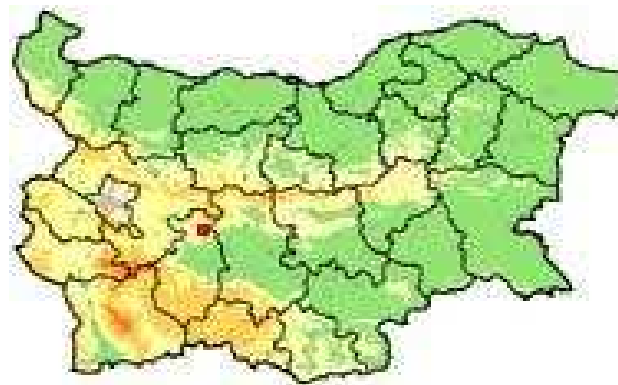


Case Continental Bulgaria Panagyurishte, Sredna Gora Mountains

**“MOdels for AdapTIVE forest Management”
(MOTIVE)**



G. Kostov, A.Goleva, E.Rafailova – University of Forestry, Sofia, BG





CONTENT

Common data – Coppice oak forests; Case study area

Environment – climate, expected changes

Forests, management

Model and scenarios

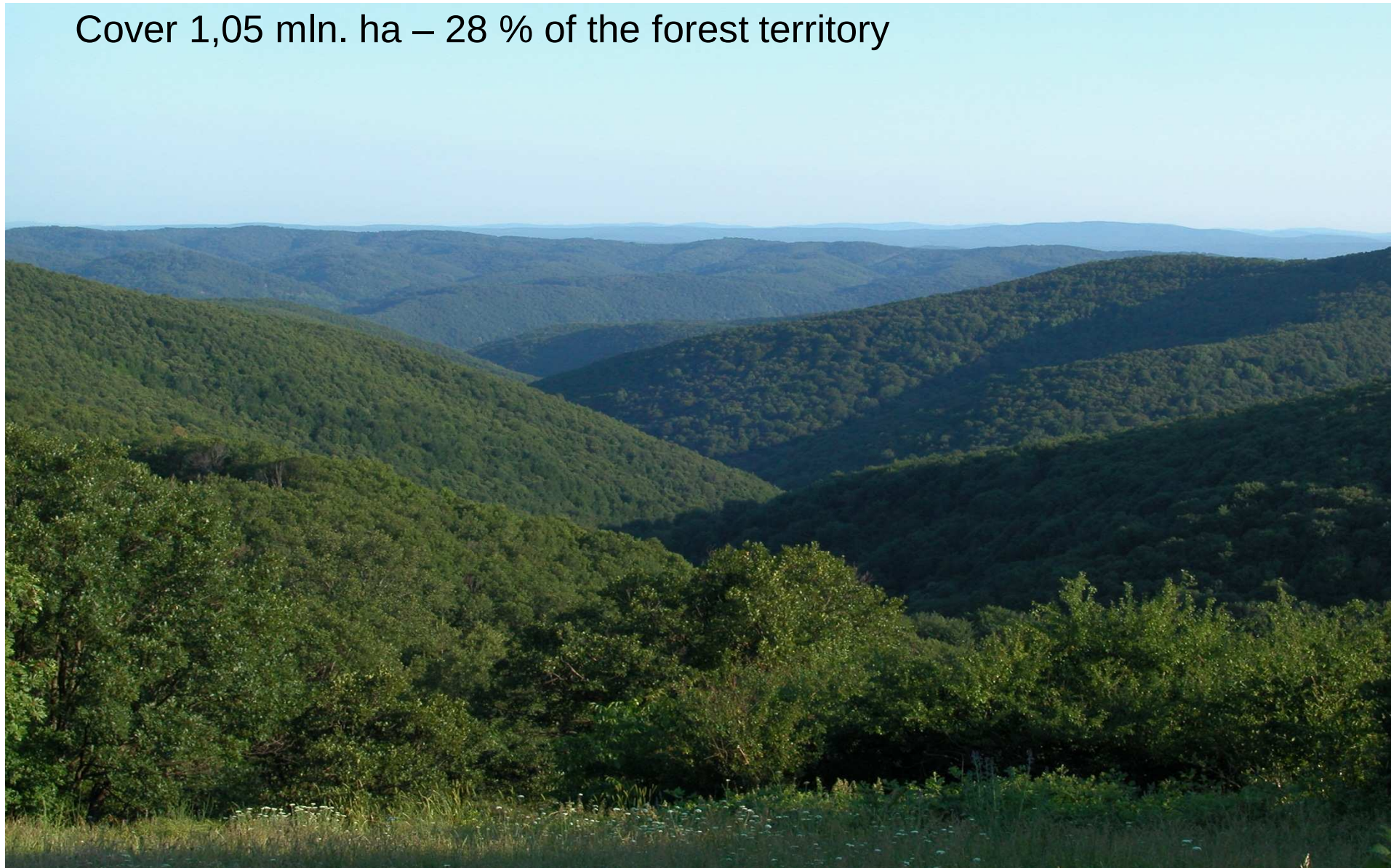
Results – growth; timber supply; other forests ecosystem services and functions

Conclusions



Coppice oak forest stands in Bulgaria

Cover 1,05 mln. ha – 28 % of the forest territory





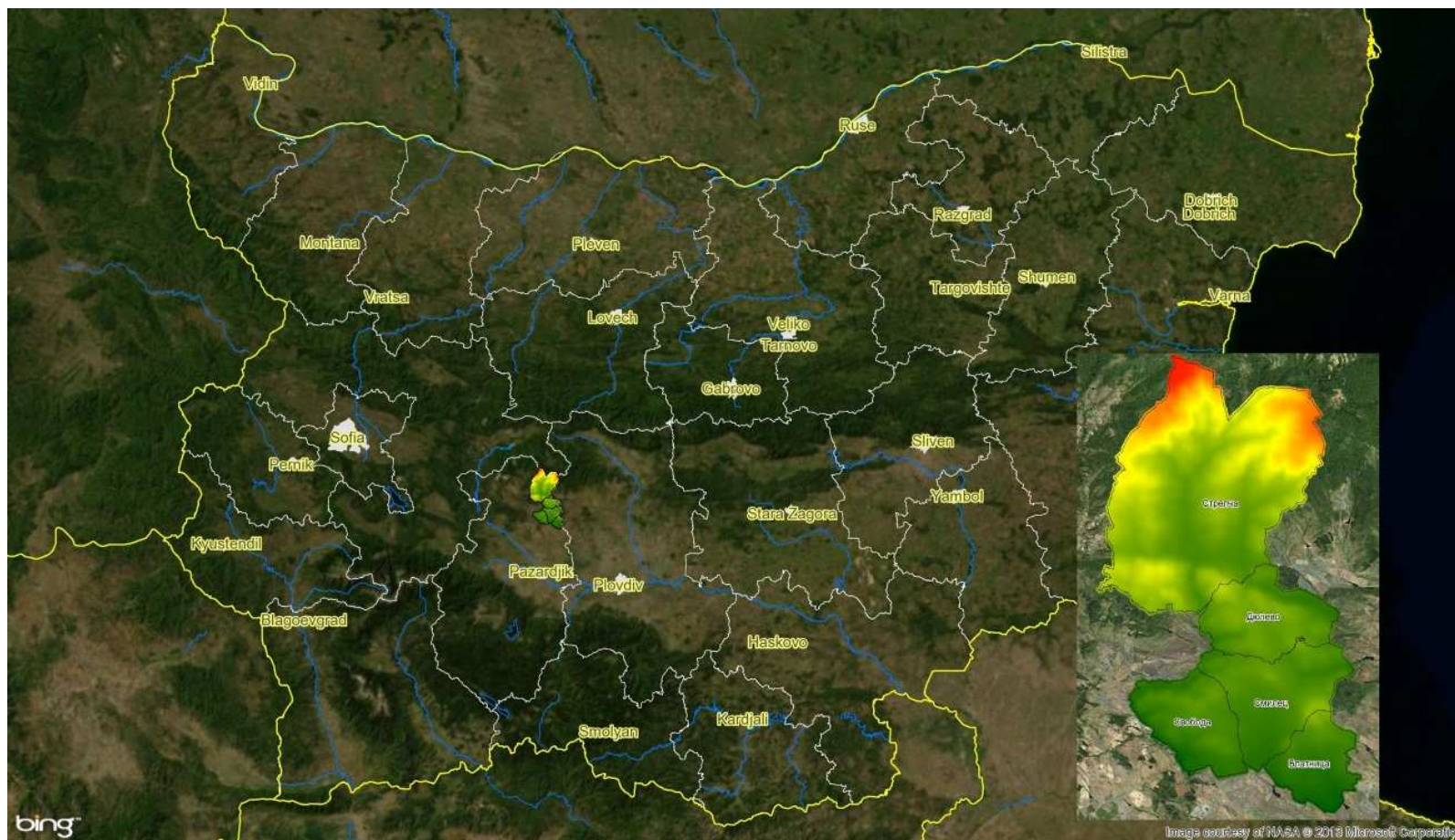
Provide 70 % of the hardwood's fuel-wood (1,7 mln. solid cub.m for 2012), i.e. heating of 450 000 households.



Coppice oaks stands produce some 0,3 mln. cub. m. construction wood annually. (The major part is used as a fire-wood, because the market prices favour it).

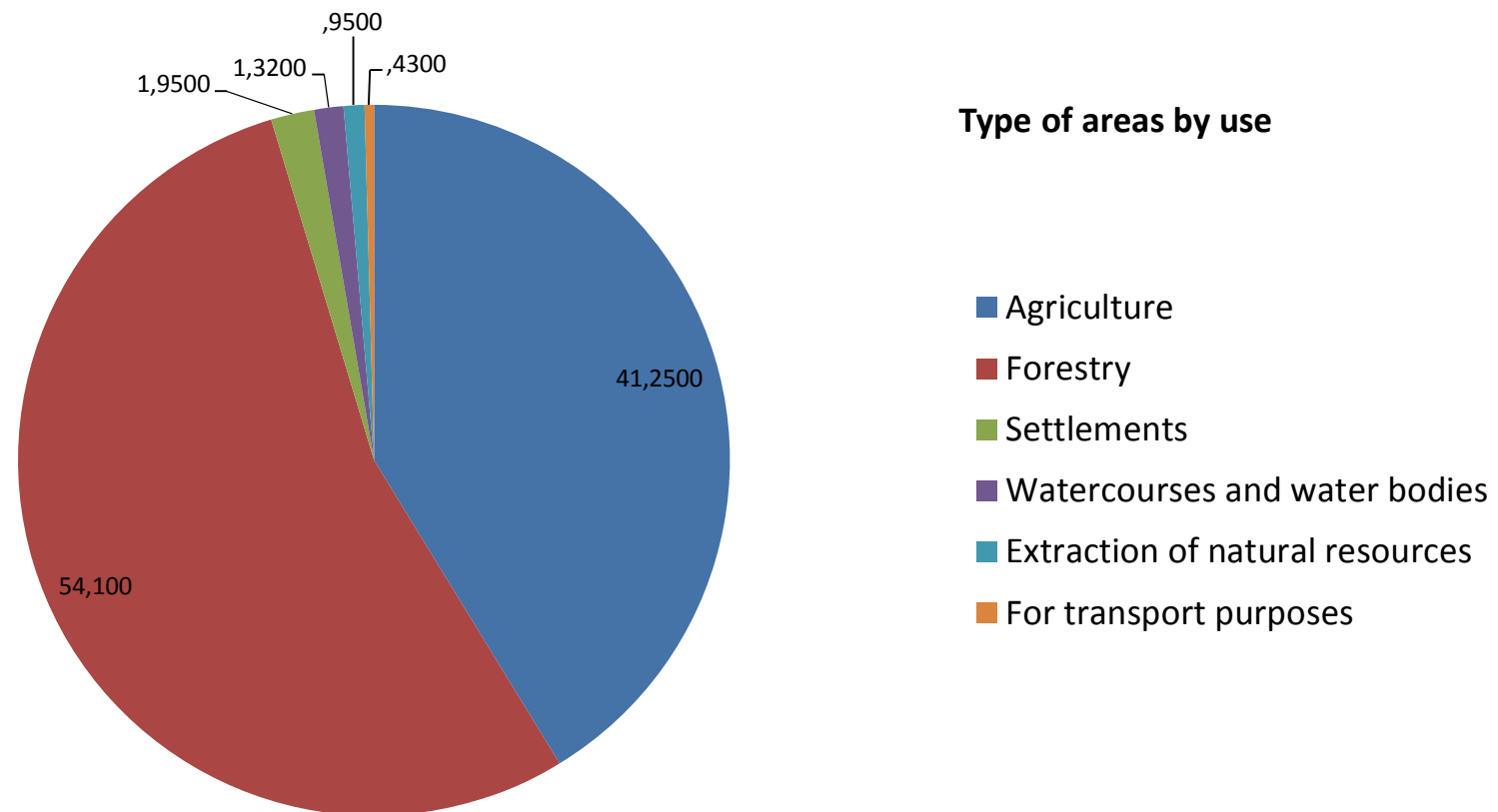


Case study – municipality of Strelcha, Forest unit of the town of Panagyurishte





The municipality Strelcha, where is the case study area permanently reside 5,600 people (25 people per sq.km), who are largely dependent on adjacent agricultural and forest areas

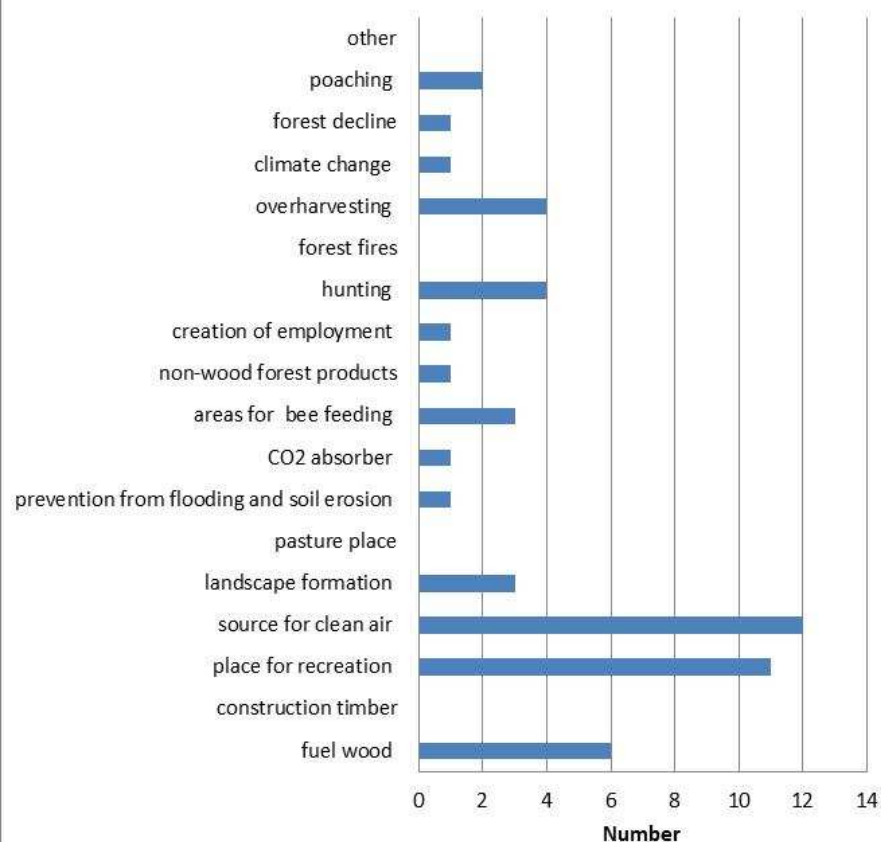




Demanded ecosystem services

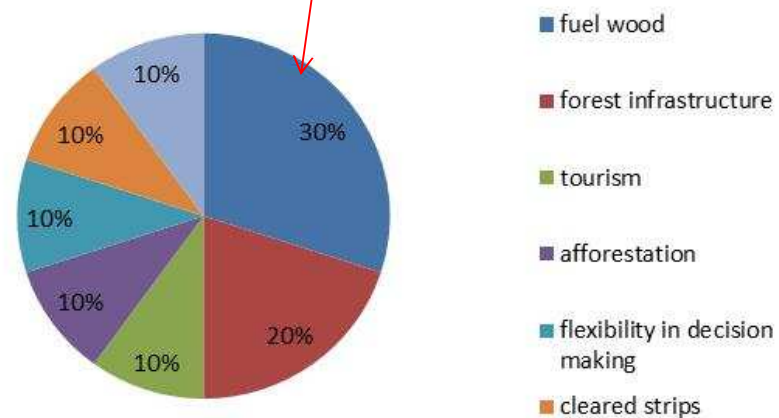


People's notions about forests



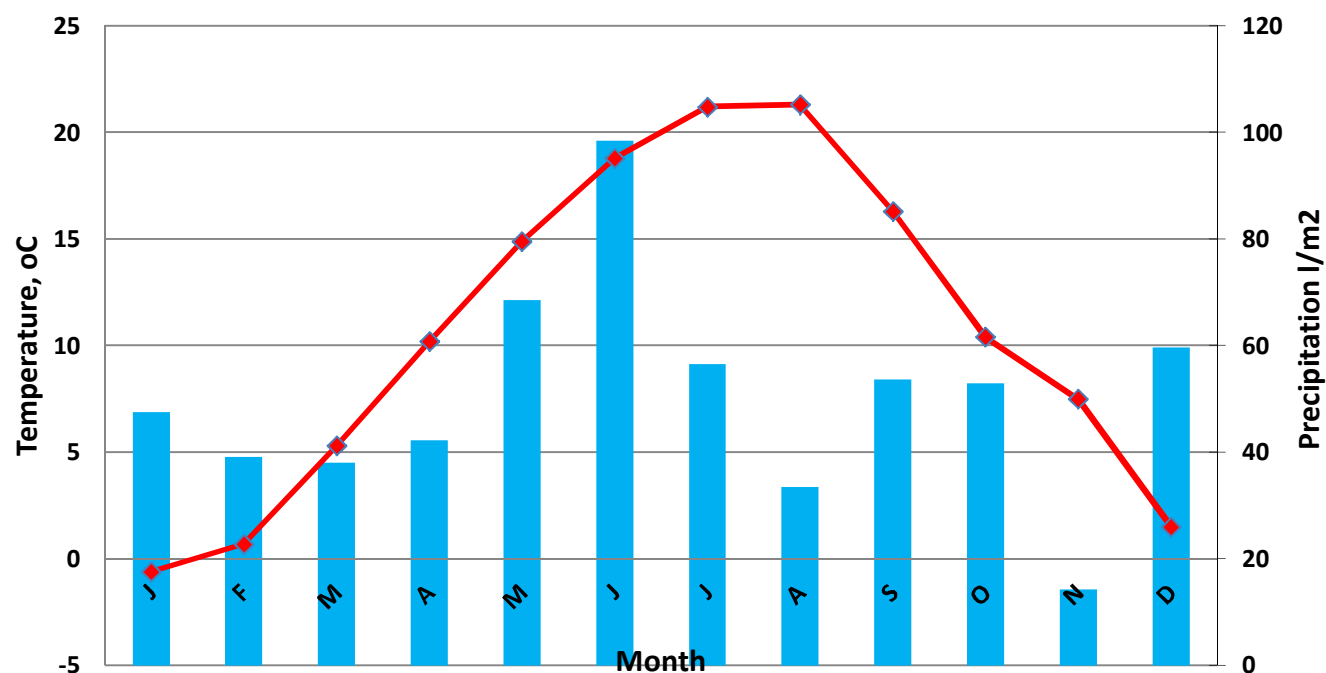
Fuel wood demand is leading between the services which are not enough, according the opinions of stakeholders

What people want to have more from the forest



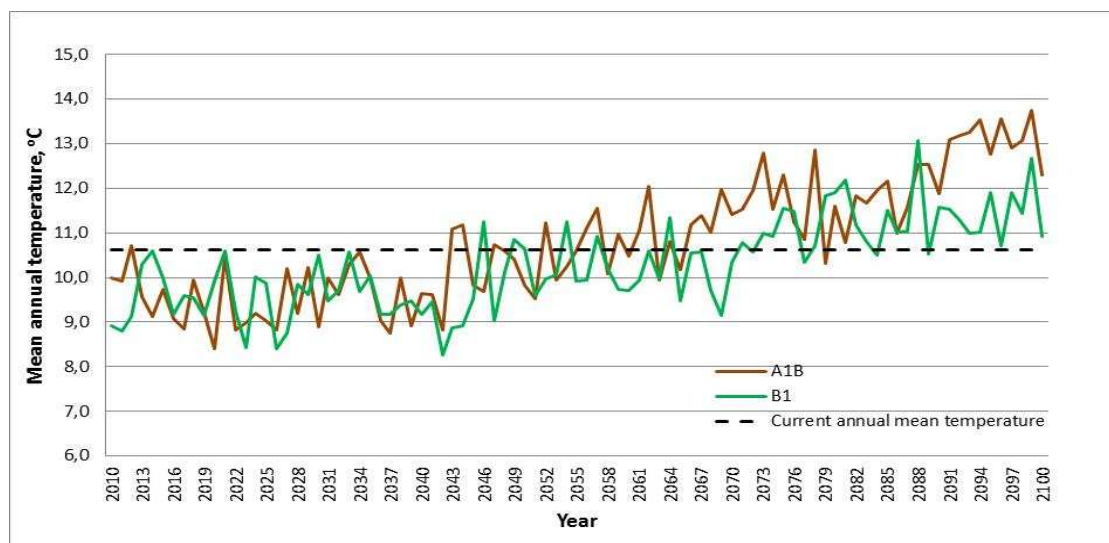


Current climate - Panagyurishte



Source: National
Institute of
Meteorology and
Hydrology - BAS

- The climate is typical temperate-continental.
- Mean annual temperatures are 10,6 °C.
- The average January temperatures run about -1 °C.
- Absolute maximum temperatures are 34°C - 36°C.
- Total mean annual precipitations are 60 l/sq.m with late spring maximum and summer minimum

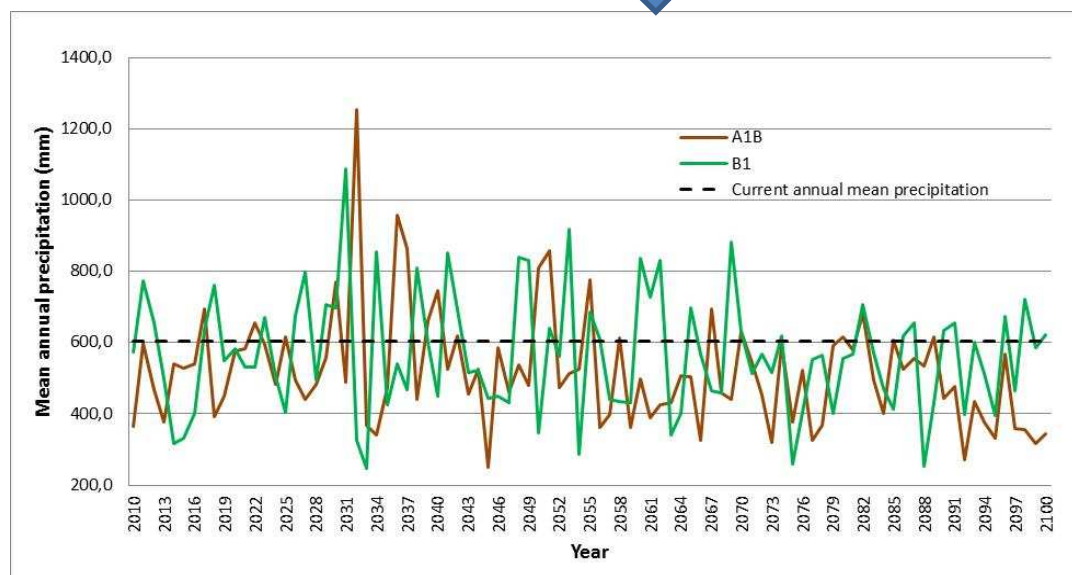


Increase of the mean annual
T ° between 1,5 to 3.5 ° C

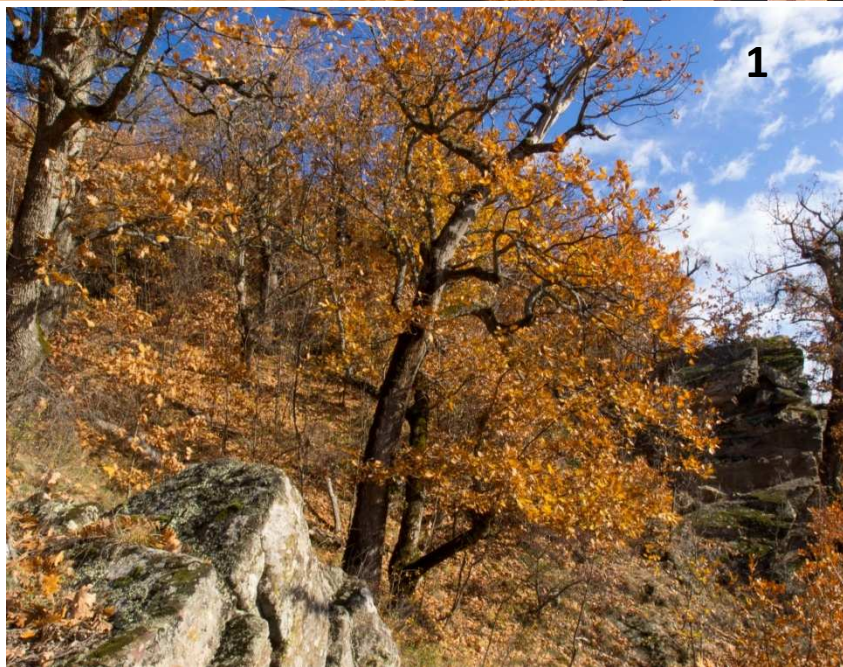
Decrease of the mean annual
precipitations between 60 to
120 mm

The most expected Impacts on the forests of climate change in this region are :

- drought stress to trees
(increasing water deficit during the vegetation period);
- increased risk of fire;
- secondary pathogens



Source: CLM/ECHAM5 data(Zimmermann 2010, and MOTIVE D2.2 Climate and land-use data)

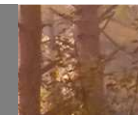


***Thaumetopoea pityocampa* Schiff**

Photos: 1 and 2 – Executive Forest Agency; 3 D. Doichev - UF



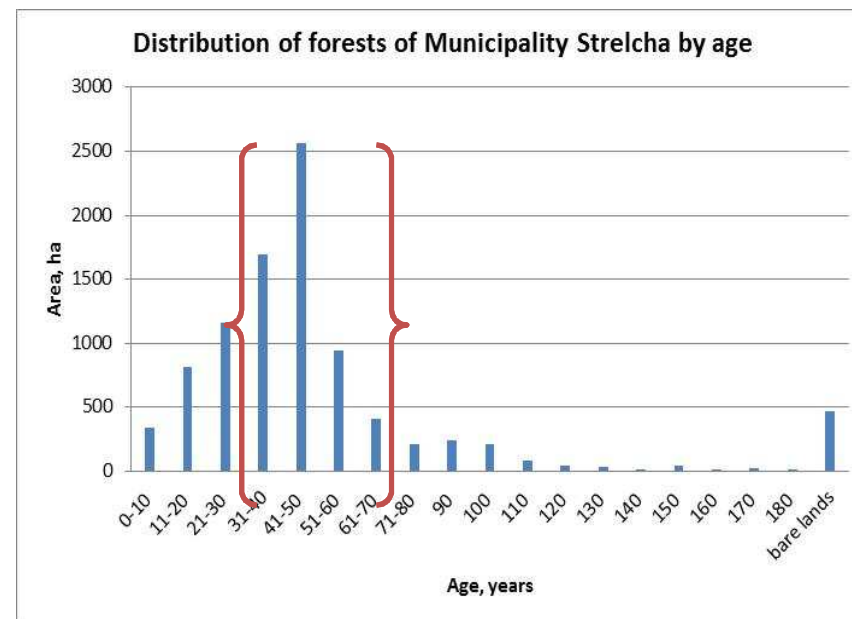
The forest in the case study



1200 stands with total area of 6500 ha
92 representative stands, consistent with their age, site type and composition

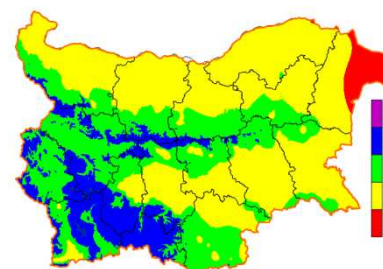
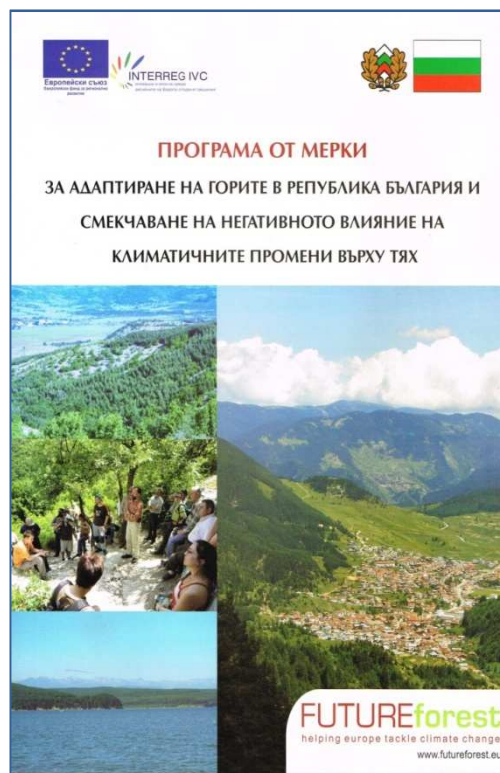


Quercus petraea - 55% from the area
Q. cerris - 18 %
Q. frainetto – 15 %
Pine plantations – 12 %



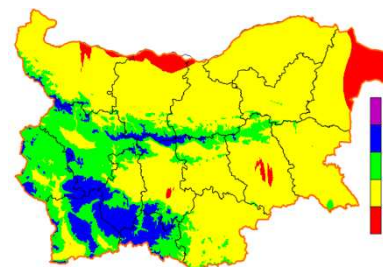
Project “FUTUREforest” 2007-2011,
program INTERREG IV C of EC

Program of measures for adaptation of
the forests of the Republic of Bulgaria
and mitigation the negative impact of
climatic changes (2011)



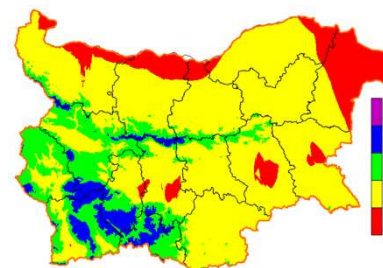
Year 2020

De Martone's index realistic
scenario



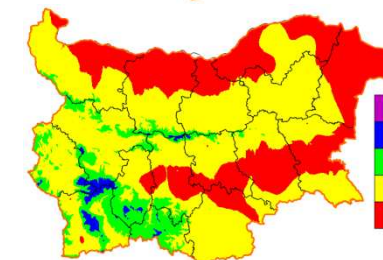
Year 2050

De Martone's index realistic
scenario



Year 2080

De Martone's index realistic
scenario



Year 2080

De Martone's index pessimistic
scenario

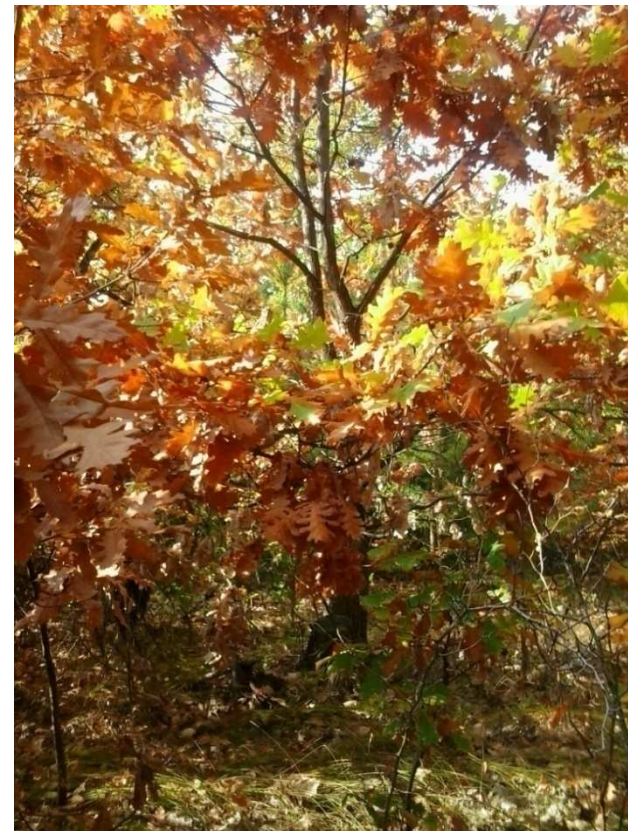
Forests - Main management goals:

1. Production of timber to satisfy the public's needs of fire-wood and production of some construction wood on the best sites;
2. The transformation of the coppice stands in to high ones by natural seed regeneration of over-mature coppice stands.

Typical 60 years old mature coppice stand, dominated by Turkey oak



When no tendings are applied after final felling, sprouts shift seed saplings as it shown in that stand dominated of Hungarian oak (Quercus frainetto).





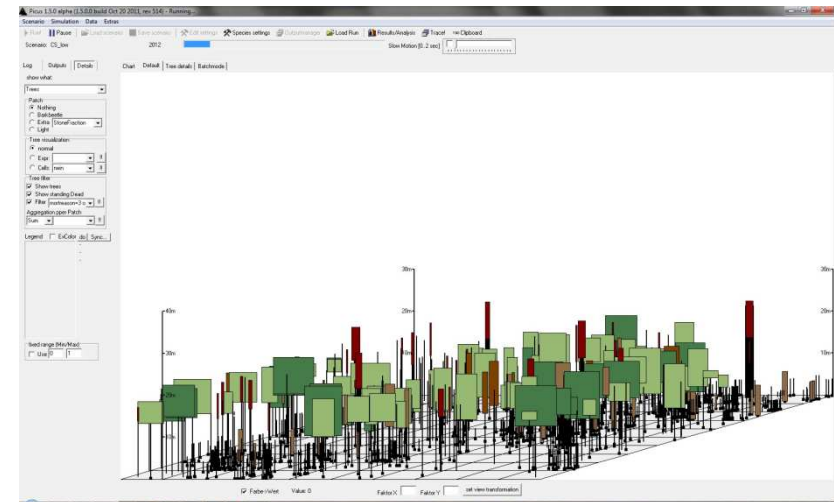
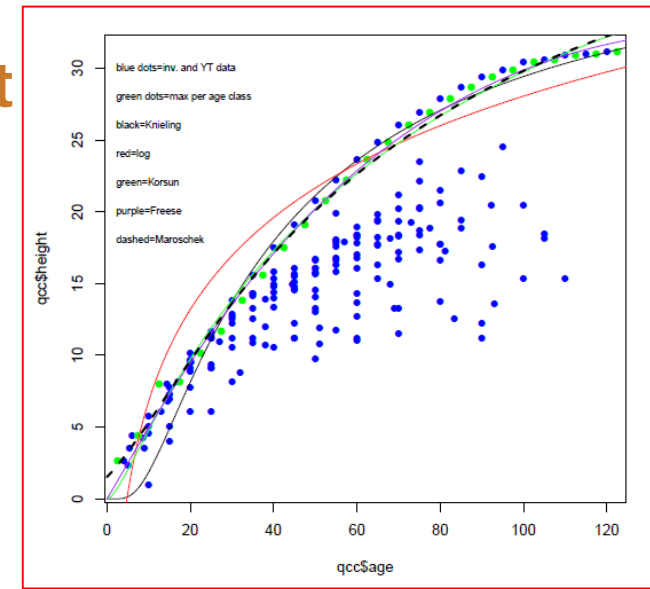
PICUS v1.5 – model development

1. Four new tree species have been parameterized for Bulgarian conditions:

- Pinus nigra,
- Quercus frainetto,
- Q. cerris,
- Q. petrea.

This was done by using observed data from the case study, from literature studies (incl. yield tables) and expert knowledge.

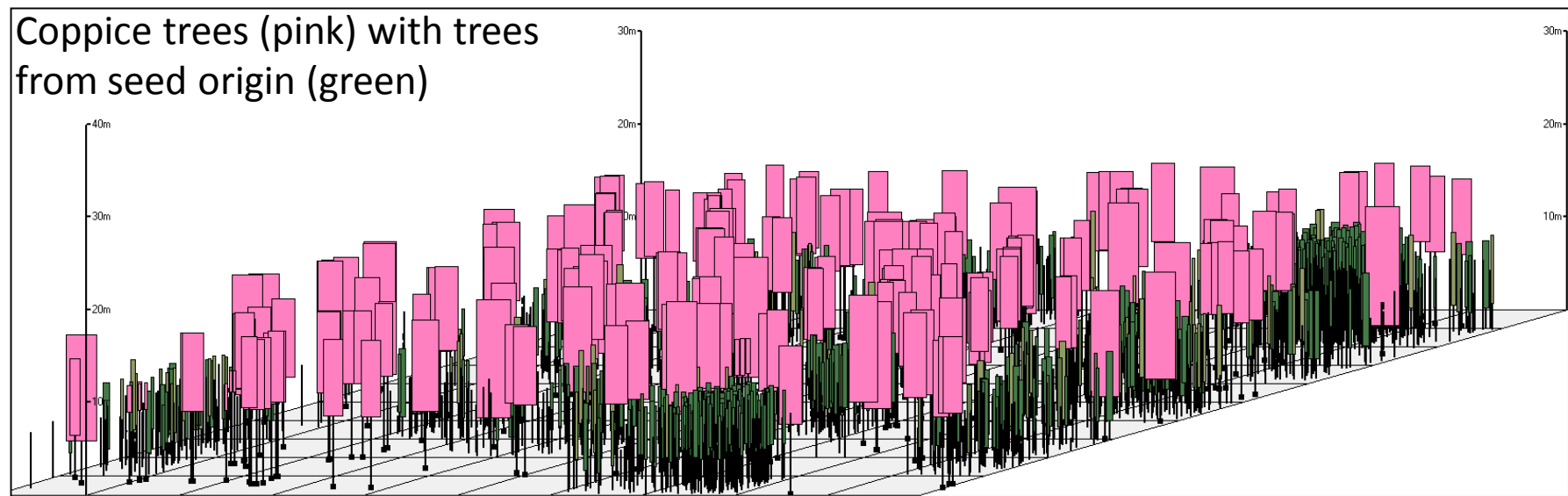
2. The regeneration module was extended to allow the simulation of sprouting.
3. The management module was enhanced to be able to conduct coppice management routines.



PICUS – the new sprouting module



- Implemented for three broadleaved species :
 - Q. frainetto,
 - Q. cerris,
 - Q. petrea
- Main features:
 - Sprouting is possible after a management intervention, i.e. a coppice cut.
 - The probability of a stump to re-sprout has been derived from observations in the case study area.
 - The sprouting capacity of a stump is determined by it's diameter, according to field data.
 - Within PICUS trees of seed or coppice origin are treated as different species, as the parameter sets show clear differences (esp. with regard to growth).

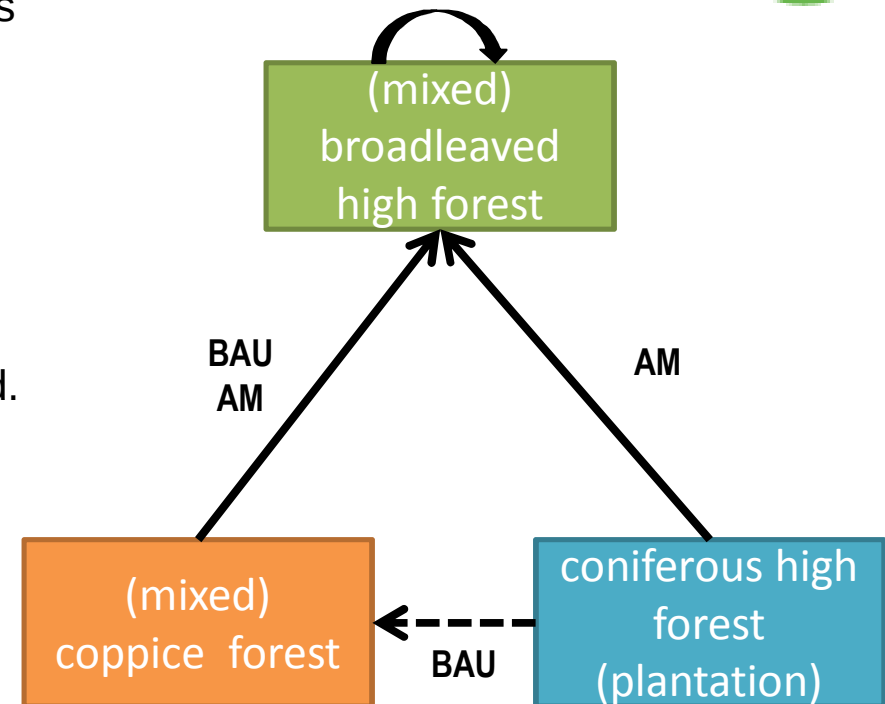




Simulation design



- According to their initial state the forest stands can be classified in three groups:
 - Coppice (n=68)
 - Pine plantations (n=21)
 - Broadleaved high forest (n=3)
- For each stand x site type combination one business as usual (BAU) and one adaptive management (AM) scenario has been defined.
- For each stand 2 management scenarios and 3 climate scenarios have been considered.
- Transition from coppice to high forests is a current silvicultural policy and practice in Bulgaria.
- Therefore, for the coppice, and the plantation management a transition to (mixed) broadleaved forests has been implemented in all management scenarios.
- This transition takes place after reaching the planned rotation age for the coppice or plantation stand.
- The simulations have been run for 90 years (2010-2100).



PICUS model

The main difference between the AM and the BAU lies in the a little **shorter rotation period, accepted for the AM**. Additional difference is that according the AM scenario, felling applies to all stands in their mature (rotation) age, while according to the BAU scenario some of the potential felling (into mature stands) is postponed due to the limited capacity to perform logging. There are some differences related to the intensity of potential felling and the following tending and thinning, between the AM and the BAU.

Generally the AM includes more regular treatments, as the existing silvicultural concepts recommend. It stays close to “Handbook” scenario. The transformation felling happens faster than according the BAU.

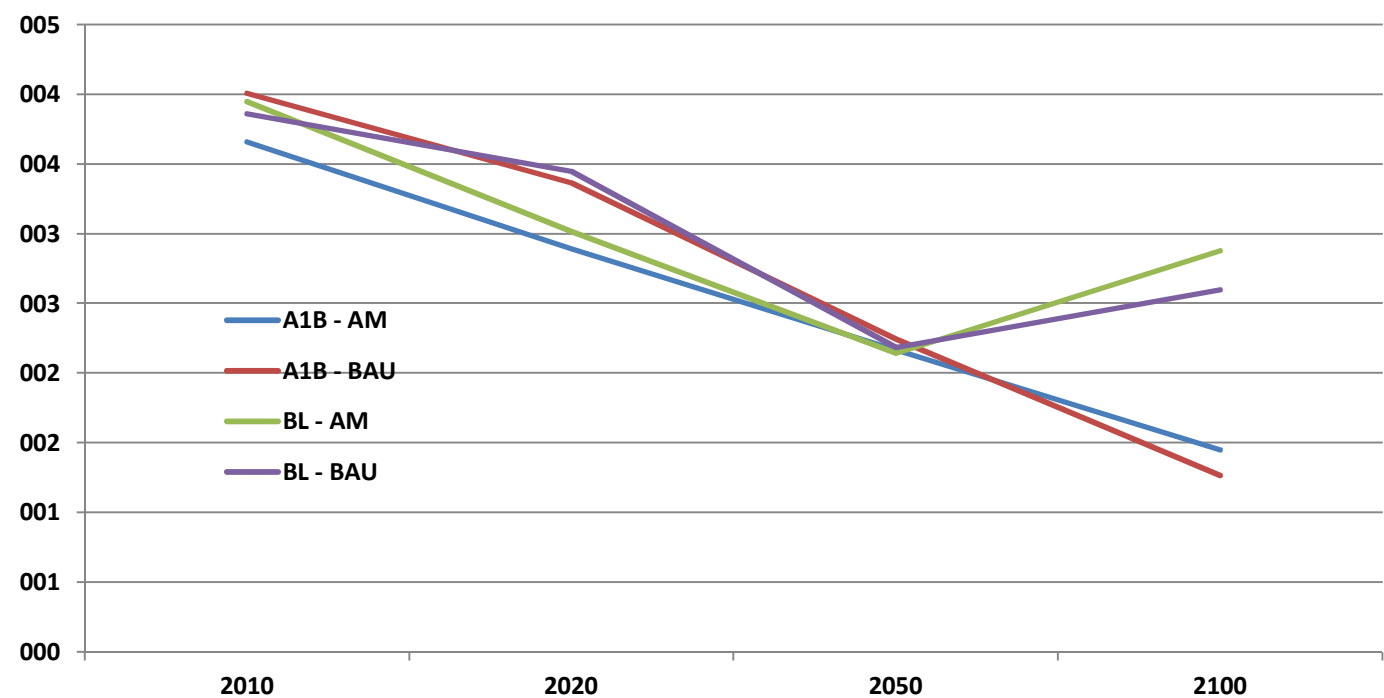


Management scenarios - details

- Coppice (n=12)
 - BAU: coppice management with 2 tendings and 2 thinnings from below until the end of the coppice rotation (clear cut at 50 – 90 years), transformation into broadleaved high forest with natural regeneration, 2 tendings, 2 thinnings from above and a 3 stage shelterwood cut after 100 to 160 years
 - AM: coppice management with 2 tendings and 2 thinnings from below until the end of the coppice rotation (clear cut at 50 – 70 years), transformation into broadleaved high forest with natural and artificial regeneration, 2 tendings, 2 thinnings from above and a 3 stage shelterwood cut after 90 to 120 years
- Pine plantations (n=4)
 - BAU: pure pine management with 1 tending and 1 thinning from below until the end of the pine plantation rotation (clear cut at 60 years), transformation into mixed high forest with natural and artificial regeneration, 2 tendings, 2 thinnings from above and a 3 stage shelterwood cut after 100 to 110 years.
 - AM: pure pine management with 1 tending and 1 thinning from below until the end of the pine plantation rotation (clear cut at 60 years), transformation into mixed high forest with natural and artificial regeneration, 2 tendings, 2 thinnings from above and a 3 stage shelterwood cut after 95 to 110 years.
- Broadleaved high forest (n=4)
 - BAU: mixed broadleaved forest management with 2 tendings, 2 thinnings from above and a 3 stage shelterwood cut after 120 to 140 years.
 - AM: mixed broadleaved forest management with 2 tendings, 2 thinnings from above and a 3 stage shelterwood cut after 100 to 120 years.

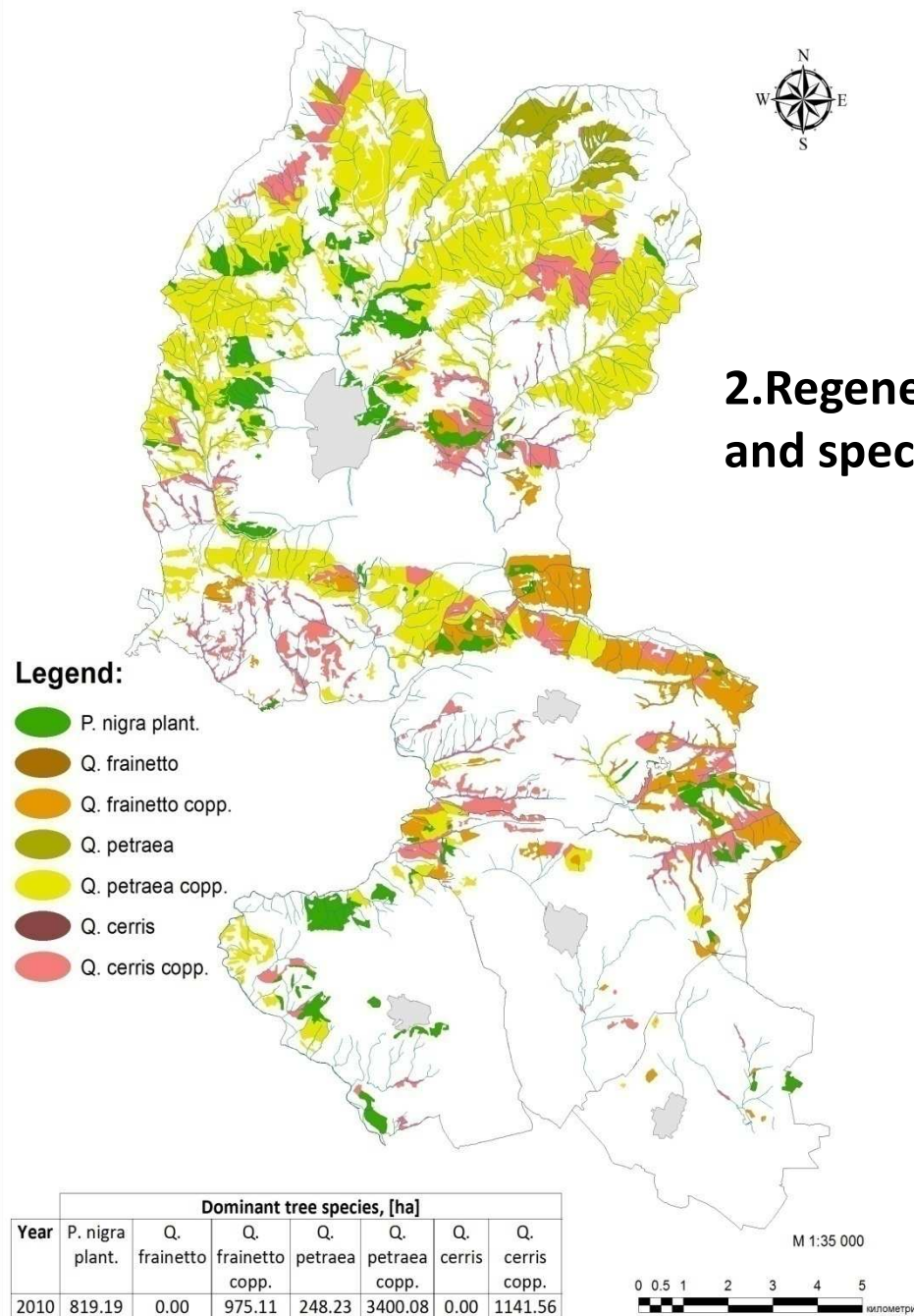
Are the tree species in the forest sensitive to climate change?

1. Growth



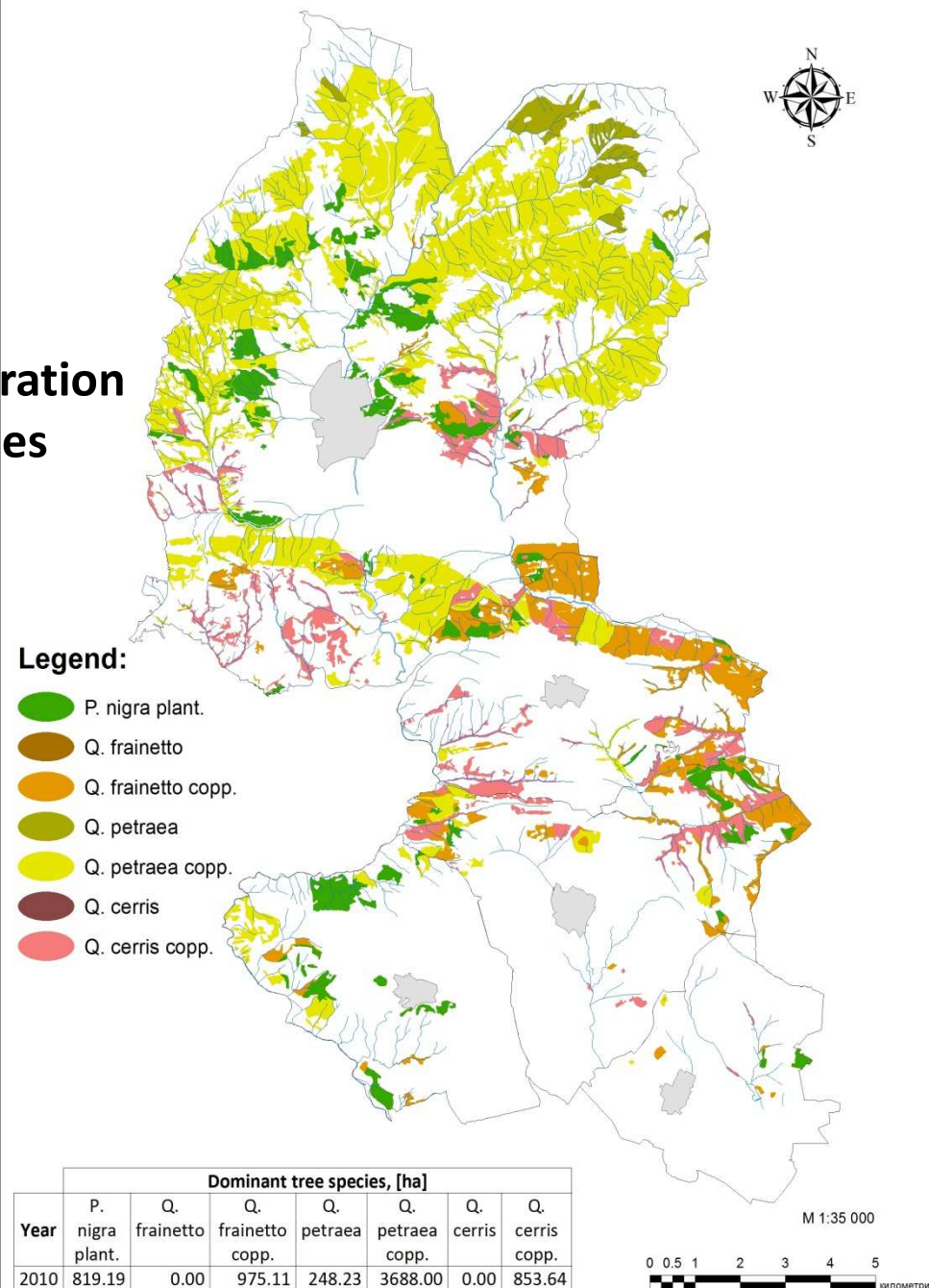
Average annual increment (cub.m/ha/year) simulation data for the forest case-study area Panagyuriste, by two climate scenarios (A1B& BL) and both BAU and AM management scenarios

Forest areas [ha]: A1B_AM_2010

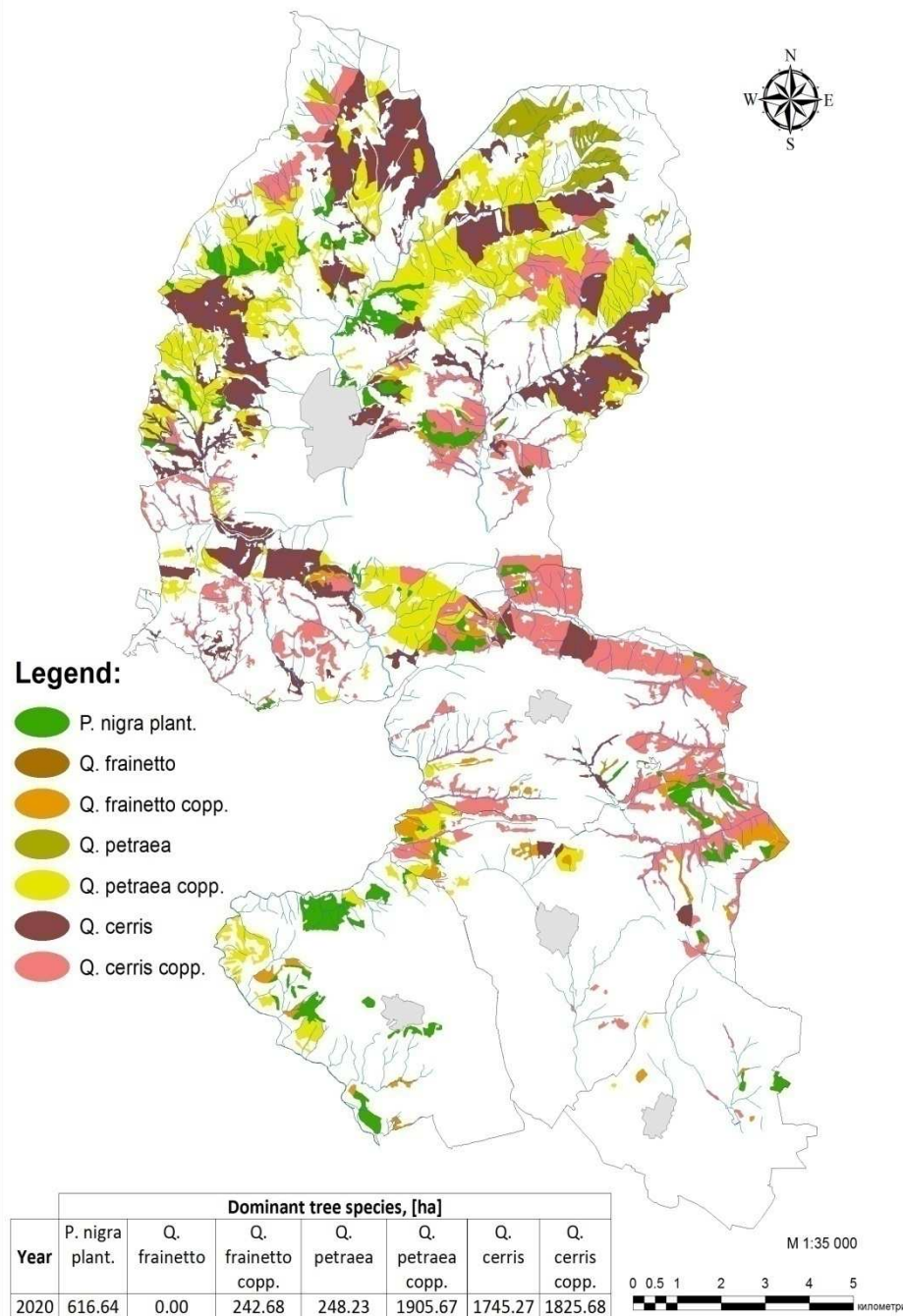


2.Regeneration and species

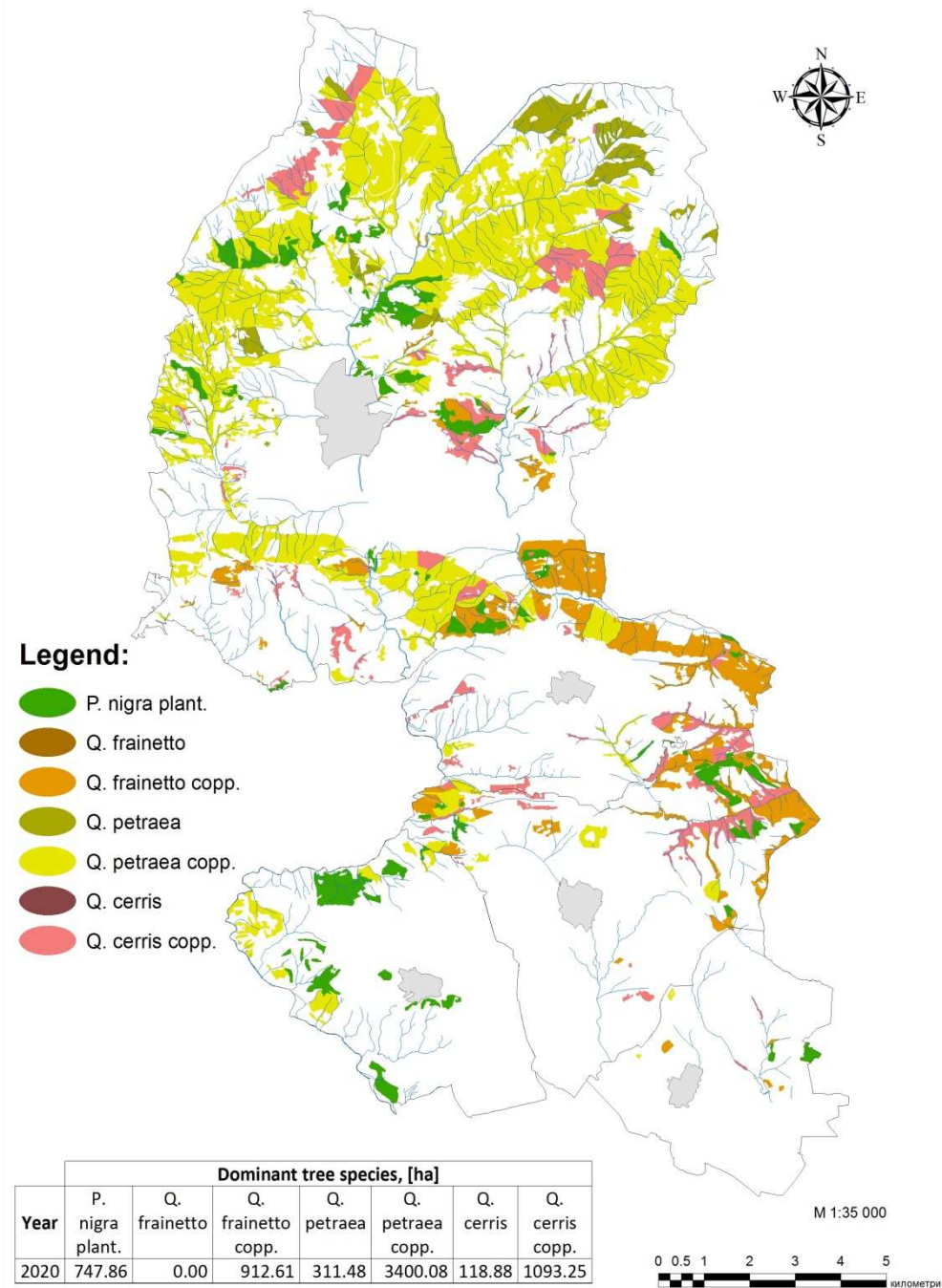
Forest areas [ha]: A1B_BAU_2010



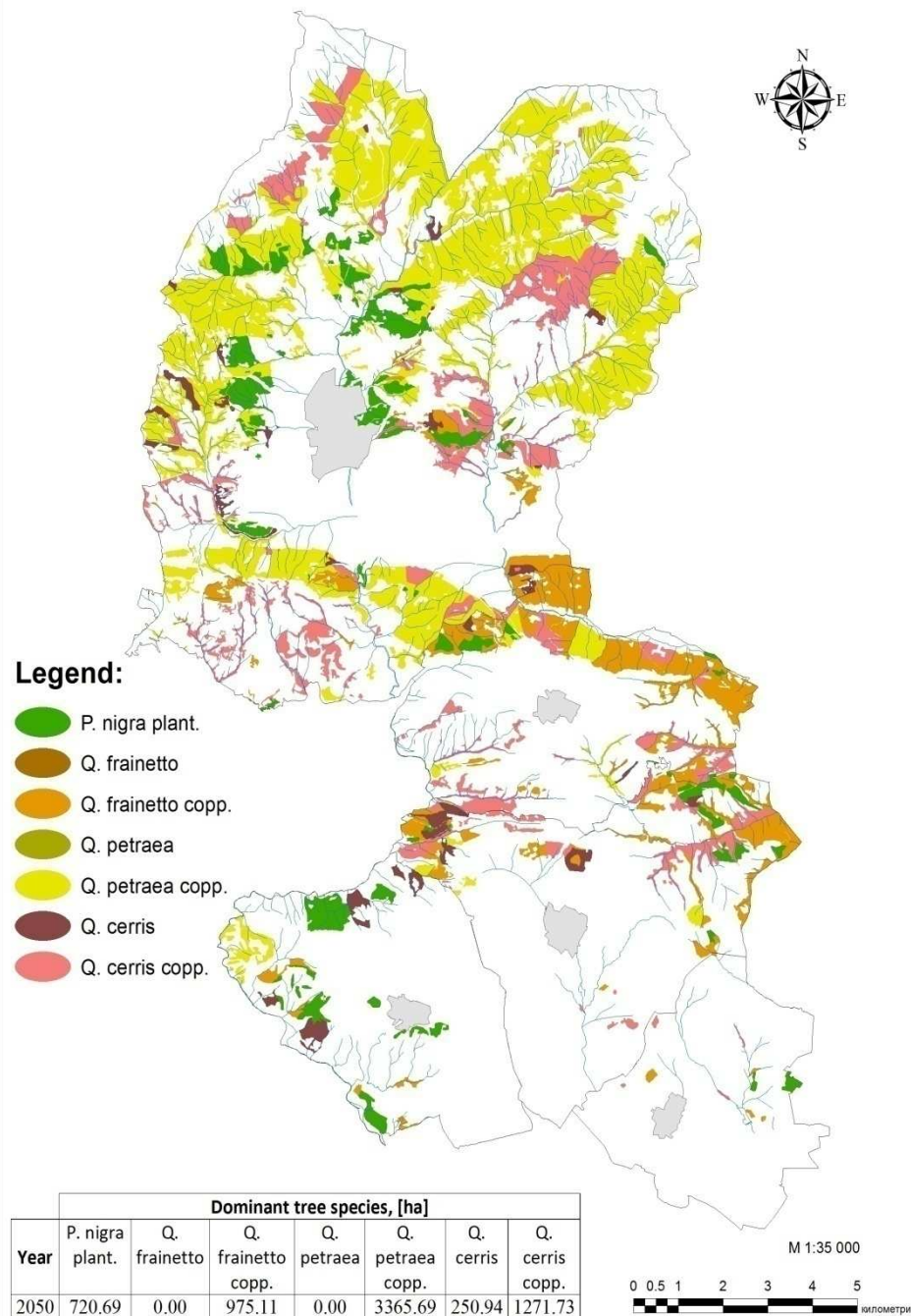
Forest areas [ha]: A1B_AM_2020



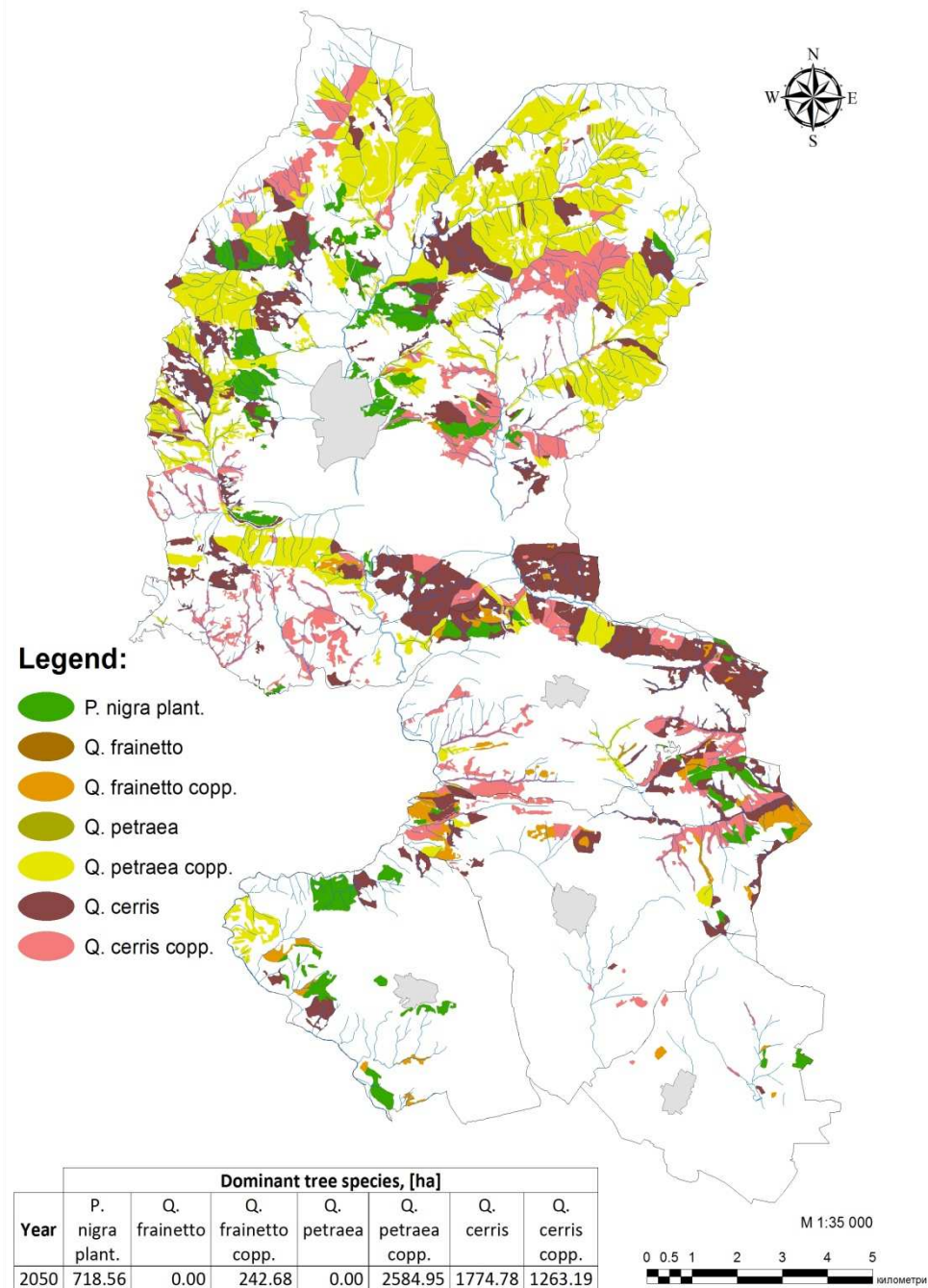
Forest areas [ha]: A1B_BAU_2020



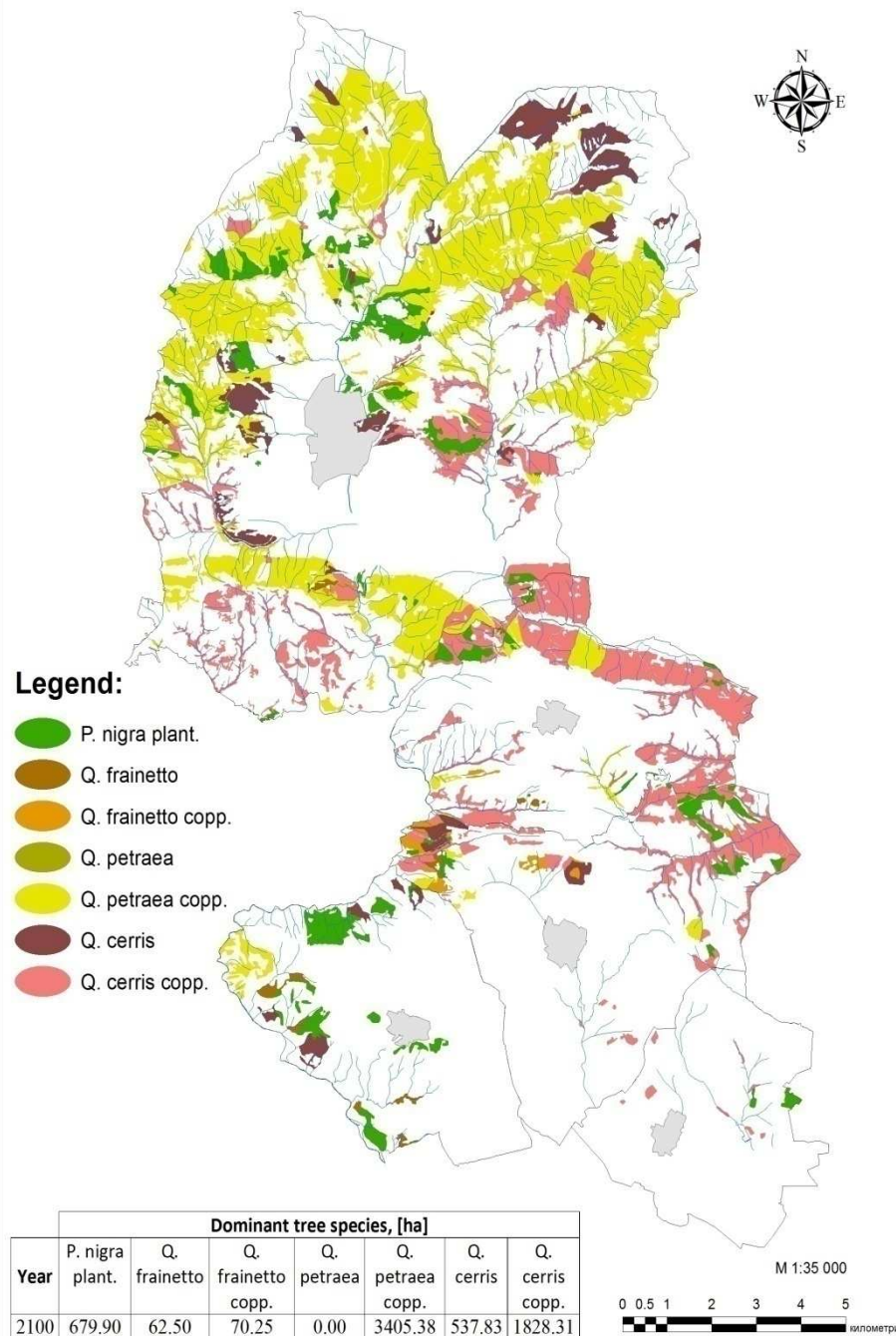
Forest areas [ha]: A1B_AM_2050



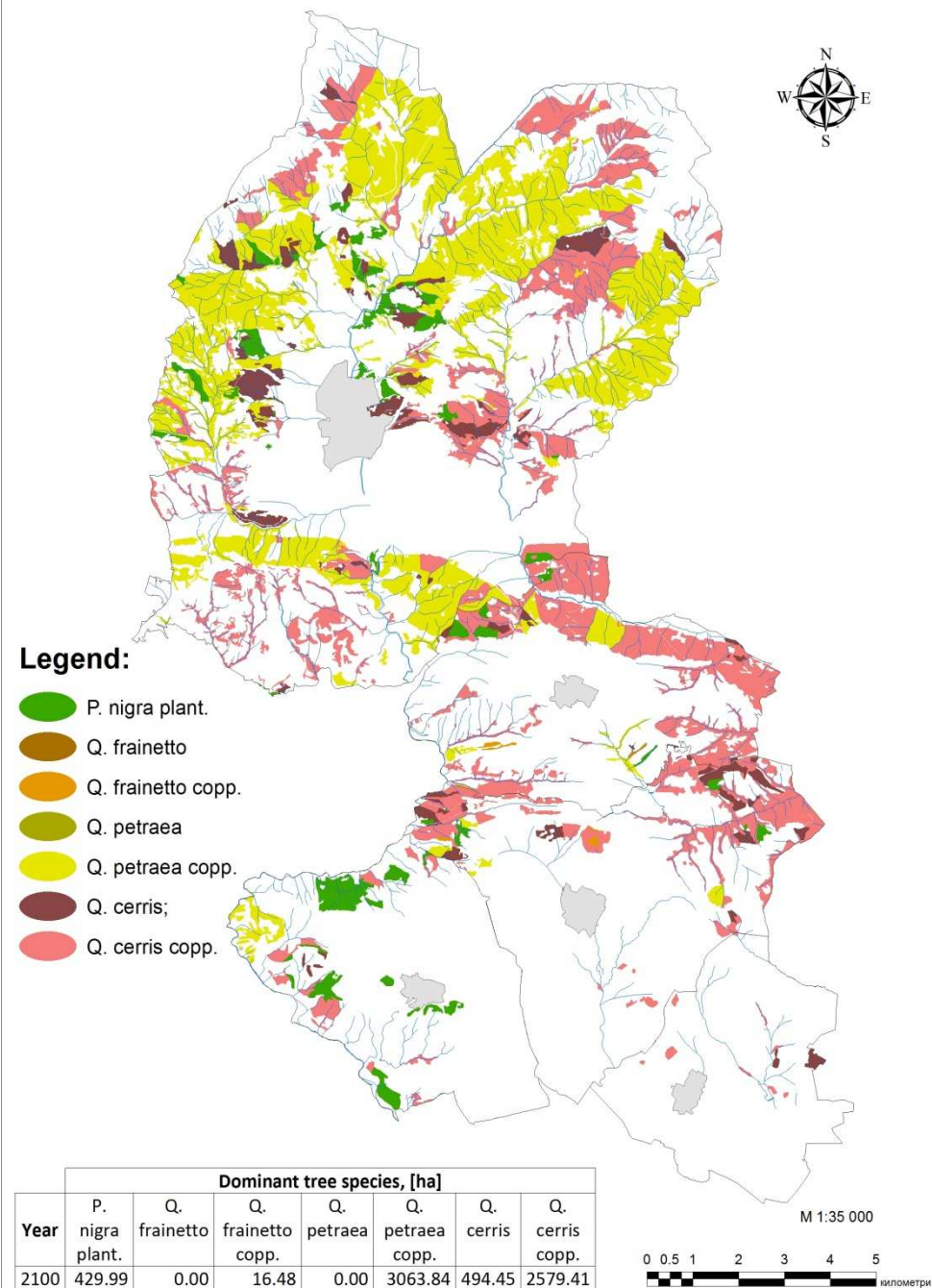
Forest areas [ha]: A1B_BAU_2050



Forest areas [ha]: A1B_AM_2100



Forest areas [ha]: A1B_BAU_2100

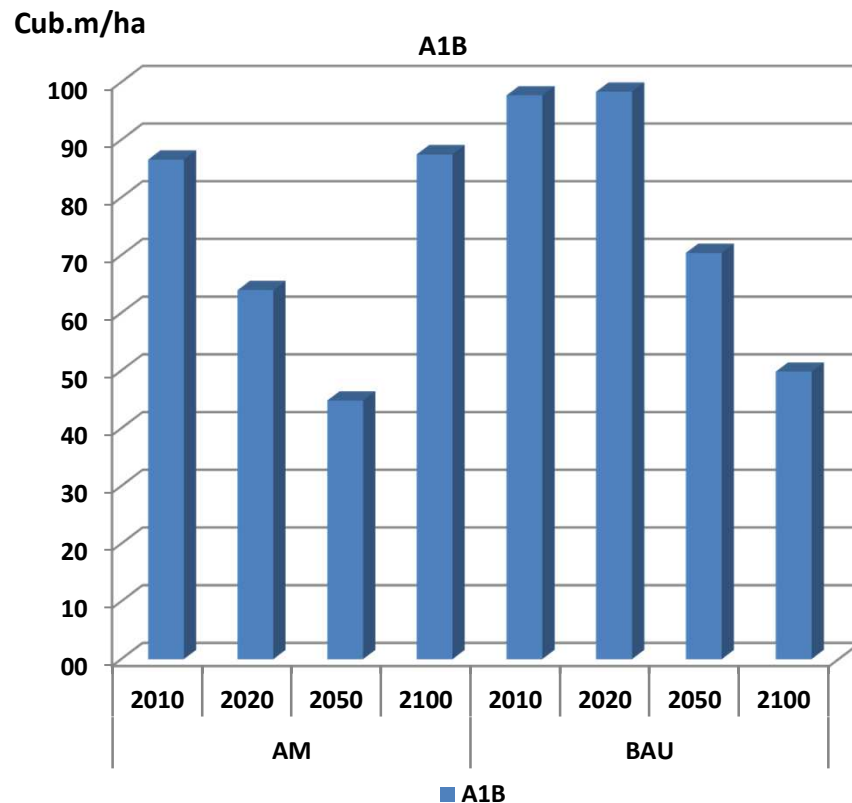


Mid- to longterm tree species sensitivities towards projected climate change for the three forest ecosystem processes. (+ increase, ~ no change, - decrease)

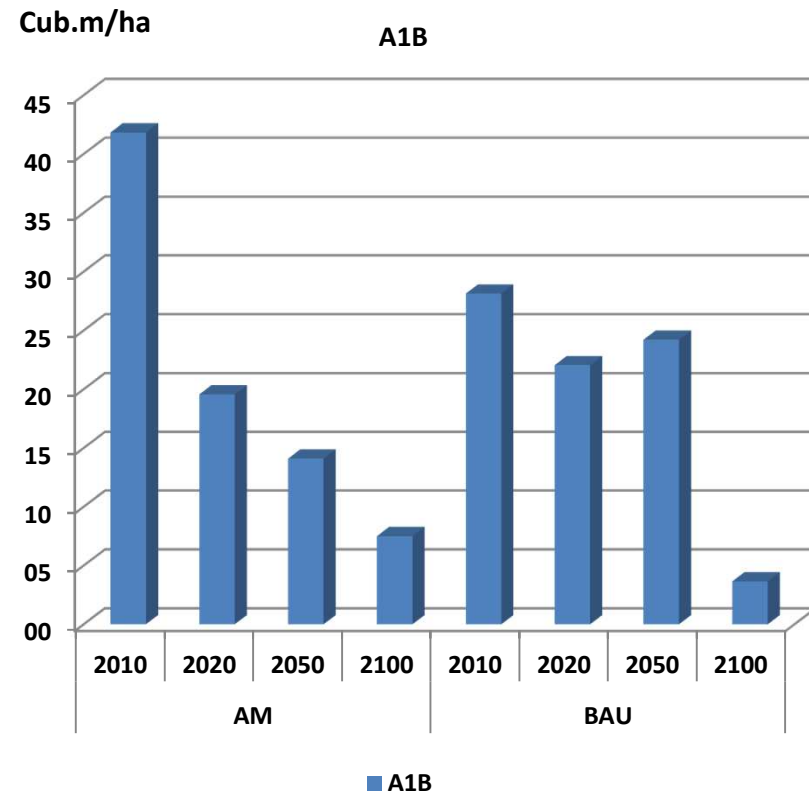
	growth		regeneration		mortality	
Tree species	2020-2050	2050-2100	2020-2050	2050-2100	2020-2050	2050-2100
Turkey oak – coppice	~	--	++	+	~	+
Turkey oak – high	-	---	~	-	~	-
Sessile oak – coppice	-	--	+	~	~	--
Sessile oak – high	--	---	-	---	-	---
Hungarian oak-coppice	-	--	+	+	~	-
Hungarian oak-high	-	---	~	--	-	--
Austrian pine	-	--	~	+	~	--
Flowering ash	~	-	~	+	~	-

The growing stock and the potential harvest

Current and projected average volume per ha of the coppice oak stands under moderate climate scenario A1B, the AM and the BAU management



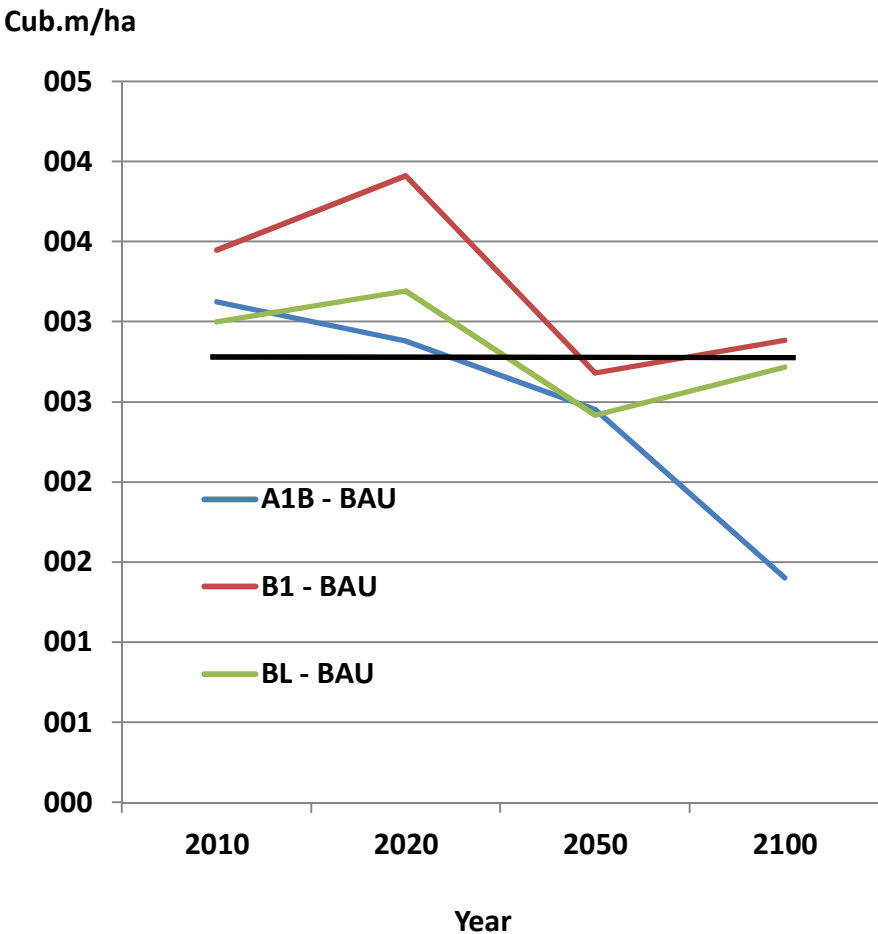
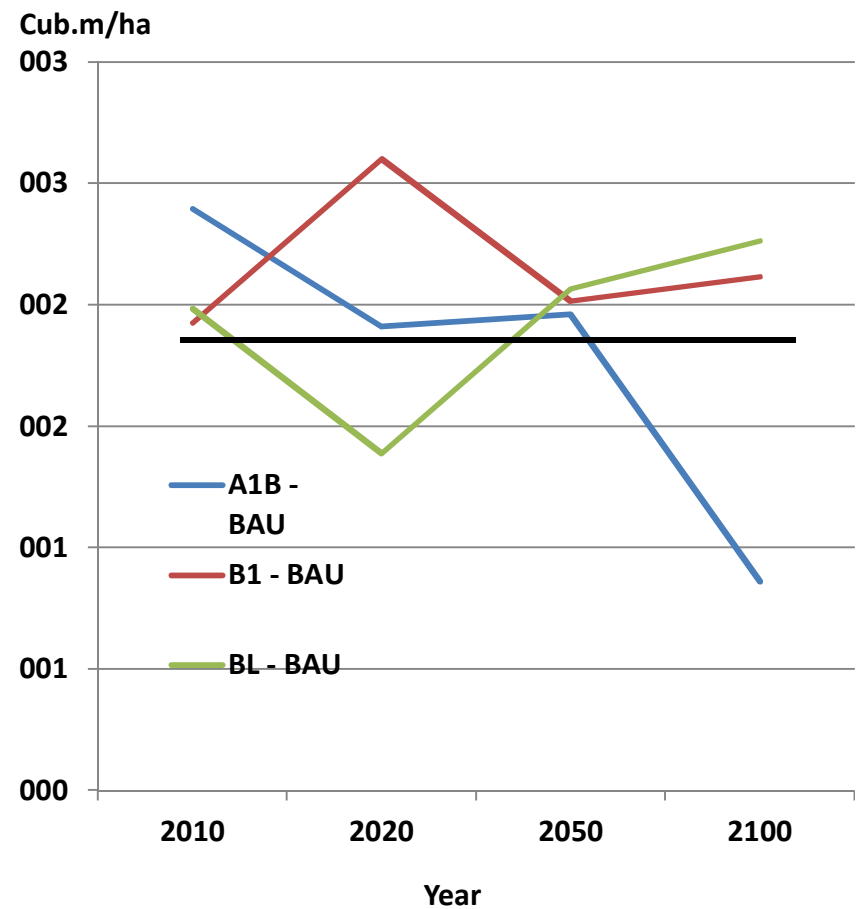
Current and projected 10 years average removed timber volume per ha from the coppice oak stands under moderate climate scenario A1B, the AM and the BAU management



Average (10 years period) annual increment simulated by the BAU

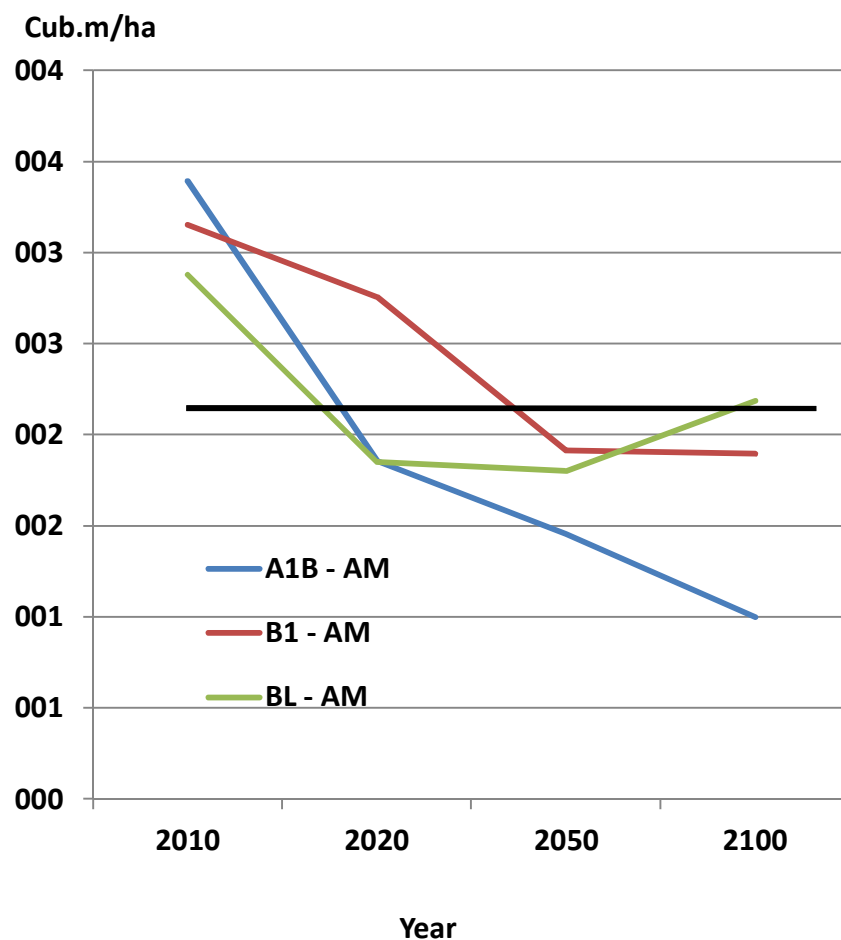
Average annual increment (cub. m/ha/year) simulation data for **the high** oak stands by climate scenarios (A1B, B1, BL) and the **BAU** management scenario

Average annual increment (cub. m/ha/year) simulation data for **the coppice** oak stands by climate scenarios (A1B, B1, BL) and the **BAU** management scenario

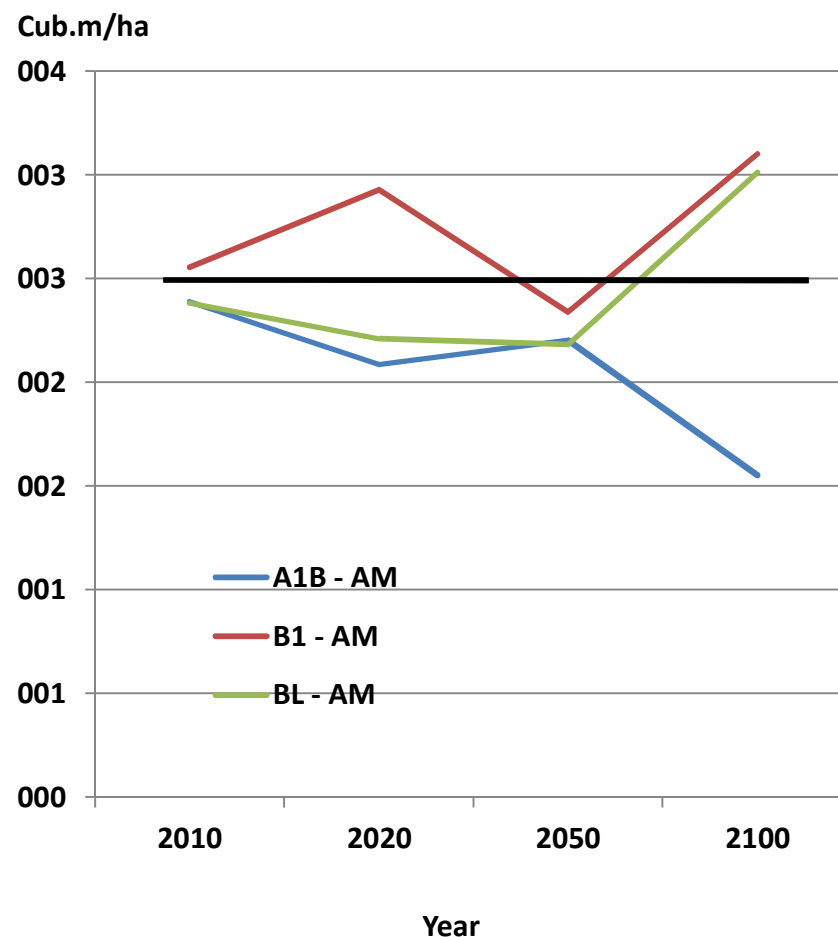


Average (10 years period) annual increment simulated by the AM

Average annual increment (cub. m/ha/year) simulation data for **the high** oak stands by climate scenarios (A1B, B1, BL) and the **AM** management scenario



Average annual increment (cub. m/ha/year) simulation data for **the coppice** oak stands by climate scenarios (A1B, B1, BL) and the **AM** management scenario



Comparison between the AM and the BAU management concerning legal management goals, related to different forest ecosystem functions in the Panagyurishte case-study (+ positive impacts, - negative impacts, ~ indifferent).

Management goals	2010-2020		2020-2050		2050-2100	
Management scenario	AM	BAU	AM	BAU	AM	BAU
Conversion the coppice to high	++	+	~	+	-	--
Production of construction timber	+	~	-	-	--	---
Fuel-wood supply	+	~	~	-	--	---
Protection of erosion	~	~	-	--	+	~
Landscape improving, recreation	~	~	-	~	+	-
Source of clean air	~	~	-	-	+	~



Main conclusions



- **No significant differences in the BAU and the AM in terms of yield, growth** and other stand characteristics (density, composition, origin) are observed;
- In all climate scenarios, adaptive management scenarios determine higher share of **high forests** in the case study area in comparison with current practice (BAU).
- More intensive regeneration felling according to AM will lead to increasing the areas of young stands dominated **by trees of seed origin** in short to mid-term outlooks. Long-term projections predict **back-turn to coppice** dominate origin of the existing stands.
- **The share of the most adaptive Turkey oak increase faster** in short-term run replacing more often Sessile oak and pine .
- **Potential timber harvest will decrease during the projection time**, since the main annual increment decreases for both the AM and the BAU scenarios and both coppice and high stands .
- The AM management require urgent, short-term harvest in all coppice stands, which will decrease considerably after the year 2020. After felling down the **current generation** coppice stands, the next one will have **reduced productivity** and will ensure less options to harvest.
- This rises the potential problem concerning the **lack of ability of the stands to supply the timber demand** in mid and long-term outlook, if assumed that it will keep the current level.
- From the other hand **the risk of men-caused fires will diminish since less human activities will be possible in more dense young forests.**
- The AM scenario promotes ability of the future coppice oaks stands to produce and support aboveground biomass, like coppice forest today. This mean that the stands will be similar to the current ones and will consist from closed forests and they **could guarantee their protective and other environmental services, despite the low timber production and supply.**



Some additional conclusions:



- The **AM scenario** provides **higher species diversity** and performs a steady share of coniferous;
- The **biodiversity protection** in the regions of the coppice oak forest will be **difficult** due to the serious losses of the aboveground biomass of the forests ecosystems, higher fire risk and other uncertainties;
- The **potential room for adaptation in terms of traditional silvicultural aims** for all coppice forests is narrow;
- The AM scenario moderates potential harm concerning timber supply and forest diversity;
- The black pine plantations will be partial able to compensate some of the losses of timber growth from the coppice oak forests in the low land regions;
- Important conclusion of the long-term projection is that **the conception of total conversion of the coppice oak stands will not be fulfilled, never than the less the AM scenario promotes higher future share of high forests, than the BAU.**



Recommendations



The conclusions should lead to changes in long-term goals and traditional expectations from today's coppice oak stands.

1. For the existing oak coppice forest stands **should not be set** common and equal (**uniform**) management goals and silvicultural techniques to achieve them. It is necessary to have **more flexible approach** corresponding to the specific state of stands in different parts of the forest.
2. Since there are not enough silvicultural tools for the total compensation of the losses concerning timber production it should be introduce some additional **political measures**, which could help for proper maintain and regeneration of the **ecosystems services** as landscape improving, erosion control, watershed and biodiversity conservation and so on. This means **evaluation of these ecosystem services** and create a regional markets to trade them.
3. The **forest industry must adapt** to the future irregular and uncertain wood supply from the current coppice oak stands.
4. In mid-term period, there will be **necessity for additional fire-wood supply** to satisfy the demand of the people which live in the low regions, where coppice oak forests dominate.

Coppice oak stands - The future depends of today's actions!



The End
Thank you for your attention!

Photos: G.Popov