Dead-Sea & Arava Science Center
מרכז מדע ים המלח והערבה
Under the Auspices of Ben-Gurion University of the Negev
בחסות אוניברסיטת בן גוריון בנגב

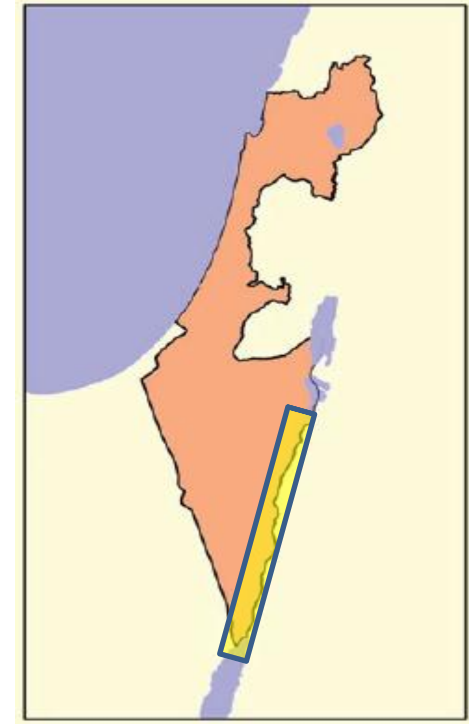
Geoecosystem-related dynamics of Acacia populations in the Israeli hyper-arid Arava Valley

Ilan Stavi[1,*], **Yoav Avni**[2], **Hezi Yizhaq**[1,3], **Golan Bel**[3], **Hanan Ginat**[1]

[1]Dead Sea and Arava Science Center, Yotvata 88820, Israel; [2]Geological Survey of Israel, Jerusalem 95501, Israel; [3]Department of Solar Energy and Environmental Physics, Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Sede Boqer Campus, Israel; [*]Email address: istavi@adssc.org

Journal of Dead-Sea and Arava Research (2011) Vol 1: 1-7
מחקרי ים-המלח והערבה (2011) כרך 1: 1-7

Dead Sea & Arava Science Center
מרכז מדע ים המלח והערבה
under the auspices of Ben Gurion University of the Negev
בחסות אוניברסיטת בן גוריון בנגב



REDUCTION IN PRECIPITATION LEVELS IN THE ARAVA VALLEY (SOUTHERN ISRAEL AND JORDAN), 1949-2009

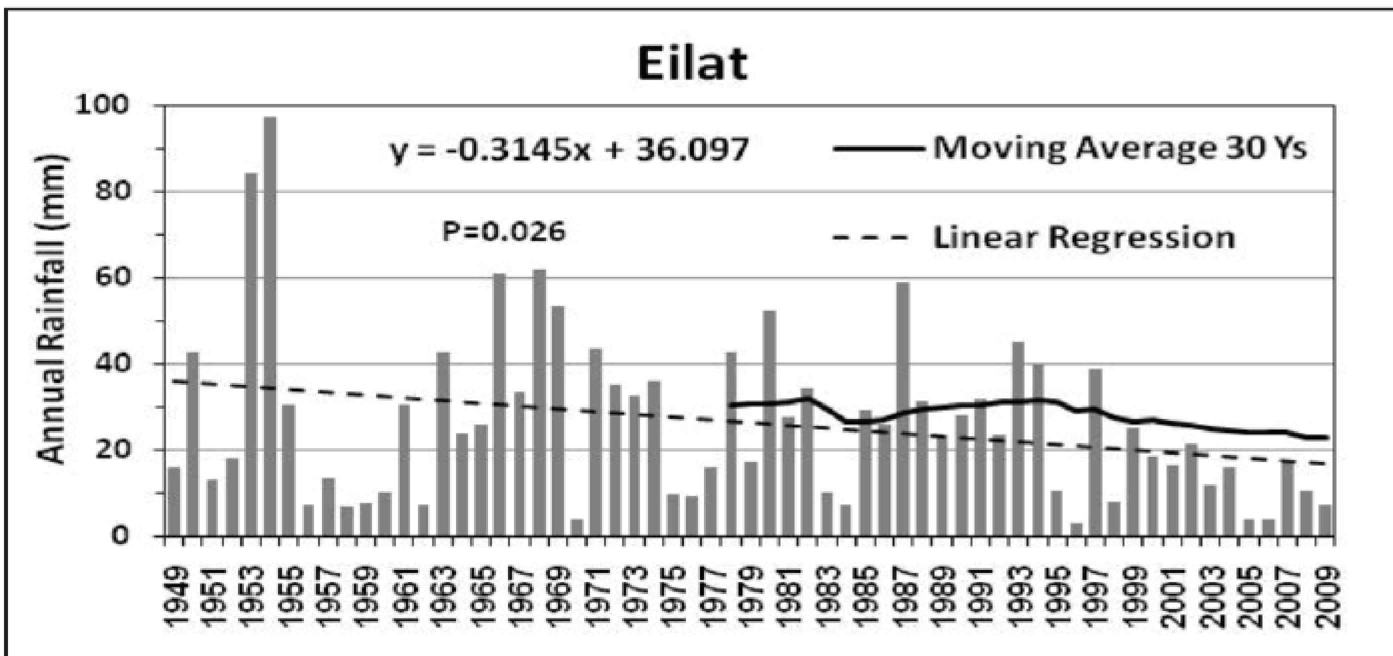
Ginat, Hanan*, Shlomi, Yanai*, Batarseh, Sawsa**, Vogel, Justin**

Acacia trees in the Negev and Arava, Israel

a review
following reported large-scale mortality

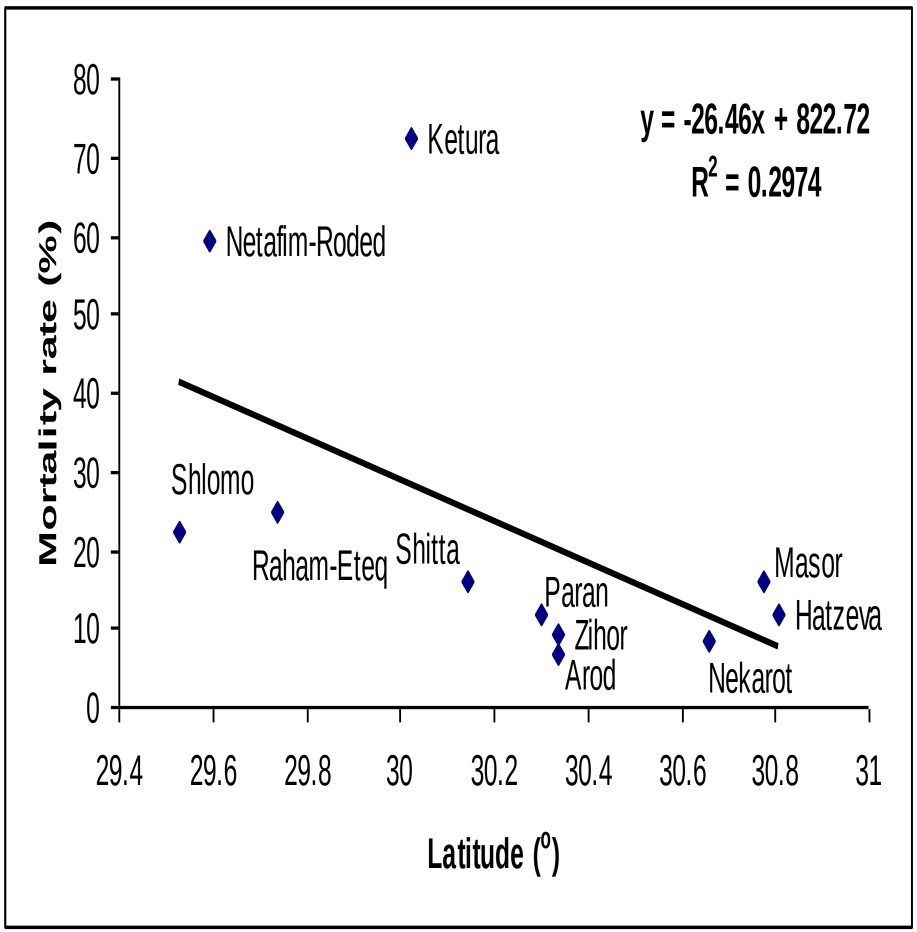
Shoshana Ashkenazi

August 1995



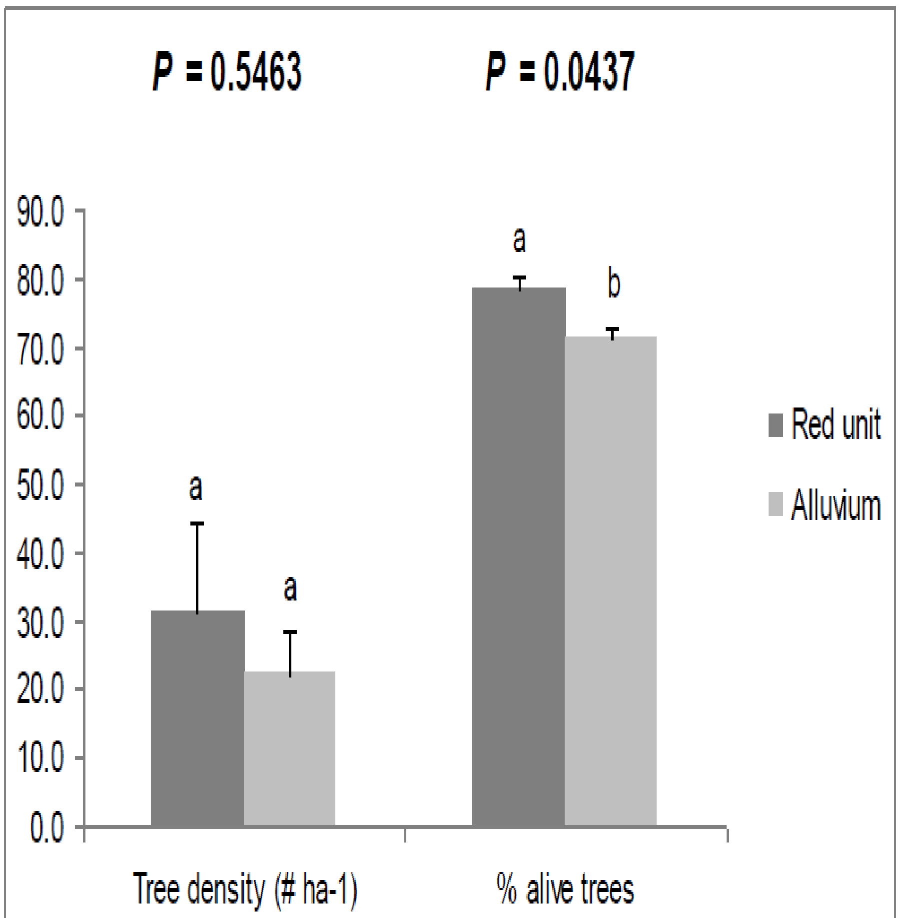
Section 1: Geographic factors

Latitude, basin size, and microhabitat effects on the viability of Acacia trees



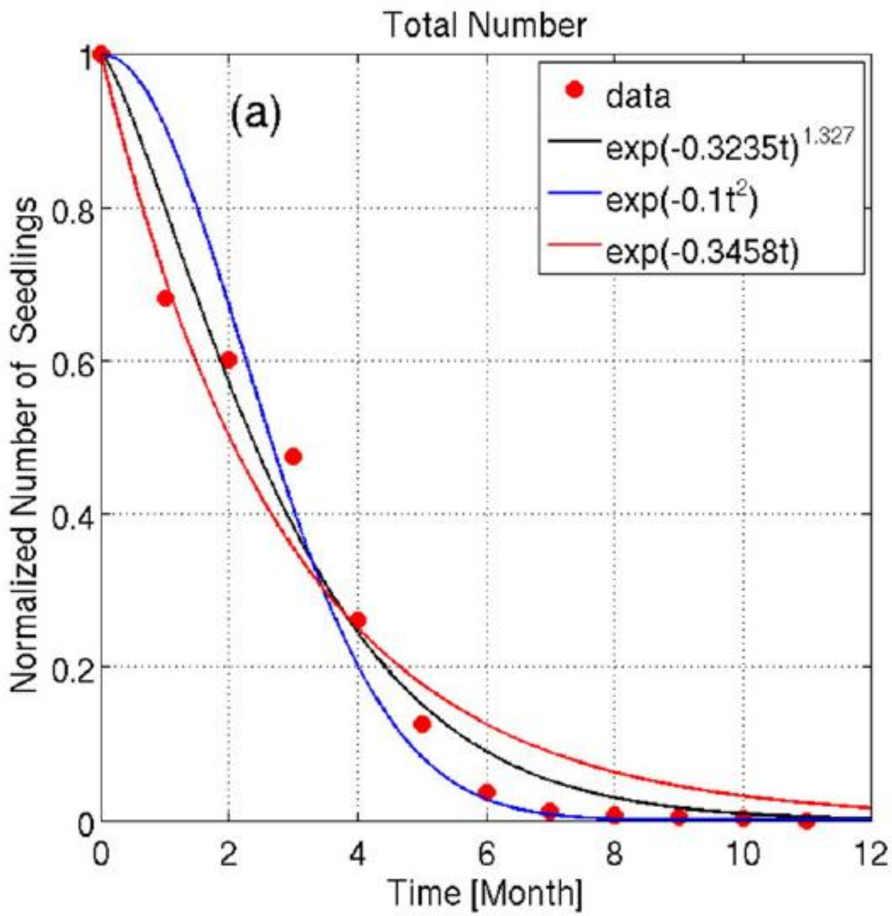
Section 2: Wadi bed

Effects of ‘red unit’ paleo deposit on Acacia trees density and vitality



Section 3: Recruitment of seedlings

Recruitment and decay patterns of Acacia seedlings



Acacia trees in the Negev and Arava, Israel

a review following reported large-scale mortality

Shoshana Ashkenazi

Ecology and Nature Conservation Consultant
P.O. Box 1057, Rosh Pina 12100 Israel. Tel: 06-930391

Scientific editor: **Uzi Ritte**
English language editing: **Esther Lachman**
Photographs: **Shoshana Ashkenazi**

Graphic design: Studio **Efrat** 02-6522144

Cover picture: *Gazella dorcas* in the shade of *Acacia raddiana*, Nahal Zenifim, July 1993.

the motivation

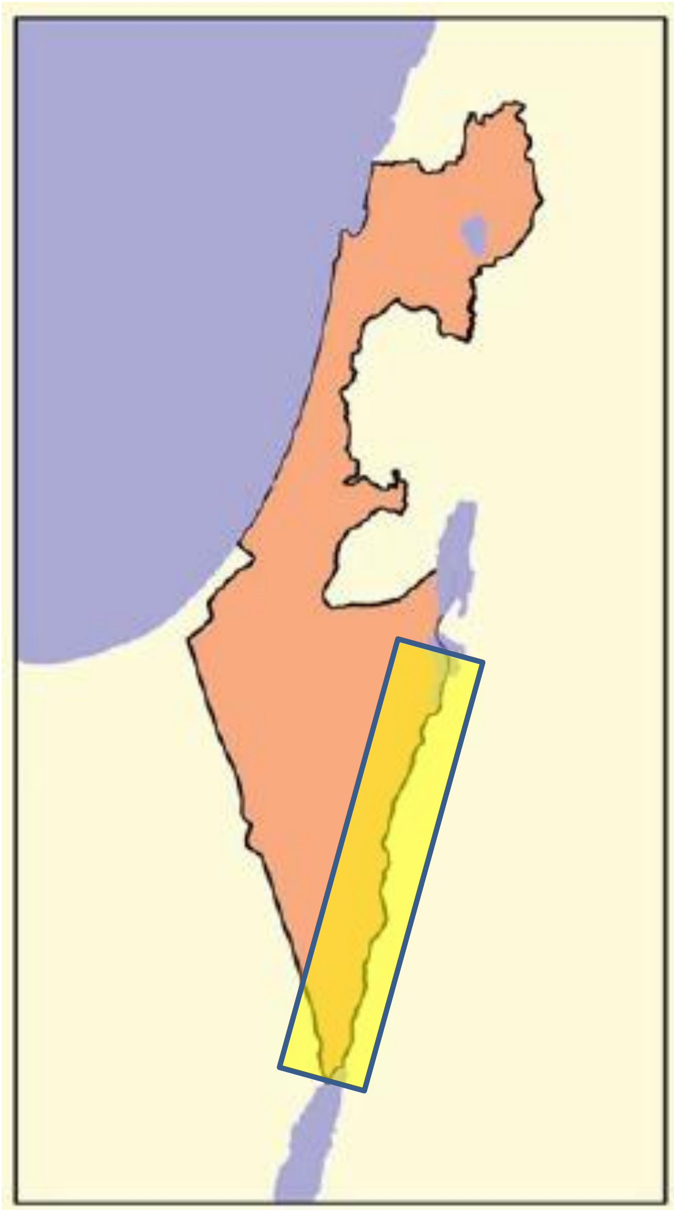
Acacia trees in the Negev and Arava, Israel

a review
following reported large-scale mortality

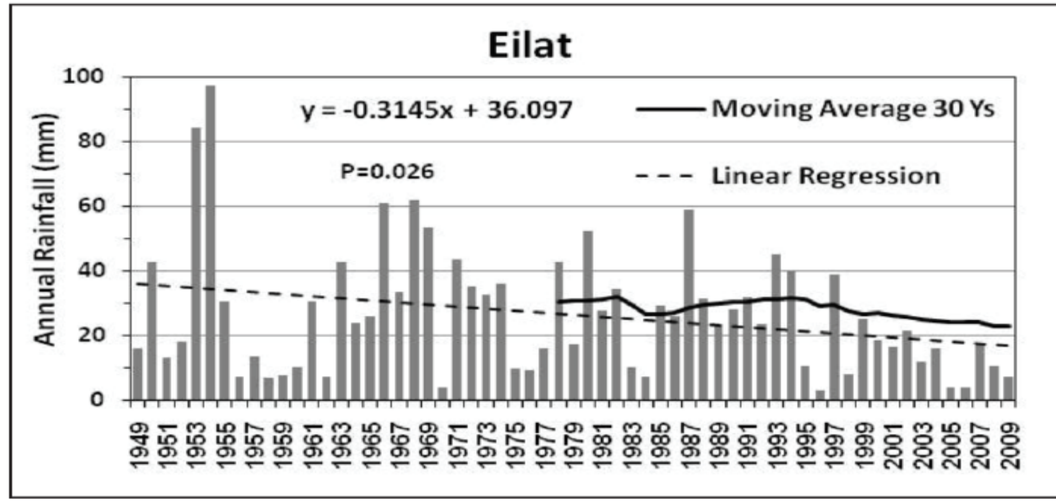
Three woody species of the genus *Acacia* (Leguminosae: Mimosoideae) of Sudanian origin, *Acacia raddiana*, *A. tortilis* and a sub-species of *A. gerrardii*, *A. g. negevensis*, are among the most important plants in the desert ecosystem of the Negev and Arava Valley in Israel.

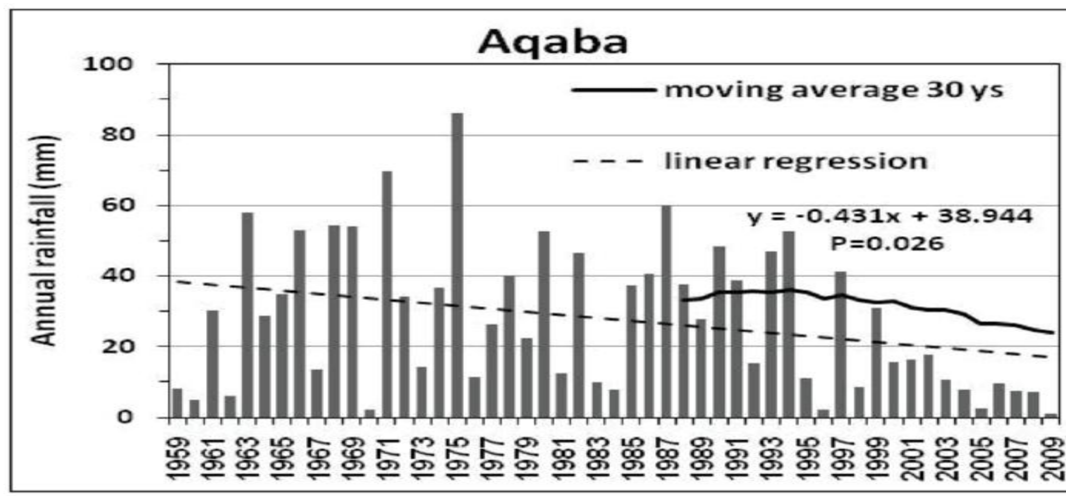
Conservation of large areas containing stands of Acacia trees in the Negev Desert and Arava Valley are included in the long-term outline plans for afforestation in Israel. However, during the last two decades, there have been reports of large-scale drying and mortality in various stands of Acacia trees in the Negev and the Arava, found at different stages of the drying process.

During deployment for the afforestation plans by Keren Kayemet LeIsrael, it became clear that evaluation of Acacia population demography and possible reasons for mortality, is necessary, before any further conservation and management activities are undertaken. This report is the result of a literature survey on the Acacia drying problem.



precipitation decrease





Ginat et al. (2011) J Dead Sea & Arava Res

1. Latitude, basin size, and microhabitat effects on the viability of Acacia trees

Objectives

- Comprehensively studying the viability of acacia trees throughout this region
- Specifically, focusing on the relationships between mortality rates of acacias and the presumed availability of water

Hypotheses

Mortality rates are greater:

(1) **in the more southern wadis**. This is due to the decreasing precipitation regimes from north to south

(2) **in the smaller basins**. Because of that the low frequency and small quantities of precipitation, results in lower likelihood of flood emergence in small-area basins

(3) **in the relatively dryer locations (microhabitats) across the valley floor,** *i.e.* in locations other than the channels themselves

M & M

- criss-crossing through the width of each valley floor
- locating of all acacias, including both alive and dead trees, to a total of **60 individuals per block**
- total number (n) of sampled trees was 60 individuals x 3 blocks x 11 wadis = 1,980

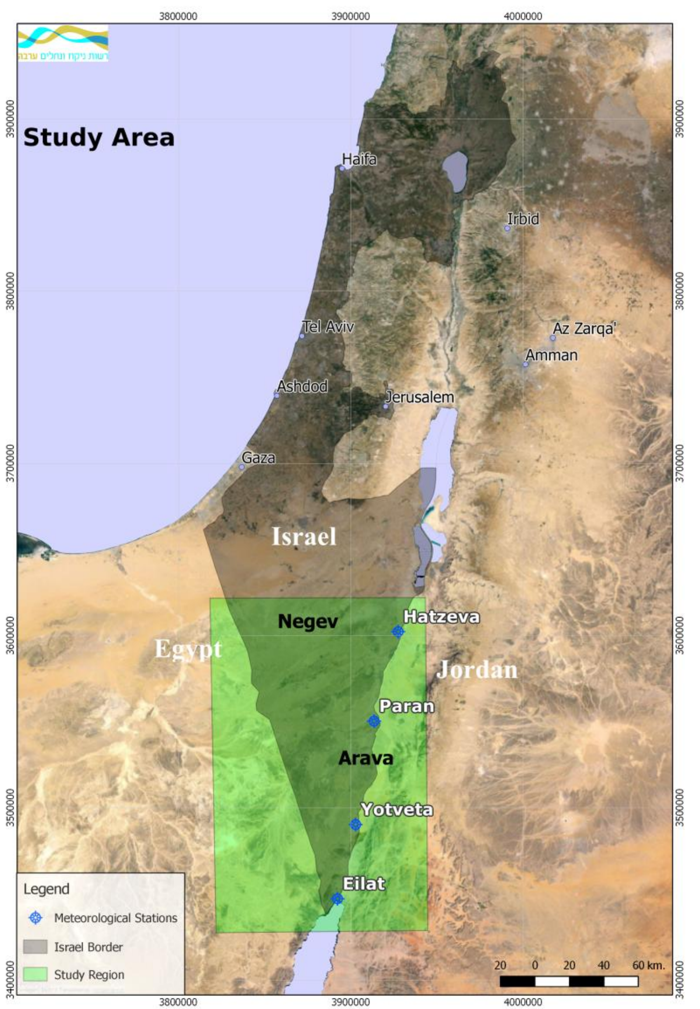
Data collection

- **viability**: "alive" or "dead"
- **microhabitat**: main channel; secondary channel; bar; low-bank (up to one m above the nearest channel), and high bank (one m or more above the nearest channel)
- existence of the hemiparasite *Plicosepalus acaciae* **(miseltoe):**

  “yes” or “no”
- **species**: "*raddiana*", "*pachyceras*", or "*tortilis*”
- **Canopy’s diameter** (m) **and height** (m)*

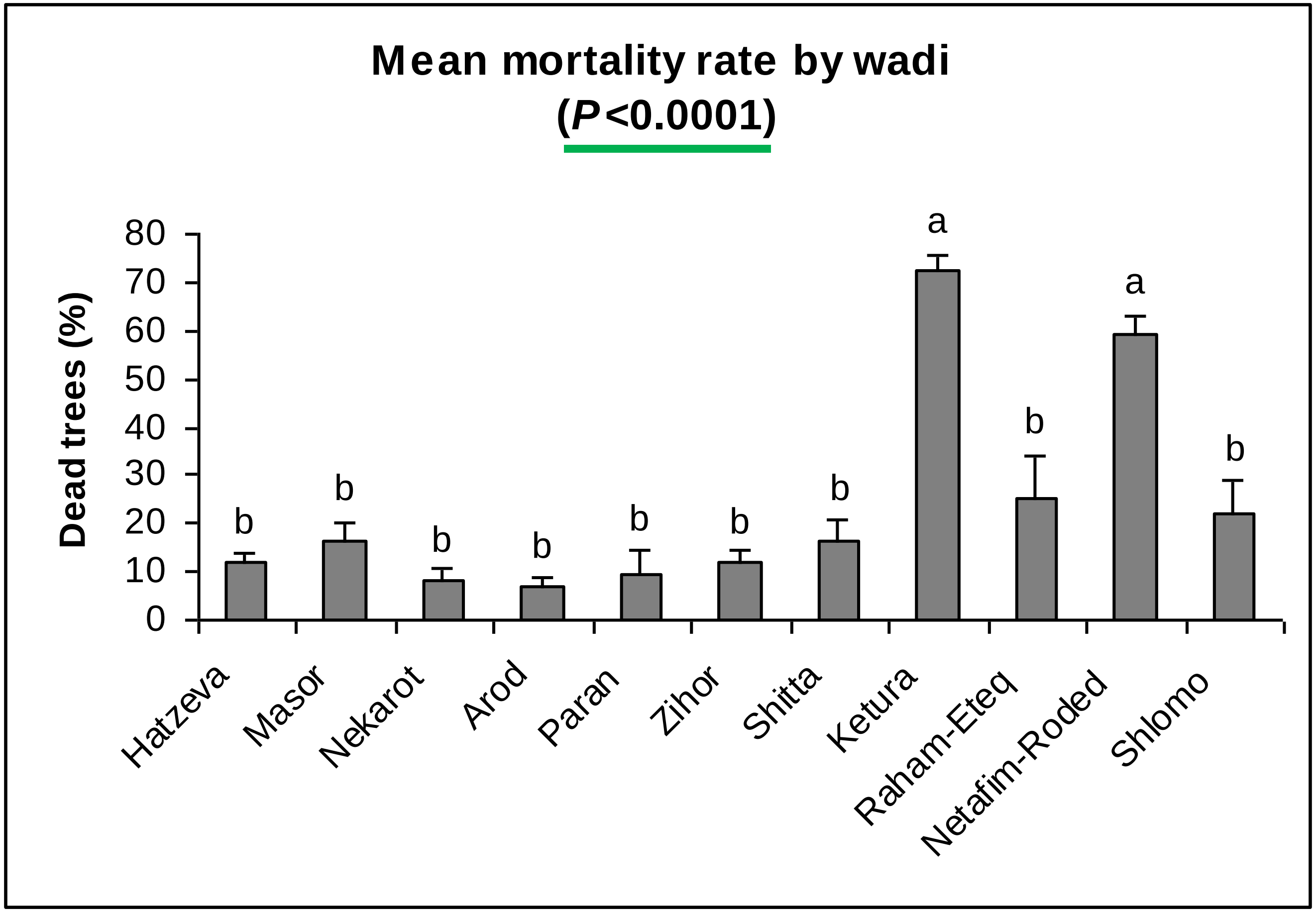
*then used for calculating a **size index**, by multiplying these two variables. The full range of values for this index was divided, on a log-like basis, into four groups, entitled "small" (0–1), "medium" (1.1–10), "large" (10.1–100), and "giant"(>100).

The study region

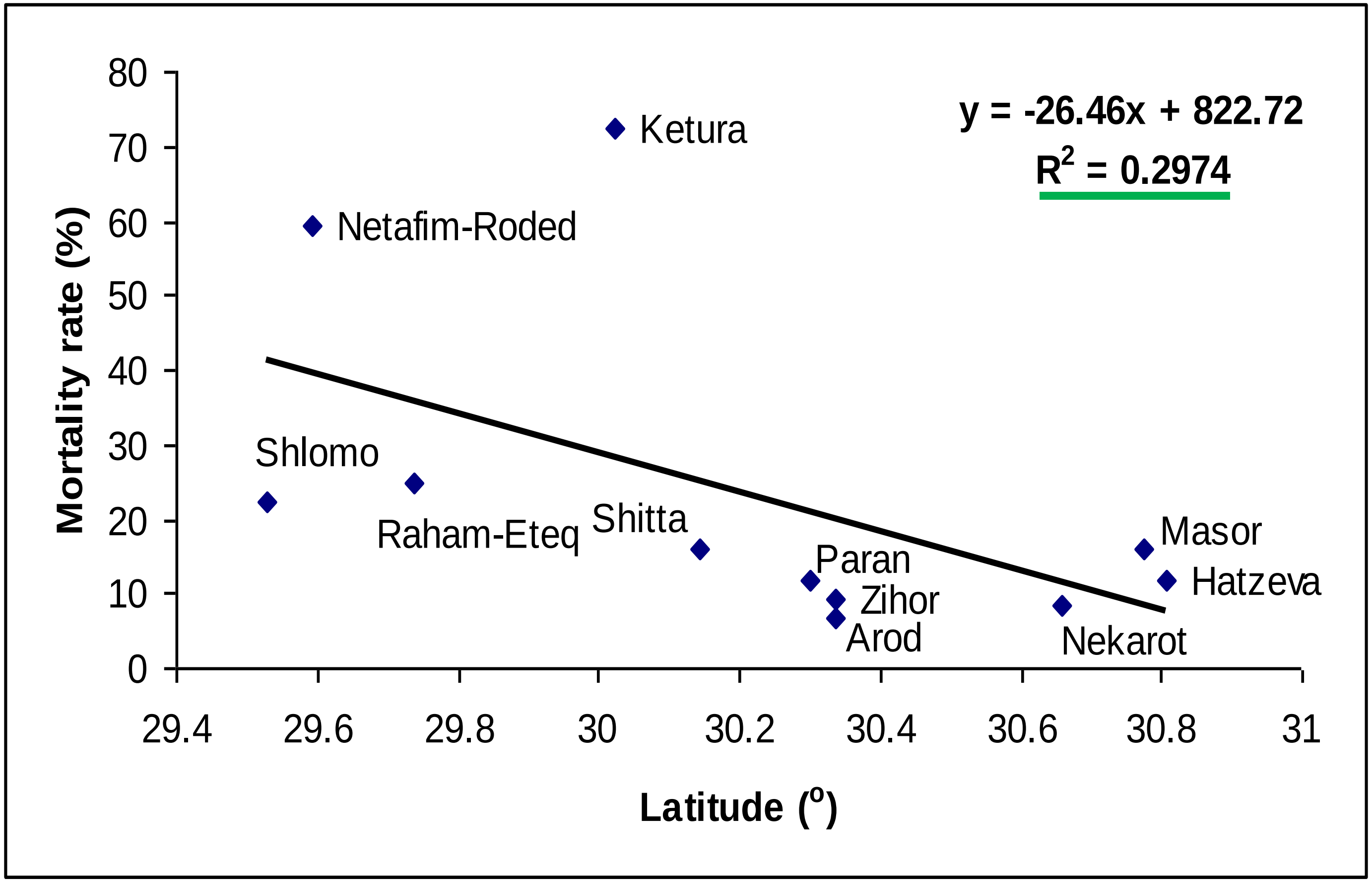


12 wadis:

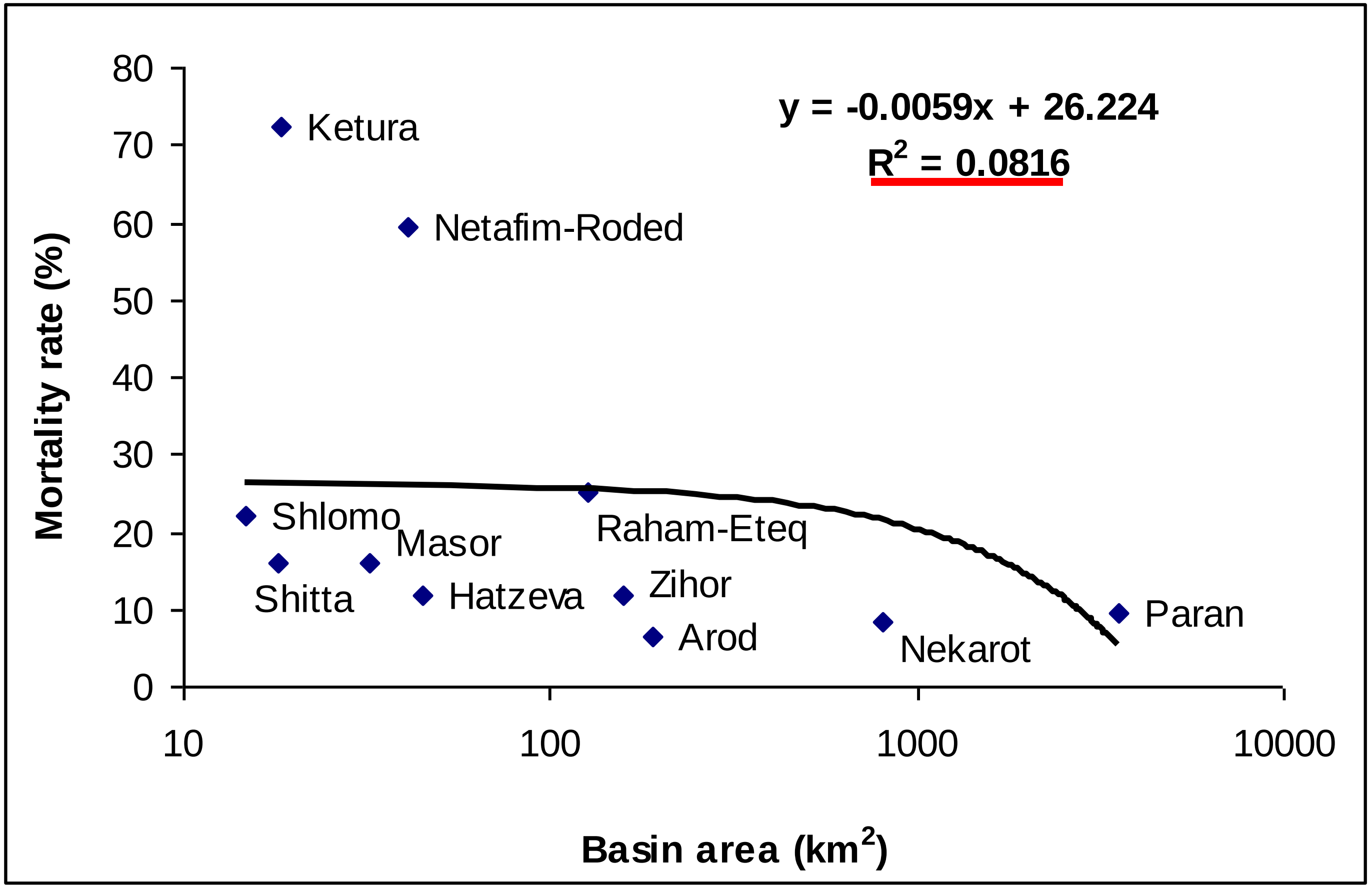
- Masor
- Neqarot
- Omer
- Hayun
- Yotvata
- Argaman
- Odem
- Psalim
- Nitzotz
- Amram
- Netafim
- Shlomo



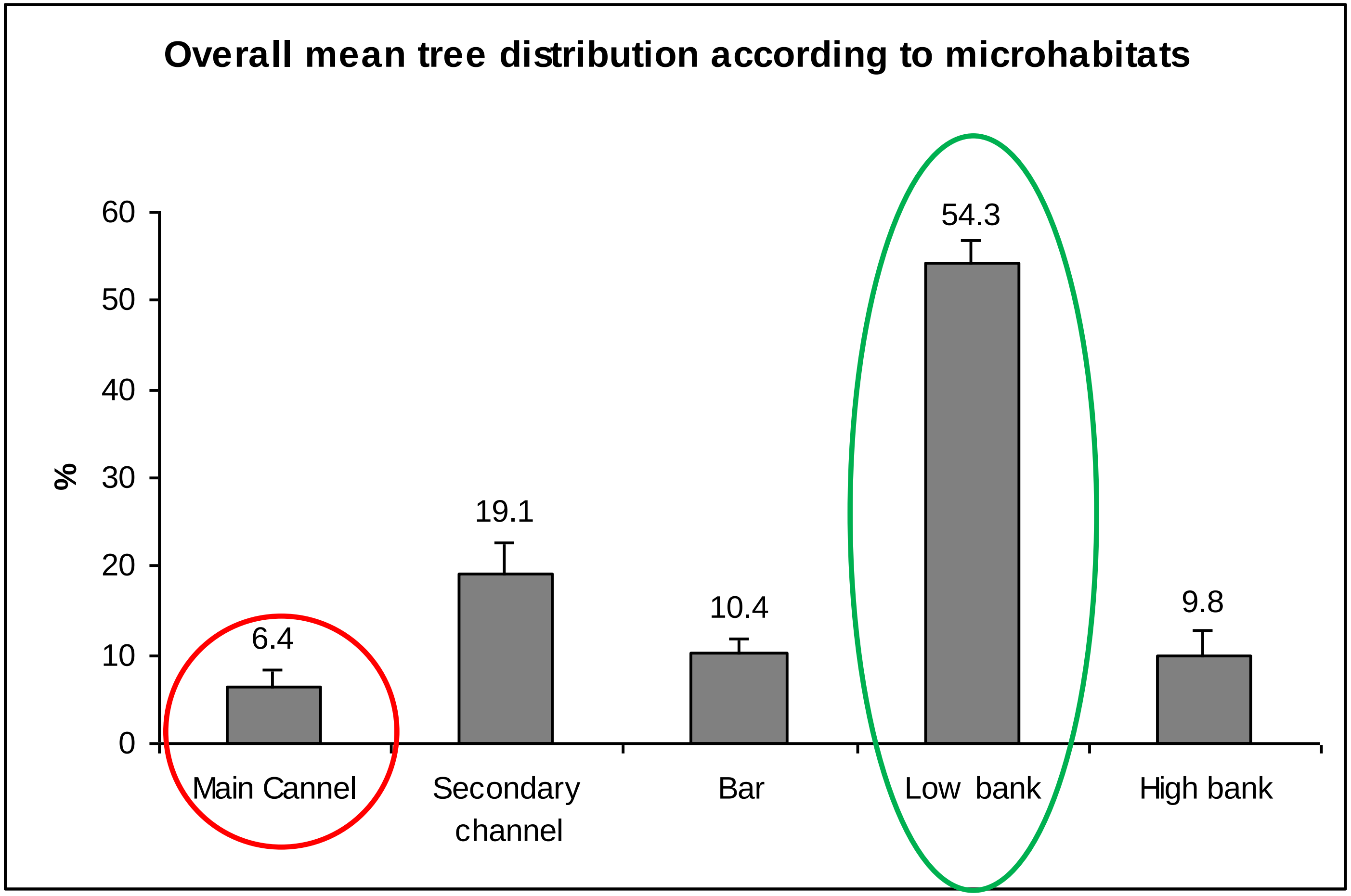
Stavi et al. (2014) Catena



Stavi et al. (2014) Catena



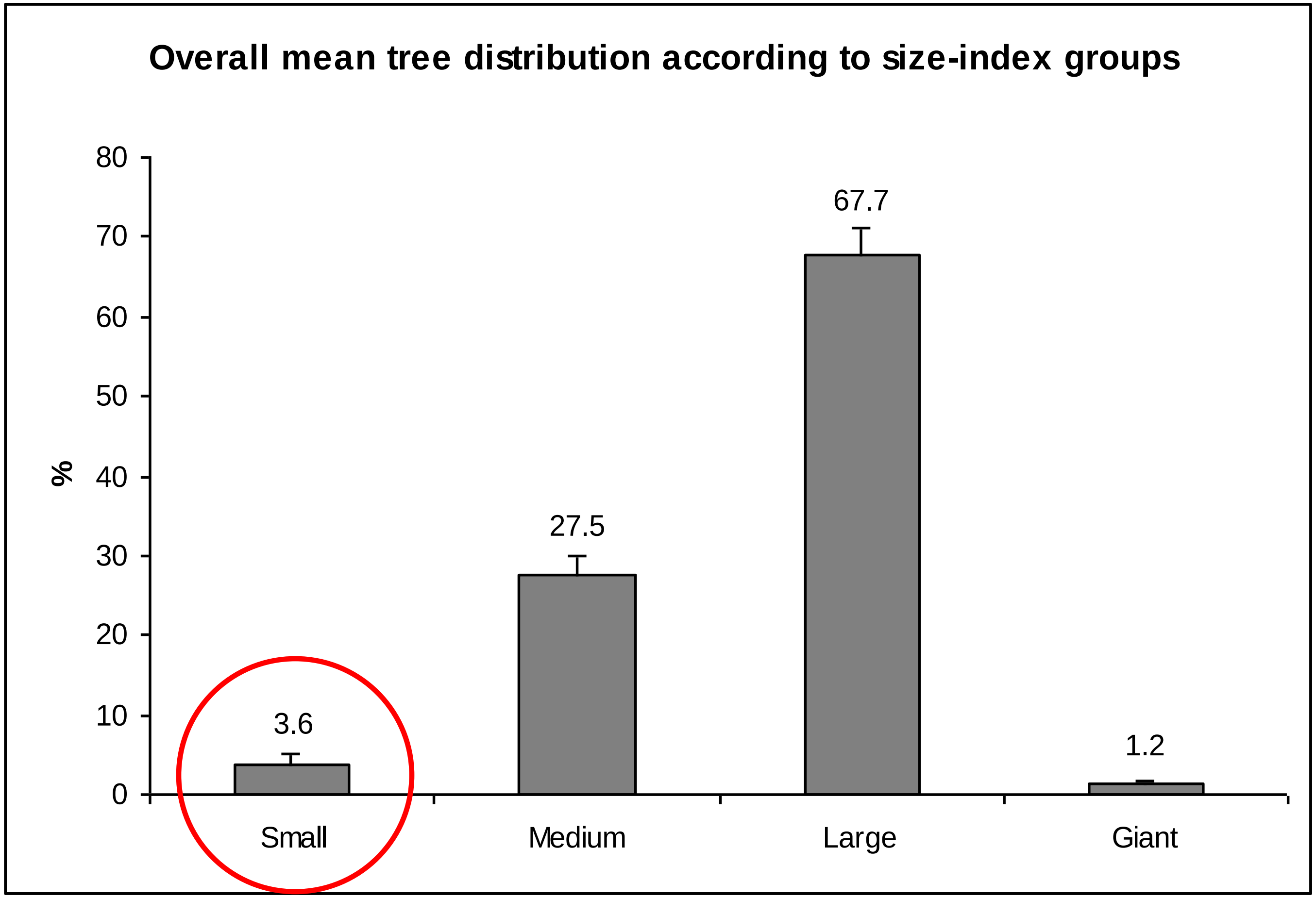
Stavi et al. (2014) Catena



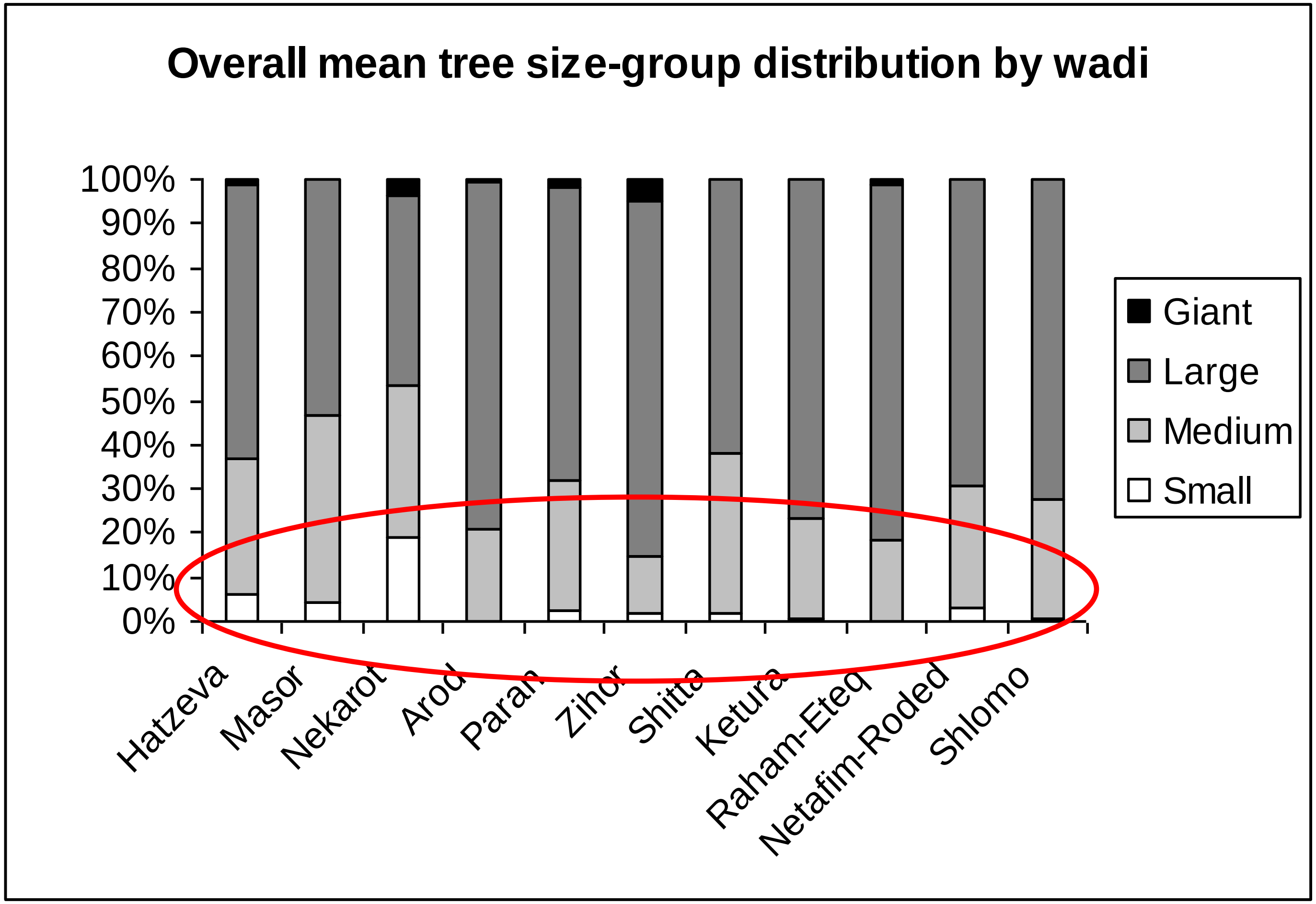
However, the effect of microhabitat on mortality rate was not significant (*P* = 0.2240)

Stavi et al. (2014) Catena

A tree of the small tree-size group, located in a secondary channel of Wadi Nekarot.



Stavi et al. (2014) Catena

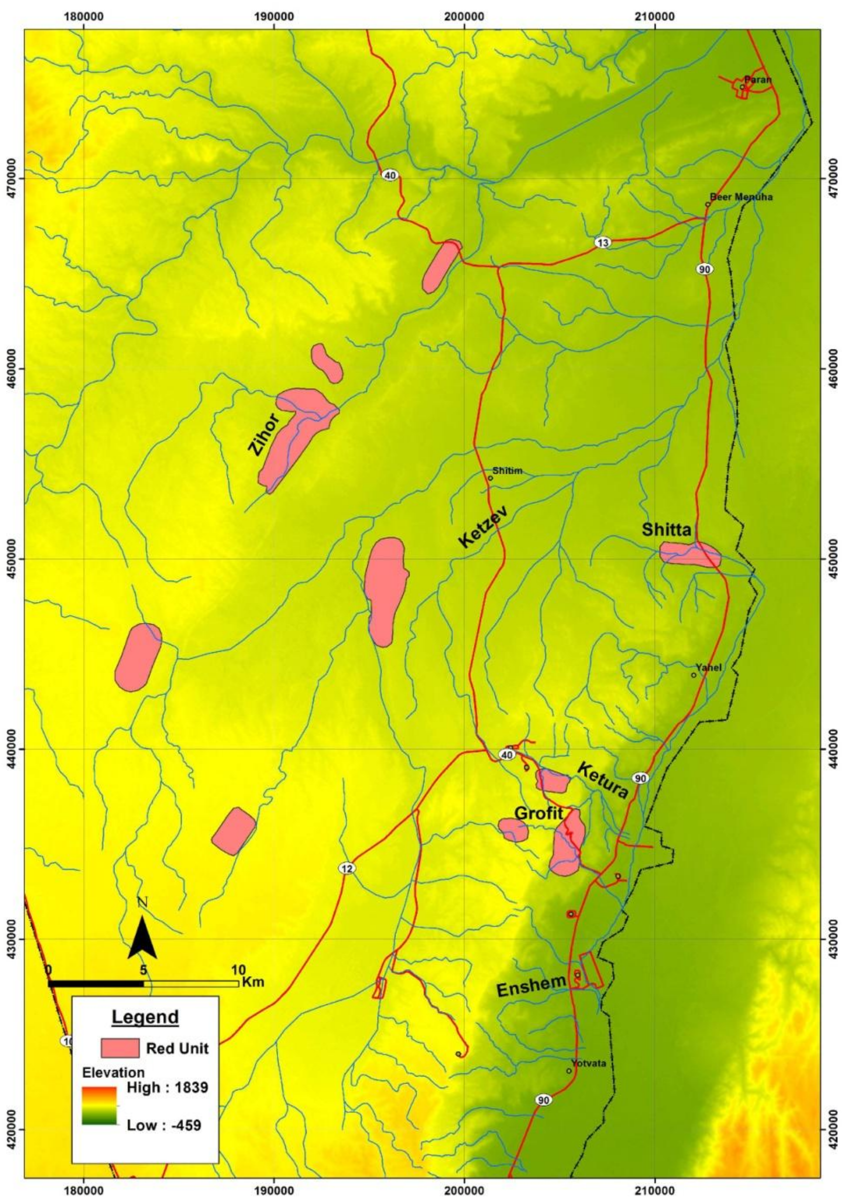


Stavi et al. (2014) Catena

Conclusions

- Mortality rates are negatively related to latitude
- **However**, mortality rates are not related to either basin size or microhabitat
- **Mortality occur** across all size groups. This could indicate water stress, which probably leads to death during relatively early stages of a tree's life cycle.
- Very low rate of trees of the small tree-size group probably indicates low rate of recruitment, and **should be of concern**

2. Effects of 'red unit' paleo deposit on Acacia trees density and vitality



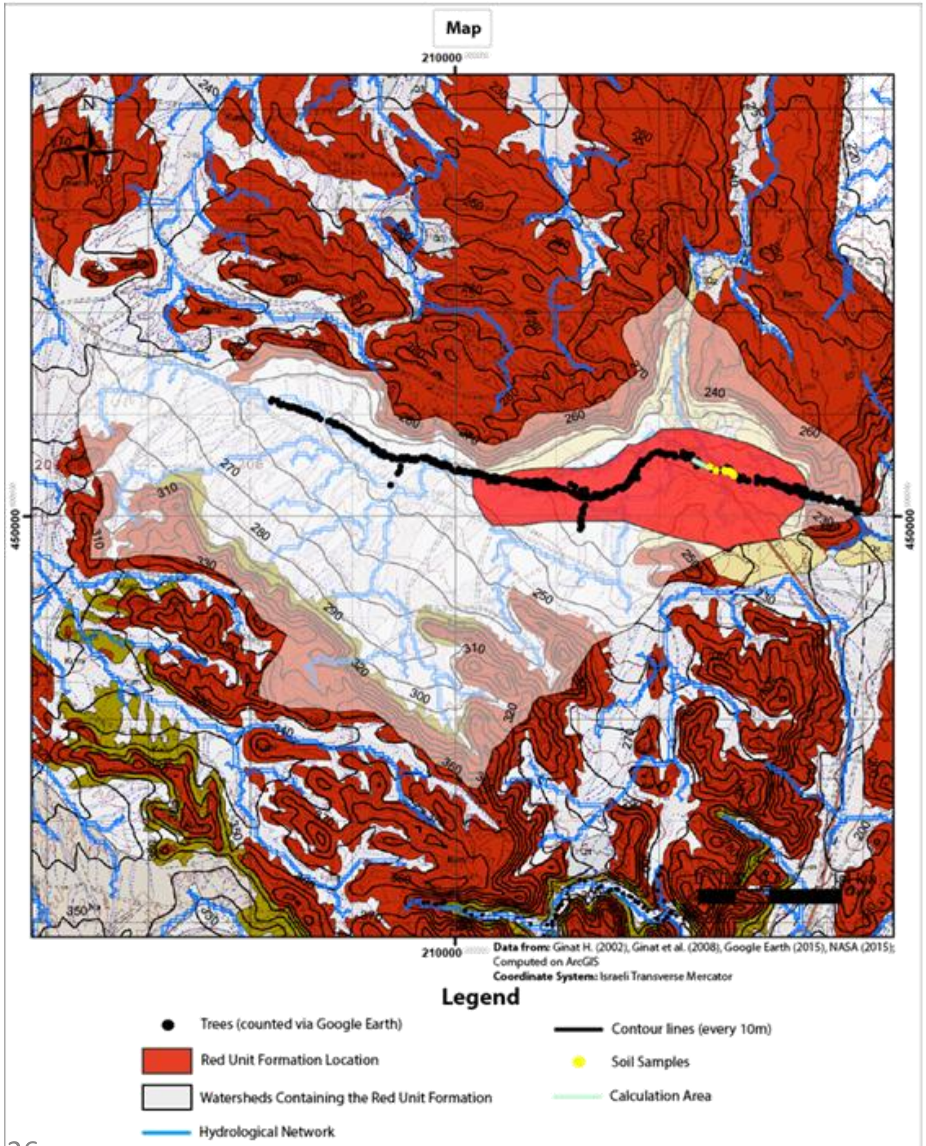
180000
190000
200000
210000
470000
460000
450000
440000
430000
420000
Paran
Beer Menuha
Zihor
Shitim
Ketzev
Shitta
Yahel
Ketura
Grofit
Enshem
Yotvata
40
13
90
12
N
0
5
10
Km
Legend
Red Unit
Elevation
High : 1839
Low : -459

Lebanon
Syria
Mediterranean Sea
Israel
Jordan
Reaserch area
Egypt
Gulf of Aqaba
Saudi Arabia
N
0
50
100
Km

The “red unit” description

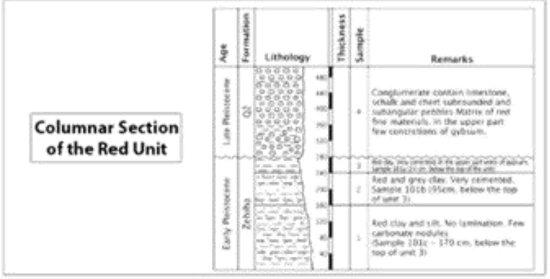
- Name: “Zhiha Formation”
- Several m thick
- Fine-grained sandstone to red clayey-silt
- Beds of calcitic paleosols with carbonate concretions, formed by pedogenic processes

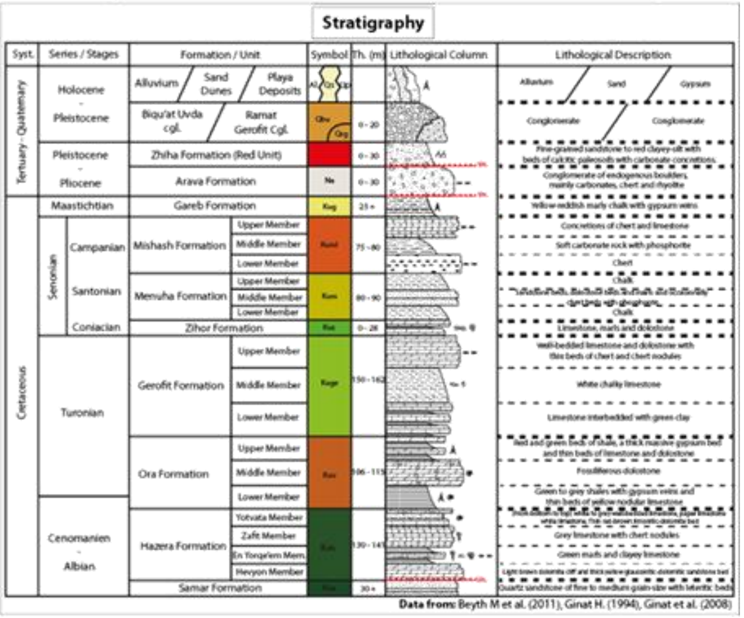
Wadi Shita

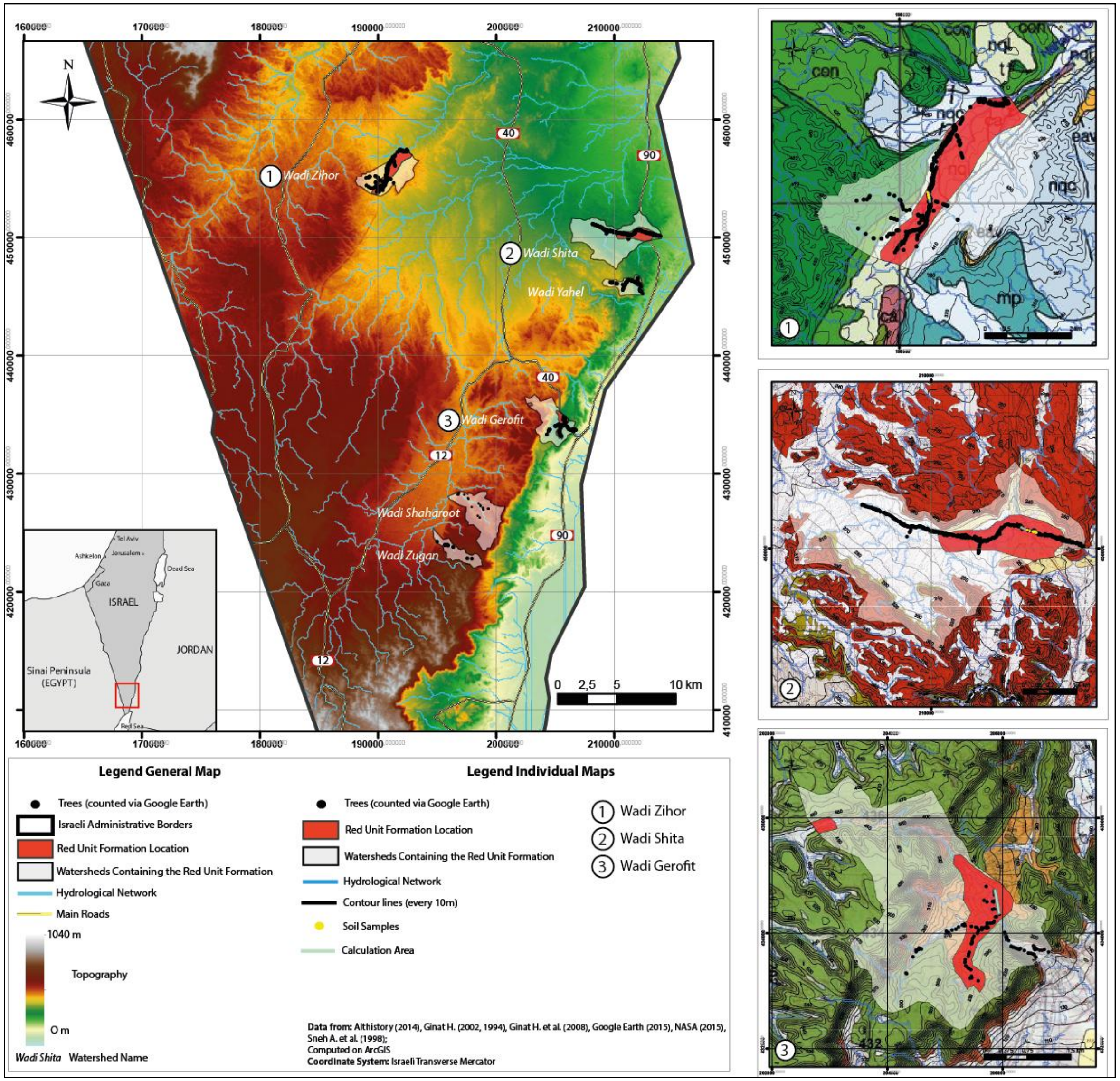


Information on Wadi Shita

Wadi Shita	
Red Unit	Yes
Surface of Red Unit, (km²)	2,4
Size of Watershed, (km²)	18,92
Approximate Number of Trees (measured via Google Earth)	415
Alive trees in measured section	18
Dead trees in measured section	12
Total trees in measured section	30
Area of the measured section, (km²)	1,02
Tree density (using measured section), (trees/km²)	29,55
n° of Samples	10 (1 to 10)
Underlying Geological Formations	Alluvium, Zehiha Frm, Mishash Frm, Menuha Frm



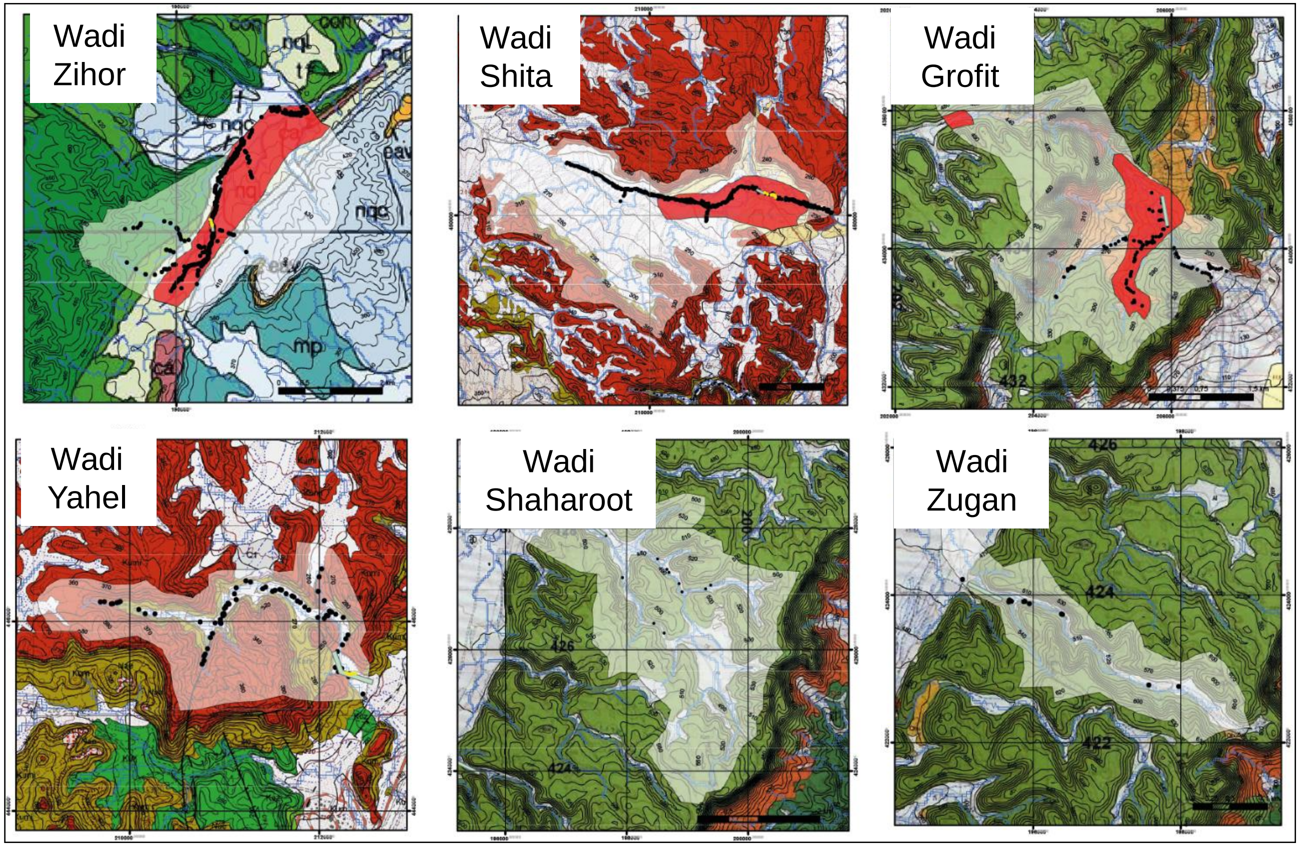


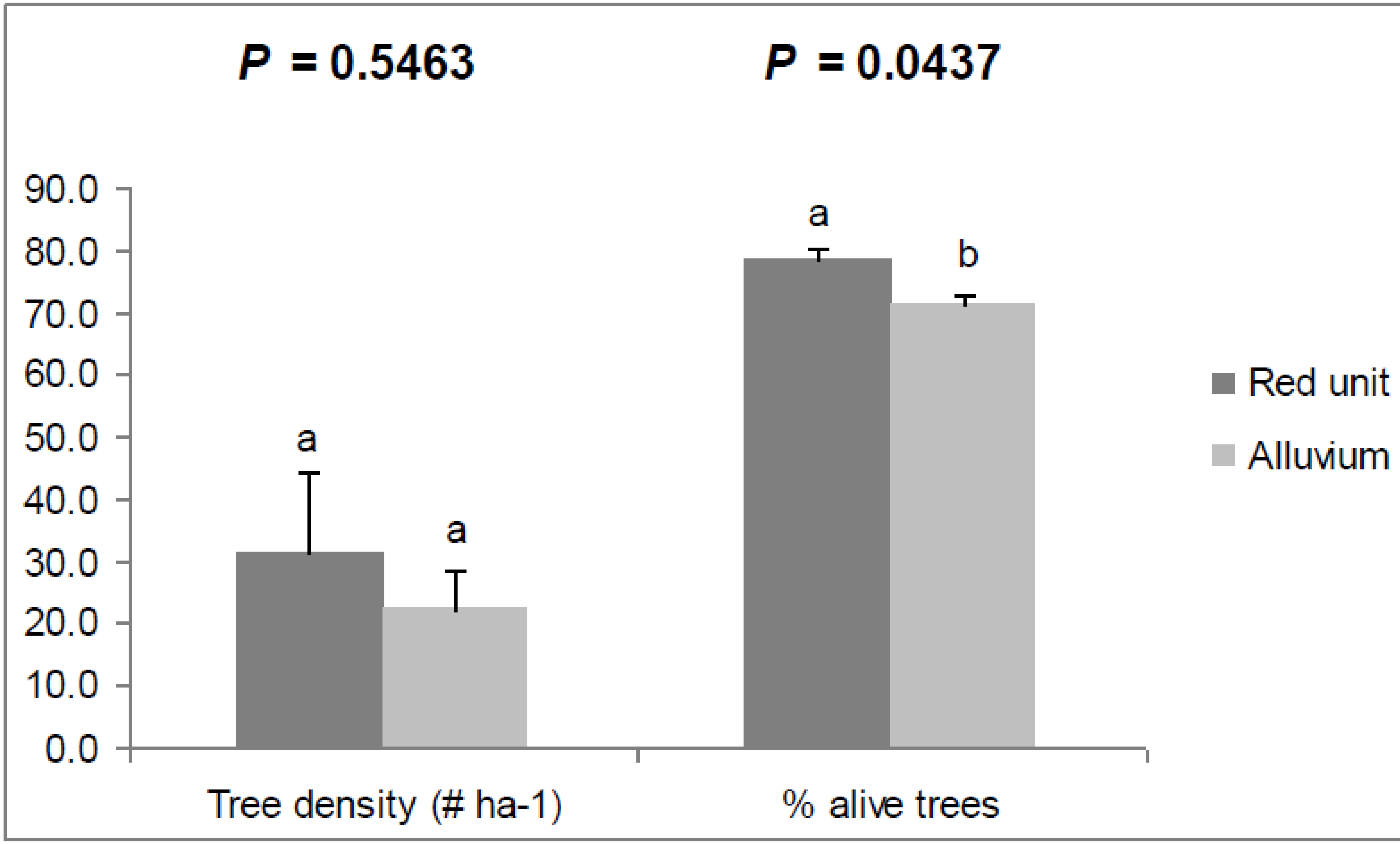


The "red unit" study area

- Wadi Zihor
- Wadi Shita
- Wadi Gerofit

Wadi Name	Surface of Drainage System (km²)	Trees			Area of Calculation		Density of trees (Trees/ha)	Percentage of Alive Trees	Red Unit (Y/N)
		Alive	Dead	Total	m²	ha			
Zihor	10,97	27	16	43	11771	1,18	36,53	62,8%	Y
Shita	18,92	18	12	30	10153	1,02	29,55	60,0%	Y
Gerofit	9,54	14	4	18	21964	2,20	8,20	77,8%	Y
Shaharoot	11,72	14	5	19	22501	2,25	8,44	73,7%	N
Yahel	3,65	7	11	18	28945	2,89	6,22	38,9%	N
Zugan	4,37	1	0	1	25536	2,55	0,39	100,0%	N





Stavi et al. (2016) Catena

Table 2. Wadi floor type characteristics

Wadi floor type effect	***P* value**	**Red unit**	**Alluvium**
Total organic carbon concentration (g kg^{-1})	< 0.0001	17.9 a (0.4)	10.6 b (0.3)
Calcium carbonate content (%)	0.0077	55.1 b (3.7)	68.1 a (3.8)
Bulk density (Mg m^{-3})	< 0.0001	1.641 b (0.031)	1.819 a (0.016)
Rock fragment content (%)	< 0.0001	0.0 b (0.0)	74.8 a (2.0)
Sand content (%)	< 0.0001	32.9 b (2.3)	85.0 a (1.3)
Silt content (%)	< 0.0001	22.4 a (2.1)	6.9 b (0.8)
Clay content (%)	< 0.0001	44.7 a (2.2)	8.0 b (0.7)
Hygroscopic moisture content (%)	< 0.0001	2.01 a (0.14)	0.41 b (0.03)
Water field capacity (%)	< 0.0001	25.6 a (0.7)	8.4 b (0.2)
Permanent wilting point (%)	< 0.0001	10.2 a (0.3)	3.6 b (0.2)
Available water capacity (mm per 5 cm depth)	< 0.0001	7.7 a (0.3)	2.3 b (0.1)

Stavi et al. (2016) Catena

Table 2. Wadi floor type characteristics

Wadi floor type effect	*P* value	Red unit	Alluvium
Total organic carbon concentration (g kg^{-1})	< 0.0001	17.9 a (0.4)	10.6 b (0.3)
Calcium carbonate content (%)	0.0077	55.1 b (3.7)	68.1 a (3.8)
Bulk density (Mg m^{-3})	< 0.0001	1.641 b (0.031)	1.819 a (0.016)
Rock fragment content (%)	< 0.0001	0.0 b (0.0)	74.8 a (2.0)
Sand content (%)	< 0.0001	32.9 b (2.3)	85.0 a (1.3)
Silt content (%)	< 0.0001	22.4 a (2.1)	6.9 b (0.8)
Clay content (%)	< 0.0001	44.7 a (2.2)	8.0 b (0.7)
Hygroscopic moisture content (%)	< 0.0001	2.01 a (0.14)	0.41 b (0.03)
Water field capacity (%)	< 0.0001	25.6 a (0.7)	8.4 b (0.2)
Permanent wilting point (%)	< 0.0001	10.2 a (0.3)	3.6 b (0.2)
Available water capacity (mm per 5 cm depth)	< 0.0001	7.7 a (0.3)	2.3 b (0.1)

Stavi et al. (2016) Catena

Table 2. Wadi floor type characteristics

Wadi floor type effect	*P* value	Red unit	Alluvium
Total organic carbon concentration (g kg^{-1})	< 0.0001	17.9 a (0.4)	10.6 b (0.3)
Calcium carbonate content (%)	0.0077	55.1 b (3.7)	68.1 a (3.8)
Bulk density (Mg m^{-3})	< 0.0001	1.641 b (0.031)	1.819 a (0.016)
Rock fragment content (%)	< 0.0001	0.0 b (0.0)	74.8 a (2.0)
Sand content (%)	< 0.0001	32.9 b (2.3)	85.0 a (1.3)
Silt content (%)	< 0.0001	22.4 a (2.1)	6.9 b (0.8)
Clay content (%)	< 0.0001	44.7 a (2.2)	8.0 b (0.7)
Hygroscopic moisture content (%)	< 0.0001	2.01 a (0.14)	0.41 b (0.03)
Water field capacity (%)	< 0.0001	25.6 a (0.7)	8.4 b (0.2)
Permanent wilting point (%)	< 0.0001	10.2 a (0.3)	3.6 b (0.2)
Available water capacity (mm per 5 cm depth)	< 0.0001	7.7 a (0.3)	2.3 b (0.1)

Stavi et al. (2016) Catena

Conclusions

The obtained results only partially support the study hypothesis. This is because the mean Acacia density was only somewhat, but not significantly, greater in the red unit deposit than that in the alluvium stratum. At the same time, the significantly greater mean Acacia vitality in the red unit deposit does support the study hypothesis. This leads to the conclusion that as long as rainstorm regimes and flood frequencies are normal (similar to the long-term average), the Acacia populations in this hyper-arid region similarly establish and grow under each of the two riverbed types. However, once prolonged droughts occur or

Stavi et al. (2016) Catena

However, once prolonged droughts occur or climatic change lessens precipitation rates and flood frequencies, the survival of existing trees can be put at risk. Under such circumstances, the red unit deposit alleviates water stress for the Acacias, improving their vitality and increasing their chances of survivability. This consists with the long-term decreasing precipitation rates across the Arava Valley between the mid-20th century and early 21st century (Ginat et al., 2011), with the resultant adverse modifications in vitality of the Acacia populations across the region (Stavi et al., 2014). This conclusion is further demonstrated by the strongly positive and significant ($P < 0.0001$) correlations between the percentage of alive trees and the available water capacity ($r = 0.91$), as opposed to the no significant correlation between overall tree density and this variable. Therefore, this study shows that unlike the overall Acacia density (as determined by the total number, of both alive and dead individuals), the Acacia vitality is considerably determined by the riverbed type, with the better living conditions provided by the red unit deposit than those provided by the stony alluvium stratum.

Stavi et al. (2016) Catena

3. Recruitment and decay patterns of Acacia seedlings

Motivation

Rainy season 2012-2013 defined with:

- Heavy rains over the Arava Valley
- Frequent floods in many of the wadis drained to the Arava along the rainy season
- Occasional observations revealing germination of acacia seedlings in some wadis

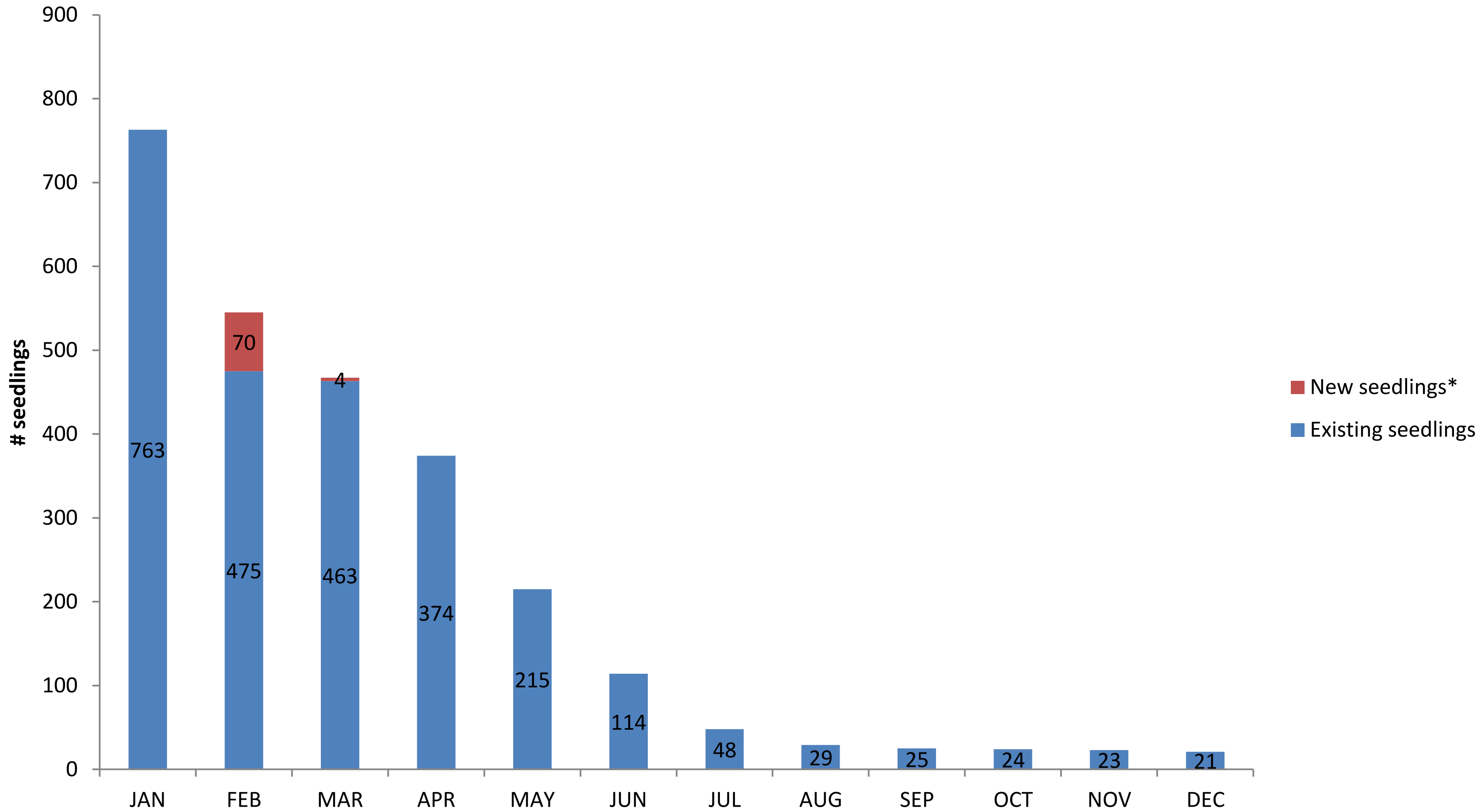
Objective

- studying the survival rates of seedlings after germination; during the rainy season and the subsequent dry season

- identifying patterns of seedlings mortality, and the related mechanisms

M & M

- **Delineation of 1-ha land unit** along the undisturbed wadi bed
- **Rough searching** for 'green patches' of herbaceous vegetation
- **Precise searching** for acacia sprouts in the green patches
- Marking each sprouts separately
- Revisiting the wadis to a once-a-month frequency


900
800
700
600
500
400
300
200
100
0
seedlings
763
70
475
4
463
374
215
114
48
29
25
24
23
21
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
New seedlings*
Existing seedlings

Data analysis

- In order to fit mortality curves to mathematical function, data was normalized and then modeled by three functions: exponential, Gaussian, and fractional exponential:

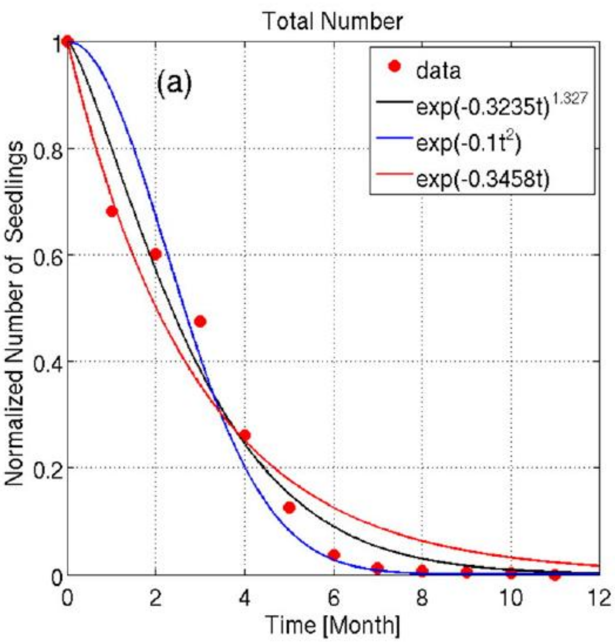
exponential	$f(t) = \exp(-bt)$
Gaussian	$g(t) = \exp\left(-(bt)^2\right)$
fractional exponential	$h(t) = \exp\left(-(bt)^a\right)$

- Where a and b are coefficients to be determined from the curve fitting procedure.
- In all of the three functions, 1/*b* indicates the characteristic time scale of the decay (mortality).
- *a* indicates how stretched/squeezed the mortality process is relative to exponential decay (i.e., if *a* > 1 then decay rate is faster than an exponential process. At the same time, if *a* < 1 then decay rate is slower than an exponential process).

Stavi et al. (2015) Catena

Data analysis (cont.)

- These three functions were chosen due to their simplicity and fitness in analyzing datasets that describe demographic changes of populations.
- Analysis and fitting procedure were performed in MATLAB.



Overall, the three functions (exponential, Gaussian, and fractional exponential) fit the data well.

The total number of seedlings is well fitted by the exponential decay ($R^2 = 0.9621$) .

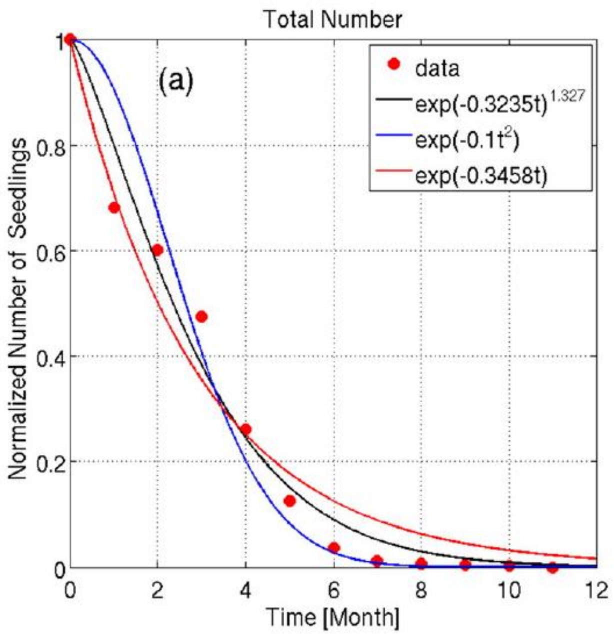
Therefore, total mortality rate was almost constant, implying that mortality is proportional to the number of seedlings, being high at the beginning and decreased as the number of seedlings declined.

Exponential, Gaussian, and fractional exponential curve fitting coefficients, by wadi.

Location	R^2 exponential	R^2 Gaussian	R^2 fractional exponential	*b* coefficient exponential	*b* coefficient Gaussian	*b* coefficient fractional exponential	*a* coefficient fractional exponential
Shlomo	0.8964	0.9940	0.9996	0.3570	0.3336	0.3343	2.5380
Amram	0.9199	0.8630	0.9244	0.4153	0.3624	0.3992	1.1630
Psalim	0.9857	0.9834	0.9936	2.2530	1.5620	4.0000	0.5096
Argaman	0.9349	0.9953	0.9957	0.4882	0.4474	0.4467	2.1320
Ketzev	0.9810	0.9779	0.9925	0.5974	0.5496	0.5608	1.3840
Omer	0.9982	0.9981	0.9984	3.5820	1.9068	6.0000	0.6743
Neqarot	0.8990	0.9870	0.9893	0.2677	0.2497	0.2494	2.3320
Masor	0.9712	0.9998	1.0000	0.9772	0.8625	0.8650	2.1330
All sites	0.9621	0.9501	0.9768	0.3458	0.3087	0.3235	1.3270

Stavi et al. (2015) Catena

Section 1: Geographic factors | Section 2: Wadi bed | Section 3. Recruitment of seedlings



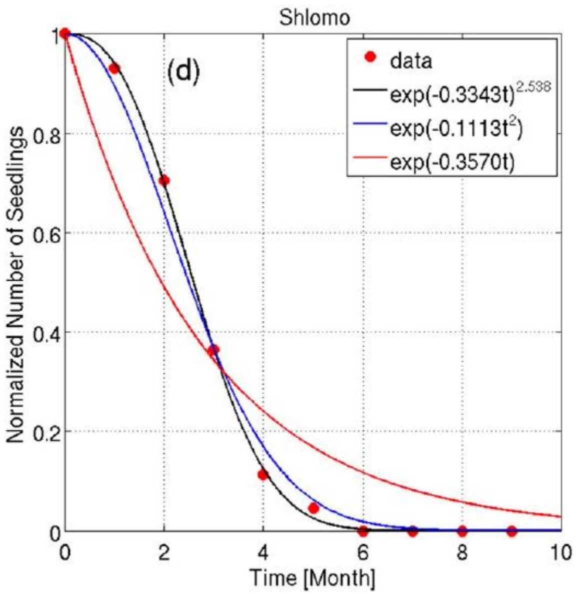
Yet, while in some of the wadis, mortality rate was almost independent of time and remained constant (exponential fit)…

in other wadis, the mortality rate grew with time (Gaussian or fractional exponential fit, with *a* > 1).

Exponential, Gaussian, and fractional exponential curve fitting coefficients, by wadi.

Location	R^2 exponential	R^2 Gaussian	R^2 fractional exponential	*b* coefficient exponential	*b* coefficient Gaussian	*b* coefficient fractional exponential	*a* coefficient fractional exponential
Shlomo	0.8964	0.9940	0.9996	0.3570	0.3336	0.3343	2.5380
Amram	0.9199	0.8630	0.9244	0.4153	0.3624	0.3992	1.1630
Psalim	0.9857	0.9834	0.9936	2.2530	1.5620	4.0000	0.5096
Argaman	0.9349	0.9953	0.9957	0.4882	0.4474	0.4467	2.1320
Ketzev	0.9810	0.9779	0.9925	0.5974	0.5496	0.5608	1.3840
Omer	0.9982	0.9981	0.9984	3.5820	1.9068	6.0000	0.6743
Neqarot	0.8990	0.9870	0.9893	0.2677	0.2497	0.2494	2.3320
Masor	0.9712	0.9998	1.0000	0.9772	0.8625	0.8650	2.1330
All sites	0.9621	0.9501	0.9768	0.3458	0.3087	0.3235	1.3270

Stavi et al. (2015) Catena



For example, in Shlomo Wadi, the mortality rate grew with time, and therefore, both the Gaussian function and the fractional exponential function ($a > 1$) provided a good fit.

At the same time, the exponential function (which corresponds to a constant mortality rate), did not fit the data well.

Exponential, Gaussian, and fractional exponential curve fitting coefficients, by wadi.

Location	R^2 exponential	R^2 Gaussian	R^2 fractional exponential	*b* coefficient exponential	*b* coefficient Gaussian	*b* coefficient fractional exponential	*a* coefficient fractional exponential
Shlomo	0.8964	0.9940	0.9996	0.3570	0.3336	0.3343	2.5380
Amram	0.9199	0.8630	0.9244	0.4153	0.3624	0.3992	1.1630
Psalim	0.9857	0.9834	0.9936	2.2530	1.5620	4.0000	0.5096
Argaman	0.9349	0.9953	0.9957	0.4882	0.4474	0.4467	2.1320
Ketzev	0.9810	0.9779	0.9925	0.5974	0.5496	0.5608	1.3840
Omer	0.9982	0.9981	0.9984	3.5820	1.9068	6.0000	0.6743
Neqarot	0.8990	0.9870	0.9893	0.2677	0.2497	0.2494	2.3320
Masor	0.9712	0.9998	1.0000	0.9772	0.8625	0.8650	2.1330
All sites	0.9621	0.9501	0.9768	0.3458	0.3087	0.3235	1.3270

Stavi et al. (2015) Catena

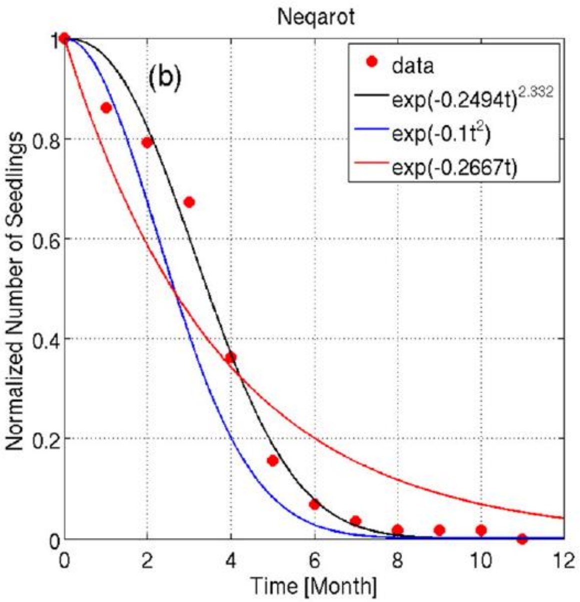
In Amram Wadi, the mortality rate was almost constant, and therefore, the Gaussian function did not fit well the data.

The exponential function and fractional exponential function (*a* ~ 1) better fitted the data.

Exponential, Gaussian, and fractional exponential curve fitting coefficients, by wadi.

Location	R^2 exponential	R^2 Gaussian	R^2 fractional exponential	*b* coefficient exponential	*b* coefficient Gaussian	*b* coefficient fractional exponential	*a* coefficient fractional exponential
Shlomo	0.8964	0.9940	0.9996	0.3570	0.3336	0.3343	2.5380
Amram	0.9199	0.8630	0.9244	0.4153	0.3624	0.3992	1.1630
Psalim	0.9857	0.9834	0.9936	2.2530	1.5620	4.0000	0.5096
Argaman	0.9349	0.9953	0.9957	0.4882	0.4474	0.4467	2.1320
Ketzev	0.9810	0.9779	0.9925	0.5974	0.5496	0.5608	1.3840
Omer	0.9982	0.9981	0.9984	3.5820	1.9068	6.0000	0.6743
Neqarot	0.8990	0.9870	0.9893	0.2677	0.2497	0.2494	2.3320
Masor	0.9712	0.9998	1.0000	0.9772	0.8625	0.8650	2.1330
All sites	0.9621	0.9501	0.9768	0.3458	0.3087	0.3235	1.3270

Stavi et al. (2015) Catena



Since 1/b indicates the characteristic time scale of the decay …

then, the slowest mortality was observed for the Neqarot Wadi (where *b* is the smallest for each of the three fitting functions).

The very large *a* value shows that initial (up to 4 months) decay rate is slower than the exponential decay, and later on, decay rate is faster than the exponential decay.

Exponential, Gaussian, and fractional exponential curve fitting coefficients, by wadi.

Location	R^2 exponential	R^2 Gaussian	R^2 fractional exponential	*b* coefficient exponential	*b* coefficient Gaussian	*b* coefficient fractional exponential	*a* coefficient fractional exponential
Shlomo	0.8964	0.9940	0.9996	0.3570	0.3336	0.3343	2.5380
Amram	0.9199	0.8630	0.9244	0.4153	0.3624	0.3992	1.1630
Psalim	0.9857	0.9834	0.9936	2.2530	1.5620	4.0000	0.5096
Argaman	0.9349	0.9953	0.9957	0.4882	0.4474	0.4467	2.1320
Ketzev	0.9810	0.9779	0.9925	0.5974	0.5496	0.5608	1.3840
Omer	0.9982	0.9981	0.9984	3.5820	1.9068	6.0000	0.6743
Neqarot	0.8990	0.9870	0.9893	0.2677	0.2497	0.2494	2.3320
Masor	0.9712	0.9998	1.0000	0.9772	0.8625	0.8650	2.1330
All sites	0.9621	0.9501	0.9768	0.3458	0.3087	0.3235	1.3270

Stavi et al. (2015) Catena

The fastest decay was observed for the Omer Wadi (where *b* is the largest for each of the three functions).

The very small *a* value suggests that initial decay (one month at most) is faster than the exponential decay, and later on decay (of the survived very few seedlings) is slower than an exponential decay.

The very fast mortality is attributed to an extreme flood event, which occurred in early February (between the 1st and 2nd monitoring rounds), removing/burrying 148 seedlings of a total of 153 in this wadi.

Exponential, Gaussian, and fractional exponential curve fitting coefficients, by wadi.

Location	R^2 exponential	R^2 Gaussian	R^2 fractional exponential	*b* coefficient exponential	*b* coefficient Gaussian	*b* coefficient fractional exponential	*a* coefficient fractional exponential
Shlomo	0.8964	0.9940	0.9996	0.3570	0.3336	0.3343	2.5380
Amram	0.9199	0.8630	0.9244	0.4153	0.3624	0.3992	1.1630
Psalim	0.9857	0.9834	0.9936	2.2530	1.5620	4.0000	0.5096
Argaman	0.9349	0.9953	0.9957	0.4882	0.4474	0.4467	2.1320
Ketzev	0.9810	0.9779	0.9925	0.5974	0.5496	0.5608	1.3840
Omer	0.9982	0.9981	0.9984	3.5820	1.9068	6.0000	0.6743
Neqarot	0.8990	0.9870	0.9893	0.2677	0.2497	0.2494	2.3320
Masor	0.9712	0.9998	1.0000	0.9772	0.8625	0.8650	2.1330
All sites	0.9621	0.9501	0.9768	0.3458	0.3087	0.3235	1.3270

Stavi et al. (2015) Catena

Discussion

sured – over one entire year – the survivability of acacia seedlings in 12 ephemeral rivers (wadis). Data analysis revealed that the main impediment to the recruitment and survival of acacia seedlings is their desiccation, resulting in their mortality. This limiting factor was predominant despite the above-average and well-distributed precipitation during the year of the study. Another, secondary impediment is imposed by erosional and depositional processes under heavy flash floods, resulting in either the uprooting of the seedlings or their burial under deposited soil and fine pebble sediments. Therefore, the novelty of this study stems from the identification, quantification, and modeling of two different mechanisms that determine the decay of acacia seedlings: one with a constant mortality rate that is caused by drying, and the second with a mortality rate that grows with time, which is caused by fluvial processes. The mortality due to drying revealed high fitting to an exponential decay, while the mortality due to fluvial processes closely fits a Gaussian decay function.

Stavi et al. (2015) Catena

Discussion

sured – over one entire year – the survivability of acacia seedlings in 12 ephemeral rivers (wadis). Data analysis revealed that the main impediment to the recruitment and survival of acacia seedlings is their desiccation, resulting in their mortality. This limiting factor was predominant despite the above-average and well-distributed precipitation during the year of the study. Another, secondary impediment is imposed by erosional and depositional processes under heavy flash floods, resulting in either the uprooting of the seedlings or their burial under deposited soil and fine pebble sediments. Therefore, the novelty of this study stems from the identification, quantification, and modeling of two different mechanisms that determine the decay of acacia seedlings: one with a constant mortality rate that is caused by drying, and the second with a mortality rate that grows with time, which is caused by fluvial processes. The mortality due to drying revealed high fitting to an exponential decay, while the mortality due to fluvial processes closely fits a Gaussian decay function.

Stavi et al. (2015) Catena

An almost fully uprooted acacia seedling. Notice the exposed ~9-cm length of root system. Photo was taken (from above, in a parallel position to the ground surface) in the Shlomo Wadi, five days after a flood event

An acacia seedling exposed after excavation in soil. The whole seedling (3-cm height) was covered with soil, and its location was identified by the marking stones around it. Photo was taken in the Shlomo Wadi, five days after a flood event

An acacia seedling partially covered with sediments. Photo was taken in the Amram Wadi, five days after a flood event

Conclusions

sured – over one entire year – the survivability of acacia seedlings in 12 ephemeral rivers (wadis). Data analysis revealed that the main impediment to the recruitment and survival of acacia seedlings is their desiccation, resulting in their mortality. This limiting factor was predominant despite the above-average and well-distributed precipitation during the year of the study. Another, secondary impediment is imposed by erosional and depositional processes under heavy flash floods, resulting in either the uprooting of the seedlings or their burial under deposited soil and fine pebble sediments. Therefore, the novelty of this study stems from the identification, quantification, and modeling of two different mechanisms that determine the decay of acacia seedlings: one with a constant mortality rate that is caused by drying, and the second with a mortality rate that grows with time, which is caused by fluvial processes. The mortality due to drying revealed high fitting to an exponential decay, while the mortality due to fluvial processes closely fits a Gaussian decay function.

Stavi et al. (2015) Catena

Conclusions

sured – over one entire year – the survivability of acacia seedlings in 12 ephemeral rivers (wadis). Data analysis revealed that the main impediment to the recruitment and survival of acacia seedlings is their desiccation, resulting in their mortality. This limiting factor was predominant despite the above-average and well-distributed precipitation during the year of the study. Another, secondary impediment is imposed by erosional and depositional processes under heavy flash floods, resulting in either the uprooting of the seedlings or their burial under deposited soil and fine pebble sediments. Therefore, the novelty of this study stems from the identification, quantification, and modeling of two different mechanisms that determine the decay of acacia seedlings: one with a constant mortality rate that is caused by drying, and the second with a mortality rate that grows with time, which is caused by fluvial processes. The mortality due to drying revealed high fitting to an exponential decay, while the mortality due to fluvial processes closely fits a Gaussian decay function.

Stavi et al. (2015) Catena

References

- Stavi, I., Shem-Tov, R., Gourjon, E., Ragolski, G., Shlomi, Y., Ginat, H., 2016. Effects of 'red unit' deposit on Acacia trees in the hyper-arid southern Israel. *Catena* 145, 316–320. doi: 10.1016/j.catena.2016.06.030
- Stavi, I., Shem-Tov, R., Shlomi, Y., Bel, G., Yizhaq, H., 2015. Recruitment and decay rate of Acacia seedlings in the hyper-arid Arava Valley, Israel. *Catena* 131, 14–21. doi: 10.1016/j.catena.2015.03.004
- Stavi, I., Silver, M., Avni, Y., 2014. Latitude, basin size, and microhabitat effects on the viability of Acacia trees in the Negev and Arava, Israel. *Catena* 114, 149–156. doi: 10.1016/j.catena.2013.10.006

An additional related reference:

- Stavi, I., Zinnes, T.A., Joseph, A., Solowey, E., Groner, E., 2015. The role of large herbivores in recruitment of Acacia trees via endozoochory in the Arava Valley, Israel. *European Journal of Wildlife Research* 61, 775–781. doi: 10.1007/s10344-015-0954-0