TURKEY OAK (*QUERCUS CERRIS* L.) SMART FORESTS FROM ROMANIA'S WEST PLAIN

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RESEARCH ARTICLE

Abstract
The smart forest concept is relatively recent while some researchers search nowadays for methods to frame stands in this category. The present article proposes a new method of quantifying smart forests from a certain species (Turkey oak) on a certain habitat (Romania's West Plain), by taking into consideration and quantifying 13 site and stand characteristics. Based on this quantification it was established that Turkey oak smart forests occupy 6% of the areal and are represented by seed reservations and forests under extreme conservation regime, aged 60-70, with even aged or relatively even aged structures and diverse soil or station types. The proposed method can be applied in any condition and is especially useful for identifying these valuable forests.

Keywords: functional category, soil type, smart forests, Turkey oak, current growth.

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INTRODUCTION

West Plain is located in East Romania, at the border with Hungary (Cantar et al., 2021). With a length of 375 km, the area is characterized by annual average temperatures of 10-120C and by phaeozem, luvisol and fluvisol soils (Dinca et al, 2019).

Turkey oak growth and productivity is linked to late spring-early summer hydrologic balance (Di Filippo et al, 2010), with low soil water content (Montagnoli et al, 2012), or roe deer activity (Cutini et al, 2011). This species has multiple ecological roles, like other forest species: red oak (Dinca et al., 2021); staghorn sumac (Timiș-Gânsac et al., 2020); white willow (Timiș-Gânsac et al., 2020); birch (Hapa et al., 2021).

Starting with the year 2000, only four articles mentioned the concept of "Climate-Smart Forestry" (Jandl et al, 2018; Nabuurs et al, 2017; Nabuurs et al, 2018; Yousefpour et, 2018). The most recent definition offered by specialists considers that "Climate Smart Forestry is sustainable adaptive forest management and governance to protect and enhance the potential of forests to adapt to and mitigate climate change.

The aim is to sustain ecosystem integrity and functions and to ensure the continuous delivery of ecosystem goods and services, while minimizing the impact of climate-induced changes on forests well-being and nature's contribution to people." (Bowditch et al, 2020). In Romania, alder (Blaga et al, 2019), pubescent oak (Dincă et al, 2020), douglas fir (Dinca et al., 2021) and manna ash smart forests (Dinca et al., 2020) were identified and described in the Southern Carpathians.

MATERIAL AND METHOD

The material for the present paper is represented by Turkey oak stand elements from Romania's West Plain, that were extracted from forest management plans realized during 1995-2008 for 13 forest districts (Forest management plans). The exceedingly large number of values (5074 stand elements) offers a good statistical insurance of the results obtained. Stands up to the age of 40 were not taken into consideration.

In total, 13 stands or site-specific parameters were taken into consideration (table 1). Each analysed parameter has obtained a grade from 1 to 5, where: 1 = very low; 2 = low; 3 = average; 4 = high; 5 = very high. The grade was given by taking into consideration the ecological requests of Turkey oak.

The addition of all these values has resulted in a hierarchy of Turkey oak stands, while the ones with very high values were situated in the smart forest category.

The meaning of some terms used in Table number 1 is rendered below:
Vitality: 1=very vigorous; 2= vigorous; 3= normal; 4 = weak; 5 = very weak.
Structure: 1= even aged stand; 2= relatively even aged stand; 3= relatively uneven aged stand; 4= uneven aged stand.
Production/protection subunits (SUP): A= Regular Forest, normal assortments; C= Conversion; K= Seed reservations; M= Forests under the extreme conservation regime.
Functional group (GF) and functional category (FCT): 1,2L= Forests located on fields with lithological substratum, very vulnerable to erosion and landslides; 1,3A= Steppe forests from the limit between steppe and silvosteppe; 1,4B= Forests located near cities; 1,4J= Forests of game interest.
Soil type: 2201= preluvisol; 2401= luvisol; 2407= stagnic luvisol; 3101= eutric cambisol; 6401= stagnosol.
Station type (TS): 6142= Hill Turkey oak stand, Bi stagnic luvosol, subaverage edaphic with *Carex-Poa pratensis*; 7332= Hill Turkey oak stand with oak, Bm stagnic luvosol with *Poa pratensis-Carex carryophyllea.*

Table 1.

Grade obtained based on the stand's and site's characteristics

Nr crt	Characteristic	Grade				
		1	2	3	4	5
1	Average diameter (cm)*	10-22	24-26	28-30	32-36	38-80
2	Average H (m)*	9-18	19-20	21-22	23-24	25-34
3	Production class	5	4	3	2	1
4	Current growth (m^3/an/ha) *	0.1-0.6	0.7-1.1	1.2-1.8	1.9-3.1	3.2-9.5
5	Pruning	0.3	0.4	0.5	0.7	0.6
6	Vitality	5	4	3	2	1
7	Structure	1	2	3	4	
8	Crown density	0.2-0.4	0.5-0.6	0.9	0.7	0.8
9	SUP	O, C	A, Q	V	B, M	E, K
10	Functional group + Functional category	2,1C	1,3G; 1,4J; 2,1B	1,1A; 1,1B; 1,1C	1,2A;1,2; 1,2I; 1,4B; 1,4I	1,3A; 1,4A; 1,5H
11	Litter	1	2	3	4	5
12	Soil type	2405	2108;2401; 6401	2101;2201; 2209	1307;3109	3101
13	Station type	5131	6131; 6142;	5132;6132; 6152;7332	5153;6143 6153;6253	7334

* The entire value range was divided in 5 categories for these characteristics, 1 = the smallest 5 = the highest. The category division was realized so that the analyzed biometric characteristics are respected. In addition, a balanced division was intended as number of values for each category.

RESULTS AND DISCUSSIONS

The final grades obtained for the analysed stands vary between 54 and 22. We consider smart forests as those that have obtained grades higher than 50, which amount to 29 stands (6% of the total number of stands).

The main characteristics of Turkey oak smart forests from Romania's West Plain are rendered in Table number 2.

Table 2.

The characteristics of smart Turkey oak forests from Romania's West Plain

Nr crt	Age (years)	Current growth (m^3/year/ha)	SUP	Functional category	Structure	Flora	Soil type	Site type
1	70	6.0	E	5C	1	81	9501	9624
2	75	6.4	M	4A	1	81	2101	8430
3	80	1.8	M	4A	1	81	2101	8430
4	100	0.7	K	5H	3	63	2407	6143
5	120	0.2	K	5H	2	61	3101	6153
6	60	6.1	A	5B	2	81	9506	9641
7	60	3.8	V	4J	2	71	9501	9540
8	65	6.2	M	21	1	71	2212	8511
9	65	4.3	K	5H	1	92	2201	6153
10	65	3.7	K	5H	1	92	2201	6153
11	70	6.7	V	4I	1	73	1301	9531
12	70	6.0	V	4J	1	73	1301	9531
13	70	4.7	V	4J	1	73	1301	9531
14	90	1.2	K	5H	2	63	2407	6143
15	100	0.7	K	5H	2	63	2407	6143
16	150	1.9	M	4F	3	91	2212	8336
17	60	8.5	M	4A	1	81	2101	8430
18	65	4.3	M	4C	2	51	2407	7333
19	70	6.0	M	2I	1	91	2108	8511
20	85	3.2	A	3A	2	73	2407	8321
21	85	1.8	K	5H	2	81	1210	8430
22	85	3.8	A	4B	1	91	2108	8511
23	90	3.6	K	5H	2	92	2101	8323
24	90	4.2	V	4J	1	91	2212	8336
25	90	1.5	M	4F	3	91	2212	8336
26	100	0.3	K	5H	2	63	2407	6143
27	105	0.3	K	5H	2	61	2201	6153
28	120	1.4	K	5H	2	71	2401	6143
29	120	1.6	M	2B	2	91	2407	6143

The smart Turkey oak forests from Romania's West Plain have advanced ages (between 60 and 150 years), with most of them ranging between 60 and 70 years (figure 1).

The current growth of these forests has a large variability gathered between 0.2 and 8.5 (m^3/year/ha), (figure 2).

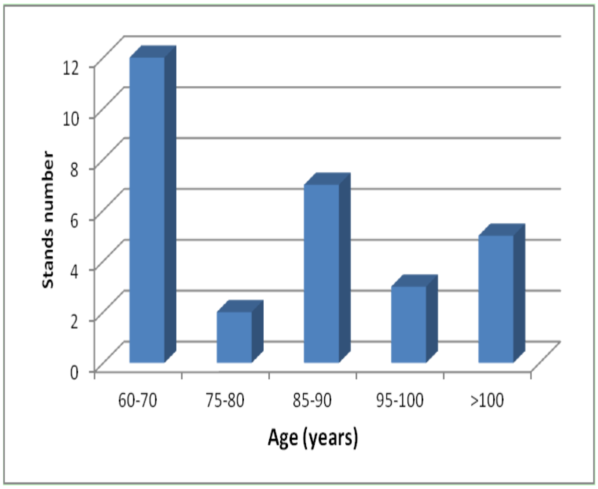

Figure 1 **The distribution on age of Turkey oak smart forests from Romania's West Plain**

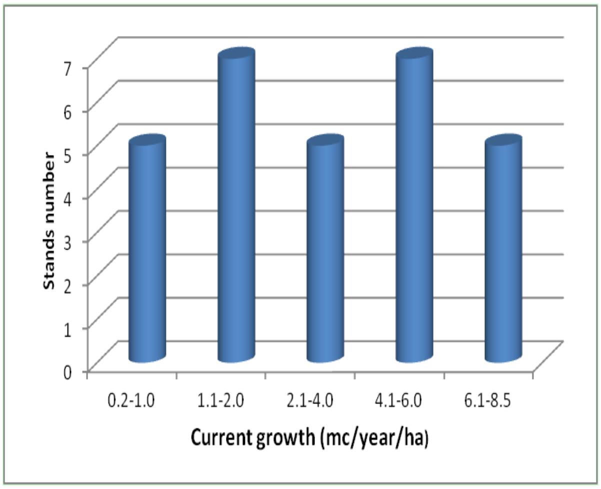

Figure 2 **The distribution on current growth of Turkey oak smart forests from Romania's West Plain**

The stand belongs generally to K (Seed reservations) and M (Forests under the extreme conservation regime) production/protection subunits (figure 3) and to no less than 12 functional categories (figure 4), with the highest percentage (38%) in the 5H category – Forests established as reservations for producing forest seeds and conserving the forest geno-fund.

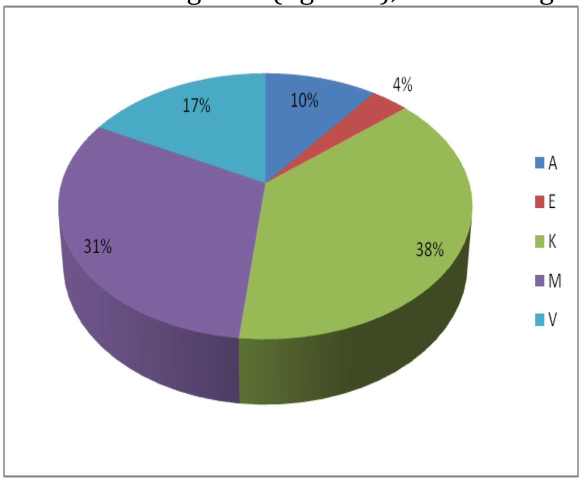

Figure 3 **The distribution on production/protection subunits Turkey oak smart forests from Romania's West Plain**

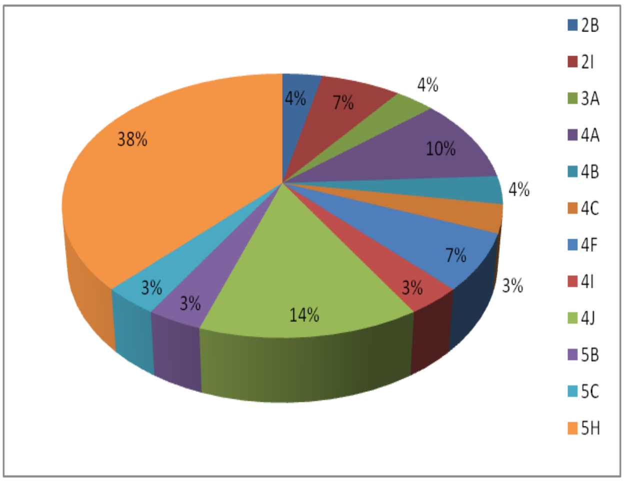

Figure 4 **The distribution on Functional category of oak smart forests from Romania's West Plain**

The structure of theses stands is even aged (45%), relatively even aged (45%) and less likely to be relatively uneven aged (10%). The characteristic flora for these stands is *Arum-Pulmonaria* and *Carex-Poa pratensis*. The most widespread soils are stagnic luvisol and rodic preluvisol. The soils from these stands are characterized by a good supply in nutritive elements (Edu et al., 2012; Crișan et al, 2020; Chisăliță et al, 2015; Enescu et al, 2019), microorganisms (Enescu et al., 2017) and humidity (Constandache et al., 2021).The number of soils on which these stands vegetate is very high (11), as well as the number of forest stations (12), which indicates a high variability of stational conditions characteristic to the studied area and stands.

CONCLUSIONS

We can consider smart Turkey oak forests from Romania's West Plain as those that record a total higher than 50 by adding the grades obtained by their stational and stand characteristics. From the total of Turkey oak stands located in this area, 6% can be framed in the smart forest category. These stands are characterised by ages of 60-70 years, are situated in seed reservations and forests under extreme conservation regimes, have an even aged or relatively even aged structure, an *Arum-Pulmonaria* and *Carex-Poa pratensis* flora as well as a high variability of current growth, soil or station types. The method proposed for identifying smart forests can also be applied in other regional or climatic conditions and is of great importance as it can establish (based on clear, quantifiable criteria) a special forest category over which specialists can then apply specific conservation measures.

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