The potential of Lebanon oak (*Quercus libani Oliv.*) for coppice regeneration in northern Zagros forests of Iran

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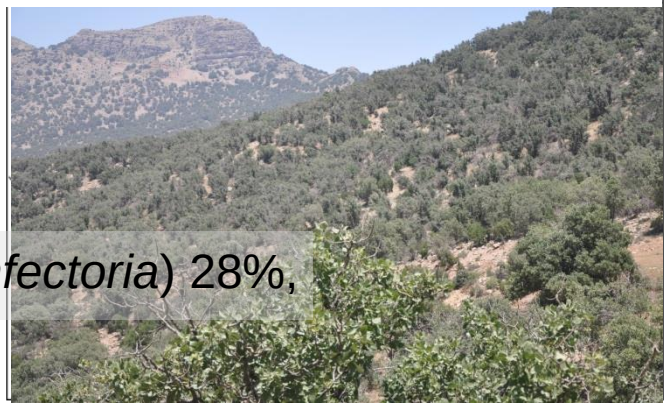
Zagros forests

IR Iran: 12 million ha forests (7.3 % of country's area)

Armardeh region

- MAT: 14°C
- MAP: 647 mm
- altitude: 1550 m a.s.l.



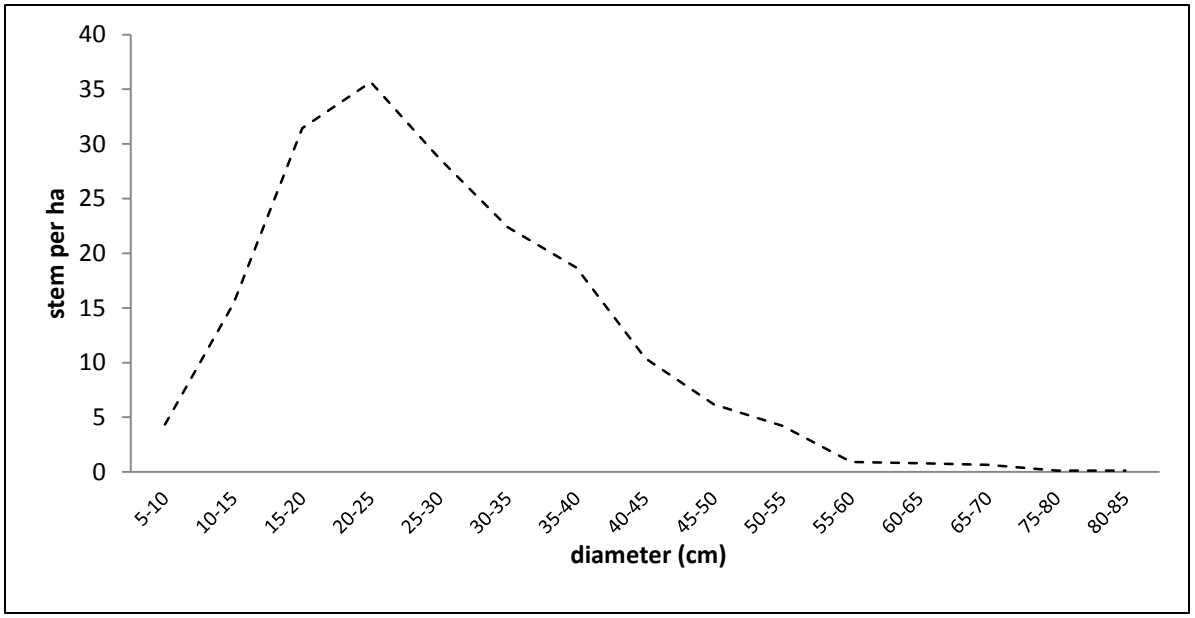
Lebanon oak (*Quercus libani*) 32%, Gall oak (*Q. infectoria*) 28%,
Persian oak (*Q. brantii*) 34%
other species (6%)

Zagros forests - roles and uses

- Traditional practices since ancient times
  - grazing of livestock (goats)
  - pollarding (mainly for fodder)
  - fuel-wood collection
  - farming
  - NWFPs
- charcoal production (clearcut and re-sprouting)
- Nationalization of forests (1963)
  - current formal policy in Zagros: forest conservation
  - traditional silvopastoral practices still continue

Problem identification

- Failure of oak regeneration to pass the browsing horizon /threshold (the upper reach of grazing animals)
- Soil compaction due to extensive livestock herding



Objectives

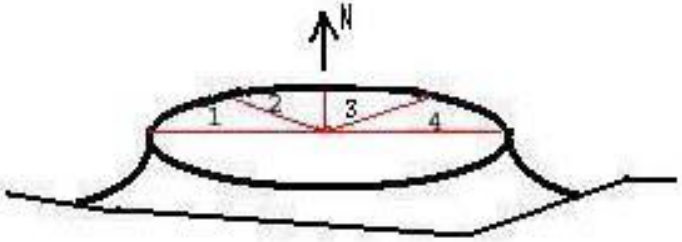
Strategies and methods to regenerate the forests are urgently needed.

(1) To investigate the sprouting ability in order to identify the most productive diameter classes for coppice regeneration

(2) To investigate early height growth of sprouts

Study design

- 5 sites (Galajars)
- 9 trees (Qu. libanii) in 3 DBH cat
  - 25-35cm
  - 35-45cm
  - 45-60cm
- trees cut in January
- fenced in spring
- data collected in June and September 1st year & end of 2nd year
  - sprout numbers and pattern on the stump
  - height of all sprouts



analysis

- Testing normality of data and homogeneity of variances
- Using two-way ANOVA to investigate the **effect of stump size** on sprout number height development
- Using one-way ANOVA to analyze the **effect of sprout density** on height development
- Using paired t-test to investigate **changes in sprout number and height** from June to September
- **Spatial distribution of shoots** on stump was assessed using one-way ANOVA

Results (1)

sprout numbers

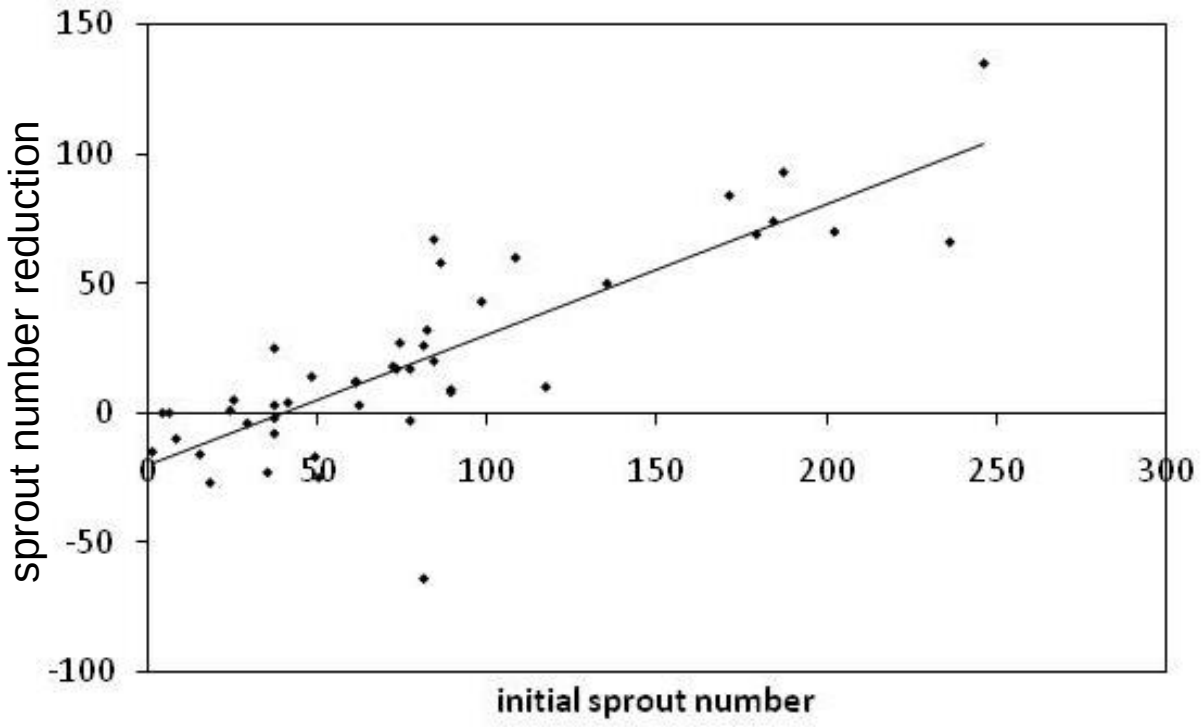
- the first sprouts were observed in May
- 41 stumps (91%) produced at least 5 sprouts
- Stumps without any sprouts were found in DBH-class 35-45cm and 45-60cm

Sprout numbers

DBH [cm]		June	September
25 – 35	$\bar{x}$ ($\pm$ s_x)	73 (49.2)	49 (27.2)
	min, max	8, 184	12, 110
35 – 45	$\bar{x}$ ($\pm$ s_x)	101 (72.4)	81 (43.2)**
	min, max	18, 246	33, 170
45 – 60	$\bar{x}$ ($\pm$ s_x)	66 (59.5)	49 (32.1)
	min, max	1, 187	4, 110
Total	$\bar{x}$ ($\pm$ s_x)	80 (61.7)	60 (37.3)

Results (2)

change of sprout density



- Interplay of sprout mortality and newly emerging shoots during the growing season
  - Higher sprout density in June >> stronger decrease until September
  - in relative terms 40-50% loss in sprout number/stool

Results (3)

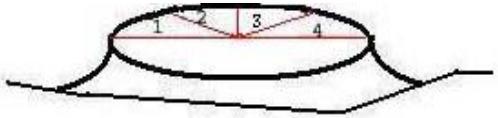
sprout height

- average height was 31.7cm (June) and 74.9cm (September)
- highest shoots (max, mean) always in dbh class 35-45cm
- lowest shoot heights in largest stumps

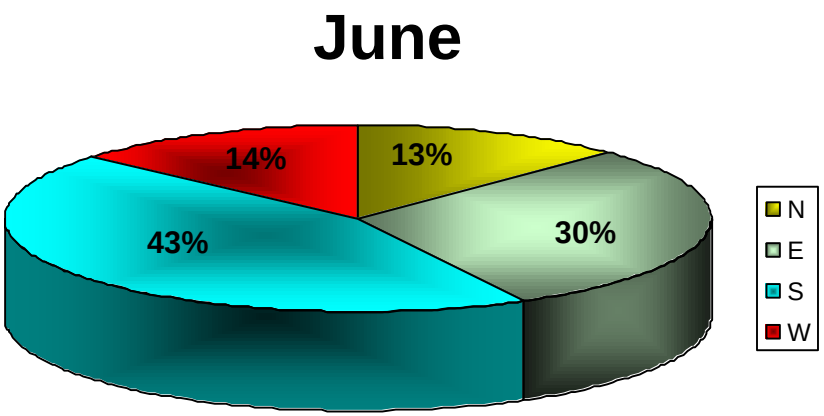
DBH class [cm]		Height June [cm]				Height September [cm]			
		max		mean		max		mean	
25-35	$\bar{x}$ ($\pm$ s_x)	46.2 (19.6)	AB	31.1 (13.3)	A	90.9 (16.7)	A	70.3 (16.7)	A
35-45	$\bar{x}$ ($\pm$ s_x)	58.9 (13.1)	A	35.7 (9.7)	A	113.7 (25.3)	B	77.8 (17.4)	A
45-60	$\bar{x}$ ($\pm$ s_x)	43.0 (18.8)	B	30.3 (13.2)	A	96.1 (19.7)	AB	76.0 (14.5)	A

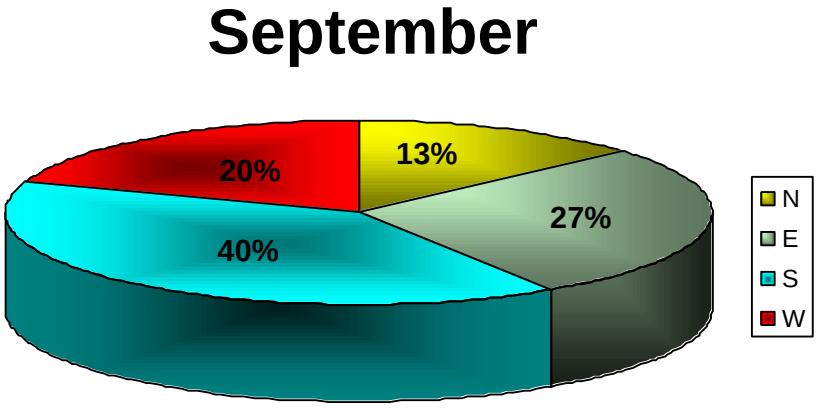
Results (4)

Sprouting pattern



- more sprouts observed in stump segments that receive more light: **south** and **west**



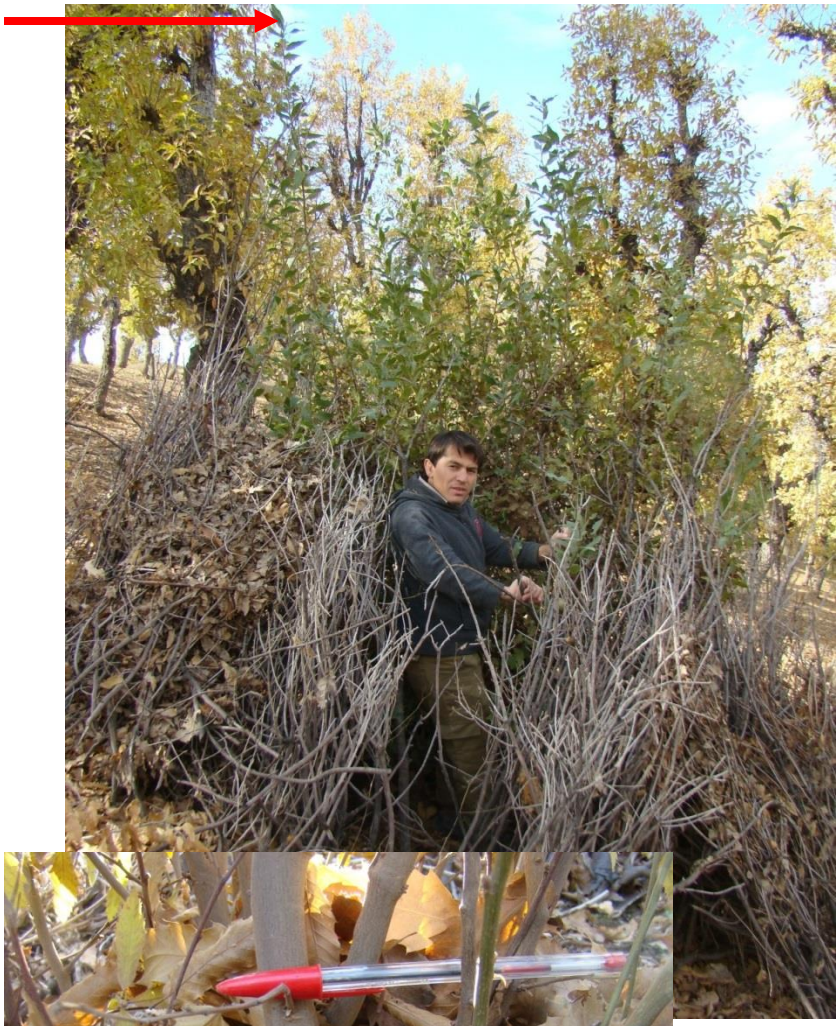


Results (5)

2nd growing season

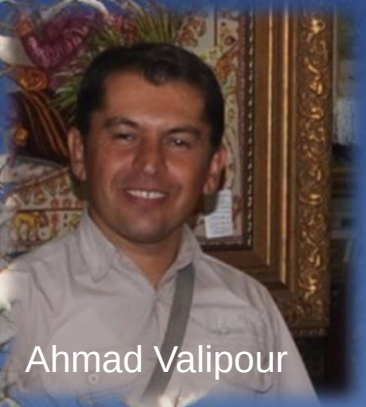
- average height of dominant shoots: 2m
- average height of all shoots: 1.5m
- maximum height: 2.9 to 3.2m

- average collar diameter of dominant shoots: 15mm
- average collar diameter of all shoots: 10mm



conclusions

- expected time period to reach browsing horizon (approx. 2m): 3(+) years
- estimated time required for seed regeneration: 30 years (approx. 7cm per year)
- intermediate trees (DBH 35-45cm) have the fastest height growth, but are most productive in the current management system for fodder production
- establishment of individuals from seed origin is vital to guarantee long-term survival of oak forests in Zagros
- **>> change (regulation) in landuse system required**



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Thank you . . .

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