

Black locust-dominated coppice forests and continental sand dunes, a happy symbiosis in the Valea lui Mihai-Carei Plain (NW of Romania)

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Overview

Introduction

Valea lui Mihai-Carei Plain: landforms and soils, climate, forest vegetation, black locust as main tree species

Case studies

Conclusions

Introduction

Wind erosion = a serious environmental problem/common phenomenon occurring mostly in flat, bare areas; dry, sandy soils; or anywhere the soil is loose, dry, and finely granulated. It causes soil loss, dryness and deterioration of soil structure, nutrient and productivity losses and air pollution.

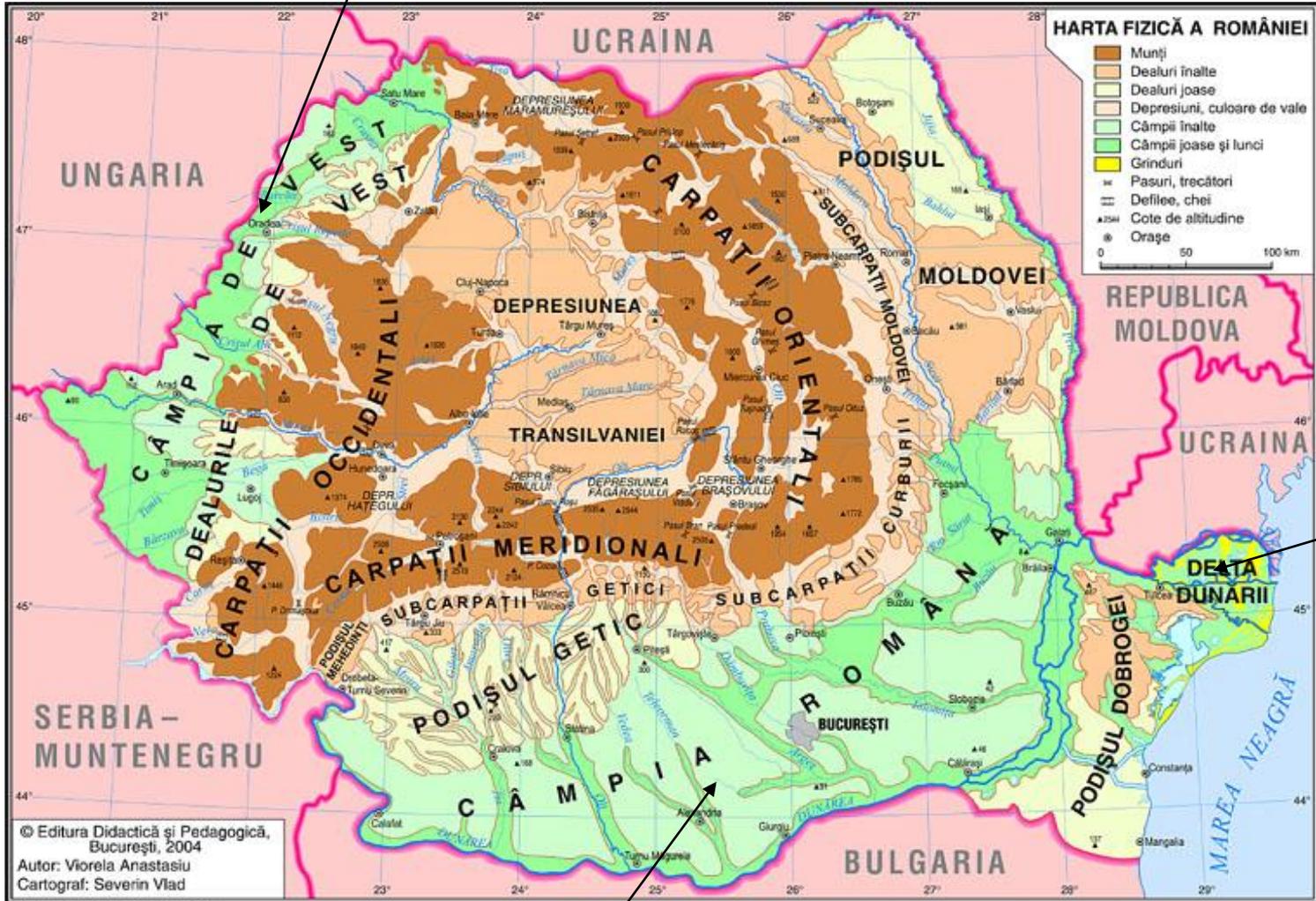
In general, the **wind erosion control** is carried out for (i) reducing wind-speed at ground level, and (ii) increasing soil cohesion, thus improving soil resistance to wind. *The most efficient solution to reduce the wind-speed is to increase the plant cover by planting blocks of forest, hedges and wind-breaks.*

In case of **sand dunes**, the point of their fixation/stabilization: to eliminate the source of sand and to keep the dunes in place.

Romania

- sand dunes (and sandy soils) are an important component of landscape, covering about 560,000 ha, of which over 80% (about 460,000 ha) are located in the Romanian Plain (south of RO).

Western Plain



Danube Delta

Romanian Plain

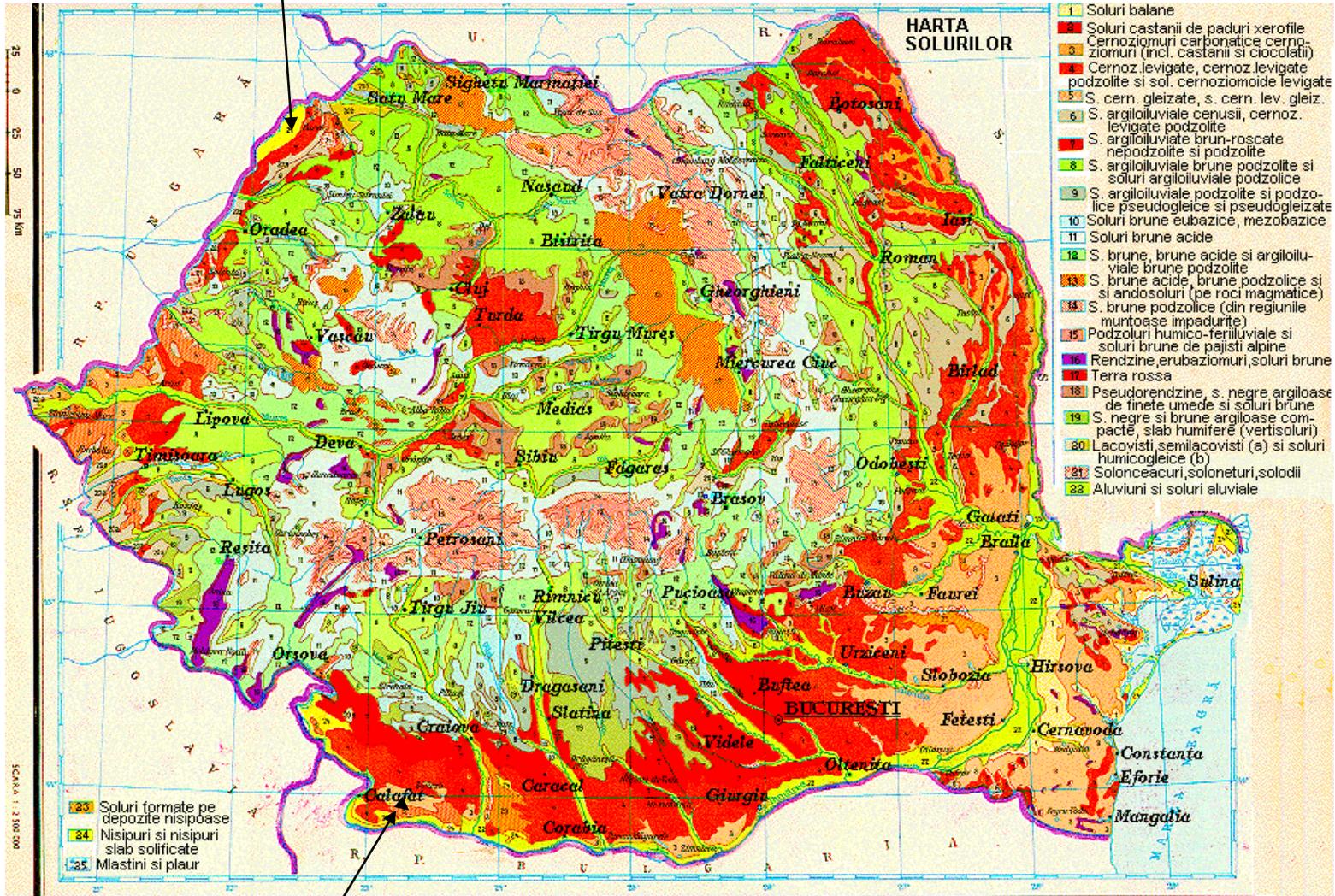
Continental sand dunes of Oltenia (S-SW of the country, about 351,000 ha) = the largest block of sands and sandy soils. The first plantations of black locust (*Robinia pseudoacacia*) in the area, in order to prevent further movement of continental sand dunes (a process started in 1830-1850 - about 200-250 m/yr), were established at Băilești (Stirbei Estate) in 1852.

Other important areas of sands and sandy soils in Romania:

- **Câmpia de Vest (Câmpia Tisei - Western Plain)**
- Câmpia Tecuciului (Tecuci Plain)
- Delta Dunării (Danube Delta), etc.

In the **Valea lui Mihai-Carei Plain**, part of the Western Plain, located along the Hungarian-Romanian border, sands and sandy soils cover over 26,000 ha - the area with its specific features will be the main focus of this presentation.

Valea lui Mihai-Carei Plain



Continental sand dunes of Oltenia

Valea lui Mihai-Carei Plain

Landforms and Soils

a. **Landforms:** *continental sand dunes*, of river and wind origin, formed in the Holocene epoch, with a SW-NE and NW-SE orientation and an elevation ranging between 140 and 160 m.

Two types of dunes:

- **main:** 5-15 m height, 1-1.5 km length, 100-350 m width; distance between main dunes: 500-3,000 m.
- **secondary:** 1-6 m height, 100-1000 m length; distance between secondary dunes: 100-500 m.

b. Soils = psamosoils:

- very deep but poor: **low fertility** and nutrient content (N, P, and K).
- soil texture: light (85-90% sand, mostly fine).
- pH: moderately acid to neutral (between 5 and 7).
- the maximum fraction of humus: 1% in the upper 25 cm of soil.

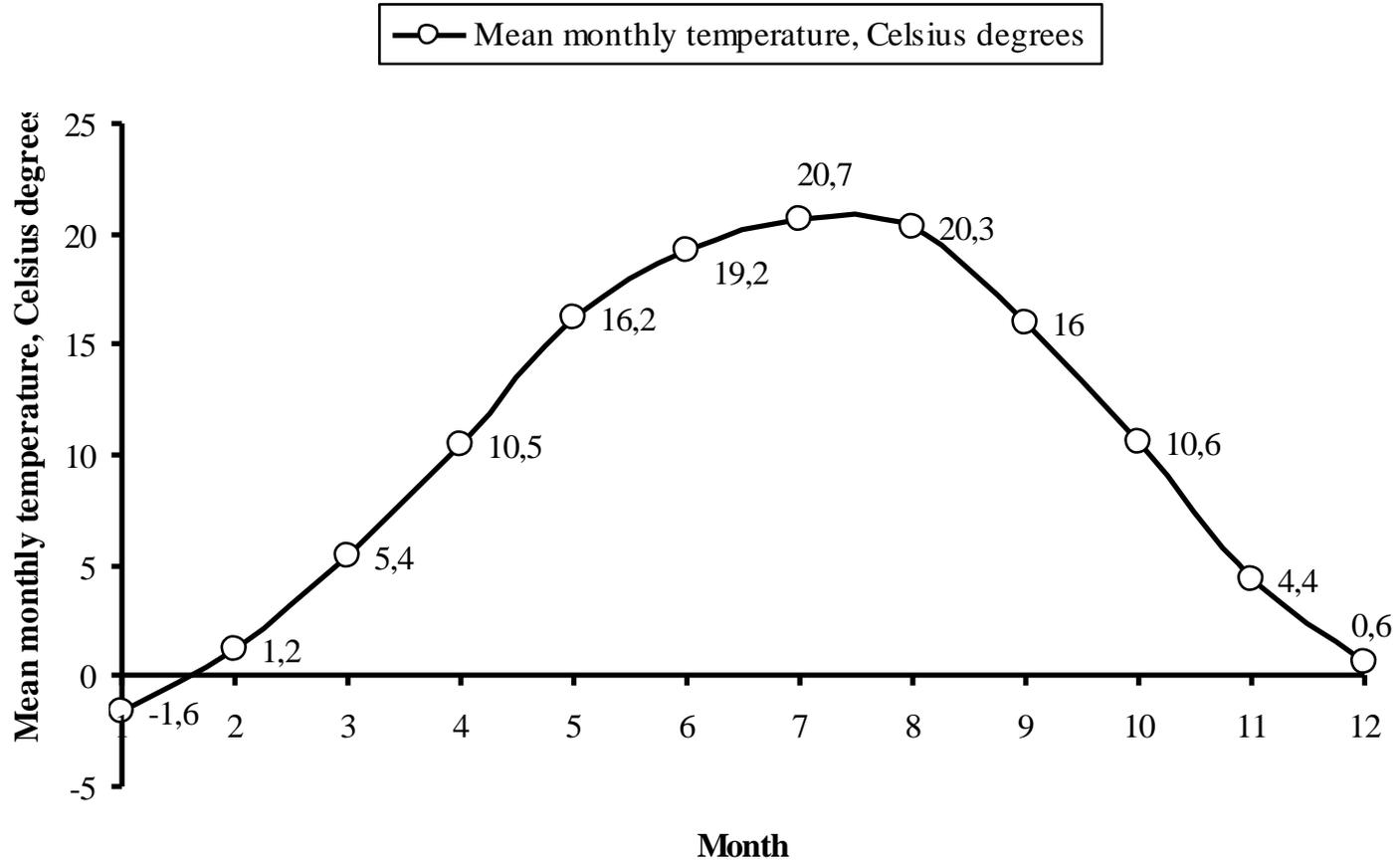
Specific to these soils: presence of a hard, cemented and poorly drained **ortstein horizon**, formed as a result of illuviation of aluminium, iron, manganese, and humus compounds from the overlying shallow O horizon. This horizon halts the water infiltration so plays a very important role in the growth and development of woody plants; water is kept within the ortstein during the most dry summer periods, when the sand gets very warm at the surface (up to 60-70 degrees Celsius) as well as quite deep below.



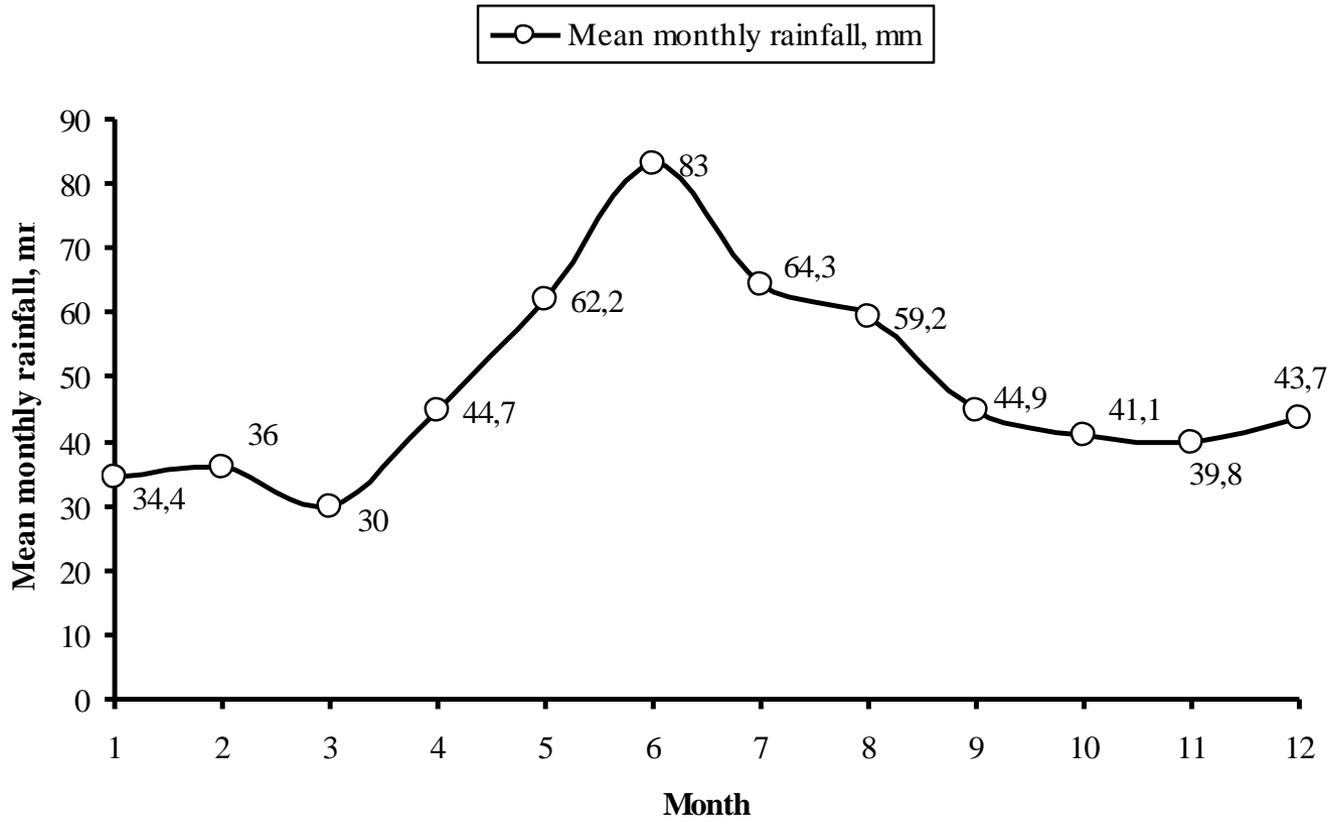
Natural regeneration by seed of black locust, as a result of very high summer temperatures forcing the breakage of seed tegument

Climate

- *temperate-continental (C.f.b.x. type according to Köppen).*
- mean annual temperature: **10.3 C degrees**; max. July-August, min. December-January.
- mean annual rainfall: **573.3 mm** (but in the last two years down to ca. 350 mm...); max. June-July, min. January-March.
- potential mean annual evapotranspiration: **ca. 600 mm.**
- frost-free season: **270 days**
- annual aridity index: **28.2** = *transition zone between the plain forest zone and the forest steppe zone.*
- maximum wind speed: **4.0 m/s** (South) = no damages to forest vegetation.



Mean monthly temperature - Săcueni-Bihor Weather Station



Mean monthly rainfall, Sacueni-Bihor Weather Station

Forest vegetation

a. History

- **1892-1900: first** black locust plantations - 200 ha, 2 x 2 m spacing
- 1905-1909: 14.56 ha plantation of Scots pine (*Pinus sylvestris*) and 2.55 ha of black pine (*Pinus nigra var. austriaca*), both 2 x 1 m or 1.5 x 1 m
- 1905: 0.60 ha plantation of pin oak (*Quercus palustris*)-black cherry (*Prunus serotina*), 1.5 x 1.5 m
- 1905: 2.79 ha plantation of pedunculate oak (*Quercus robur*)-northern red oak (*Quercus rubra*), 1.5 x 1.5 m
- **1933-1940: 790 ha** planted by important local forest owners and communities, on low-fertility sites for agricultural uses
- **1946-1959: 1,958 ha** planted by the state (low-fertility agricultural land)
- **1960-1980: 450 ha** planted by the state (low-fertility agricultural land)

b. Nowadays

- Forest vegetation covers ca. 12% of overall area of Valea lui Mihai-Carei Plain, of which **black locust** is the main species (cover over 80% of total area).
- Other species: black cherry, Canadian poplars (*Populus x euramericana*), oaks (e.g., pedunculate, red, pin), pines (black, Scots), mulberry (*Morus alba*), etc.



Pure Canadian poplar culture



Mixed Canadian poplar-black locust stand



Plantations of northern red oak (left) and northern red oak-pedunculate oak (down)



Black locust

- Introduced on (i) low-fertility agricultural lands or (iii) for replacing low-productive tree species such as pedunculate oak, small-leaved linden, field maple, and field elm, in order to prevent wind erosion and sand dune movement as well as produce firewood.
- Subsequently treated **only** as *low coppice*, with a rotation of 20-30 years depending on yield class.
- The best results in terms of both sand dune fixation and wood production = in the last 40-50 years, since using mixtures with black cherry, an invasive tree species able to compete with black locust above- and belowground and forming a dense understorey after regenerating from seed, stump sprouts and root suckers.

Case-studies

a. Sub-compartment 52A%: pure natural regeneration (*by root suckers*) of black locust, 2-year old, following low coppice cut (winter 2013) and removal of stumps. Two plots of 25 sq.m (5 x 5 m) each.

		Overall	Plot 1	Plot 2
Number of trees/ha		17,000	12,000	22,000
Basal area (sq.m/ha)		0.7314	0.5324	0.9304
Diameter (cm)	Mean	0.68	0.69	0.67
	Maximum	1.51	1.44	1.51
	Minimum	0.28	0.30	0,28
Height (m)	Mean	1.58	1.62	1.55
	Maximum	2.64	2.57	2.64
	Minimum	0.50	0.60	0.50



b. Sub-compartment 52A%: pure black locust exploitable stand (32-year old), regenerated by *root suckers*. Three plots of 500 sq.m (25 x 20 m) each.

		Overall	Plot1	Plot2	Plot3
Number of trees/ha		347	280	340	420
Basal area (m²/ha)		19.191	17.916	21.482	18.174
Diameter (cm)	Mean	25.92	28.23	27.61	23.01
	Maximum	40.60	39.90	40.60	29.60
	Minimum	15.30	23.80	19.00	15.30
Height (m)	Mean	20.38	21.91	22.18	17.92
	Maximum	27.50	26.00	27.50	22.00
	Minimum	12.00	14.75	12.50	12.00
Stability index (h/d) *100	Mean	80	78	82	79
	Maximum	116	102	110	116
	Minimum	58	60	58	66
Volume (m³/ha)		183	176	222	151
Mean annual volume increment (m³/ha)		5.72	5.50	6.94	4.73



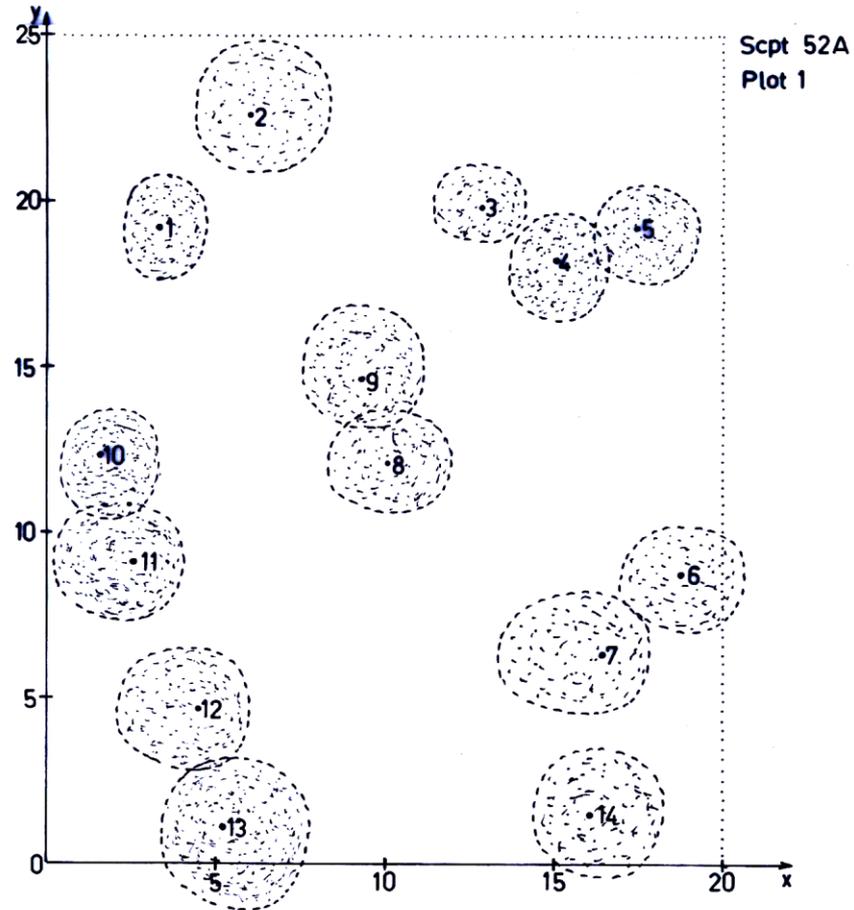
**Plot 1 (left) and
plot 2 (down)**



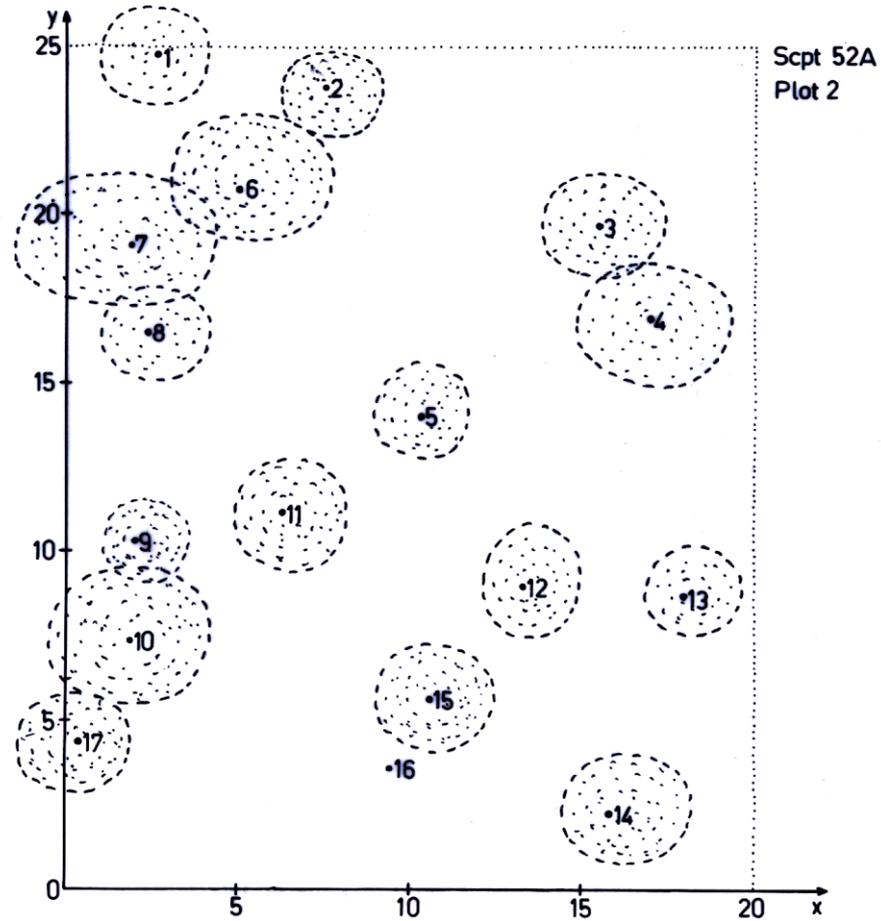


Plot 3

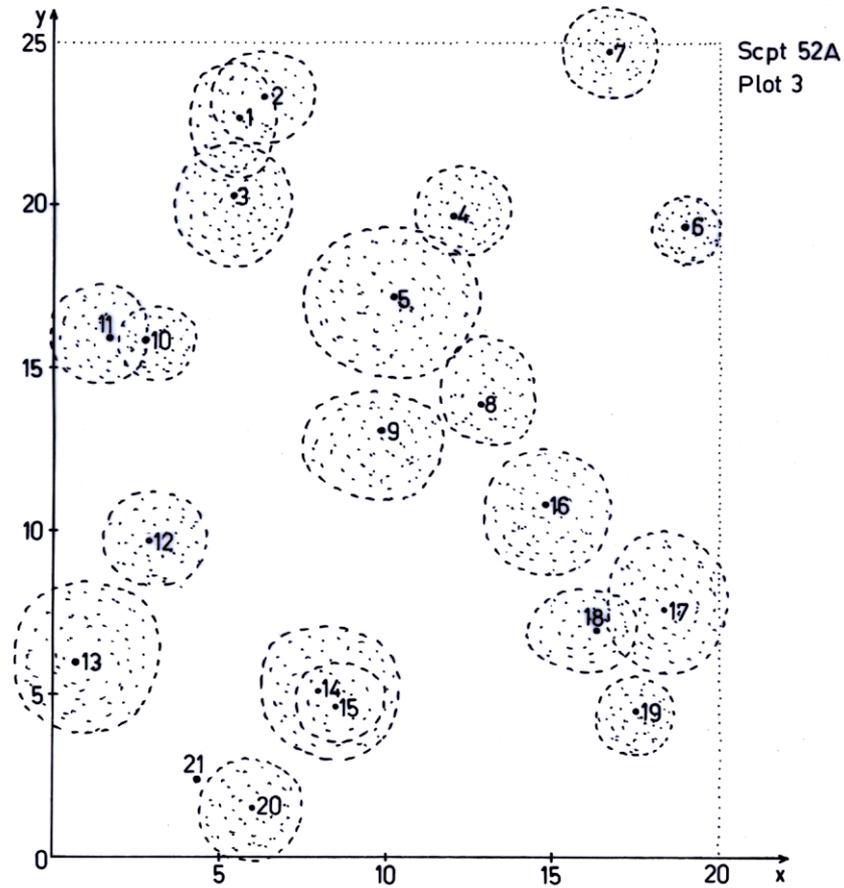




Horizontal projection of trees in plot 1



Horizontal projection of trees in plot 2



Horizontal projection of trees in plot 3

a. **Pure and young black locust stands** (max. 10-12 years old): closed canopy, **poor** herbal layer.



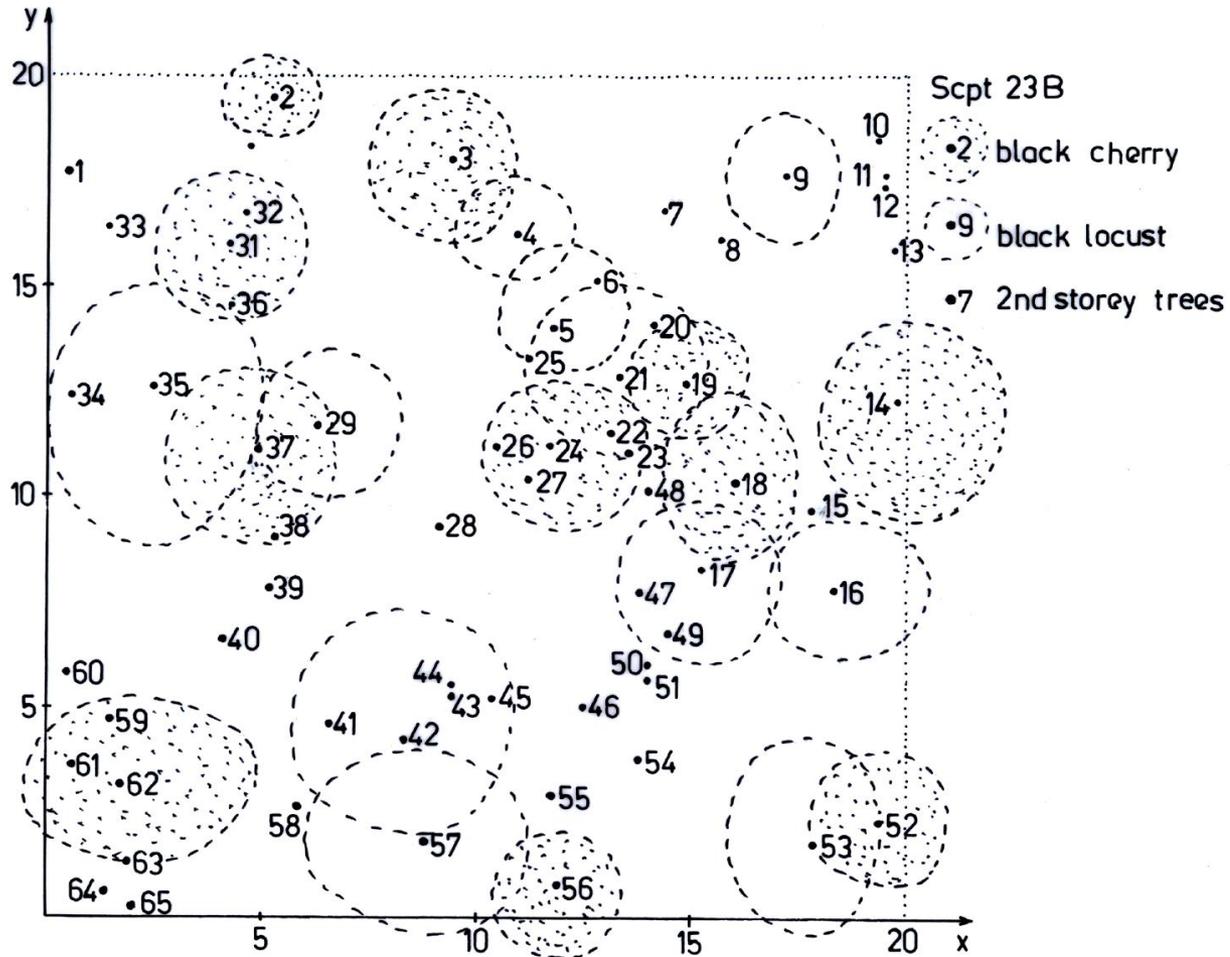
b. **Pure and older black locust stands:** open canopy, **very rich and dense** herbal layer.



c. Sub-compartment 23B: mixture black cherry-black locust, 53 years old (rotation age 60 years). One plot of 400 sq.m (20 x 20 m).

- Two-storied stand, with black locust and black cherry in the upper storey and black cherry in the lower one.





Horizontal projection of trees in plot 1, scpt. 23B

		Total	Tree species				
			Black cherry (BC)			Black locust (BL)	
			Upper storey	Lower storey	Dead trees	Upper storey	Lower storey
Number of trees/ha		1,625	275	750	175	275	150
Basal area (m ² /ha)		32.2680	9.4025	3.1050	4.1025	15.0900	0.6625
Diameter (cm)	Mean		19.92	7.06	14.89	25.50	7.47
	Maximum		31.90	14.90	27.50	35.70	8.70
	Minimum		11.10	4.00	8.70	14.70	6.50
Height (m)	Mean		17.77	7.35	11.54	23.16	10.10
	Maximum		23.00	13.75	17.50	26.75	12.50
	Minimum		13.00	3.70	7.00	20.50	6.50
Stability index (h/d) *100	Mean		94	107	88	96	133
	Maximum		117	170	109	139	149
	Minimum		72	60	76	69	120
Volume (m ³ /ha)		283	84	14	22	160	3
Mean annual volume increment (m ³ /ha)		5.34	1.58	0.26	0.42	3.01	0.07



- Very poor herbal layer but rich natural regeneration by seed of black cherry.



Some other important issues in relation to black locust

- **High need/demand** for firewood (local population); increasing price, up to 70 euro/cu.m beginning of 2016.
- **Good market and high price** for sawlogs (up to 80 euro/cu.m), for domestic and international market (e.g., Hungary, Austria, Italy, Germany).



Black locust sawlogs

Some conclusions

- Difficult area in ecological terms (e.g., climate, soils, etc.).
- Long-term (over a century...) commitment in using **black locust** as the main forest tree species, mostly on top and along dunes = *the only species able to fully and successfully withstand the harsh ecological conditions and have positive results in (i) wind erosion control and (ii) production of wood for different uses.*
- Best results (e.g., soil protection, wood production) in mixed black locust-black cherry stands.

Thanks for your attention!

