30	96	33.6	90 ↓	41 ↑	33 ↑	49 ↑	96	48.5 ↑	14.9		
		MK	100	36	7	54	100	39.6	90 ↓	36	10 ↑	54	85 ↓	38.4 ↓	-1.2		
		RS	90	41	20	34	100	42.2	90	43 ↑	29 ↑	35 ↑	85 ↓	43.6 ↑	2.0		
		SI	100	53	35	18	25	37.4	100	46 ↓	33 ↓	24 ↑	85 ↑	44.1 ↑	6.7		
GR		100	27	42	29	85	42.2	100	27	42	29	85	42.2	0.0			
Western	SWE	ES-CAT	90	76	81	76	85	79.2	90	76	81	76	85	79.2	77.7	0.0	0.1
		PT	100	67	67	86	100	75.9	100	67	68 ↑	86	100	76.2 ↑	0.3		
	CWE	AT	100	80	64	69	85	73.5	100	80	71 ↑	69	85	75.9 ↑	2.4	-0.4	
		BE-WAL	100	77	83	67	100	81.1	100	77	77 ↓	67	100	79.1 ↓	-2.0		
		CH-AG	100	56	58	36	100	59.9	100	56	58	36	100	59.9	0.0		
		DE-BY	100	75	88	61	88	79.3	100	74 ↓	84 ↓	62 ↑	88	77.8 ↓	-1.5		
		FR	90	69	63	87	100	74.9	90	69	61 ↓	96 ↑	85 ↓	73.8 ↓	-1.1		
		GB-SCT	90	78	76	65	96	77.4	90	78	76	54 ↓	96	75.4 ↓	-2.0		
		IE	100	67	76	91	70	75.8	100	67	72 ↓	84 ↓	100 ↑	77.0 ↑	1.2		
		NL	100	83	79	86	100	85.0	100	82 ↓	79	86	100	84.7 ↓	-0.3		
	NWE	DK	100	85	73	73	100	80.9	100	84 ↓	76 ↑	73	100	81.5 ↑	0.6	0.6	
FI		100	81	74	34	84	70.5	100	82 ↑	79 ↑	34	84	72.6 ↑	2.1			
NO		100	76	77	34	88	70.7	100	76	77	34	88	70.7	0.0			
SE	90	73	73	39	88	69.1	90	73	73	39	88	69.1	0.0				
Average (N=28)		96.1	58.3	48.8	54.2	89.8	59.4	95.0	60.3	52.7	58.2	91.1	62.3				

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Note. The table presents values for the five property rights categories (PRCs) namely access rights (Acc), withdrawal rights (Withd.), management rights (Mgt.), exclusion rights (Excl.) and alienation rights (Alien.) and on the overall PRIF. The scores for each PRC and for the PRIF are ranging from 0 meaning "rights were fully restricted" to 100 meaning "no legal restrictions were imposed". The changes in the overall PRIF are identified by comparing the values from 2015 with the ones from mid-1990s. The arrows are used to highlight increases and decreases to scores for each property rights category and PRIF when comparing 2015 with the mid-1990s. (Source: compiled by authors based on empirical data).

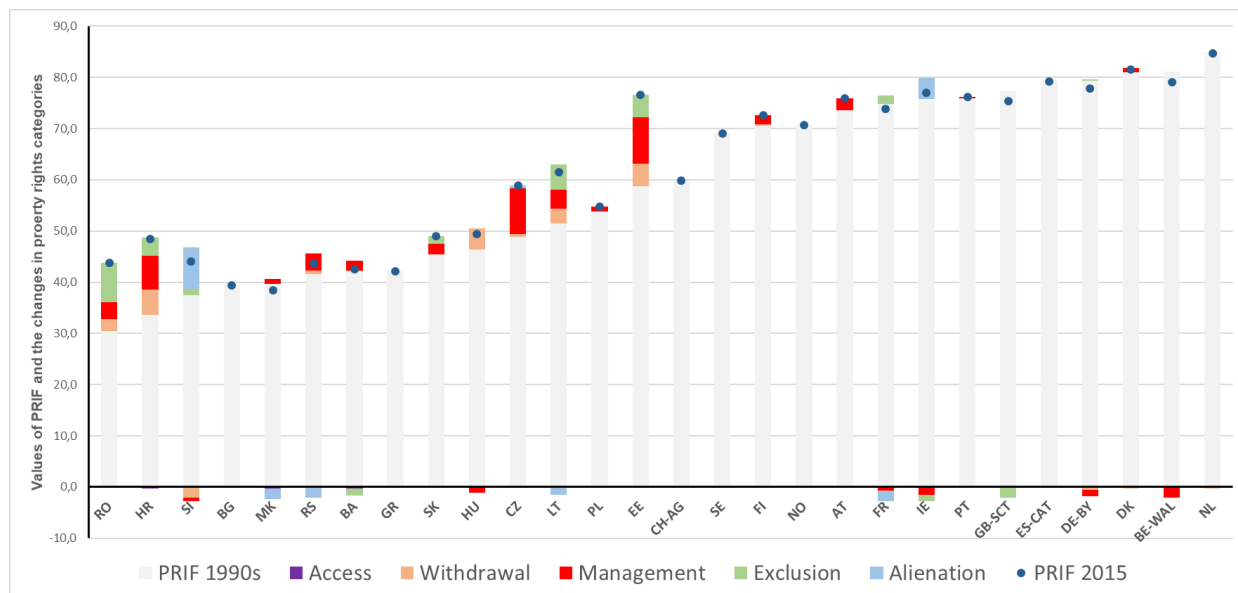
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At jurisdiction level, we identified differences in the direction of change in the property rights categories in relation to the values of PRIF (figure 4). Thus, very few changes occurred for the countries that had high values of PRIF in the 1990s (PRIF >70). For example, in half of the western countries, with high values of PRIF in the mid-1990s, there were no changes at all (Norway, Sweden, ES-Catalonia) or only minor changes (Netherlands, Portugal, Denmark). In the rest of the countries with high level of PRIF in the 1990s, management rights were slightly liberalised in Austria and Finland, while on the contrary, some management restrictions were imposed in Bavaria and Wallonia. In Ireland the direction of changes to property rights categories was mixed, important changes occurred to the liberalisation of the right to sell forest land, while minor restrictions were imposed on the PFO's ability to prevent public access on grant aided forest roads. In France, besides the recognition of the right to refuse hunting activities, restrictions came from the introduction of pre-emption rights and from the additional requirements for FMPs. In Scotland, only exclusion rights have been restricted in favour of the public. In general, the property rights in the Western countries have largely been stable, regardless of their geographical grouping and are generally characterised by high PRIF values already in existence from the 1990s.

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The diversity of changes in property rights categories (figure 4) is highly visible for the low to mid-PRIF countries (most of the Eastern Europe groupings) where the patterns of change in property rights categories varied significantly. Important changes occurred in most of the former socialist countries with respect to management rights. The obligation to have an FMP in all private forests previously required in all former socialist jurisdictions, is now applicable in only seven out of the 13 former socialist countries (Bosnia-Herzegovina, Bulgaria, Croatia, Hungary, Serbia, Slovakia and Slovenia) while in the others this obligation depends on the size of the property and/or the forestry works the owner intends to carry out. The changes in the management rights are also reflected in the changes to the withdrawal rights for timber products. Exclusion rights contributed most to the increased PRIF values in Romania, due to the fact that since 2008 forest owners were granted full exclusion rights for public access and the harvesting of NWFPs. Estonia and

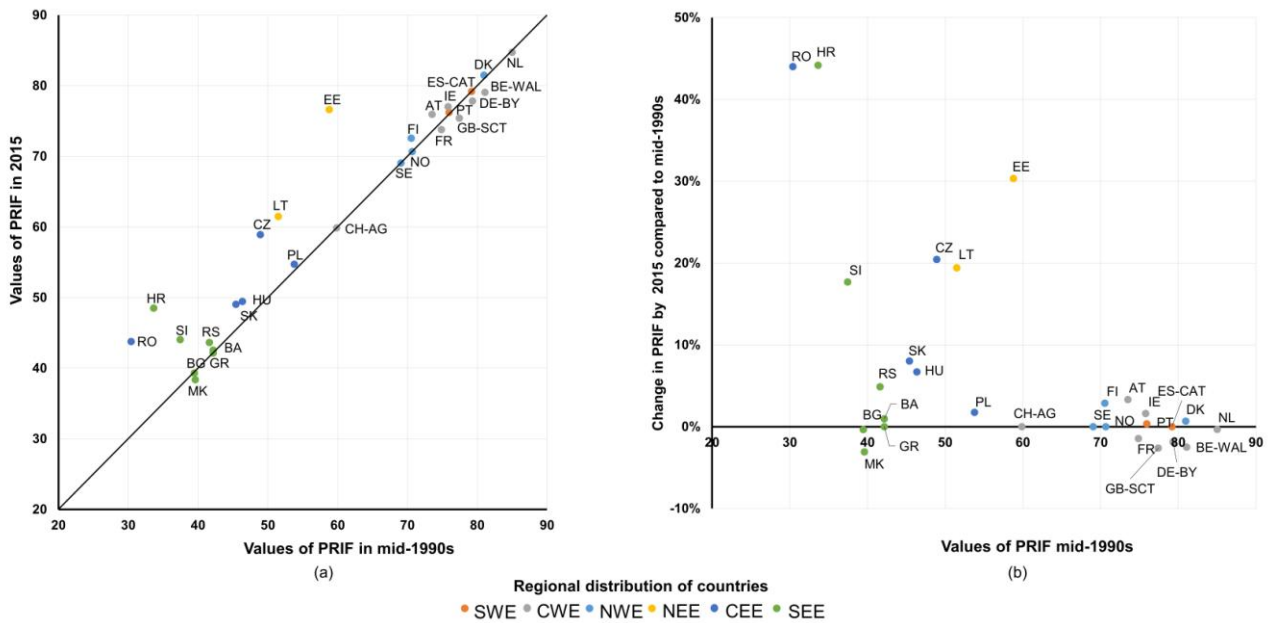
691 Lithuania are the only former socialist countries where PFOs were granted the right to forbid hunting
 692 activities on their property. Alienation rights decreased in the countries that introduced the pre-emption right
 693 for the sale of forest land (FYR Macedonia, Serbia, France and Lithuania). In Slovenia, the overall increase
 694 in PRIF is mainly attributable to the termination of the state monopoly in timber sales from private forests in
 695 1993. The reduction in access rights is explained by the fact that temporal access restrictions imposed on
 696 forest owners were regulated in some Western Balkans countries that had been involved in military conflicts
 697 during the period analysed.



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 699 **Figure 4: Changes in absolute values (mid-1990s and 2015) of the five property rights categories.** The values
 700 present the contribution of each of the five property rights categories in the PRIF values from 2015 compared to PRIF
 701 values from mid-1990s. The countries are presented in the order of the increasing PRIF values from mid-1990s, from left
 702 to right along the horizontal axis (Source: compiled by the authors)

703 In terms of the relative changes in the PRIF values for 2015 when compared with the mid-1990s (figure 5b),
 704 major changes are recorded for only six countries, all having a former socialist political background (Croatia,
 705 Romania, Estonia, Czech Republic, Lithuania and Slovenia), while the rest of countries had limited changes,
 706 below 10%.

707 Croatia has the highest value of relative changes in the overall PRIF (44%) being the only SEE country in
 708 which 11 indicators are liberalised. Nevertheless, the legislative framework remains highly restrictive namely
 709 the retention of the obligation to have a FMP in all private forests even though the owner can now contract
 710 this service to private entities and can stipulate and influence the management goals (e.g. species selection).
 711 The overall level of PRIF also remains highly restricted in Romania and Slovenia despite a relatively high
 712 increase in PRIF. In Romania the relative increase in PRIF is mainly due to the changes in exclusion rights.
 713 In Slovenia, the changes were mainly related to alienation rights for timber. The current level of PRIF in
 714 Slovenia, Croatia and Romania remains below the Baltic country's levels of the mid-1990s, despite their high
 715 relative increase in PRIF (figure 5a). In the Czech Republic, the changes in the forest code applicable since
 716 1996 resulted in a liberalisation of the management rights indicators, while the regulation of the exclusion
 717 rights largely favoured the public. Thus, Czech Republic is currently found in the group of countries with
 718 moderate restrictions in PFOs rights. In Lithuania, more freedom of decision is granted for withdrawal and
 719 management rights but the implementation of the pre-emption right reduces the overall increase in the PRIF
 720 value. In Estonia, there has been a very significant trend towards liberalisation with respect to the
 721 withdrawal, management and exclusion rights. This results in the highest absolute increase in PRIF of all of
 722 the countries analysed due to Estonia having the largest number of legal changes documented in the
 723 analysed period.



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725 **Figure 5: Plot of PRIF values in mid-1990s and 2015 (a) and the relative changes (b).** In figure (a) the line is the “no
 726 change line”; countries above the line feature a change towards less regulated property rights. The relative changes
 727 between the two time periods are presented in figure (b) (Source: compiled by the authors)

728 5. Discussion

729 Our analysis of changes to property rights identified broad patterns in the manner in which European
 730 countries have adapted forest-focused legislation to the new policy challenges of the last two decades. The
 731 approach provides new insights and allows us to analyse dynamics and responsiveness of forest policy
 732 systems over the past decades. Hence it demonstrates the value of the PRIF as a tool for analysing policy
 733 change, in addition to the comparative snap-shot analyses previously undertaken (Nichiforel et al., 2018). Its
 734 value in this regard is two-fold. First, by analysing the *direction* of legal changes, it enables us to
 735 demonstrate geographical patterns in the changing regulatory role of the state with respect to activities of
 736 PFOs. Second, by analysing the *content* of the changes in property rights categories we explore the
 737 connections with major challenges influencing forest policies in the last two decades. Such political trends
 738 and motives that may be driving those changes are e.g. deregulation of forest policy (Arts et al, 2010),
 739 environmental discourse (Leipold et al, 2019) and increased influence of EU strategies in national forest
 740 policies (Pülzl et al., 2013).

741 Regarding geographical patterns, our analysis shows a marked distinction in the mid-1990s, between the
 742 forest governance approaches applied in western Europe (which gave more freedom of decision making to
 743 PFOs), and countries from the former socialist bloc (which had state-centred forest regulatory frameworks).
 744 With the exception of Switzerland and Greece, PFOs in the western countries in our study already had high
 745 degrees of freedom in management and withdrawal rights, varying mainly in the distribution of exclusion
 746 rights. This was because most western countries had already deregulated forest policy during the 1980s
 747 (Arts et al., 2010), moving from centralised “command-and-control” approaches to market-based, self-
 748 regulatory and voluntary measures (Glück et al., 2005). For example, many of the obligations previously
 749 imposed on the PFOs in Sweden in accordance with the Forest Act from 1983 had been withdrawn in 1993
 750 (such as the obligations to clean young forest, to thin it, to clearfell it and to have a FMP).

751 At the beginning of the 1990s, forest policies in the socialist countries were based on stringent regulatory
 752 frameworks, designed to perform in the context of predominantly public ownership and centralised economic
 753 systems (Dembner, 1994). These frameworks advocated strong mandatory technical norms (Lawrence,
 754 2009; Buliga and Nichiforel, 2019) imposing long rotations, small clear cuts, and annual allowable cuts
 755 significantly below the mean annual increment (Brukas et al., 2001; Cashore et al., 2006). Current forest
 756 governance approaches in former socialist countries are very diverse. Some countries still base their forest
 757 policy system on strong regulations (most of the SEE), while others (such as the Baltic countries) have given
 758 PFOs freedom of decision making similar to those in CWE. In between these extremes, most CEE countries

759 maintain a strong role for the state in private forest management, although in some cases owners are
760 granted substantial management (Czech Republic) or exclusion rights (Romania).

761 Private forest governance systems in former socialist countries are particularly related to the approach taken
762 by each country in the forest land restitution (e.g. Avdibegović et al., 2010; Glück et al., 2011; Nonic et al.,
763 2011; Brukas et al., 2013; Teder et al., 2015). For example, in the Baltic countries, radical changes in the
764 share of private ownership (from 0% to more than 40%) were implemented in a single step at the beginning
765 of the 1990s (table A3-Appendix). The number of legislative changes in this region is the highest among the
766 countries analysed (figure 1), which may explain the changes in values of a significant number of indicators
767 in the main property rights categories (withdrawal, management and exclusion). These substantial changes
768 give forest owners a larger decision space, and reduce administrative costs while maintaining control
769 mechanisms for management planning and felling (Teder, 2016). Romania is an interesting contrast to the
770 Baltic states. It also had a significant shift to private ownership, but implemented over several rounds of
771 legislation, thus the lobby power of PFOs was directed more towards the forest restitution process that lasted
772 for more than 20 years and less on adapting the forest management rules in their interest (Scriban et al.,
773 2019). On the other hand, countries that made minor changes in the share of private ownership, because
774 they maintained some forms of private property during socialist times (e.g. Slovenia, Serbia, Bosnia-
775 Herzegovina, Poland), are characterised by fewer changes in the structure of rights, the state maintaining a
776 central role in private forest governance (Dobsinska et al., 2020).

777 The general differentiation between regulatory approaches used in European private forestry has to be
778 interpreted in the larger context of policy instruments used to steer implementation of forest policy goals.
779 One factor differentiating regulatory frameworks is the integration of neo-liberal principles in forest policy and
780 the shift towards market-based policy instruments (Humphreys, 2009). We have shown that the degree to
781 which changes occurred in property rights between the two time periods depends on the degree of
782 restrictions existing in the mid-1990s: the higher the PRIF value was in the mid-1990s, the more stable
783 property rights were at the end of the next two decades. Where policy assumes that individuals are
784 responsible and that markets are functioning well, changes have usually involved the liberalisation and
785 extension of PFO rights. Where regulation has increased, this is often intended to integrate environmental
786 concerns into forest legislation, and simultaneously introduces financial instruments such as compensation
787 or incentives for adopting aligned sustainable management (Deuffic et al., 2018). The shift towards more
788 individual responsibility and market based approaches may also result in state withdrawal from financial
789 responsibility for aspects that can be covered by market instruments. Our analysis has pointed to some
790 countries where the state no longer covers damages to private forests in the case of natural hazards, but still
791 maintains the obligation to replant. In this case, PFOs have to rely on private market insurance mechanisms,
792 in order to cover the cost of replanting.

793 The shift from 'Soviet era' rationales for forest management, and adaptation to the EU common markets,
794 manifest in a range of rather diverse policy instruments in former socialist countries. For example, the Baltic
795 countries, Hungary and Slovakia, have successfully used EU financial mechanisms from the Rural
796 Development Program to provide annual payments to compensate private owners for the disadvantages
797 related to Natura 2000 areas (Sarvašová et al., 2019). In contrast, the stringent legal framework applied in
798 Romania hinders the capacity of the government to access EU compensation mechanisms related to Natura
799 2000 areas as there is little room to add restrictions additional to those already imposed through existing
800 legislation (Drăgoi and Toza, 2019). Croatia has developed a private forest governance system distinct from
801 the rest of the SEE countries. While many indicators have been slightly liberalised giving more freedom of
802 decision making to forest owners, the state maintains the obligation for all private forests to have
803 management plans. The government funds this through a "green tax" imposed on every company operating
804 in Croatia, which provides annual grants to support the activities of PFOs who provide ecosystem services
805 (Krajter Ostoić and Vuletić, 2016).

806 The deregulation trend has been challenged during the last two decades by increased pressure on forest
807 policies, especially from the environmental discourse (Sergent et al., 2018). The distribution of rights is often
808 debated between two advocacy coalitions: e.g. in Germany the forestry coalition tries to defend the property
809 rights of the PFOs while the nature protection coalition pushes for legal minimum standards, which reduce
810 owners' freedom of decision (Winkel et al., 2011). Since our analysis did not focus on forests located in
811 protected areas (e.g. Natura 2000 network), the restrictions imposed in forests with protected status are not
812 displayed in the current values of PRIF. Nevertheless, especially in high-PRIF countries, we observe a
813 pressure for more environmental issues to be addressed by owners' decisions even for forests located
814 outside protected areas. For example, at the same time as the 1993 deregulation of the Swedish forest

815 management legislation, environmental concerns were integrated by giving the possibility for authorities to
816 stop clear-felling in areas of specific biodiversity concerns, of up to approximately 5-10 % of a stand's value
817 without financial compensation to the land owner. In the Netherlands, since 2002 felling has been banned
818 during the nesting season. Such restrictions are common in Natura 2000 sites across many countries, yet we
819 see in the case of the Netherlands a transfer of this regulation to all type of deciduous and mixed forests
820 irrespective of whether they are inside or outside of Natura 2000 sites. The deregulation trend can even be
821 reversed when proven to bring high environmental risks. For example, in Portugal the 2013 legislation
822 facilitating eucalyptus plantations was recently repealed given the scale of the devastation caused by the
823 forest fires in 2017; a new law has been recently issued, with the objective of limiting the establishment of
824 eucalyptus plantations.

825 Despite these examples, it is clear from our data that the environmental discourse in the last two decades
826 has had little influence on the PRIF in "regular productive forests". This suggests that environmental
827 legislation and forest-specific legislation are still disconnected in most of the European countries (Weiss et
828 al., 2017). However, the transposition of European environmental legislation into forest management practice
829 is an ongoing process (Pukall, 2019). This trend can be seen in some countries, where, for example, forest
830 laws have been integrated into nature conservation laws (e.g., Netherlands). New environmental rules
831 combine restrictions (e.g. Natura 2000 standards, limitations of clear-cut areas) and new financial and
832 management opportunities. Management measures, including consideration of close-to-nature forestry and
833 species diversification, may provide some opportunities to explore new forestry models that were not
834 supported up to now by the traditional foresters. Comparative studies across European countries (e.g.
835 Feliciano et al., 2017) suggest the need for more innovative support schemes and advisory services to
836 encourage forest owners to engage with these new models.

837 On the other hand, our research shows that owners' rights can increase as a consequence of increased
838 social awareness. For example, in France and Germany PFOs now have the right to prevent hunting
839 activities for ethical reasons. For NWE, increases in PRIF are related to increased rights in management and
840 freedom of decision, but these are often motivated by increased environmental concerns. In Finland,
841 deregulation is explicitly aimed at allowing PFOs more freedom in their forest management decisions,
842 implicitly also increasing their responsibility and empowerment to practice more active and multi-faceted
843 forestry. In Denmark, the voluntary windthrow schemes directed towards native species are based on the
844 same principles as the voluntary grants for enhancing management in Natura 2000 areas (Jacobsen et al.,
845 2013).

846 Overall, most of the changes we identified across Europe were recorded in the categories of management
847 rights and exclusion rights. This reflects policy maker's concerns to balance between, on the one hand, an
848 individual's responsibility and the imposition of easily achievable forest management requirements, and, on
849 the other hand, forest owners' collective duties and their relations with other users (e.g. hunters, mushroom
850 pickers, recreationist). These concerns are also the result of the increased influence of EU strategies on
851 national forest policies (Pülzl et al., 2013).

852 Management rights have a central role in most of the European strategies. For example, the EU Biodiversity
853 strategy (EC, 2011) address the forestry measures by encouraging the adoption of FMPs, and the Natura
854 2000 network also places a high emphasis on management plans (Weiss et al., 2017). While in many former
855 socialist countries the elaboration of a FMP remains an obligation for PFOs, other countries use financial
856 instruments to stimulate PFOs to draw up FMPs. For example, support to small forest holders to formulate
857 FMPs has been programmed in six member states (Austria, Germany, Spain, France, Italy and UK) within
858 the framework of the 2014-2020 EU RDP (Alliance Environment, 2017). At the same time, the "bio-economy"
859 and "bioenergy" turn advocated by forest policy makers over the last decade (Kleinschmit et al., 2014; Pülzl
860 et al., 2014) has put pressure on management rights, in order to increase wood mobilization from
861 sustainable sources (Orazio et al., 2017). For example, in 2010 French forest policy-makers decided to
862 slightly adjust the requirements for FMPs through an amendment to the Forest Code, and as a result the
863 number of PFOs obliged to contract an FMP has doubled (CNPFF, 2015). In other countries, this issue is
864 addressed by soft policy instruments such as subsidies and advisory services targeting "new", "absentee" or
865 "passive" forest owners in the direction of wood mobilisation (Weiss et al., 2019a), often through multi-
866 faceted support programmes (Lawrence, 2018).

867 The exclusion rights are often disputed between the forest users, who want free access for recreational
868 activities or for the collection of NWFPs, and the PFOs who may gain entrepreneurial benefits from using the
869 exclusion rights (Nichiforel and Schanz, 2011). For example, in Czech Republic, Romania and Slovakia, as a

870 result of increased exclusion rights attributed to PFOs, the transfer of hunting rights from PFOs to hunting
871 associations has become a growing market. Similar developments may be seen also from the introduction of
872 picking fees and mushroom picking norms favouring PFOs (Górriz-Mifsud et al., 2017). As our analysis has
873 shown, PFOs have received increased legal support to exclude commercial use of mushrooms without their
874 consent. However, the collection of NWFPs is often embedded in the culture of household economy and
875 exclusion rights for NWFPs are difficult to enforce in practice. Thus, the selling and leasing of rights to collect
876 NWFPs are, with few exceptions, seldom practiced in European private forests (Wolfslehner et al., 2019).

877 This redefinition of rights, in particular forest management and exclusion rights, confirms the proliferation in
878 European forest governance of an approach based on soft laws where policy makers steer forest policies
879 through a new set of policy instruments (Kleinschmit et al., 2014; Sergent et al., 2018). Current efforts in
880 research and policy development have a significant focus on financial instruments for environmental
881 regulation in forestry as well as agriculture, thus still respecting a significant degree of individual PFO
882 discretion. Despite this common deregulation trend, the structure of property rights remains diverse between
883 countries, and our research shows that there is still a long way to go for the European countries to align their
884 forest management regulations towards the vision of a common European forest policy.

885 **6. Conclusions**

886 Our analysis has illustrated how different forest governance approaches exist and develop in different ways
887 at the European level, emphasising the role of the state in the distribution of *de jure* access, withdrawal,
888 management, exclusion and alienation rights between forest owners, forest authorities, and other users.

889 At the beginning of the 1990s there was a clear distinction in property-rights distribution between the western
890 countries (with a higher freedom of decision making attributed to PFOs) and the former socialist countries
891 entering the transition period. We conclude that there is no longer a clear line between the western countries
892 and former socialist countries with respect to PRIF scores. In the western countries, many of the changes to
893 forest-related laws and their amendments in the last two decades were made at similar level of rights, which
894 means few additional rules or norms were introduced, but legislative acts were tidied up and updated. In
895 contrast, in most of the former socialist countries, both the number of legal changes and the impact in
896 property rights changes was higher. In countries with high PRIF scores in mid-1990s we sometimes find
897 these declining (mainly in CWE), driven by environmental and forest user concerns; in other cases,
898 environmental concerns are pursued using deregulation or market based instruments, which rely on
899 decision-making of PFOs (e.g. Finland and Denmark). In these latter cases we see PRIF scores continuing
900 at a high level. Across the former socialist countries, we see deregulation in some areas, at various speeds.
901 Nevertheless, most of the former socialist countries, with the exception of Baltic states, still maintain a high
902 level of state coercion on private forest management.

903 Although we cannot extrapolate our conclusions outside the analysed period, we can still note implications
904 for possible future legal changes. The general deregulation trend begs the question: how far is it possible to
905 liberalise the freedoms of PFOs to make decisions, without negatively affecting the practice of sustainable
906 forest management? The future development of property rights is likely to be accompanied by increasing
907 demands from outside the forestry sector, the endorsement of policies by a complex constellation of
908 stakeholders and – at least in some states, by a focus on decentralization (from the state to regional forest
909 authorities).

910 While it is expected that national forest policy goals will slowly converge to a more uniform distribution of
911 rights across Europe under the pressure of biodiversity and climate change policies, national governance
912 frameworks may pursue shared goals with diverse policy instruments. Such a convergence may mean more
913 management restrictions in the high-level PRIF countries and new policy instruments and more freedom of
914 decision in the field of forest management in the low-level PRIF countries. Potential forest policy instruments
915 may not necessarily focus on the reconfiguration of property rights, particularly not on the material dimension
916 of rights, but rather on the redefinition of fiscal advantages and the financial instruments used to balance the
917 cost/benefits of PFOs, to alleviate unintended economic losses or to promote responsible forest
918 management practices.

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- 1105

1106 **Supplementary material**

1107 To the article: **Two decades of forest-related legislation changes in European countries analysed from**
 1108 **a property rights perspective**

1109

1110 **Table A1: Indicators used for the quantification of property rights changes**

Indicator	Property right category	Issue assessed
i1	Access	Restrictions on owners to enter their own property
i2		Scope of decision on the amount of wood to be harvested
i3		Approvals that owners need to harvest timber
i4	Withdrawal rights for wood products	Scope of decision for brushwood (fallen branches on the soil)
i5		Approvals that owners need to harvest brushwood
i6		Legal possibility that owners perform the timber harvesting operation
i7		Rigour of bureaucratic procedures to get harvesting permits for timber removal
i8		Restriction on owners to harvest mushrooms for his/her personal consumption
i9		Restriction on owners to harvest mushrooms for commercial use
i10	Withdrawal rights for non-wood products	Ownership on game/wild animals in a private forests
i11		Scope of decision on the amount of game that can be hunted from a private forest
i12		How are the rights of grazing in the private forest regulated?
i13	Management rights for land use	Scope of decision to change the forest land use
i14		Obligation for reforestation of forest lands after final cutting
i15		Obligation for reforestation of forest lands after natural catastrophes
i16		Requests for a forest management planning (FMP) for private forests
i17		Types of planning documents required for the final felling
i18	Rights for forest management planning	Integration of owners goals into the FMP
i19		Authorized persons to design the FMP for private forests
i20		Approval of the FMP for private forests of individuals
i21		Scope of decision for abandoning the timber production and producing NWFPs
i22		Technical expertise for the implementation of forest operations
i23	Rights to implement management operations	Scope of decision on the selection of trees to be harvest
i24		Scope of decision on the rotation length
i25		Scope of decision on the type of species to be used for reforestation
i26	Exclusion of public access	Scope of decision to restrict public access for recreational purposes
i27		Scope of decision to restrict access on forest road crossing the property
i28		Scope of decision to exclude non-owners from camping in the forest
i29		Scope of decision to exclude the public from the recreational harvesting of mushrooms
i30	Exclusion for NWFPs use	Scope of decision to exclude others from the commercial harvesting of mushrooms
i31		Scope of decision on how hunting activity take place in a private forest
i32		Legal requirements in respect to fencing the private forests
i33	Alienation for forest land	Scope of decision for selling the forest land
i34		Scope of decision in setting the price of forest land
i35	Alienation for timber products	Scope of decision for selling the timber
i36		Scope of decision on the form of timber commercialisation
i37		Scope of decision on the price to sell the timber

1111 **Appendix A2**

1112 Methodology used for PRIF calculation (based on the steps described in Nichiforel et al, 2018)

1113 1. Data processing

1114 Processing of the initial respondents' questionnaires was conducted to ensure that each indicator is covered by the full
1115 range of relevant alternatives, describing the diversity of legal stipulations identifiable across the analysed jurisdictions.
1116 For example, if a particular situation for a jurisdiction was identified as missing in the initial list of alternatives, a new
1117 alternative was created, based on the comments recorded in the questionnaires. Similarly, if multiple answers for any
1118 indicator were applicable, intermediate categories were created describing more precisely the legal provision for the
1119 indicator. In many situations the initial deductive categories have been complemented with additional ones so that each
1120 jurisdiction is represented in a category as close as possible to the legal provision. In the case where multiple answers
1121 were applicable for an indicator, the category that gave the most freedom to the owners was considered in the
1122 assessment (e.g. an owner may be allowed to do the selection of the trees to be harvested but of course he may also use
1123 a professional forester for that). In a situation when the legal system did not address a certain indicator at all, the
1124 specific category "not-regulated" was used. An internal validation of the post-hoc categorisation was carried out by
1125 sending the final inputs back to the national experts for a second time.

1126 2. Data weighting

1127 The full range of alternatives were sorted out and weighted to quantify the degree of freedom in decision making.
1128 Alternatives for each indicator were presented in the order of an increasing restriction on PFOs and were weighted from
1129 "no restrictions" (100% degrees of freedom) to "fully restricted" (0% degrees of freedom) with intermediate levels of
1130 restriction being present. Extreme alternative answers were not found to be present in the legislation (e.g. fully
1131 restricting owners from entering their property) for some indicators but they were included to facilitate the weighting of
1132 the intermediate alternatives. As the scoring distance between the possible alternative answers could not be presumed to
1133 be linear for all indicators, a weighting of the intermediate categories was carried out based on inputs from an expert
1134 panel. Out of the initial list of 18 core group members, 12 members provided answers for weighting the categories. The
1135 members of the expert panel came from four different backgrounds (forest practitioners, forest policy analysis, social
1136 sciences and juridical sciences) and covered all the geographical regions identified by Forest Europe (2015).

1137 The role of the experts was to compare the degree of freedom in decision making that a particular indicator may bestow
1138 on the PFO in the context of the other possible alternatives for that indicator, on the basis of their interpretation of the
1139 rigour of legal provisions. When scoring the alternatives, experts were provided with 6 background categories that set
1140 the limits of restrictions: no restrictions apply (100% freedom); low level of restrictions (75%-99% freedom); moderate
1141 level of restrictions (50%-74% freedom); high level of restrictions (25-49% freedom); extremely high level of
1142 restrictions (1-24% freedom); fully restricted (0% freedom). The role of the background categories was to link the
1143 qualitative observations derived from the legislation with the quantitative assessment of the degree of freedom and thus
1144 to assure the consistency among the perceptions of different experts. The members of the panel provided their valuation
1145 of alternatives in a double blind weighting process. At first, an individual weight was assigned for each alternative, and
1146 then the experts were asked to validate or adjust the answers considering the average weight calculated for each
1147 alternative.

1148 3. The aggregation of the indicators

1149 All indicators were considered to be equally weighted in the index to allow for comparisons between jurisdictions with
1150 different forest policy and regulatory landscapes. The Property Rights Index in Forestry (PRIF) scores for each
1151 jurisdiction was the mean of the values for each indicator (q_i) for the set of 37 indicators (n). The value of the index
1152 ranges from 0 (when full restrictions apply for all the indicators) to 100 (when owners have a full degree of freedom for
1153 all the indicators).

1154
$$PRIF = \frac{\sum_{i=1}^n q_i}{n} \quad (1)$$

1155 Each PRC was assessed using a similar method and represents the mean value of the indicators corresponding to that
1156 category. However, the number of indicators in each of the PRCs reflects the influence each category has on the overall
1157 PRIF value: access rights accounts for 3% in the PRIF formation, withdrawal rights account for 30%, management
1158 rights account for 35%, exclusion rights account for 19% and alienation rights account for 13%. Depending on one's
1159 relationship with the forest, viewpoints may differ on the role the various private forests attributes have in the provision
1160 of ecosystem services, and consequently on the importance of each of the PRCs which may be perceived differently
1161 among stakeholders in terms of their relative importance. Thus, an interpretation of the overall PRIF needs to be made
1162 in the context of its constituent PRC's.

1163 Table A3. Changes in the forest ownership characteristics in former socialist countries

Country	Ownership prior to 1990	Private ownership (%)			Type of forest land restitution
		1990	2015	2015-1990	
Slovenia	Private forest ownership existing to some extent	60.4	76.6	16.2	Restitution of private ownership in addition to the area existing during the socialist times
Serbia		50.6	57.4	6.8	
Croatia		24.3	28.4	4.1	
Bosnia-Herzegovina		18.2	20.4	2.2	
Poland		16.6	18.1	1.5	
Estonia	No form of private ownership	0	49.0	49.0	Integral private forest land restitution in one stage
Lithuania		0	39.7	39.7	
Slovakia		0	37.8	37.8	
Czech Republic		0	23.5	23.5	
Romania		0	35.6	35.6	Integral private forest land restitution in multiple stages
Bulgaria		0	12.4	12.4	

1164 Source: compiled based on the data for forest ownership from UNECE Database (<https://w3.unece.org/PXWeb/en>) and Živojinović et al.
1165 (2015). Current national statistics data may provide different values (e.g. data presented for Serbia were reported by Forest Directorate
1166 in 2014 based on stand inventory, and are different from the data presented in National Forest Inventory from 2009).

1167 Reference:

1168 Živojinović, I., Weiss, G., Lidestav, G., Feliciano, D., Hujala, T., Dobšinská, Z., Lawrence, A., Nybakk, E., Quiroga, S., Schraml, U. 2015.
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