Forest Research
Open Access
ISSN: 2168-9776

Lucas-Borja, Forest Res 2014, 3:4
DOI: 10.4172/2168-9776.1000e113

Editorial Open Access

Forest Management and Climate Changing Conditions: Some Insight from *Pinus nigra* Arn. Ssp. *Salzmannii* Cuenca Mountains Forest

Manuel Esteban Lucas-Borja*

Department of Agroforestry Technology and Science and Genetics, Higher Technical School of Agricultural and Forestry Engineering, Castilla La Mancha University, Spain

In the Mediterranean region, rising temperatures and decreasing rainfall will lead to increased occurrence of drought periods. Yearly rainfall is expected to drop by up to 20% of current annual precipitation, with up to 50% reduction in summer [1]. However precipitation is expected to increase in winter. Annual mean temperature increases throughout southern Europe would be in the order of 3-4°C (4-5°C in summer and 2-3°C in winter). Models predict changes in frequency, intensity, and duration of extreme events with more hot days, heat waves, heavy precipitation events, and fewer cold days [2]. Our studies support this warming trend in the Cuenca Mountains, as well as a higher likelihood of extreme drought events.

Forest management and planning is becoming more challenging in the perspective of climate change. In the past management planning has been primarily aimed at preserving the status quo rather than allowing or even explicitly aiming for change. However, there is evidence of an increasing awareness to include climate considerations in strategic and operational planning, particularly in Europe. Forest managers are already adapting to the observed effects as they increasingly perceive the need for adaptation. For example some biotic disturbances have forced forest management and planning effort in disturbed regions to conform with the new conditions [3]. These effects of climate change highlight that a climate change adaptation strategy should be viewed as a risk management component of sustainable forest management [4,5]. Generally, the capacity to adapt to climate change must be integrated into forest management [3]. But not only planning and decision making has to be improved under climate change. Bürgi and Brang [6] highlight the necessity of an effective controlling in forest management, which is getting even more important under climate change conditions and is a key component of adaptive management [7].

The changes in the pattern of rainfall distribution may have a stronger effect on growth than the decreased precipitation because trees are adapted to grow within the constraints of a given climate and water regime [8]. Although forest stands show some plasticity, growth and vitality are expected to suffer with changes in timing and duration of water stress. Dendrochronological records showed that growing season drought has a great impact on different tree species in Spain [9,10]. Previous dendrochronological studies showed that *P. nigra* growth is mainly enhanced by wet spring conditions during the year of tree-ring formation [11,12]. Dry conditions before tree-ring formation constrain growth in rear-edge *P. nigra* populations. The comparisons of climate-growth responses along aridity gradients allow characterizing the sensitivity of relict stands to climate warming [13]. Our results allow expecting contrasting climate change effects on *P. nigra* growth. Low-elevation studied stands (warmer and drier conditions) did not yield the lowest growth rate but showed negative correlations among temperature and climate, and therefore, growth models forecasted growth decline and virtual extinction of these populations. Nonetheless, old-growth and higher-elevation stands yielded steady and slightly declining growth predictions, despite the showed very low mean growth rates. Central populations showed positive growth trends related to positive winter and autumn temperatures. Moreover, the stands having favorable climatic and soil conditions showed lower drought sensitivity and significantly higher growth trends.

Other of the most important researches needed in the Mediterranean zone are provenance selection and genetic diversity [2]. The on-going and planned measures in the Mediterranean area include selection of adaptable species, provenances and genotypes that are less sensitive to changing environmental conditions and which are resistant to drought. A selection of a wider range of species and genetic diversity may improve the resilience of forests to climate change autonomously. This diversity can be supported by use of natural regeneration techniques [8,14-16]. Whether natural or artificial, regeneration is the stage at which the species and genetic composition of the stand gets established, where diversity can be manipulated the most. Later silvicultural steps may modify to some extent the initial composition but cannot correct insufficient suitability for current or future site conditions. The low genetic diversity observed in some of the eight populations selected from southeastern Spain to northern Morocco is probably a consequence of inappropriate management. Basic requirements in terms of suitability and diversity at the species and genetic level therefore need to be fulfilled at the regeneration stage. In this context all spatial and biological levels should be considered, as the species and genetic composition can be manipulated from the stand to the forest or regional levels. Genetic differentiation among populations of *P. nigra* is essential for conservation of genetic resources, so we recommend that an estimation of genetic variability of populations should be achieved before initiating forest management.

Wherever possible, natural regeneration is to be enhanced because evolutionary processes are less disturbed. However, this requires that the gene pool of available seed trees is suitable for the site [17]. Under a changing environment, using natural regeneration allows natural selection to take place. This will drive the population to meet the fitness optimum corresponding to the local environmental conditions. Because the genetic composition of populations needs to be shifted to cope with environmental changes, diversity levels should be set at higher levels than under standard regeneration conditions. Natural regeneration should result from the contribution of a sufficient number of parental genitors, preventing that seeds are only produced by very few maternal parents. Forest regeneration offers a direct and immediate opportunity to select tree species or provenances that are believed to be

***Corresponding author:** Manuel Esteban Lucas-Borja, Department of Agroforestry Technology and Science and Genetics, Higher Technical School of Agricultural and Forestry Engineering. Castilla La Mancha University, Spain, Tel: 967599200 ext. 2818; E-mail: ManuelEsteban.lucas@uclm.es

Received October 15, 2014; **Accepted** October 17, 2014; **Published** October 19, 2014

Citation: Lucas-Borja ME (2014) Forest Management and Climate Changing Conditions: Some Insight from *Pinus Nigra* Arn. Ssp. *Salzmannii* Cuenca Mountains Forest. Forest Res 3: e113. doi:10.4172/21689776.1000e113

better adapted or adaptable to the changing climatic conditions. On the other hand the regeneration phase is sensible to changes in climate [4] as young seedlings and plants are particularly sensitive to drought [18] or other extreme climatic conditions. Thus, regeneration processes and techniques may warrant modification and adaptation itself.

Of great importance for forest regeneration is that successful establishment and early growth of young stands may be strongly influenced by soil preparation, selection of species and provenances, quality of plant material and weed control. These factors might gain importance in ensuring successful regeneration under climatic changes [14,19]. The stages of seed germination, seedling survival, and early seedling growth, have been recognized as the most limiting stages to natural regeneration and therefore the determinants of forest structure [20]. As other studies showed before [21,22], we probed that preferable conditions for seedling survival and growth differ from habitats for seedling emergence. Our results also showed significant differences among elevations and pine species. Stand density has a clear influence on the percentage of emerged seedlings. Moreover, drier and warmer conditions of the lower altitude forest induced a drastic decline in the survival proportion. A strategy may involve regenerating different stands in different ways. For example some stands could be regenerated naturally with current species adapted to the current site conditions, whereas other stands could use species or provenances adapted to different future scenarios.

References

1. IPCC (2007) Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment. Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.
2. Lindner M, Garcia-Gonzalo J, Kolström M, Geen T, Reguera R, et al. (2008) Impacts of climate change on European forests and options for adaptation. Report to the European Commission Directorate-General for Agriculture and Rural Development. Brussels, Belgium.
3. Ogden AE, Innes JL (2007) Perspectives of forest practitioners on climate change adaptation in the Yukon and Northwest Territories of Canada. Forestry Chronicle 83: 557-569.
4. Spittlehouse DL, Stewert RB (2003) Adaptation to climate change in forest management. BC Journal of Ecosystems and Management 4: 1-11.
5. Vanhanen H, Veteli TO, Päivinen S, Kellomäki S, Niemela P (2007) Climate change and range shifts in two insect defoliators: Gypsy moth and nun moth - A model study. Silva Fennica 41: 621-638.
6. Bürgi A, Brang P (2001) Das Klima ändert sich – Wie kann der Waldbau sich anpassen? Wald und Holz 43-46.
7. Rauscher HM (1999) Ecosystem management decision support for federal forests in the United States: A review. Forest Ecology and Management 114: 173-197.
8. Resco De Dios V, Fischer C, Colinas C (2007) Climate change effects on Mediterranean forests and preventive measures. New Forests 33: 29-40.
9. Peñuelas J, Boada M (2003) A global change-induced biome shift in the Montseny mountains (NE Spain). Global Change Biology 9: 131-140.
10. Piovesan G, Biondi F, Bernabei M, Di Filippo A, Schirone B (2005) Spatial and altitudinal bioclimatic zones of the Italian peninsula identified from a beech (Fagus sylvatica L.) treering network. Acta Oecologica 27: 197-210.
11. Martín-Benito D, del Rio M, Cañellas I (2010) Black pine (Pinus nigra Arn.) growth divergence along a latitudinal gradient in Western Mediterranean mountains. Ann For Sci 67:401.
12. Linares JC, Tíscar PA (2010) Climate change impacts and vulnerability of the southern populations of Pinus nigra subsp. salzmannii. Tree Physiol 30: 795–806.
13. Camarero JJ, Manzanedo RD, Sánchez-Salguero R, Navarro-Cerrillo R (2013) Growth response to climate and drought change along an aridity gradient in the southernmost Pinus nigra relict forests. Annals of Forest Science 70: 769-780.
14. Spiecker H (2003) Silvicultural management in maintaining biodiversity and resistance of forests in Europe - Temperate zone. Journal of Environmental Management 67: 55-65.
15. Badeck F-W, Furstenau C, Lasch P, Suckow F, Peltola H, et al. (2005) Adaptive Forest Management at the Scale of Management Units. Research Notes, University of Joensuu, Faculty of Forestry 315-382.
16. Broadmeadow MSJ, Ray D, Samuel CJA (2005) Climate change and the future for broadleaved tree species in Britain. Forestry 78: 145-161.
17. Geburek T (1994) Genetische Strategien für das forstwirtschaftliche Handeln angesichts klimatischer Änderungen. Klimaänderung in Österreich. Herausforderung an Forstgenetik und Waldbau, FBVA Berichte 81: 19-35.
18. Oliet J, Planelles R, López Arias M, Artero F (2002) Soil water content and water relations in planted and naturally regenerated Pinus halepensis Mill. seedlings during the first year in semiarid conditions. New Forests 23: 31-44.
19. Kellomäki S, Karjalainen T, Mohren F, Lapveteläinen T (Eds.) (2000) Expert assessment on the likely impacts of climate change on forests and forestry in Europe. European Forest Institute, Joensuu, Finland.
20. Dalling JW, Muller-Landau HC, Wright SJ, Hubbell SP (2002) Role of dispersal in the recruitment limitation of neotropical pioneer species. J. Ecol. 90: 714–727.
21. Haruki M, Tsuyuzaki S (2001) Woody plant establishment in the early stages of volcanic succession on Mount Usu, northern Japan. Ecological Research 16: 451-457.
22. Egawa C, Tsuyuzaki S (2011) Seedling establishment of late colonizer is facilitated by seedling and overstory of early colonizer in a post-mined peatland. Plant Ecology 212: 369-381.