Model forests in Russia as landscape approach: Demonstration projects or initiatives for learning towards sustainable forest management?

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ABSTRACT

Implementing sustainable forest management (SFM) policy on the ground is not straightforward, and depends on the social-ecological context. To meet the need for place-based stakeholder collaboration towards regionally adapted knowledge production and learning in support of SFM an integrated landscape approach can assist. Hosting most of the circumboreal forest Russia is a key global player. To transition boreal forestry in the Russian Federation from wood mining towards SFM after the collapse of USSR several initiatives were initiated. Our aim is to review the outcomes and consequences of the initiatives employing the international Model Forest concepts' six principles in Russia. To identify candidates for the study we identified 12 local initiatives using this term, all in Russia's boreal forest biome. However, while seven demonstration forests focused on improving wood production practices, five were long-term stakeholder-driven development processes aimed at SFM, and were approved members of the International Model Forest Network. The five latter were selected for a detailed study to understand their temporal dynamic in the circumboreal Model Forest context, and the extent to which they complied with the six principles of the Model Forest concept as an example of a landscape approach. The sources, amounts and durations of these initiatives' funding affected both outcomes and consequences on the ground. All five had developed a partnership that formally shared a commitment to SFM. However, not all areas were large enough to represent all dimensions of SFM. Not all Model Forests developed a representative, participative, transparent, and accountable governance structure, which affected the programs of their activities. Finally, knowledge-sharing, capacity-building and networking at multiple levels was variable. In spite of Russia hosting most of the circumboreal forest the Model Forest concept was not sustained in Russia due to ending of foreign project funding, to limited continuity of committed local capacity, and poor support from national-level decision makers. The exception is the Komi Model Forest's transition to a successful consulting company focusing on SFM. To develop regionally adapted approaches to implement SFM policy we stress the importance of sharing experiences from Model Forests as well as other landscape approach concepts among countries and regions with different landscape histories and governance arrangements. To enhance this, we propose a general analytic framework for learning through evaluation about place-based long-term initiatives that integrate evidence-based knowledge about states and trends of sustainability and cross-sector multi-level governance.

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1. Introduction

Sustainable forest management (SFM) is an agreed international explicit grand policy vision for the sustainable use and governance of forest landscapes’ goods, services and values (Anon, 1995; Montréal Process, 2009; Forest Europe, 2011). To implement this vision, governance, spatial planning and forest management to satisfy economic, ecological and socio-cultural objectives need to be integrated at multiple levels of societal steering and spatial scales. Given that different SFM objectives are often rival (e.g., Mönkkönen et al., 2014; Triviño et al., 2015; Angelstam, 2018a; Eyvindson et al., 2018; Naumov et al., 2018), policy implementation requires collaborative learning among stakeholders based on active adaptive management (sensu Shea et al., 2002). This involves both the societal process of sustainable development (Baker, 2006), such as landscape or regional stewardship (Giesen, 2010; Angelstam and Elbakidze, 2017) as multi-level governance by stakeholders from public, private and civil sectors (Elbakidze et al., 2010), and the consequences of this process on the level of economic, ecological and socio-cultural sustainability. Governance, planning and management towards sustainability thus requires continuous monitoring of the states and trends of economic, ecological and socio-cultural dimensions of forest landscapes as social-ecological systems. Place-based integration of knowledge production and learning towards sustainable landscapes has become termed landscape approach (World Forestry Congress, 2009; Axelsson et al., 2011; Sayer et al., 2013; Freeman et al., 2015; Sabogal et al., 2015). However, the context for policy implementation varies considerably among states and regions due to biophysical, historical, social and political conditions affecting forest landscapes as social-ecological systems (Pierce Colfer and Capistrano, 2005; Lehtinen, 2006; Angelstam et al., 2005, 2011a, 2017a, 2017b, 2018a, 2018b; Blicharska et al., 2012; Henry and Tysiachniouk, 2018; Naumov et al., 2016).

Being the world’s largest country hosting the majority of the circumboreal forest biome, the Russian Federation harbours a large part of the world’s wood resources (Niskanen et al., 2003) and carbon stocks (Kranzina et al., 1996; Goodale et al., 2002), and hosts many of the last intact boreal forest landscapes and biodiversity hotspots (Potapov et al., 2008). The Russian Federation is thus a key global player for the implementation of SFM policy in the circumboreal biome. Russia is also interested in forestry intensification (Nordberg et al., 2013; Naumov et al., 2016; Angelstam et al., 2017a), and is challenged with retaining social and cultural values of forest landscapes associated with traditional land use practices supporting sustainability and governance (Kulyasova and Kulyasov, 2009; Lehtinen, 2006; Nordberg et al., 2013; Stryamets et al., 2015).

Since the end of the Soviet Union in 1991, and still with a top-down governance system (Malyshева, 2005; Elbakidze et al., 2010), forestry and the forest sector in the Russian Federation are in transition from planned to market economy (Nilsson and Shvidenko, 1998; Pappila, 1999). Forest legislation has been revised (e.g., Krot et al., 2000; Malyshева, 2005; Torniainen et al., 2006), forestry has been exposed to international pressure to develop market economy (Karvinen et al., 2006), and to the challenges of biodiversity conservation (Aksenov et al., 2002), increased use of bioenergy (Gerasimov and Karjalainen, 2009) and rural development (Blagovidov et al., 2006; Lehtinen, 2006).

The Russian Federation is committed to SFM through both the Montréal Process since 1995 and more recently the Pan-European forest policy process (Forest Europe, 2011). However, implementation of SFM policy in the Russian Federation, and other former socialist countries, face numerous specific challenges. Economically, the transition from planned to market economy and reformation of the forest sector, forest tenure and land ownership, and forest intensification issues are key topics (e.g., Carlsson, 2000; Carlsson et al., 2001; Solberg et al., 2010; Nordberg et al., 2013; Naumov et al., 2016). Ecologically, while policy objectives about forest biodiversity conservation and the related tools for implementation reflect state of the art, they are not well understood by those in charge of biodiversity policy implementation (e.g., Lazdinis et al., 2007; Blicharska et al., 2012). There are also limited knowledge, resources and tools for planning of functional habitat networks and collaboration, poor connections between local and regional planning, and weakly developed public participation (e.g., Blicharska et al., 2011). Furthermore, the maintenance of social and cultural capital is crucially important, especially in rural remote areas (Carlsson, 2000; Kulyasova et al., 2009). Finally, the current governance contexts, including both the federal-regional balance and degree of international influence, are clearly different today compared to the Soviet period (Lehtinen et al., 2004; Malyshева, 2005; Nysten-Haarała, 2009). New additional challenges are the emerging uncertainty and instability linked to global economic and climate change (i.e. ‘Anthropocene’), which make prediction and control difficult (Lawrence, 2016). This stresses the need to transition from planned top-down decision-making towards regionally adapted solutions where forest landscape stewards and managers need to collaborate, learn, assess risk, innovate, share findings and evaluate alternatives.

Russia has a legacy of mining wood for industrial use (Knize and Romanyuk, 2005), but is now seeing the need for new approaches (Naumov et al., 2016). An interesting aspect of the forest-related development in the Russian Federation is a suite of national and international initiatives using the term model forest to support the implementation of SFM, or aspects thereof, on the ground that, beginning in the 1990s appeared in regions with different forest ecosystems and forest history (Gromtsev, 2002; Elbakidze et al., 2007, 2010; Elbakidze and Angelstam, 2008). These initiatives form an important, but so far poorly utilized, pool of knowledge that is needed to the understand how different concepts and initiatives succeed with their intentions to promote SFM in the Russian context (Angelstam et al., 2009).

The aim of this study is to analyse place-based initiatives that used the term Model Forest sensu IMFN (2008) in the Russian Federation to understand and learn from their contribution to the implementation of SFM policy on the ground. First, we mapped all local and regional initiatives using the term model forest in Russia. Given the global role of the circumboreal forest biome we mapped the temporal dynamic of Model Forests in Russia, Canada and Fennoscandia. Second, for those initiatives in Russia currently or once listed on the web site on the International Model Forest Network (www.imfn.net), and thus committed to the Model Forest concept as an example of landscape approach, we analysed how these initiatives complied with the six core principles of the Model Forest concept according to IMFN (2008): landscape, partnership, commitment to sustainability, governance, program of activities, and knowledge sharing, capacity building and networking. We discuss lessons learned, and the need to encourage collaborative learning processes (Axelsson et al., 2013) by comparative studies of the effects of Model Forest as well as other landscape approach initiatives on landscapes as social-ecological systems in different governance and landscape history contexts in Europe and beyond (Angelstam et al., 2011a, 2013; Lehtinen et al., 2004; Nysten-Haarała, 2009). Finally, to enhance this, we propose a general theoretical neutral analytic framework to operationalise learning through evaluation from multiple place-based landscape approach concepts and initiatives applying them.

2. Theory: model forest as a landscape approach concept

Providing a wide range of consumptive and non-consumptive benefits to people, firms and society, landscapes’ renewable natural resources and values continue to be at the centre of many policies about forests, water, agriculture and rural development. To translate policies to practices that sustain an increasing range of benefits it is essential to navigate the complexity of interactions within coupled social and ecological systems of many kinds. Sustainable development theory recognizes since long the need for participants in resource management issues to work in partnership to build consensus on options (e.g., Sinclair and Smith, 1999). This implies both sustainable development
as an inclusive societal process (e.g., Baker, 2006), and ensuring sustainability as consequences on the ground (e.g., Norton, 2005). A key challenge is to actually operationalise this (e.g., Freeman et al., 2015). To maintain natural capital and enhance human well-being, modified landscapes often require capacity-building in social systems to help achieve resilience towards maintenance and restoration of landscapes as social-ecological systems (Dawson et al., 2017). This involves both place-based modification of the biophysical environment, coordination of human management of land and water, and motivation of stakeholders and actors to act sustainably.

The term landscape approach emerged with the aim to cope with this complex web of interactions on the ground (Axelsson et al., 2011; Sayer et al., 2013, 2015; Freeman et al., 2015; Sabogal et al., 2015). To enhance regionally adapted implementation of policies aimed at sustainable development and sustainability in landscapes as local social–ecological systems, a wide range of landscape approach concepts aimed towards place-based knowledge production and engaged stakeholder collaboration have emerged (Axelsson et al., 2011, 2013). Model Forest, Biosphere Reserve, Ecomuseum and Long-Term Socio-Ecological platform are four examples of landscape approach (Axelsson et al., 2011; Angelstam and Elbakidze, 2017). These concepts are paralleled by other efforts towards area-based rural development programmes (e.g., Giessen, 2010), such as based on regional governance of collaborative development processes involving forestry, agriculture and water.

Landscape is a well-established concept that can aid knowledge production and learning by fostering the necessary transdisciplinarity, thus integrating researchers and other knowledge producers representing different disciplines, as well as stakeholders representing different sectors at multiple levels (Ternorshuizen and Opdam, 2009; Freeman et al., 2015). The term landscape captures the manifold dimensions of areas and places where people live and work (Angelstam et al., 2013). Consideration of landscapes’ biophysical, anthropogenic and perceived dimensions at multiple scales represents a holistic approach to implement policy about sustainable use of natural capital through spatial planning and integrated land use management across landscapes as large areas (Prömdahl et al., 2017). Climate, terrain, soil and the flow of water determine the particular types of natural ecosystems, and form the biophysical checkerboard that underpins the delivery of ecosystem services. These range from tangible goods and ecological functions to habitat for species and cultural values. Human land use has modified once natural ecosystems, and resulted in cultural landscapes, agricultural fields, managed forests and built infrastructure. Furthermore, landscapes’ different land covers provide intangible cultural values, including sense of place to people. When landscapes have been intensively used to deliver one kind of ecosystem service, other ones may not be satisfied or disservices may occur.

Public participation builds on the hypothesis that if those affected by the use and conservation of natural resources system are involved in the decision-making steering the system, it will be easier to realize the aims expressed in policies (e.g., Blicharska et al., 2011). However, because ecological, economic and socio-cultural contexts vary in space and time, participatory approaches need to be adapted to specific local and regional context (e.g., Freeman et al., 2015; Angelstam and Elbakidze, 2017). To encourage the necessary collaborative learning among actors and stakeholders, there is a need to develop integrated place-based partnerships involving all key players across different sectors at multiple levels in local landscapes that matter to people living there, and beyond (Axelsson et al., 2015). The term landscape approach captures this, and focuses on strengthening cultures of maintaining inclusive social processes on the one hand, and sharing different actors’ and stakeholders’ views and needs of what multi-functional landscapes and regions should satisfy, and how to accomplish that on the other.

“Partnership towards sustainable landscapes”, i.e. Model Forest such as defined by IMFN (2008) is one type of landscape approach. Satisfying the different dimensions of SFM and other natural resource policies requires governance systems, which support coordination and co-operation across the horizontal and vertical organizational dimensions of a landscape as a social-ecological system (e.g., Elbakidze et al., 2010). Therefore, participation and deliberative consensus-building processes with the goal of enhancing cooperation and coordination among a diverse range of stakeholders is crucial (e.g., Healey, 2006). Thus, development of a partnership among stakeholders that represent private, public and civil sectors, as well as different levels of governance is one of the major conditions (Elbakidze et al., 2010). Partnerships may support implementation of approaches towards solving problems in landscape, land or water management; elaboration of new mechanism of knowledge and experience exchange; enhancement of the resource basis (technical, financial, etc.) for common targets; understanding of values and qualities of each sector necessary for integration and sustainability of society (Tennyson and Wilde, 2000). Ideally a partnership replaces competition by collaboration and leads to the development of improved personal, organizational and institutional capacity of partners.

Freeman et al. (2015) identified three meanings of landscape approach, namely a large spatial extent, a sectoral approach, and an integrated approach. Focusing on an integrated landscape approach, like the Model Forest concept, they examined five criteria that emerged from their analysis of landscape approach, i.e., multifunctionality, participation, inter/transdisciplinarity, sustainability and complexity (Table 5 in Freeman et al., 2015). Axelsson et al. (2011) presented a practical operationalization of landscape approach using five core attributes that should be satisfied: (1) a sufficiently large area that matches management requirements and challenges to deliver desired goods, services and values, (2) multi-level and multi-sector stakeholder collaboration that promotes sustainable development as a social process, (3) commitment to and understanding of sustainability as an aim among stakeholders, (4) integrative knowledge production, and (5) sharing of experience, results and information, to develop local tacit and general explicit knowledge. All five require collaborative participation. Sayer et al. (2013) noted that at the international level there has been a shift from conservation-oriented perspectives towards increasing integration of poverty alleviation goals. They listed ten summary principles (see also Table 2 below in the discussion) to support implementation of a landscape approach, all emphasizing adaptive management, stakeholder involvement, and multiple objectives.

The application of the analytic framework we used to address compliance with the international Model Forest concept followed the approach used by Blicharska et al. (2012) to analyse the implementation of the Polish Promotional Forest Complex’s 19 local initiatives, a concept aimed at promoting the Polish interpretation of SFM, against the principles that define that concept. Regarding the Model Forest concept, there are six core principles established by IMFN (2008) that define the acceptance of a Model Forest as a member into the international network: (1) a landscape large enough to present an area’s diverse forest uses and values; (2) an inclusive and dynamic partnership; (3) a commitment to sustainability; (4) a governance structure that is representative, participative, transparent and accountable; (5) a program of activities reflective of partner needs and values; (6) a commitment to knowledge-sharing, capacity building and networking from the local to the international levels.

3. Methods

To map initiatives using the term model forest in the Russian Federation we first made an internet search using the string “model forest” AND “Russia” in both English and Russian in 2011, which was the last year with an active model forest initiative (see Table 1). Russia hosts the majority of the circumboreal forests. Therefore, to put Russian Model Forest initiatives in a global perspective, we first mapped the temporal dynamic of initiatives in the circumboreal biome by using the website of the international and Canadian networks of Model Forests,
Table 1
Characteristics of place-based initiatives in Russia that used the term Model Forest (2004–2011).

| Name                  | Location and subject of Russian Ecoregion | Area (sq. km) | Duration of Model Forest | Initial Donor Model Forest | Frequency of occurrence on English vs. Russian web sites (n=500) | References |
|-----------------------|------------------------------------------|---------------|--------------------------|--------------------------|---------------------------------------------------------------|------------|
| Gassinski             | Nanaiski, Chabarowsk boreal              | 3890          | 1994–2005                | Canadian-Russian          | 9 vs. 7%                                                       | Matsuo (2002), Anon (2006), Lytzenko (2008) |
| Komi                  | Priluzje, Komi south boreal              | 8000          | 1996–2006                | Swiss                    | 11 vs. 14%                                                     | Majevski et al. (2008), Elbakidze et al. (2010, 2012) |
| Kovdordzky            | Murmansk region, Nizhny Novgorod WWF      | 5600          | 2007–2009                | Finnish-Russian          | 11 vs. 50%                                                     | Valueva (2008), Angelstam et al. (2009) |
| Pskov                 | Sestroretsky, Nizhny NIzhny Novgorod      | 22,000        | 2007–2009                | Finnish-Russian          | 11 vs. 50%                                                     | Indufor Oy (2009) |
| Tyumen                | Not decided, boreal                      | NA            | Plan 2008–2011           | Finnish-Russian          | 11 vs. 50%                                                     | NA         |
| Ulchsk                | Not decided, Chabarowsk                   | NA            | Plan 2008–2011           | Finnish-Russian          | 11 vs. 50%                                                     | NA         |
| White Sea             | Not decided, Archangelsk                 | NA            | Plan 2008–2011           | Finnish-Russian          | 11 vs. 50%                                                     | NA         |
| Yugra                 | Sovietsky, Xanti-Mansi mid boreal        | 5000          | Plan 2008–2011           | Finnish-Russian          | 11 vs. 50%                                                     | NA         |

4. Results

4.1. Survey and dynamics of model forest initiatives

The Internet search to map place-based initiatives using the combined key words “model forest” and “Russia” resulted in 36,600 hits in English, and 17,400 in Russian. Using the first 500 results from each of the searches we identified 12 initiatives (Table 1, Fig. 1). There were, however, clear differences between the information on the English and Russian web sites. On web sites in English the five Model Forests (Gassinski in Khabarovsk kraj, Kologrivski in Kostroma oblast, Komi in the Komi Republic, Kovdordzsky in Murmansk oblast and Pskov in Pskov oblast) were listed, as well as an additional five initiatives (Table 1, Fig. 1). These initiatives were listed, as well as an additional five initiatives (Table 1, Fig. 1). In terms of the frequency of occurrence of all initiatives, Komi Model Forest ranked highest on English web sites and Pskov Model Forest highest on Russian sites. Gassinski Model Forest ranked third in both languages. General information and discussion about Russian initiatives was represented in 12–13% of web sites in both languages. Finally, English web sites comprised a high proportion of sites without relevant content to Model Forest initiatives in Russia (49%) compared to Russian sites (1%). The initiatives varied much in terms of origin (Russian or foreign), year of appearance (1994–2011) and stage of development (from idea to terminated project) (Table 1). The temporal dynamic of the five Russian Model Forest initiatives and updating this data through interviews with the coordinators of the Russian, Fennoscandian and Canadian network of Model Forests in 2017. Next, we focused the analysis on the five initiatives that once were committed to the Model Forest concept in the Russian Federation, and following the guidelines in IMFN (2008).

To understand the drivers behind the establishment of initiatives using the term model forest, and to assess compliance of individual model forest initiatives with the Model Forest concept’s principles (IMFN, 2008) we used mixed methods (Greene, 2007). The qualitative analysis was inspired by grounded theory (Glasser and Strauss, 1967). First, open-ended qualitative interviews were conducted with Model Forest coordinators, facilitators and leaders, as well as with stakeholders and actors at different levels of governance. The total number of face-to-face interviews amounted to 36 in Kovdordzsky, 102 in Komi, 77 in Pskov, and 30 in Kologrivsky. The interviews focused on the development process of the Model Forests from idea to implementation, maturation and eventually termination. This included the nature of stakeholder participation and governance structures of Model Forests to understand correspondence to the IMFN principles 2, 3, 4 and 6.

Second, to analyse how the programs of Model Forests’ activities reflected the partners’ needs and values (Model Forest principle 5), we analysed documents and reports stored in Model Forest archives, and published information in regional newspapers, journals and magazines. Our aim was to assemble an overview of the local and regional issues or concerns related to natural resource management that eventually led to the establishment of a Model Forest initiative. Third, we made literature searches for peer-review research articles and papers in professional forestry journals. Data were collected during the period 2005–2017 during multiple periods of research in the Model Forest initiatives in Kologrivsky (by AK, BP), Komi and Pskov (by ME, MT, PA), and Kovdordzsky (by ME, PA). Gassinski was terminated before this study commenced, but was observed by EZ; here we relied on two key informants who were involved with this initiative as auditors. Finally, regarding principle 3 we developed one ecological, one economic and one social sustainability argument regarding what is a sufficient size of a Model Forest landscape. In the results section each of the Model Forest principles are summarised, after which the results are presented.
that eventually became members of IMFN for longer or shorter time was bell-shaped, starting with Gassinski in 1994 and ending with Kologrivsky and Kovdozersky in 2009 (Fig. 2). For comparison at the circumboreal level, all the Model Forest initiatives being members of www.imfn.net, also including Canada and Fennoscandia, are presented in Fig. 2. The peak was 22 Model Forests in 2007 and 2008. Hosting the majority of the circumboreal forest biome, the proportion of Model Forest initiatives in Russia committed to IMFN principles was disproportionately low.

4.2. Drivers for establishment of model forest initiatives

Since the early 1990s organizations and policy processes in several different countries were involved with plans and initiatives to support implementation of SFM policy on the ground in the Russian Federation (Lehtinen et al., 2004; Besseau et al., 2008). Official plans to establish Model Forests in Russia began in 1992, and in 1993 a limited competition among several proposals resulted in the creation of Gassinski Model Forest in 1994 with Canadian funding and Russian in-kind support (Anon, 2006). Within the framework of the Barents Council, which includes Russia, Finland, Sweden and Norway, high level meetings were held and argued for place-based initiative using the term Model Forest (Barents Region Forest Sector Initiative, 2001). Three Model Forests (Kologrivski, Komi and Pskov) emerged independently, being initiated and financed from abroad, i.e. the Netherlands, Switzerland and Sweden/Finland, respectively (Elbakidze et al., 2007, 2010; Table 1). At their initiation none of them were associated with the IMFN. During 2002–2003 the Barents Euro-Arctic Council Working Group on Economic Cooperation’s Forest Sector Task Force (FSTF) started the planning process to identify a suitable new Model Forest area in NW Russia. An open call for Model Forest proposals was launched and questionnaires were sent to the regional committees of natural resources in Karelia, Murmansk, Novgorod, Vologda and Leningrad oblasts. In 2003 the FSTF received three proposals from Archangelsk region and one from Murmansk. Archangelsk’s suggestion included three alternative forest management units. Murmansk region proposed the Kovdozersky state forest management unit as the location for developing a Model Forest (Elbakidze et al., 2007).

Bordering Russia, Finland has a long history of forest-related collaboration with Russia. This includes the establishment of the Taiga Model Forest in the Karelian Republic and the Volga Forestry Model Forest project in Nizhny Novgorod oblast. Within the framework of the Russian-Swedish forest sector co-operation the Swedish International Development Agency (SIDA) funded Pskov Model Forest during several project periods in periods 2000–2008. The European Union (EU) funded the Baltic Forest project (2006–07) and the Baltic Landscape project (2011−2013), both of which aimed to establish a network of Model Forest initiatives in the Baltic Sea Region. In November 2007, an agreement on collaboration between the Swedish Agency of Forestry and the Russian Federal Agency of Forestry was signed. Development of a Model Forest network was one of the main items discussed during the meeting. Also under the trade collaboration agreement between Sweden and the Russian Federation and the Barents Sea Region co-operation initiatives the Model Forest concept was highlighted. Focusing on Pskov Model Forest, funding from Swedish SIDA for 2009–2010 facilitated (1) exchange of existing knowledge between forest landscape managers in Russia and Sweden; (2) overcoming of cultural barriers for efficient knowledge and information exchange; (3)
obtaining knowledge on how SFM can be implemented in regions with different systems of management and level of economic development to satisfy social needs in forest products, services and values; (4) development of approaches, which include local communities in the processes of making decisions in the sphere of natural resources management on local and regional levels.

The web site http://modelforest.ru created in 2010, but now gone, and operated on behalf of the Russian Forestry Agency by the International Forest Institute and All-Russian Scientific Research Institute of Forestry and Mechanisation (VNIIILM) was a clear sign of the ongoing Russian-Canadian collaboration. In 2007 the Russian Federal Agency of Forestry, inspired by the experience of the Canadian Model Forests, had a plan to create 31 Model Forests in all forest zones of the Russian Federation (Elbakidze et al., 2007; Elbakidze and Angelstam, 2008). Each Model Forest initiative was supposed to include both a geographical area and apply a special approach to SFM based on partnerships of all representative stakeholders (V. Roshchupkin, pers. comm; Anon, 2006). Following the appearance of the new Russian Forest Code in 2007, the idea was to develop Model Forests as “forest laboratories” and examples of how to implement policies about SFM based on domestic and international experiences (Zhdalak, 2008; Martyuk et al., 2009). Zhelzhak (2008) listed 22 different sites in a proposed (or potential) Russian Model Forest network. From a geographical perspective, the idea was that each Model Forest should embrace a concrete territory, and the Model Forest network would represent all types of forests, and forest goods, services and values in Russia. However, due to changes in the political establishment in the Russian Federation the idea of development of Russian Model Forest network disappeared.

Summing up, the 12 Model Forest initiatives varied much in terms of origin (Russian or foreign), year of appearance and stages of development (from idea to completed project) during the period 1994–2011 (Table 1). In 2016 three Model Forest initiatives (Komi, Pskov and Kvodozersky) were still listed on www.imfn.net. In spite of this they were not active (Table 1, Fig. 2). In 2018 only Komi was listed, and the co-ordinating body for Komi Model Forest, the Silver Taiga foundation, had developed into a successful consultancy company focusing on developing different aspects of SFM in NW Russia. The Pskov Model Forest project ended in 2008. To continue the dissemination of the experiences of forestry intensification developed by the Pskov Model Forest by adopting Scandinavian experiences in the Russian context, the NGO Green Forest established in 2002 continued as a consultant NGO (P. Hazell, pers. comm.). Former Pskov Model Forest staff members still continue the dissemination of how to introduce intensive forest management in the boreal biome in Russia (B. Romanyuk, pers. comm.). This is supported by the international pulp-and-paper industry that depends on local and regional wood resources. These companies lobbied for the intensive forest management model to the Russian Federal forest authority; and from 2015 the Federal Agency of Forestry provided their official support to dissemination of this model.

4.3. Compliance with the model forest core principles

4.3.1. Principle 1: A landscape large enough to represent an area’s diverse forest uses and values

4.3.1.1. General. According to IMFN (2008) the area of a Model Forest should therefore include the diversity of forest use and regional values, and to represent large ecosystems. It must not, however, be excessively large so that forest users lose the sense of place. These criteria are fluid and dependent on context. To provide some idea of the size of a landscape we provide one ecological, one economic and one social sustainability argument. Using the minimum occurrence thresholds of breeding birds listed in the EU Habitat Directive at the home-range and landscape scales Angelstam et al. (2004) estimated that the average minimum area needed for 100 females was about 250,000 ha for a dynamic managed boreal forest landscape. Assuming that viable populations would need to encompass an effective population of 500 females (Meffe and Carroll, 1994), the area needed for viable populations would thus exceed 1,000,000 ha for the bird species in the example above. An economic example is a fictive boreal forest management unit that delivers 2,000,000 cubic meters of timber and pulpwood to sawmills and paper and pulp industries every year. Assuming a growth rate and harvest of 4 cubic metres per year the size of the forest management unit would be about 500,000 ha. From a regional planning perspective, and assuming that forest cover in this region is 50%, thus excluding bogs and wetlands, cities and settlements, agricultural and other land, this would also be equivalent to an administrative region or catchment of about 1,000,000 ha. Without the wood supply provided through commercial thinning, as in Sweden and Finland, the “growth rate” would be about 2 cubic meter per ha, and the management unit twice as large. Finally, from a social system perspective the daily home-range of people can be estimated based on the observation that across time and space people do not commute to work > 1.5 h per day, i.e. corresponding to ca 50–60 km one-way travel distance by car or train (e.g., Lindelöw, 2018). With a radius of 56 km around a regional center a social system landscape also covers 1,000,000 ha.

The sizes of Gassinski, Kologrivski, Komi and Kovdozersky Model Forests were all several 100,000 to 1,000,000 ha in size while Pskov Model Forest was much smaller (Table 1). This suggests that the territories of the four first Model Forests listed above were of sufficient size to address economic, ecological and social sustainability issues at multiple spatial scales, while the area of Pskov Model Forest was too small to cover all sustainability dimensions. For example, the size of Kologrivski Model Forest was large enough to test the relevance of the catchment-based approach for planning logging sequences as well as to elaborate specific technologies adapted to various abiotic landscape units (e.g., forest site types linked morainic, glacioluvial and loess soils). However, there were also limitations. Landscape-ecological tools proposed for decision-making in the Model Forest assume priority of natural boundaries, which are curvilinear in most cases. However, the regional-scale planning documents insist on following strict linear boundaries of logging areas. Measures aimed at protection of old-growth forests were often perceived by practitioners as undesirable due to the lack of other easily accessible coniferous stands. Tenants of state forest lands did not enough stimuli to build networks of roads and prefer to use existing ones. This leads to overexploitation of accessible forests and emergence of huge monotonous young stands with low biodiversity. At the same time remote stands are not harvested. Although some experienced forest managers, showed awareness of the necessity to high conservation value forest stands such as old-growth remnants and riparian forests, they prefer to use conventional technologies in order to avoid fines (e.g., for leaving groups of trees in a logging area).

4.3.2. Principle 2: An inclusive and dynamic partnership

4.3.2.1. General. Our analyses of the coordination and co-operation at different governance levels and among sectors in order to improve local governance show that the five Russian Model Forests committed to IMFN principles varied in their approaches to partnership development.

4.3.2.2. Gassinski model forest. The ultimate goal of this Model Forest was to provide support for socio-economic development in the remote and natural resource dependent Nanajski district in Khabarovsk kraj in easternmost Russia. There was a heavy dominance of partners from public (government) sector at the creation in 1994, because the state was the only owner of forests and natural resources. Canadian funding of 1,000,000 CAD/yr was granted for the first 5-year period of this project, and in kind contributions of the same order of magnitude were provided by the Russian counterparts. This allowed for sustaining open discussion and deal with elitism, which later evolved into participation of civil and indigenous people, governmental organizations and
4.3.2.3. Kologrivski model forest. This Model Forest project ran under a grant from the Dutch government during the period 2006–2009, which was spent to conduct research and organise public and stakeholder involvement needed to formulate the main tasks of Kologrivsky Model Forest (Ladonina and Pedroli, 2009). At the start it was recognised by the project leaders that the local stakeholder commitment to SFM in this area, located far from the European market, was very weak (Anon., 2005). The majority of stakeholders from local to regional levels did not understand the idea of SFM, and were negative to the development of a Model Forest. They were afraid that it would bring serious limitations to the exploitation of forest resources for the national market. The almost simultaneous formal establishment of the Kologrivsky Model Forest Federal Strict Nature Reserve (Zapovednik) in January 2006, although in line with the Model Forest concept, did not make the position of the Kologrivsky Model Forest easier. Local forest managers argued that the Model Forest had no sufficient legal credentials to implement environmentally-friendly harvesting techniques, which in many cases turned out to be in contradiction with present-day practice. The loss of a local champion had a negative impact on the further development of the Model Forest.

4.3.2.4. Komi model forest. A total of 51 partners participated in the project’s later phases 2000–2006, and represented public, civil and private sectors. Since 2006 it was continued in the form of the non-profit foundation “Silver Taiga”. This partnership successfully created a platform for discussing a broad spectrum of local and regional SFM problems, and for gradual development of collaboration. However, the majority of partners were from the public sector, and the private sector was less represented. The partners from civil sector actively participated in implementation of different Model Forest activities on the ground by working closely with local schools, museums and local youth clubs (Majevski et al., 2008; Elbakidze et al., 2010; Tysiachniouk, 2005, 2010; Tysiachniouk, 2006). Although not primarily focussing on the model forest issue, also Russian-Dutch cooperation on the Pechora River Integrated System Management 2003–2008 was strongly engaged in SFM issues in the Komi Republic (Van der Sluis et al., 2004; Van Eerden et al., 2005).

4.3.2.5. Kovdaesersky model forest. This initiative began in 2006. > 30 organizations representing local and regional business, local administration and regional non-governmental organizations responded to the invitation to become partners of the Model Forest project. However, the public sector dominated, and the majority of partners did not understand the ideas of the Model Forest defined by the IMFN (2008) (see Elbakidze et al., 2007, 2012).

4.3.2.6. Pskov model forest. The main partners of the Pskov Model Forest project were the World Wildlife Fund (WWF) and the international forest company StoraEnso. Additionally the public sector participated (the Ministry of Natural Resources of the Russian Federation, the administration of the Pskov region, the local administration of the Model Forest area in the Strug-Krasny district, the Forest Agency of the Pskov region, the North-Western State Forest Company; St Petersburg Forest Research Institute). This partnership was initially directed at solving a number of specific issues in forestry associated to introducing Fennoscandian intensive forest management, and with hope that this would help to change forest legislation to accommodate this transition (Tysiachniouk, 2008, 2010, 2012; Tysiachniouk, 2006; Tysiachniouk and Tulaeva, 2008; Tysiachniouk and Meidinger, 2012).

4.3.3. Principle 3: A commitment to sustainability

4.3.3.1. General. According to official documents and statements, the objectives of all the Model Forests were to implement SFM by satisfying its economic, ecological and social dimensions at the regional level, and to disseminate new experience in the Russian Federation. Due to regional differences, determined by natural characteristics of the local forest landscapes, however, their environmental history and current differences in economic development, the motivations of Model Forest development were different. This, in turn, influenced the priority of SFM-related tasks of the Model Forests.

4.3.3.2. Gassinski model forest. The charter document and work plans indicated a formal commitment to all dimensions of SFM. A large portion of work was dedicated to inventory of biological resources, including forest and non-wood forest resources. During the first phase of the project, forest zoning, classifications of forest resources and its management plans were developed based on large scale inventory. The second phase of the project was focused on economic development. Gassinski Model Forest in cooperation with Canadian McGregor Model Forest carried out a project focused particularly on small business development.

4.3.3.3. Kologrivski model forest. This Model Forest was initiated as a continuation of two Russian-Dutch cooperation projects in Kostroma Oblast, namely the Kologrivski Model Forest strict nature reserve and Kostroma-ECOMET (Ladonina and Pedroli, 2009; Glazov and Pedroli, 2011; Nemchinova and Khoroshev, 2011). The main goal of this model Forest initiative was to implement sustainable multiple use forestry through spatial planning based on landscape ecological principles (Khoroshev, 2008). An additional objective was to certify the forest management according to the Russian National standard of forest management developed by the Russian National Committee of forest certification. There was a plan to create a Model Forest information centre. However, these plans were not realized (Ladonina and Pedroli, 2009). The regional wood-processing industry showed no active interest in cooperation for preparation of forest certification procedures. A typical explanation from timber harvesting companies involved was that there was no need for certification given their preferred orientation on Russian markets only. However, some managers demonstrated interest in cooperation with the Model Forest concerning an update of the state forest inventory results and recalculation of available timber resources taking into account actual landscape diversity.

4.3.3.4. Komi model forest. Protection of pristine forests from wood harvesting was the original motivation for developing the Komi MF. In the beginning of the 1990s, several foreign forest companies began logging operations in the naturally dynamic forests adjacent to the Pechora-Ilych Reserve in the eastern Komi Republic (Elbakidze and Angelstam, 2008; Elbakidze et al., 2010; Tysiachniouk, 2012). To prevent exploitation of these last large intact forest landscapes (Yaroshenko et al., 2001; Van der Sluis et al., 2004; Van Eerden et al., 2005), researchers from Russia and Sweden prepared a project with an aim to elaborate approaches to their sustainable management and submitted it to World Wildlife Fund (WWF) International. The project idea was accepted and began in 1996. The Swiss Agency for Development and Cooperation (SDC), which supported SFM implementation in countries in transition in the mid-1990s, funded the project. In 1999, SDC decided to shift the focus of the project to southwest Komi, and to use the term Model Forest. Criteria for selecting a Model Forest area were formulated and the area of Priluzje state forest enterprise in south-westernmost Komi was chosen for the Komi MF
development. Although the main focus of the Model Forest activity at the beginning was on ecological aspects of forest management, analysis of the project materials and publications shows that priorities had been shifted from mainly ecological to economic and socio-cultural issues in forest management, and dissemination and education.

4.3.3.5. Kovdozersky model forest. This Model Forest project was initiated by the Council of the Barents-Euroarctic region within the collaboration in the Barents region. To implement SFM in NW Russia, a working group of the Council on economic collaboration started in 2002 a search for the most optimal region for developing the Model Forest in the North-West Russia. In 2003, the Kovdozersky state forest enterprise in the south of Murmansk Oblast was chosen out of several candidates to develop the Model Forest. In 2004, consent of the Federal Agency of Forestry and the Ministry of Natural Resources of the Russian Federation was obtained. The main objective of developing the Model Forest was to revive forestry and the forest industry, which were the main employers during the Soviet time in the region, but declined dramatically in recent times which led to negative social consequences in the villages, such as high level of unemployment, depopulation and alcoholism (Elbakidze et al., 2007). Thus, the initial aim of the Model Forest was related to social and economic aspects of forest management. The Kovdozersky Model Forest initiative was not able to realize its ambitions and ended soon after when the foreign donors stopped their financial support.

4.3.3.6. Pskov model forest. In the 1990s, the Pskov region, bordering the Baltic States, began playing an important role in timber trade and came into the zone of economic interests of the trans-national corporation StoraEnso. To ensure regular wood supplies, the company decided to initiate logging operations in the Pskov region. However, use of modern Scandinavian practices contradicted the existing Russian system of forestry regulations. To reach economic efficiency, StoraEnso had to develop new norms for their operations, which would be appropriate under the conditions of the Pskov region as one with extensive secondary forests after previous clear-cuttings, and which could ensure economic profitability of the timber industry in the given market situation. In 2002 the company decided to initiate a project targeted at developing new ways of intensive forestry, adapted to the conditions in NW Russia. Given the partnership between Stora Enso, WWF and the Swedish International Development Agency (SIDA) and Russian authorities there was a balance between economic, ecological and social motives, in terms of poverty alleviation through strengthening Russian forest sector business capacity (Tysiachniouk, 2012).

4.3.4. Principle 4: A governance structure that is representative, participative, transparent, and accountable

4.3.4.1. General. The governance systems of Russian Model Forests had similar features in terms of (1) a donor, financing and controlling project development; (2) project executives (or a non-governmental organization), implementing it; (3) a council of observers, which represents the interests of donors and coordinates activities; (4) a coordinating board (or a working group), consisting of partners’ representatives and participating in the elaboration of the action plan. While the Model Forests had large partnerships, their achievements seem to have depended on the efforts of a dedicated core group (e.g., Anon, 2006). Hence we present the results for three aspects rather than for each of the five Model Forests.

The decision-making process in the Model Forests generally included (1) a project-funded NGO or project executives, who through consultations with a working group or coordinating board, revealed problems in forest use or management, evaluated them and found solutions. These were then discussed with (2) stakeholders, and then with (3) donor representatives. For example, in the Komi Model Forest the process was initiated by the donor, whose representative became a key actor in the governance system. Later, the NGO Silver Taiga took over a key role in the design of a strategic action plan to implement SFM with regard to local and regional nature resources and economic conditions and interests of the forest stakeholders. To realize the plans a working group with representatives of main partners was formed. The discussions among partners on different aspects of SFM were hot and opinions were often difficult to reconcile.

The implementation of decisions generally began after they were approved by the donor or the project leadership (see also Elbakidze et al. (2010) for Pskov and Komi Model Forests). NGO-based project teams as executives worked with target groups, stakeholders and governmental organizations to realize adopted decisions, the donor or its representatives controlling this process. In addition to involving donors into the decision-making process, the transparency of the system of management was ensured by the work of the public relations group, which disseminated information on the project implementation via mass media and publication of various materials.

The local population participated in the decision-making process and its implementation through (1) public hearings on the questions of forest use, which were also required by FSC certification in Komi and Pskov; (2) formation of forest forums as neutral platforms for discussing questions of forest use between local population and other stakeholders; (3) provision of small grants for different activities in the Model Forest, such as forest forum events, ecology festivals and preparation of ecological trails. Libraries, schools, and cultural establishments were the main recipients of grants (Tysiaichniouk, 2006, 2012).

Educational activities were important components in the Model Forest governance system (see e.g., Ladonina and Pedroli, 2009, p. 27–29). Local and regional questions and problems of forest use and management became the topics of educational programs of field seminars and excursions for forest users and representatives of governmental structures of different levels. Some of these seminars showed evidence that the employees of the local forest management departments were disappointed by the necessity to spend too much time not in the forest but in the office for bureaucracy needs, especially following frequent alterations in legislation. They complained that recent legal regulations deprived them of some important rights and duties for forest recovery and fire protection (“we know how but have no right”) while tenants in contrast “must do that but have no enough skills” (Ladonina and Pedroli, 2009). Then they were discussed on regional, federal and international levels that made the situation in the region more open and transparent, and attracted public attention to issues of forest use. Furthermore, new specialists were trained, who then possessed practical knowledge in dealing with the SFM issues.

4.3.5. Principle 5: A program of activities reflective of partner needs and values

4.3.5.1. General. Although the initial motives for creation of Model Forests were different, given sufficient time, they all developed programs directed at the balance of major dimensions of SFM (ecological, economic, socio-cultural). They all also stressed the need for developing education, and improvement of the system of forest governance. The main direction of activities in the programs were similar and envisaged the following program of activity items: maintaining ecological functions of forests, conservation of biodiversity and pristine forests, support of FSC-certification process; economics of forest use; involvement of local population into the process of decision-making related to forest management; educational courses; development of regional forest regulation. Thus, all Model Forests’ programs reflected interests and values of partners supported by discussions, collaborative work on projects and by requirements of donor organizations.

4.3.6. Principle 6. A commitment to knowledge-sharing, capacity-building and networking at multiple levels

4.3.6.1. General. We identified three stages in the development of
Model Forests in Russia, each characterized by different scales of their network activities and capacity-building. During the first “childhood stage”, a regional team of specialists was formed that acquired professional experience and knowledge for identification, evaluation and solution of concrete problems of forest use on local and regional levels. These specialists also learnt to collaborate with Model Forest partners and other stakeholders, and to establish contacts with governmental structures for implementation of decisions on SFM policy. Donor organizations, like caring and demanding parents, helped projects to develop continuously.

At the second “maturing” stage, Model Forests, having funding and the experience and knowledge on solving difficult problems related to forest use, realized the necessity of presenting themselves on the national level as knowledgeable and experienced stakeholders in the process of forest sector reformation in the Russian Federation. This evolutionary period of Model Forests was accompanied by a number of important events. One example is that the representatives of five Model Forests signed an agreement for collaboration within the framework of the Initiative Network of Model Forests of Russia in June 2006 (Elbakidze and Angelstam, 2008).

During the third “adult” period of Russian Model Forests began their independent life without donor assistance. The foreign financial support ended in 2006 for the Komi Model Forest and in 2009 for Pskov and Kologrivski Model Forests. At present two Model Forest projects resulted in the evolution into project dependent-independent organizations, Silver Taiga and Green Forest, respectively. Today, only Silver Taiga maintains its niche in addressing questions of SFM on local and regional levels with partners at different levels through projects. Kologrivski Model Forest has gone into hibernation, but a group of former participants of the Model Forest project still continue working out methodology of region-specific multifunctional forest management (Khoroshev and Koshcheeva, 2009; Nemchinova and Khoroshev, 2011).

5. Discussion

5.1. Model forests in Russia: projects with different meanings

According to IMFN (2008) a Model Forest is characterized by operating in a landscape and having a partnership of stakeholders committed to sustainability. All principles listed by IMFN (2008) were formally shared by the five Model Forest initiatives once listed at the IMFN web site. The adoption in Russia of the Model Forest idea in the early 1990s, just shortly after its creation, was related to the Russian concept “best practices demonstration forests”, which was established to develop and show forest management practices adapted to different regions (e.g., Vatsenko, 1999). This Russian concept is close to the term Model Forest, but does not imply the Model Forest principles concerning neither sustainable development as a societal process nor sustainability of multiple dimensions as outcomes. Thus, the term model forest, as originally used in Russia, referred to a demonstration or research site (Kolström and Leinonen, 2000), and did not include a partnership of stakeholders committed to SFM as a deliberative social process in landscapes with its ecosystems and social systems as defined by IMFN (2008). This is consistent with two barriers to implement SFM through landscape approach in Russia applied to forests. The first is the legacy of top-down decision-making, including a consensus of scholarly analyses showing that, if Russia ever did enter a transition to democracy after the end of USSR, that transition was not successful (Evans, 2011). The second is the clear focus on timber and pulpwood, which is illustrated by the new 2006 Russian Forest Code that came in force 2007, and which according to Hitchcock (2011) lacks commitment to environmental issues.

Hence, there are two views regarding how the term model forest is defined in Russia. The first can be described as demonstration of best practices in forest management that focuses of wood production. Those were top-down demonstration projects that were not linked to the International Model Forest Network’s approach (IMFN, 2008), and which aimed at demonstrating and introducing best practices with a focus on forestry intensification (e.g., the Finnish-funded Taiga and the Volga Forestry Model Forests) (Leinonen and Kolström, 1999; Indufor Oy, 2009). The second was a landscape approach based on applying a place-based societal sustainable development process towards sustainability that is based on integrative knowledge production regarding both social and ecological systems, respectively (e.g., Axelsson et al., 2011; Kløy et al., 2015). Three Model Forests that were linked to IMFN began top-down with funding from abroad, but then developed into more participatory governance (Gassinski and Pskov, and especially Komi Model Forest, see Elbakidze et al. (2010)). Foreign donors’ support to collaborative learning was crucial for this transition. Two Model Forests linked to IMFN had a bottom-up more Russian-led regional approach from the beginning (Kovdзерsky and Kologrivski).

The Model Forest in Komi is an example of a successful project, which transformed into the non-profit consultancy company Silver Taiga focusing on economic, ecological and socio-cultural dimensions of forest landscapes. During the period 1996–2006 a Swiss-funded project was carried out using the name Priluzje Model Forest, which was facilitated by the Silver Taiga Foundation under the active supervision of a donor committed to transdisciplinary knowledge production (Kløy et al., 2015). However, the site www.komimodelforest.ru has not been updated since January 2009, and visitors are re-directed to www.silvertaiga.ru. Similarly, the Pskov Model Forest project was carried out 2000–2008 and the most recent news on the site www.wwf.ru/pskov/ was from February 2009. The Green Forest Foundation, which was established by the donor, was expected to continue the dissemination of Pskov Model Forest experiences. However, the most recent news from the site www.green-forest.org is from January 2007. Nevertheless, in the case of the Pskov Model Forest, the experiences of introducing the Nordic intensive forestry model in Russia, as well as approaches to planning for biodiversity conservation, continue to be disseminated to other regions in Russia (B. Romanyuk, pers. comm.).

In 2007 the Russian Federal Agency of Forestry claimed that it would take administrative and financial responsibility for developing a network of Model Forests in Russia. However, during the transformation of the Russian forest sector after the new Forest Code in 2007, and the subsequent restructuring of state agencies and changing jurisdictions, the support for this network ceased. Unfortunately, the accumulated considerable practical experience in solving regional questions of SFM and its governance in Russian Model Forest and other place-based initiatives, are therefore not used to their full potential to address current challenges (see Nordberg et al., 2013; Naumov et al., 2016; Angelstam et al., 2017a). According to Crotty et al. (2014) the passing of the Russian NGO Law in 2006 has led to a reduction in NGO activity, as well as curtailment of civil society development. Foreign support to Russian civil society is considered as agent activity, and has ceased. Instead groups funded and therefore controlled by the state dominate. This has implications for landscape approach initiatives’ focus on multi-level governance as part of democratic development.

All Russian Model Forest initiatives committed to IMFN (2008) and reviewed in this study were short-term or long-term projects, which appeared as a result of a successful timing and the combination of donors interested in Russian SFM development, and sometimes a strong local or regional champion. These factors made it possible to promote and implement new decisions in order to change and improve forest management according to the desires of stakeholders. The majority of the activities in the decision-making and implementation processes were initiated, facilitated and financed by foreign donors.

The type of donor chosen by the local champion determined the interests and approaches towards the implementation of SFM in Russia. With the exception of Gassinski and Kovdзерsky initiatives all Model Forests were actively using international FSC forest certification (or, in the case of Kologrivski, the Russian forest certification system (Zhelidák, 2008) as a tool for SFM implementation. This was also a way to get
funding since the initiatives became important structures for the FSC implementation process, and thus kept the Model Forest initiatives alive (Tysiachiouk and McDermott, 2016). However, our results shows that local governance arrangement supported financially, and partly professionally, from abroad cannot be adaptive in the long run, including a “post-project” life. Similarly, without place-based facilitation, international origin forest certification frequently faces problems to include social interests and engaging local communities (Henry and Tysiachiouk, 2018; Tysiachiouk and Henry, 2015).

5.2. International sharing of knowledge among Model Forests

As a landscape approach concept focusing on forests, the Model Forest concept emerged with the aim to establish a flexible adaptive approach based on large-scale experimentation and pilot areas to demonstrate potentially useful approaches to sustainable forest management (Brand et al., 1996). A fundamental principle of the Model Forest concept is the generation and sharing of knowledge through research, innovation and collaboration (Axelsson et al., 2011, 2013; Bonnell, 2012). Hosting the largest proportion of the circumboreal forest biome, Russia is of key importance for conservation and sustainable use of boreal forests. However, the route towards implementation of SFM policy varies depending on a particular region’s or landscape’s history, social and community base, economic development, and ecological context. Our analysis of Model Forest initiatives in Russia shows that there is a rich pool of experiences that can be used to gain needed knowledge to support the implementation of SFM, and for the development of local to regional adaptive governance initiatives not only in Russia, but also internationally. In spite of multiple reasons for encouraging application of a landscape approach such as Model Forest in the circumboreal forest biome’s different contexts, it is surprising to the observe the disappearance of the Model Forest concept in Russia, and also the decline of Model Forest initiatives in Canada (Fig. 2). This diversity of path dependencies offers unique opportunities for systematic analyses of multiple Model Forest initiatives. Brand et al. (1996) and Bonnell (2012) pioneered comparisons of multiple Model Forest initiatives in Canada. Focusing on initiatives in the Russian Federation committed to the MF concept sensu IMFN (2008) this study fills a gap regarding systematic analysis of experiences of applying the Model Forest concept in a top-down governance context.

Analyses of multiple Model Forest initiatives offer opportunity for learning about participation and governance in different contexts (e.g., Elbakidze et al., 2010) as well as particular aspects of SFM (Nordberg et al., 2013). For example, the European continent’s West and East form a ‘time machine’, which provides unique potential for mutual collaborative learning towards multi-functional landscapes and regions (Angelstam et al., 2013). This is possible due to the steep gradients in land use history whereby the gradual exploitation and intensive management of forest resources has spread like a tidal wave from areas of high demand in the West to more and more remote regions in the East (e.g., Naumov et al., 2018). Similarly, there are large regional differences in governance arrangements and social and cultural capital.

Achieving increased sustained yields of wood, fibre and biomass is a key issue in Russia (e.g., Indufor Oy, 2009; Naumov et al., 2016), and there is an interest in learning about the experiences from the development of the Nordic model for intensive forest management developed in Finland and Sweden (Nordberg et al., 2013). This was the key function of the Pskov MF. However, identifying both positive and negative consequences of intensification for different SFM dimensions is crucial (Angelstam et al., 1997, 2011a). For example, comparisons of indicators of economic vs. ecological sustainability in Sweden and Russia, as well as in countries of intermediate intensification stages, demonstrate an inverse relationship (Angelstam et al., 2018a; Naumov et al., 2018). This calls for the design of functional networks of protected areas prior to the onset of forestry intensification in Russia (Degteva et al., 2015), and not afterwards, as in Sweden (Angelstam et al., 2011b). Additionally, the functionality of habitat networks need to be analysed (Elbakidze et al., 2011, 2016). As illustrated by continued wood mining in protective zones near water in the Komi Republic (Naumov et al., 2017), satisfying rival forestry objectives continues to be a challenge in Russia. On the other hand, restoration of biodiversity in countries like Sweden and Finland, both applying the Nordic intensive forest management approach, requires knowledge that can be obtained through comparative studies of species, habitats and ecological process using Russia’s remaining intact forest landscapes as benchmarks (Yaroshenko et al., 2001). Such knowledge exchange is particularly crucial as a strong bio-economy discourse is emerging (Eyvindson et al., 2018). Also regarding social sustainability and its governance there is opportunity for mutual learning among countries and regions. Focusing on forest landscapes as arenas for rural development (Giesse, 2010), both Sweden and Russia have legacies of a clear focus on producing raw material for the industry. In contrast, in Turkey a key topic for Model Forest development based on the country’s forest policy is multiple-use aimed at rural development to reduce urbanisation (see Tolonay et al., 2014). Regarding governance, a comparison of Model Forest initiatives in Russia and Sweden showed that while they were predominantly top-down projects in Russia, they were processes initiated from below in Sweden (Elbakidze et al., 2010). This pattern was found also when comparing the application of another landscape approach concept (Biosphere Reserve) in Ukraine with top-down enforcement and Sweden with the focus on collaboration with local stakeholders (Elbakidze et al., 2013).

Application of landscape approach concepts such as Model Forest implies that to balance different kinds of economic use, human well-being and conservation of ecological and cultural values, there is a need to combine integrated landscape strategy with collaborative learning among stakeholders. Continuous monitoring of and communication among stakeholders about state and trends of different SFM dimensions is crucial. According to Sayer et al. (2013) “Landscape approaches seek to provide tools and concepts for allocating and managing land to achieve social, economic, and environmental objectives in areas where agriculture, mining, and other productive land uses compete with environmental and biodiversity goals”. Also implementation of SFM policy requires consideration of both social and ecological systems, and how they interact. Thus, a landscape commonly hosts many land cover types with associated policies (e.g., Giesse, 2010). Therefore any proactive partnership aiming at sustainable forest, water, agricultural, rural or urban landscapes should become actively involved in the development of collaborative learning and knowledge production for sustainable landscapes together with public and civil sector actors at multiple levels (Kløv et al., 2015; Angelstam et al., 2017b). A landscape strategy has three fundamental components (Primidahl et al., 2017): (1) visions and goals; (2) a spatial extent and long-term plan for the direction of development, and (3) a number of specific short-term projects. To support this process requires development of inter-sectoral spatial planning and zoning to accommodate different values, ideally with a catchment-based landscape perspective, and collaborative and participatory approaches to planning and governance. To be successful, a landscape strategy process depends on a high degree of willingness to develop consensus among stakeholders in a landscape; success is therefore not likely in areas with unresolved conflicts. The role of the local stakeholder community as a mediator between the public (international, state and local administrative units) and the individual domains of land owners has, however, changed dramatically during the last 200 years (Angelstam and Elbakidze, 2017). Rural landscapes are subject to a complex arrangement of issues. The private sector must cope with dynamic markets and technologies, as well as a complicated suite of public regulations. The public sector is faced with an increasing number of contradictory policies and planning systems among different sectors and levels of governance. The experience of Model Forests in Russia demonstrates that a state transitioning from planned to market economy, and frequently changing its
Table 2

| Criterion (inspired by Lee, 1993) | Model Forest (IMFN, 2008) | Biosphere Reserve (UNESCO, 2008) | LTSER platform (Grove et al., 2013; Mirtl et al., 2013; Angelstam et al., 2018a) | General framework (Axelsson et al., 2011) | General framework (Sayer et al., 2013) |
|---------------------------------|-------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| A. Landscape as space (area, region, catchment) | • Principle 1: Landscape. A large-scale biophysical area representing a broad range of landscape values, including social, cultural, economic, and environmental concerns | • Attribute 1: A sufficiently large area that matches management requirements and challenges to deliver desired goods, services and values | | | |
| B. Infrastructure | • Principle 6. Knowledge sharing and networking. Builds on stakeholder’s capacity to engage in the sustainable management of natural resources, and collaborate and share results and lessons learned through networking. | • Logistical support for research, education, monitoring, etc. | • Attribute 4: Integrative knowledge production | | |
| C. Gyroscope (sustainable development as a societal process in a landscape as place) | • Principle 2. Partnership. A neutral forum that welcomes voluntary participation of representatives of stakeholder interests and values on the landscape. The process is participatory, transparent and accountable, and promotes collaborative work among stakeholders to achieve landscape values, needs and management challenges | • Stakeholder engagement for regional/local development involving decision makers at different levels of governance, land use stakeholders, the public and other stakeholders | • Attribute 2: Multi-level and multi-sector stakeholder collaboration that promotes sustainable development as a social process | | |
| D. Compass (states and trends of sustainability) | • Principle 3: Sustainability. Stakeholders are committed to the use, conservation and sustainable management of natural resources and the landscape | • Development of integrated management policy | • Attribute 3: Commitment to and understanding of sustainability among stakeholders | | |
legislation, constrains managers from long-term planning, especially in disadvantaged remote regions. Forest companies prefer to harvest as much timber as possible from easily accessible areas (Naumov et al., 2017). Proposals for catchment-scale or landscape-scale planning of wood harvesting, which also address runoff regulation and biodiversity conservation (e.g., Khosroshev and Koshecheva, 2009) face bureaucratic obstacles and lack of appropriate regulations. Hence, Model Forest initiatives need either to rely on well-developed legislation or to elaborate scientifically-based proposals for improving legislation and a system of state incentives to environmentally-friendly technologies of forest use. From the point of view of the local or regional social-ecological system, different sectors’ planning systems form silos that hamper collaboration at the larger spatial scale than the one dealt with by the private sector forest manager (e.g., Blicharska et al., 2011). Finally, the resulting sectoral professionalization is also a challenge for civil sector organizations of various kinds (Primidahl et al., 2018).

The comparative approach that we advocate is captured by the terms integrative and transdisciplinary research, or better knowledge production and learning (e.g., Tress et al., 2006; Axelson, 2010; Van Paassen et al., 2011; Kläy et al., 2015). To achieve this vision there is a need to review policies and empirical knowledge about not only forest management, regulation vs. market economy, but also rural development and biodiversity conservation in terms of composition, structure and function of both terrestrial and aquatic ecosystems, as well as approaches to stakeholder participation for adaptive landscape governance (Pinto Correia et al., 2018). The latter has to be adapted to regional contexts in terms of biophysical conditions, forest history and governance arrangements (e.g., Angelstam et al., 1995, 2005, 2009; Angelstam and Lazdinis, 2000; Knize and Romanyuk, 2005). Individual Russian Model Forest initiatives made repeated informal use of this comparative approach by making study tours to learn about the Nordic intensive model to forestry in Sweden (e.g., Elbakidze and Angelstam, 2010), about the post-Soviet transition in Latvia, and to Canadian Model Forest initiatives (Ladonina and Pedrø, 2009; Bonnell, 2012). This provided insights into the future development of the transition trajectory from planned to market economy (Anon., 1998; Asunta, 2000). However, multi-level learning processes take very long time to develop (Giessen, 2010). Even with committed stakeholders it may take a decade to develop the trust and collaboration that enables a partnership in a landscape and several partnerships internationally to collaborate towards learning for sustainability (e.g., Axelson et al., 2013). This is why it is crucial to get started bottom-up to establish “a strategically managed niche within which scholars and practitioners from many different disciplines can engage in a long-term common learning process” (Kläy et al., 2015).

5.3. Towards a general framework for learning through evaluation

Evaluation as a professional activity plays an important role to improve the understanding about “what really works”. The concept learning through evaluation captures this challenge (e.g., Lähteenvuo-Smith, 2007; Brulin and Svensson, 2012). Comparative studies of initiatives applying different landscape approach concepts can enhance learning about how to implement policy aiming at sustainable landscapes in different contexts such as environmental history (e.g., Blickarska et al., 2012; Naumov et al., 2016), and legacies of governance, planning and management of natural resources, ecosystem services and landscape values (see Angelstam and Elbakidze, 2017; Angelstam et al., 2018b).

The global diversity of landscapes as social-ecological systems, and contexts, is a valuable asset to use to learn about how to operationalise the idea of Model Forest and other landscape approach concepts as partnerships towards sustainable landscapes (Angelstam et al., 2017b). However, this requires a set of unified clear criteria for what landscape approach is. The terms “landscape” and “landscape approach” are increasingly applied to address how multiple objectives related to both environmental and social goals can be satisfied on the ground (Freeman et al., 2015). Noting the different and ambiguous use of the terms, several studies have made valuable efforts towards defining commonalities among different concepts advocating an integrated landscape approach (Axelsson et al., 2011; Sayer et al., 2013; Freeman et al., 2015).

However, also empirical studies about what takes place on the ground are needed, such as this study about all the Model Forest initiatives in Russia, and a previous study of the 19 Polish Promotional Forest Complex initiatives (Blicharska et al., 2012). Another example is a recent assessment of the performance on the ground of another landscape approach concept, the Long-Term Socio-Ecological Research (LTSER) platform with 67 initiatives in Europe. Angelstam et al. (2018b) developed a normative model for that landscape approach concept by integrating Grove et al. (2013) architectural metaphor “siting-construction-maintenance” and Mirl et al. (2013) triangle of region and actors (i.e. landscape as a coupled social-ecological system), research, as well as infrastructure and co-ordination, and the need for networking among LTSER platforms that represent social-ecological gradients in Europe. This approach resulted in four criteria and generation of 16 indicators for which verifier variable data were collected using both quantitative and qualitative methods.

Such empirical studies show that the partners in a place-based landscape approach initiative have the potential to support the transition from research and development projects to long-term learning processes (Giessen, 2010; Kläy et al., 2015). Sharing of both positive and negative experiences among both landscape approach concepts, and initiatives applying them on the ground, is thus a powerful tool towards social and collaborative learning (e.g., Angelstam et al., 2017b). However, evaluation should not just be a formal requirement to fulfill protocols. It should also be part of a reflexive and interpretative process to capture transferable practice-based knowledge to support participation and sustainability in local and regional socio-ecological systems.

This approach to learning through evaluation should ideally sample multiple place-based initiatives applying different landscape approach concepts in gradients that represent variation in landscape history and societal steering, such as on the entire European continent including NW Russia (Angelstam et al., 2013, 2018b). However, this calls for a focused and pedagogic narrative to introduce a comprehensive analytic framework that is neutral to existing landscape approach concepts, and which can be applied to any concept or initiative. We suggest four criteria, viz. (1) a concrete landscape representing both space and place, which is supported by (2) an appropriate administrative infrastructure, and combined with the use of Lee’s (1993) idea of (3) compass (sustainability as consequences), and (4) gyroscope (sustainable development as a societal process). In Table 2 we compare these four general criteria with those of Model Forest, Biosphere Reserve, and Long-Term Socio-Ecological Research Platform, as well as two studies proposing general attributes or principles for an integrated landscape approach. The high-level praise of landscape approach as a tool (e.g., World Forestry Congress, 2009; Sayer et al., 2013; Freeman et al., 2015) needs to be matched by comparative studies of what place-based initiatives applying any integrated landscape approach actually deliver in social-ecological systems. Bridging barriers in terms of competition between organizations and concepts that focus only on their own version of what landscape approach means is also needed. We therefore encourage wide use of systematic learning through evaluation of place-base applications of different landscape approach concepts.

6. Conclusions

In Russia the term model forest has two meanings: (1) the Russian concept “best practices demonstration forests” aimed at showing operational forest management practices focusing on wood production adapted to different regions; and (2) the international Model Forest...
concept promoting partnerships towards sustainability in landscapes. The Russian experience from place-based initiatives applying the international Model Forest concept is a valuable resource for the production of knowledge and social learning needed to develop sustainable circumpolar forest landscapes. We identified two barriers to sustaining the international Model Forest concept in Russia. The first is the legacy of top-down decision-making, unsuccessful transition to democracy and limited bottom-up processes. The second is the narrow focus on intensification of wood harvest and silviculture. The period of living Model Forests 2004–2011 can be viewed as a window of opportunity to implement the idea of partnerships for sustainability in a landscape. This allowed the Komi Model Forest’s transition from a long-term project to a successful consulting company able to facilitate collaborative processes, guided for a decade by a mentoring donor. Sharing experiences internationally among countries and regions with different forest histories and governance arrangements is crucial to encourage learning by evaluation. We encourage the use of Lee’s (1993) idea of compass and gyroscope in concrete landscapes, and with a reasonably solid infrastructure in terms of committed partners that can facilitate the transition from research and development projects to long-term learning processes.

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References
Akenson, D., Dobrynin, D., Dubinin, M., Egorov, A., Isaev, A., Karpachevsky, M., Laestadius, L., Potapov, P., Purekhojovsky, A., Turubanov, S., Yaroshenko, A., 2002. Atlas of Russia’s Intact Forest Landscapes. Global Forest Watch Russia, Moscow (184 pp.).
Angelstam, P., Elbakidze, M., 2017. In: Bilingc, E., Plieining, T. (Eds.), Forest landscape stewardship for functional green infrastructures in Europe’s West and East: diagnosing and treating social-ecological systems. Cambridge University Press, The Science and Practice of Landscape Stewardship, pp. 124–144.
Angelstam, P., Lazdinis, M., 2005. Sustainable forestry: balancing forest production and biodiversity maintenance in the Baltic drainage basin. Baltic Bull. 1, 5–9.
Angelstam, P., Majewski, P., Boudrup-Nielsen, S., 1995. West-east co-operation in Europe for sustainable boreal forests. Water Air Soil Pollut. 82, 3–11.
Angelstam, P., Amfriyev, V., Balcauskas, L., Blagovidov, A., Borgéröd, S.-O., Hodge, S., Majewski, P., Ponomarenko, S., Shvarts, E., Tishkov, A., Tomilozc, L., Wesolowski, T., 1997. Biodiversity and sustainable forestry in European forests - how west and east can learn from each other. Wildl. Soc. Bull. 25 (1), 39–48.
Angelstam, P., Roberge, J.-M., Lõhmus, A., Bergmanis, M., Brazažitis, G., Dūnas-Breuses, M., Edenius, L., Kosinski, Z., Kurlavicius, P., Lārmans, V., Lākinš, M., Mikusinskas, R., Račinskis, E., Straždž, M., Tryjanowski, P., 2004. Habitat modelling as a tool for landscape-scale conservation – a review of parameters for forest focal birds. Ecol. Bull. 51, 427–453.
Angelstam, P., Kopylova, E., Korn, H., Lazdinis, M., Naumov, V., 2017a. Transitioning from soviet wood mining to sustainable forest management by intensification: are tree growth rates different in northwest Russia and Sweden? Forestry 90 (2), 292–303.
Angelstam, P., Naumov, V., Lazdinis, M., 2017a. Transitioning from soviet wood mining to sustainable forest management by intensification: are tree growth rates different in northwest Russia and Sweden? Forestry 90 (2), 292–303.
Angelstam, P., Naumov, V., Lazdinis, M., Törnblom, J., 2013. Evaluation of multi-level social learning for sustainable landscape management: a case study in Pskov region, Russia. ArborVitae Environmental Services, Toronto (12 pp.).
Anon., 1998. Mezrole Demonstration Project on Privatization and Sustainable Forestry in Latvia. Future Development Possibilities. pp. 5 pp. (retrieved 2009-09-08 at: http://www.pdf.lv/uploads/dokumenti/Mezole_project_report.pdf).
Arms, I., 1969. A ladder of citizen participation. J. Am. Inst. Plann. 35, 216–224.
Axelsson, R., 2010. Integrative research and transdisciplinary knowledge production: a review of barriers and bridges. J. Landscape Ecol. 4 (2), 14–40.
Axelsson, R., Angelstam, P., Elbakidze, M., Stoyanov, N., Johansson, K.-E., 2011. Sustainable development and shared responsibility: Landscape approach as a practical inter-pretation of principles and implementation concepts. J. Landscape Ecol. 4 (3), 5–30.
Axelsson, R., Angelstam, P., Myhrman, L., Ståhlm, S., Ivarsson, M., Elbakidze, M., Andersson, K., Cipa, P., Diry, C., Doyon, F., Drotz, M.K., Hjortor, A., Hermansen, J.O., Bullenkberg, T., Dickers, F.H., Mccaggart, J., Axon, A., Pauvot, Yu., Svensson, L., Törnblom, J., 2013. Evaluation of multi-level social learning for sustainable landscapes: perspective of a development initiative in Berglagen, Sweden. Ambio 42 (2), 241–253.
Baker, S., 2006. Sustainable Development. Routledge, London/New York.
Barents Region Forest Sector Initiative. 2001. Forest sector program for the northern dimension. In: Framework Document. Forest Sector Task Force, Barents Euro-Arctic Council, Working Group on Economic Cooperation, Joensuu.
Besseau, P., Bonnell, B., Muni, K., 2008. Ustoschoyce rozviti partners’tskontactninihnyh dlja ustoichivogo upravleniia lenymi landshaftami: opty modelnych lesov [Sustainable development of partnerships for sustainable forest landscape: experience of model forests]. Ustoichovoe lesopользование 18 (2), 2–8.
Blagovidov, A., Kopylova, E., Tlepikov, V., Shmatkov, N., 2006. Building Partnerships for Forest Conservation and Management in Russia. IUCN Office for Russia and CIS, Moscow (91 pp.).
Blicharska, M., Angelstam, P., Antonsou, H., Elbakidze, M., Axelsson, R., 2011. Road, forestry and regional planners’ work for biodiversity conservation and public participation: a case study in Poland’s hotspots regions. J. Environ. Plan. Manag. 54 (10), 1573–1595.
Blicharska, M., Angelstam, P., Axelsson, R., Elbakidze, M., Skorupski, M., Wiegèl, A., 2012. The Polish promotion forest complexes: objectives, implementation and outcomes towards sustainable forest management? Forest Policy Econ. 23, 28–39.
Bonnell, B., 2012. Trends in research and collaboration in the Canadian model forest network, 1993–2010. For. Chron. 88 (3), 274–282.
Brand, D.G., Bouman, O.T., Bouthillier, L., Kessler, W., Lapierre, L., 1996. The model forest concept: a model for future forest management? Environ. Rev. 4 (1), 65–90.
Bruno, G., Svensson, L., 2011. Managing Sustainable Development: A Learning Approach to Change. Routledge, Oxford.
Carlson, L., 2000. Towards a sustainable Russian forest sector. Nat. Res. Forum 24, 31–37.
Carlson, L., Lundgren, N.-G., Olsson, M.-O., 2001. The Russian detour: real transition in a virtual economy? Europe-Aasia Stud. 53 (6), 841–867.
Chernenkova, E., 2008. Projekt “Piskov Model Forest” 2015 – nástupového z budúcnosti [the project Piskov Model Forest – present and future]. Ustoichovoe lesopользование 2 (18), 25–30 (in Russian).
Croty, J., Hall, S.M., Ljubomirskov, S., 2014. Post-soviet civil society development in the Russian Federation: the impact of the NGO Law. Europe Asia Stud. 66 (8), 1219–1249.
Dawson, L., Elbakidze, M., Angelstam, P., Gordon, J., 2017. Governance and management dynamics of landscape restoration at multiple scales: learning from successful environmental managers in Sweden. J. Environ. Manag. 197, 24–40.
Degtev, S.V., Ponomarev, V.I., Eisenman, S.W., Dushenkov, V., 2015. Striking the
