Final report: Biosphere Forests for the Future

Photo: participants at the forest symposium at SLU in Umeå 10th to 11th of December.

Simon Jonegård 2019-01-17

Table of content

Background 3

Biosphere Reserves – model regions for sustainable development 4

BR-networks 4

BRs and governance 5

BRs climate analogues 5

Forested landscapes and climate change adaptation 7

Climate change impacts, risks and strategies 7

Matrix on climate change challenges 8

Strategies on climate change adaptation 9

Matrix on adaptation strategies 9

Communication as a tool for forest landscape adaptation 11

Future BFF-project framework 12

Project aim and goal 12

Project themes 12

Project tools 13

Activities 2019 14

Funding opportunities 14

Conclusion 15

Bibliography 17

Appendix 1 18

Appendix 2 19

Background

Climate change is one of our biggest challenges. A large part of the increased emissions of greenhouse gases in the atmosphere comes from the way we extract, transform and use fossil energy. As a result of the increased emissions, we are likely to go against an average global warming that exceeds two degrees Celsius. We can already see effects in the forest, where new pests and diseases, droughts and fires increase the stress in the forest ecosystem and hamper the development of sustainable forestry. Climate change thus changes the conditions for entire forest landscapes, which can lead to reduced resilience and weakened ecosystem services, including the forest's ability to store coal.

UNESCO biosphere reserves (BRs) are designated to be model regions for sustainable development, where new methods are tested and developed. The BRs provide suitable areas for gathering knowledge about the effects of climate change in forest landscapes and for projecting future scenarios based on available climate models. The 686 BRs in the world form a global network, where experiences and knowledge are shared. The network is a resource for strategic global surveillance, while it is a channel for establishing collaborations and creating opportunities for international exchanges. BRs are strategic arenas to learn from when implementing the 2030 Agenda.

Biosphere Forest for the Future (BFF) is an initiative that aims to produce a project description for the further development of BRs as model regions for climate adaptation in forest landscapes. BRs from different climate and vegetation regions can thus provide learning about forest ecosystems and forest management in different climates. International collaboration and exchange will increase the awareness of forest landscape's vulnerability due to climate change. Dialogue about practical experiences will result in an analysis of challenges related to climate change adaptation in forest landscapes, including an overview of how landowners and other actors can change their actions in order to create more climate-adapted forestry strategies.

During the 10th to 11th of December an international forest symposium was arranged at SLU in Umeå. This was the first meeting bringing BRs together to start developing the BFF-initiative. This report builds on the presentations and discussions during the symposium.

The BFF-initiative have been realized through the support of the Swedish Forest Agency and Sweden's National Forest Programme.

Biosphere Reserves – model regions for sustainable development

BR-networks

There are globally today 686 designated BRs in 122 countries, including 20 transboundary sites. EuroMAB is the largest of the MAB Regional Networks with 302 BRs in 36 countries, including the United States and Canada.

The BRs that participated at the Umeå symposium and at this point are involved in the BFF-initative can be seen on the BR-map below. More BRs in southern Europe and also North America would be good to complement the network. The existing BRs include from south to north (abbreviation is used in matrixes further below):

- Italy: Appenino Tosco Emiliano BR (ATE)
- Czech Republic: Dolni Morava BR (DM)
- UK: North Devon BR (ND)
- Poland: Tuchola Forest BR (TF)
- Sweden: Kristianstad Vattenrike BR (KVR)
  Blekinge Archipelago BR (BA)
  East Vättern Scarp Landscape BR (EVSL)
  Lake Vänern Archipelago BR (LVA),
  River Landscape of Nedre Dalälven BR (ND)
- Finland: North Karelia BR (NK)
- Sweden: BR-candidate Voxnadalen (Vox)
  BR-candidate Vindelälven-Juhtatdahka (VJ)

Figure 1. Map of BRs in Europe, with participating BRs marked with red star.

BRs and governance

The Global Strategy for the MAB Programme (2015-2025) (UNESCO, 2015) underline the instrumental role of the BRs in implementation of the 2030 Agenda and the Sustainable Development Goals. While the Agenda points out the priorities and the direction of global development, the BRs guide the local, regional and national implementation of the Agenda by sharing experiences and good practices generated in BRs. With their holistic and cross-sectoral approach, BRs mediate and connect stakeholders with increased governance as a result. By building on structures already in place and by using an inclusive approach, BRs inspire positive changes within existing organizations, thus enhancing focus on sustainable practices. (Heinrup & Schultz, 2017)

BRs climate analogues

Since BRs is working with a landscape perspective and is part of a regional network there is unique possibilities to compare and learn between the sites participating in the BFF-initiative. According to the Swedish Board of Agriculture (Jordbruksverket, Harald Svensson et al., 2007), the so called "growth zone" in Sweden moving north 10 kilometre each year (or one metre per hour). In a simple way this mean that a seed that has germinated in the BR-candidate of Voxnadalen in northern Sweden after 60 years will stand in the same growth zone that today is in the BR Kristianstad Vattenrike in southern Sweden.

A selection of BRs in Europe have, by Andrew Bell from North Devon BR, been analysed using the RCP (Representative Concentration Pathways) 4.5. RCP is scenarios of how the greenhouse effect will reinforced in the future and have been used in the IPCC-reports. The scenario RCP 4.5 represent intermediate emissions with CO2 emissions peaking at year 2040, it's hence a scenario that we will likely overshoot with today's trajectory. One important factor for forests is the climatic moisture deficit (CMD); the loss of water back to the atmosphere due to the weather conditions, which is an added vegetation dynamic. By analysing the max temp in RCP 4.5 for 2020 with 2080 one could see how different regions will be differently affected (see maps in appendix 1).

Looking at the graphs below one could see that some BRs are having a climate analogue with another BR comparing CMD and temperature for year 2020 to 2080. Being aware of this can be prolific for the different stakeholders in the BRs, by making the effects of climate change more concrete having a BR to compare and make exchanges with. Armed with the knowledge of what they may face in future, BR stakeholders can determine their adaptation options based on real models and cases. They can also learn how communities have adapted to climate change over time and for example what kind of tree species and varieties that have worked in particular locations.

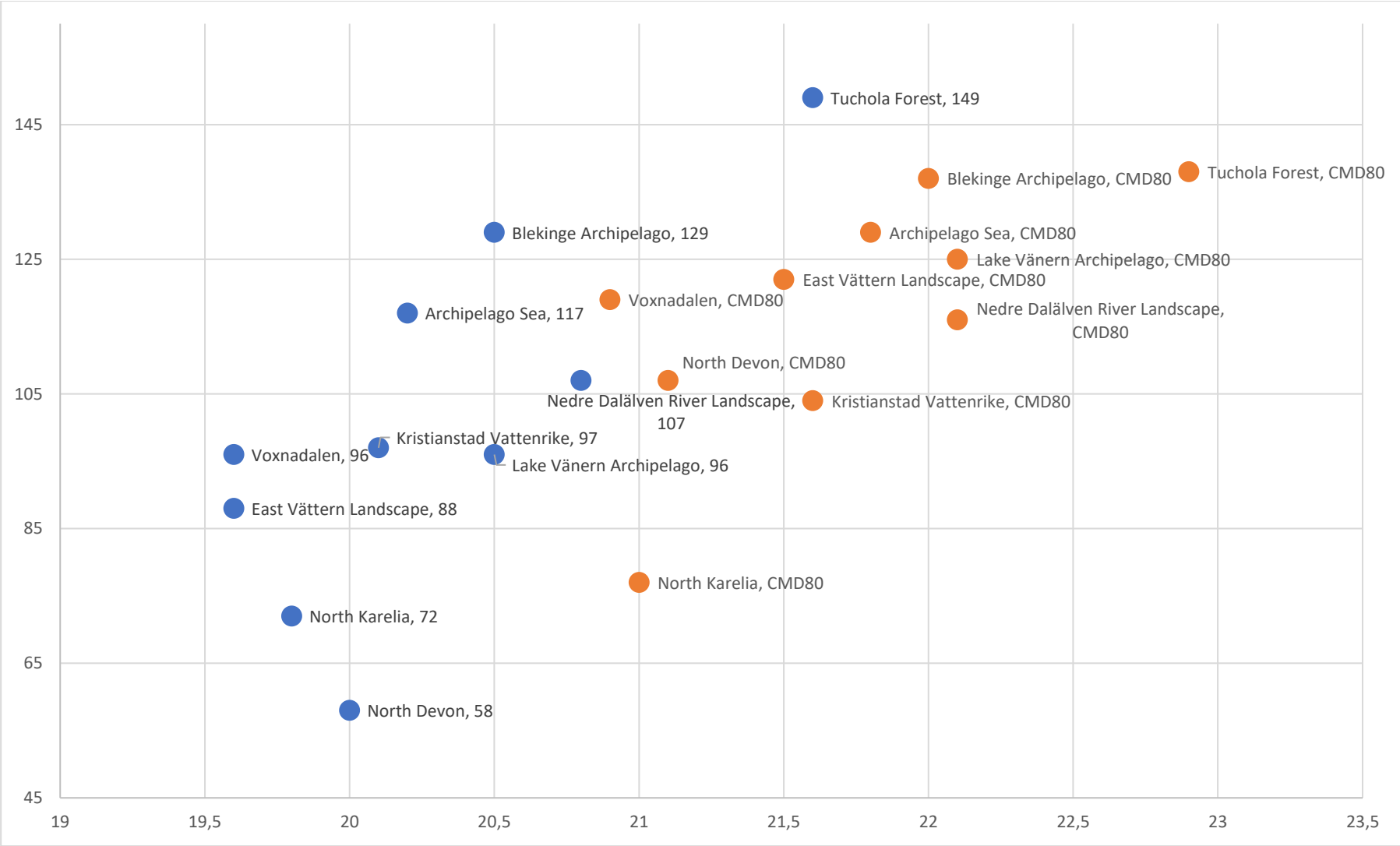

Figure 2. Scatter of BRs in northern Europe in the BFF-initiative for year 2020 (blue) and 2080 (red). The X-axis is the max temperature during warmest month (degrees C) and the Y-axis is the Climate Moisture Deficit (in mm). A zoomed-out version for Europe can be found in appendix 2.

Forested landscapes and climate change adaptation

Climate change impacts, risks and strategies

The effects on forested landscapes from climate change is complex and contextual. Landscapes in different climate regions and different socio-ecological systems will not be affected the same. But having a landscape perspective, which is inherent in BR-concept, is fundamental for learning about how the ecosystem is responding to impacts from climate change. The mapping below is a first try to conclude some of the discussions in the symposium and a starting point for further work on making the connections between the impacts, risks/effects and relevant risk management strategies more visible.

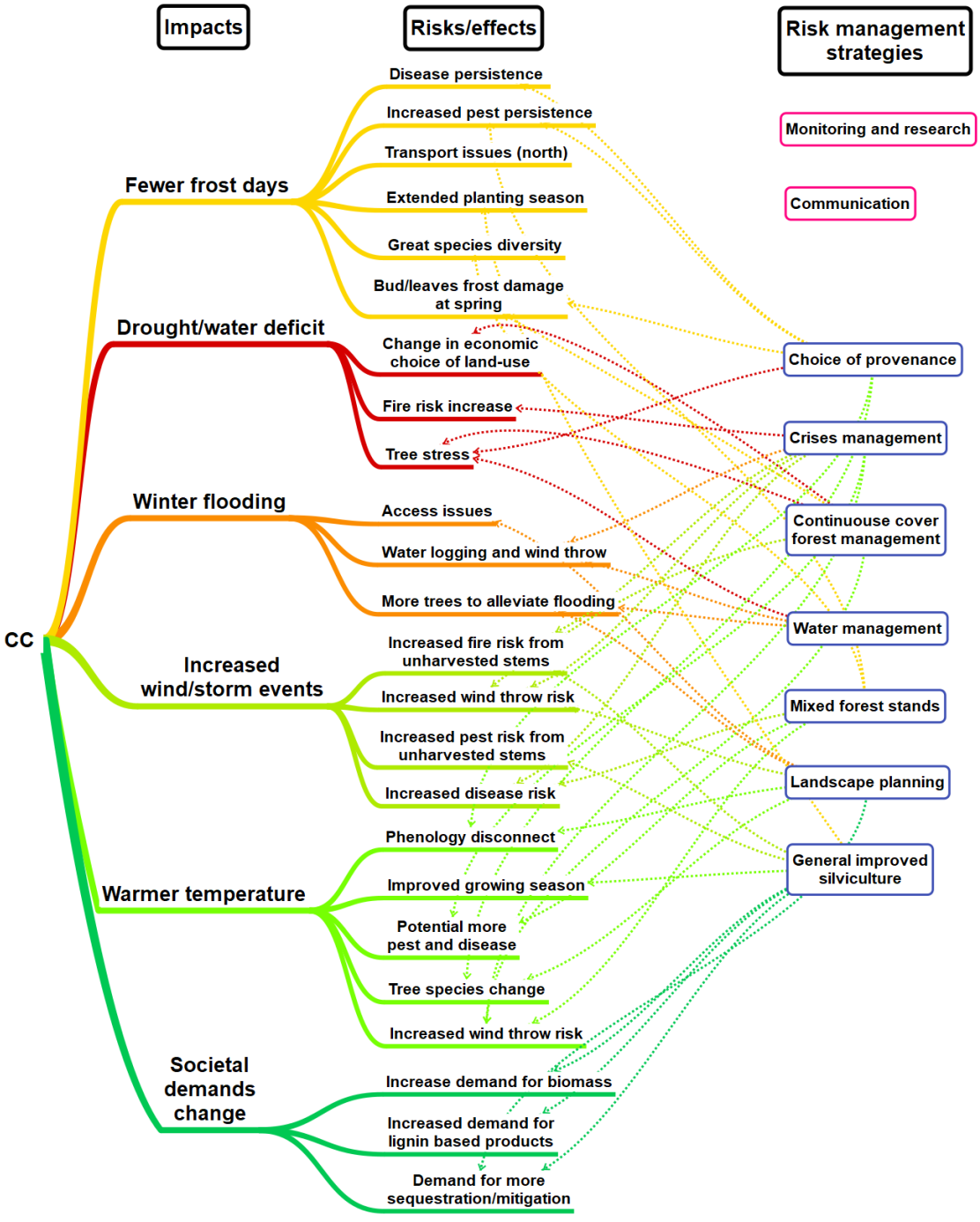

Figure 3. Climate change impact mind map.

Matrix on climate change challenges

Following matrix have been compiled from the input from participating BRs. The aim of this matrix is to give an overview and point out the most relevant challenges for cooperation and project activities. The question that the representatives from the BRs answered where: "*Why is forest landscape adaption to climate change needed in your Biosphere Reserve? Rate the local/regional challenges your Biosphere Reserve could (according to the opinion on your organization) see now or in a near future.*" To be noted is that the question was interpreted somewhat different among the representatives.

The matrix shows that many of the challenges is common for the participating BRs. The in average highest rated challenges include i) drought damage, ii) increased risk for forest pests and iii) biodiversity fragmentation. This is also where most representatives gave a rate of 5, which most clearly indicates an understanding and sense of urgency of the challenge. This opposite can be found regarding challenges for timber transportation where southern BRs doesn't seem to see this problem at all. Challenges added as "other" in the matrix include i) bud/leaves frost damages in spring and ii) brownification of streaming water.

	CHALLENGES	Italy ATE	Czech R DM	UK ND	Poland TF	Sweden BA	Sweden KVR	Sweden EVSL	Sweden ND	Sweden Vox	Sweden VJ	Finland NK	Average
1	Challenges for timber transportation	1	1	1	2	4	3	3	3	2	1	3	2,2
2	Drought damage	5	5	4	2	5	5	4	3	4	1	2	3,6
3	Flooding	4	2	5	1	1	4	2	4	3	1	2	2,6
4	Storm felling	2	2	3	5	3	3	5	3	3	1	3	3,0
5	Forest fire	5	2	3	3	1	3	3	4	4	2	3	3,0
7	Increased risk for forest pests	3	4	5	3	5	4	5	3	3	2	3	3,6
8	Invasive species	3	3	3	2	4	3	3	3	3	2	3	2,9
9	Biodiversity fragmentation and species extinction	3	2	5	1	3	3	5	3	3	3	5	3,3
10	Negative changes in wildlife	2	2	5	1	3	3	2	3	3	2	4	2,7
11	Other	5			1		5						

Figure 4. Matrix of how BRs rated the local/regional challenges they could see now or in a near future.

Strategies on climate change adaptation

Matrix on adaptation strategies

Representatives from participating BRs answered the question: "*How can your BR contribute to forested landscape adaptation to climate change? Rate the climate change adaptation strategies that is relevant and where your BR can or have contributed*." To be noted is that the question was interpreted somewhat different among the representatives.

The matrix on next page shows that many of the participating BRs rated following adaptation strategies high: i) communication on adaptation to climate changes, ii) change tree species/diversity, iii) continuous cover forest management/selective cutting, and iv) water management. The three latter are rather concrete strategies at forest management level. The strategy of using communication is described more in detail further below.

The BRs also described how they work (or will work) to contribute to the strategies they ranked highest. It's clear that the main function of the BRs is to act as a platform for learning to e.g.:

- disseminate research results into stakeholder groups
- providing ground for feedback workshops and seminars
- create owner consortia and share management guidelines
- perform activities (labs, seminaries, practical activities in the field) with e.g. schools
- carrying out restoration projects
- organize forest days and courses for forest owners and others interest groups

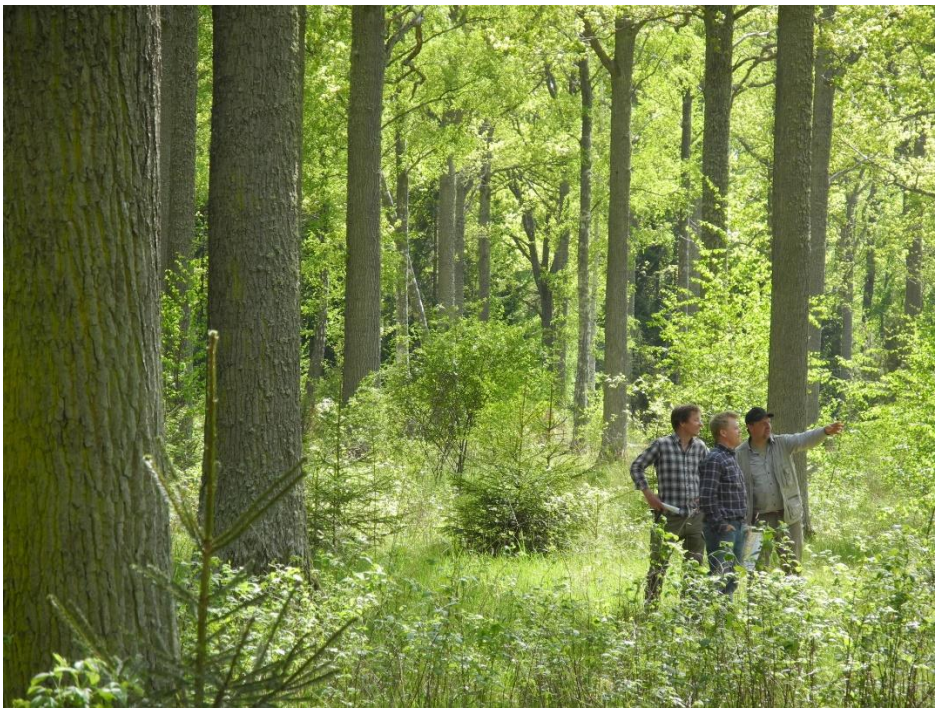

Photo: Simon Jonegård, the oak forest on the island Visingsö in East Vättern Scarp Landscape BR

	ADAPTATION STRATEGIES	Italy ATE	Czech R DM	UK ND	Poland TF	Sweden BA	Sweden KVR	Sweden EVSL	Sweden ND	Sweden Vox	Sweden VJ	Finland NK	Average
1	Improved monitoring and research on climate change effects on the forest landscape	5	4	4	3	4	3	3	2	2	5	4	3,5
2	Communication on adaptation to climate changes, e.g. guidelines	5	4	5	4	5	3	5	2	4	3	3	3,9
3	Improved climate crises management, e.g. fires, storms	4	2	3	4	1	4	3	1	4	3	4	3,0
4	Changes in forest structure for climate change adaptation (risk management). As below:												
4.1	*o Change tree species/diversity, e.g. increase resistance for pests by mixed forest stands*	4	3	5	5	5	5	5	1	3	4	3	3,9
4.2	*o General (improved) management/ silviculture, e.g. maintenance of forest edges, early thinning*	4	3	5	5	5	5	2	1	3	4	3	3,6
4.3	*o Continuous cover forest management/ selective cutting*	4	3	4	5	5	5	5	3	4	5	4	4,3
5	Soil management, e.g. fertilization	1	1	2	2	1	3	1	1	3	5	1	1,9
6	Water management, e.g. retention	5	4	5	4	4	5	4	2	4	5	1	3,9
7	Forest planning on landscape level, e.g. improve ecological conn., co-op between land-owners	5	2	5	3	4	5	5	2	3	3	4	3,7
8	Longer term (genetic variety), e.g. choice of provenance	5	4	5	2	3	4	2	1	3	5	1	3,2
9	Other					5							

Figure 5. Matrix of how BRs rated the relevance of different climate change adaptation how the BR can or have contributed.

Communication as a tool for forest landscape adaptation

The BRs were asked to describe through what channels land-owners and other stakeholders today get the most information about climate change adaptation. In general, this could be summarized as follows:

- professional associations and bigger forest companies probably get most of their information from research institutions
- (some) private land-owners get (some) practical information from forest service's/agencies, but there seems to be an information deficit to this group.
- advisors that are trusted among private land-owners probably have a big role in sharing information
- landscape coordinators could act as brokers and assist in 'interpreting' scientific knowledge and legislative policies into practical advices (Carlsson, Lidestav, Bjärstig, Svensson, & Nordström, 2017)
- in some BRs private land-owners also seeks information from universities and environmental associations, but this seems not so common
- in some countries private forest extension services provide information, but their skill and application of climate change adaptation is not evidently well used
- the general media probably have a big influence in making private land-owners aware of the wide-ranging challenges about climate change but have very little practical information that can be used by forest-owners

Photo: Simon Jonegård, stockpile with windthrown timber from the storm Gudrun in Sweden 2005.

Future BFF-project framework

Project aim and goal

The aim and goal of the BFF-initiative and a future project were discussed during the symposium.

Suggested aim of the BFF-initiative:
- *Facilitating/demonstrating transformation of landscape management in a changing climate, or*
- *Facilitating/demonstrating transformation for a resilient forest landscape in a changing climate.*

Suggested goal of BFF-initiative:
- *Co-governance of sustainable landscapes in a changing climate.*

Project themes

During the symposium some themes for a BFF-initiative was put on the table, briefly presented below:

Networking between BRs that share existing and projected climate. From the scenarios of RCP 4.5 one could see how the climatic moisture deficit changes for BRs between 2020-2080 (see page 5-6). Material like this can be a base for networking and learning between BRs that share existing and projected climate (climate analogues). The result could be interesting to communicate to media to draw attention to the big effects climate change will have on the landscape and what the future scenarios could lead to when comparing to landscapes (BRs) in other countries.

Linking climate data to people's interpretation of climate change. Satellite data can give valuable information of how the landscape have been affected by climate change, e.g. snow and ice cover, and flooding. By asking people to contribute with their own observations of the climate these two different data sets can be matched, discussed and used to develop the climate change observatory concept (see page 12). Addressing, documenting and using local and traditional knowledge could also make up a big contribution, since being in-depth knowledge at a fine temporal and spatial scale. Experiences in these fields exists in e.g. Vilhelmina Model Forest.

Test, exchange knowledge and communicate common adaptation strategies. BR stakeholders such as forest agencies, forest associations and forest extension/advisory services, all provide information about strategies for adaptation. How they choose to communicate, and what kind of information they give vary between different countries. In the BFF-initiative we can learn from each other about what communication strategies that works well and how to best reach out to land-owners and other stakeholders. Demonstration areas, restoration projects, historical maps and pictures are examples of tools that have been suggested to work well to present information to these target groups.

Climate change adaptation from a landscape perspective. Ecosystem functions, such as water, land, food, energy and climate, are interlinked in the landscape creating a so-called nexus; a coherent system dominated by complexity and feedback (sim4nexus, 2019). When working on strategies for climate change adaptation and/or mitigation in the forested landscape there will be synergies and trade-offs towards other ecosystems and ecosystem services. In BRs, that often have a broad partnership with stakeholders, these synergies and trade-offs can be analysed and discussed from the viewpoint of sustainable landscape management.

Project tools

During the forest symposium three concrete tools were presented that can be used in the next phase of the BFF-initiative.

Climate change observatories is a concept launched by UNESCO and is now included in the MAB strategies for BRs. The MAB-council have not yet fully defined the concept, but individual BRs can already today be recognized as Climate change observatories by addressing following:

1. Observation, research, participatory science
2. Prepare future scenarios
3. Define and implement mitigation/adaptation
4. Share good practices

A project with participating BRs from Europe could together be a valuable platform to develop the concept of Climate change observatories with a special focus on forests. Similar regional processes exist for example in the Africa and Arab networks with a thematic focus on water.

DeveLoP, Democratic Landscape Planning Tool, is a tool that have been developed by Kristina Blennow at SLU together with colleagues. It can be used in relation to various topics. This tool can help the BRs to build the decision-making agents' capacity to take adaptive measures in a changing climate by:

- identifying communication needs regarding adaptation to climate change
- providing guidelines for effective evidence-based communication
- providing flexible effects on decision-making through effective communication which is crucial for successful decision-making in a changing world
- design effective climate change policies other than communications, and
- contribute to sustainable and democratic development of the society.

Among others, DeveLoP includes a new tool for elicitation of peoples values (Blennow, Persson, & Persson, 2019). This valuation tool is the first tool to distinguish between means and ends (true values) as recommended by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, United Nations (IPBES).

Vulnerability Assessment and Adaption Planning is a structured process for understanding likely climate change impacts and planning adaption actions, developed under the auspices of the Canadian Council of Forest Ministers (CCFM). The CCFM tool is based on the Intergovernmental Panel on Climate Change (IPCC) vulnerability approach where vulnerability is the function of exposure, sensitivity and adaptive capacity. The CCFM tool is based on local prerequisites and is flexible enough to accommodate a wide range of land management regimes. It can thus be suitable to use in a EuroMAB-context. (CCFM, 2019)

Next step and funding opportunities

Activities 2019

To continue to build on the results and network established in the BFF-initiative it's important to plan for activities during 2019.

BRs in Europe and North America belong to the EuroMAB-network and meet every two years. During the 2nd-5th of April 2019 the next EuroMAB-meeting will take place in Dublin Bay BR in Ireland. The meeting includes ten different workshops, whereof "BRs as Climate Change Observatories" is one of them. (http://euromabdublin2019.ie/, 2019)

Photo: Simon Jonegård, stakeholders from different countries and cultures meeting at the 26th ICC-meeting.

Funding opportunities

During the forest symposium Caroline Grabbe from the Grants Office, the main support unit for external funding at SLU, presented an overview of relevant funding opportunities for the BFF-initiative.

A recommendation is that before trying to find funding opportunities it's key to define and write down your starting points with the project you want to pursue. A background check could be important in order to find out if this have been done before, if there are any publications related to this idea and if there are any other groups working on the same topic. Based on above the project idea should be matched with relevant calls.

Horizon 2020 is EU:s framework programme for research and innovation 2014-2020 and hence clearly oriented towards research. But a triple-helix project set-up, including i.e. universities, authorities and BRs, would clearly strengthen the application. Several H2020 calls could be relevant, but the most relevant call seems to be: "LC-CLA-12-2020: Advancing climate services". The specific challenge in this call is to:

"[…] *enhance action on adaptation with regard to strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making, including the economic analysis*

of adaptation options for key impact areas […] and create services that communicate and deliver critical climate information to inform risk-aware decision making and adaptation strategies."

Actions in this call should:

"[…] *assess and report on the impacts associated with overshooting temperature goals set by the Paris Agreement in 2015 [and] highlight regional differences in associated impacts and identify possible adaptation measures and solutions*."

Projects in Advancing climate services will have a size between EUR 4-6 million (100 % funding) and the deadline for application is in Jan/Feb 2020. The project must have at least three partners from three EU countries. Canada have possibilities to back-to-back financing. (ec.europa.eu, 2019)

Life is EU's funding instrument for the environment and climate action. Life is open to SMEs, large and medium sized corporates, NGOs, Universities and public bodies. Typical projects have a budget of EUR 1-5 million (maximum funding rate 55 % of eligible costs), spanning over 3-5 years. Both of the sub-programmes have annual calls opening in April 2019 and for climate action a deadline for application in September 2019.

Other funding opportunities can possibly be found through Interreg Europe, CAP, and European Space Agency.

Conclusion

BRs provide useful platforms to apply and test adaptation, but also mitigation, to climate change. One reason for this is because BRs are big enough in size to hold within them gradients between e.g. costal to alpine ecosystems, urban to rural areas and production forests to nature reserves. Through the network of BRs, being spread across different climate regions, they can also raise awareness on the impact's climate change have on human societies and ecosystems. They can facilitate learning and communication amongst stakeholders which, in the longer perspective, contributes to positive lasting changes in practice. Forest landscapes will play a very important role in adaptation and mitigation to climate change but they are under stress.

- ➔ BRs in the BFF-initiative share many forest landscape challenges associated with climate change, the most important being drought damage, increased risk for forest pests, biodiversity fragmentation, storm felling and forest fires.
- ➔ By stimulating learning processes and enhance the governance structures within BRs, the BFF-initiative could help developing strategies to meet these challenges.
- ➔ Concrete actions and management practices carried out in cooperation with research and local stakeholders, including traditional knowledge, could be shared within the BFF-initiative and help to build valuable experiences in a European context.
- ➔ A key strategy for creating change for adaptation in forest landscapes is to facilitate communication between key stakeholders – a unique function of BRs.
- ➔ Testing and developing concrete forestry methods within the BRs – such as continuous cover forest management, improved water management and creating mixed forest stand – is common among many BRs and different demonstration tools sharing these experiences is very important for reaching out to private land-owners and other local actors.
- ➔ When working on strategies for climate change adaptation and/or mitigation in forest landscapes there will be synergies and trade-offs towards other ecosystems and ecosystem services. To have an inclusive landscape perspective is hence very valuable in future work.

- ➔ There are obvious synergies between climate change adaptation and mitigation measures. During future work within the BFF-initiative one must decide how to balance these in activities and applications.

To reach the ambitions described, there is a need to continue to develop the BFF-initiative. Some key ideas/aspects for this process include following:

- ➔ The BFF-initiative should for the time being be inclusive and welcome participation from more BRs – and also Model Forests – which could make the distribution of participating regions and organisations even better.
- ➔ North America is also included in the EuroMAB-network and BRs and Model Forests from e.g. Canada could, if funding will make it possible, be a valuable contribution to the BFF-initiative
- ➔ Further analysis of how BRs could use the climate analogues concept, also comparing other climatic factors, could be made during next phase of BFF. BRs that "share existing and projected climate" could also start to build a learning programme between them.
- ➔ By matching satellite data with people's interpretation on climate change, the BFF-initiative could help spreading knowledge among local stakeholders of the impacts of climate change.
- ➔ The mapping of how impacts, risks/effects and strategies are interconnected could be further worked on and discussed in the next phase of the BFF-initiative.
- ➔ Different tools could be used by the BFF-initiative to help the process and reach the aims. The ones presented includes: Climate Change Observatories, DeveLoP and Vulnerability Assessment and Adaption Planning
- ➔ The BFF-initiative can be presented during the EuroMAB-meeting in Dublin in April 2019, with meetings before or after to continue the planning process for next phase.
- ➔ The project idea should be further developed and then matched with coming calls. The work with preparing a project application should ideal start early 2019 to not miss any suitable calls such as H2020 Advancing climate services.

Photo: Simon Jonegård, final extinction of a small-scale forest fire in southern Sweden.

Bibliography

Blennow, K., Persson, E., & Persson, J. (2019). Are values related to culture, identity, community cohesion and sense of place the values most vulnerable to climate change? Retrieved from https://doi.org/10.1371/journal.pone.0210426

Carlsson, J., Lidestav, G., Bjärstig, T., Svensson, J., & Nordström, E.-M. (2017). Opportunities for Integrated Landscape Planning – the Broker, the Arena, the Tool. *IALE*(DOI 10.3097/LO.201755), pp. 1-20.

CCFM. (2019, 01 16). Retrieved from http://www.ccmf.org: http://www.ccmf.org/english/coreproducts-cc.asp

ec.europa.eu. (2019, 01 16). Retrieved from http://ec.europa.eu/programmes/horizon2020/

Heinrup, M., & Schultz, L. (2017). *Swedish Biosphere Reserves as Arenas for Implementing the 2030 Agenda.* Naturvårdsverket. Retrieved from http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6742-7.pdf?pid=19696

http://euromabdublin2019.ie/. (2019, 01 16). Retrieved from http://euromabdublin2019.ie/

Jordbruksverket, Harald Svensson et al. (2007). *En meter i timmen - klimatförändringarnas påverkan på jordbruket i Sverige.* Marknadsenheten. Retrieved januari 2019, from http://www.jordbruksverket.se/download/18.1d9bdd9f1155fcd550c800098/Klimat+o+jordbruk_071002.pdf

sim4nexus. (2019, 01 08). Retrieved from https://www.sim4nexus.eu/page.php?wert=Projectoverview

UNESCO. (2015). *MAB Strategy (2015-2025).* UNESCO. Retrieved from http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/strategies-and-action-plans/new-mab-strategy-and-action-plan/documents/

Appendix 1.

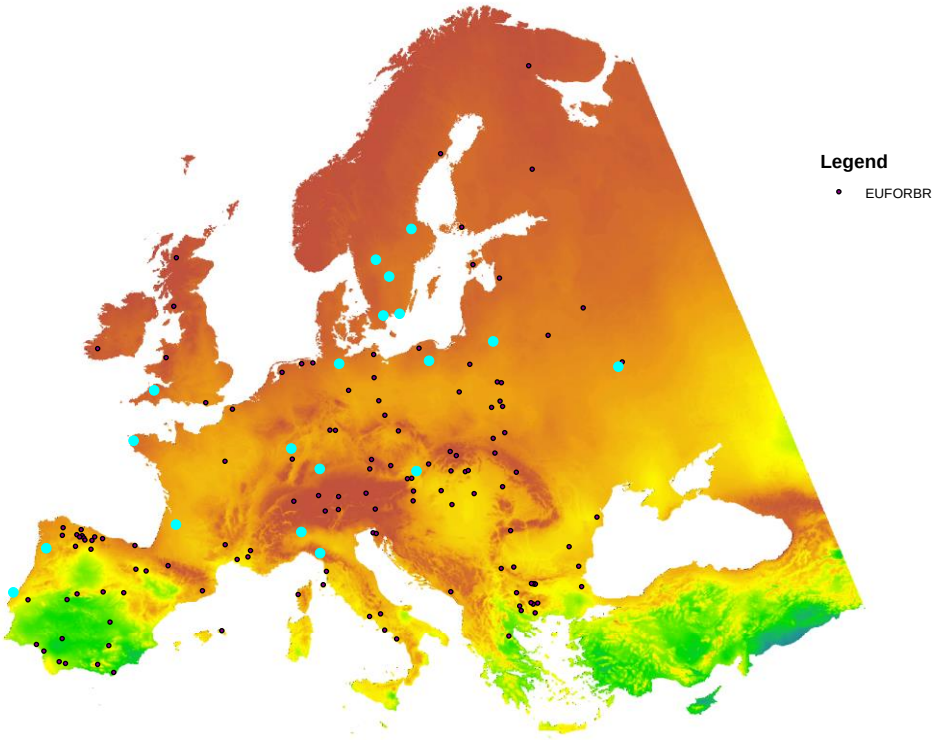

Figure 6: Climatic Moisture Deficit (CMD) year 2020. Black dots represent BRs in Europe and blue dots represent BRs included in the CMD-diagram in appendix 2. High CMD is blue/green and low CMD is red.

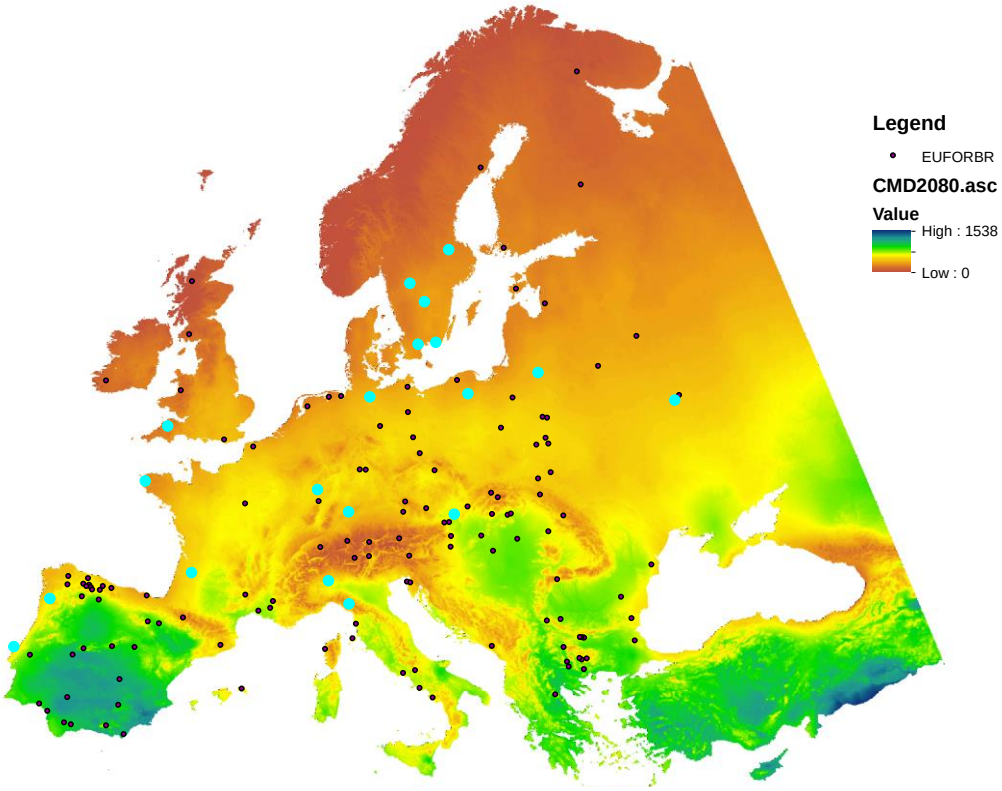

Figure 7: Climatic Moisture Deficit 2080. Black dots represent BRs in Europe and blue dots represent BRs included in the CMD-diagram in appendix 2.

Appendix 2

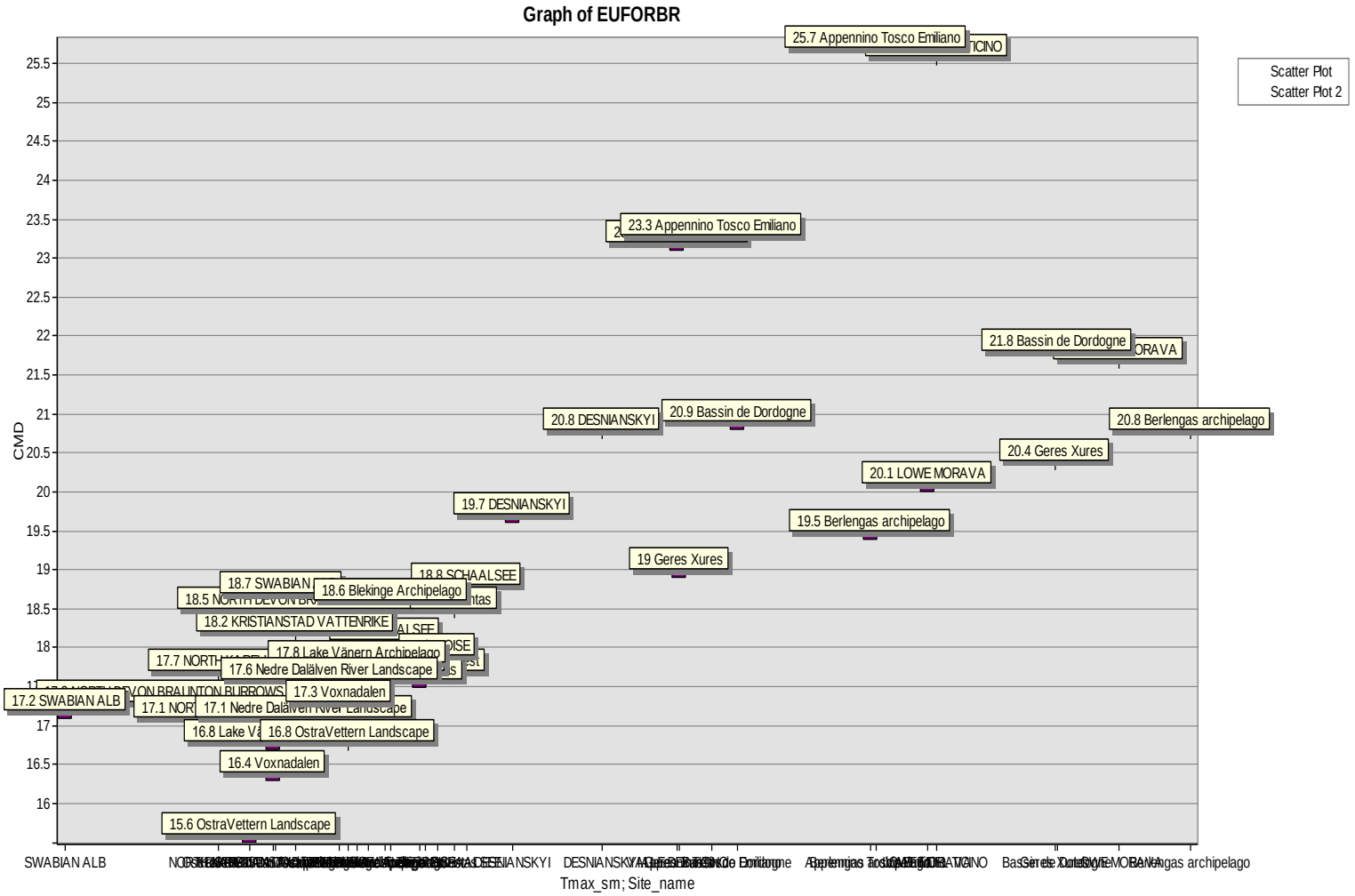

Figure 8. Scatter of Climate Moisture Deficit (CMD) for BRs with max temp 2020 vs. 2080.