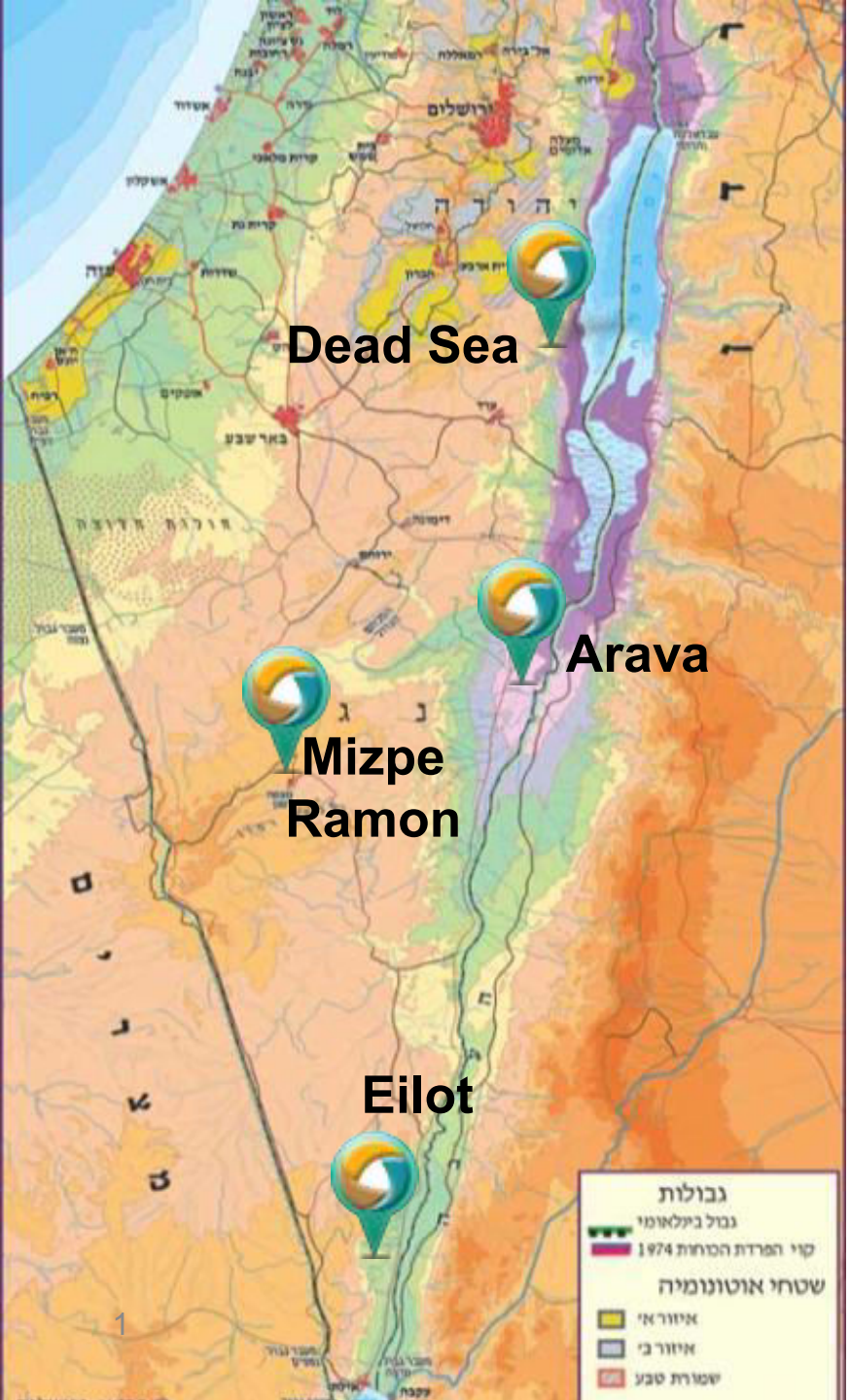


Dead Sea & Arava Science Center
under the auspices of Ben Gurion University of the Negev
מרכז מדע ים המלח והערבה בחסות אוניברסיטת בן גוריון בנגב

Dead Sea & Arava Science Center

Along the Great Rift Valley

Under the auspices of Ben-Gurion University of the Negev

Supported by the Israeli Ministry of Science and Technology
and
Megilot, Tamar, Arava, Ramon and Eilot regional councils

Science Center Research Fields

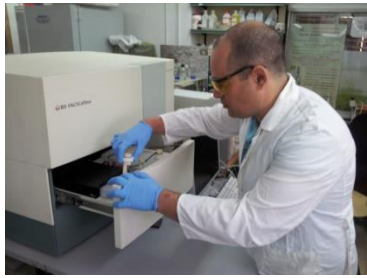
Dead Sea & Arava Science Center
מרכז מדע ים המלח והערבה
under the auspices of Ben Gurion University of the Negev
בחסות אוניברסיטת בן גוריון בנגב





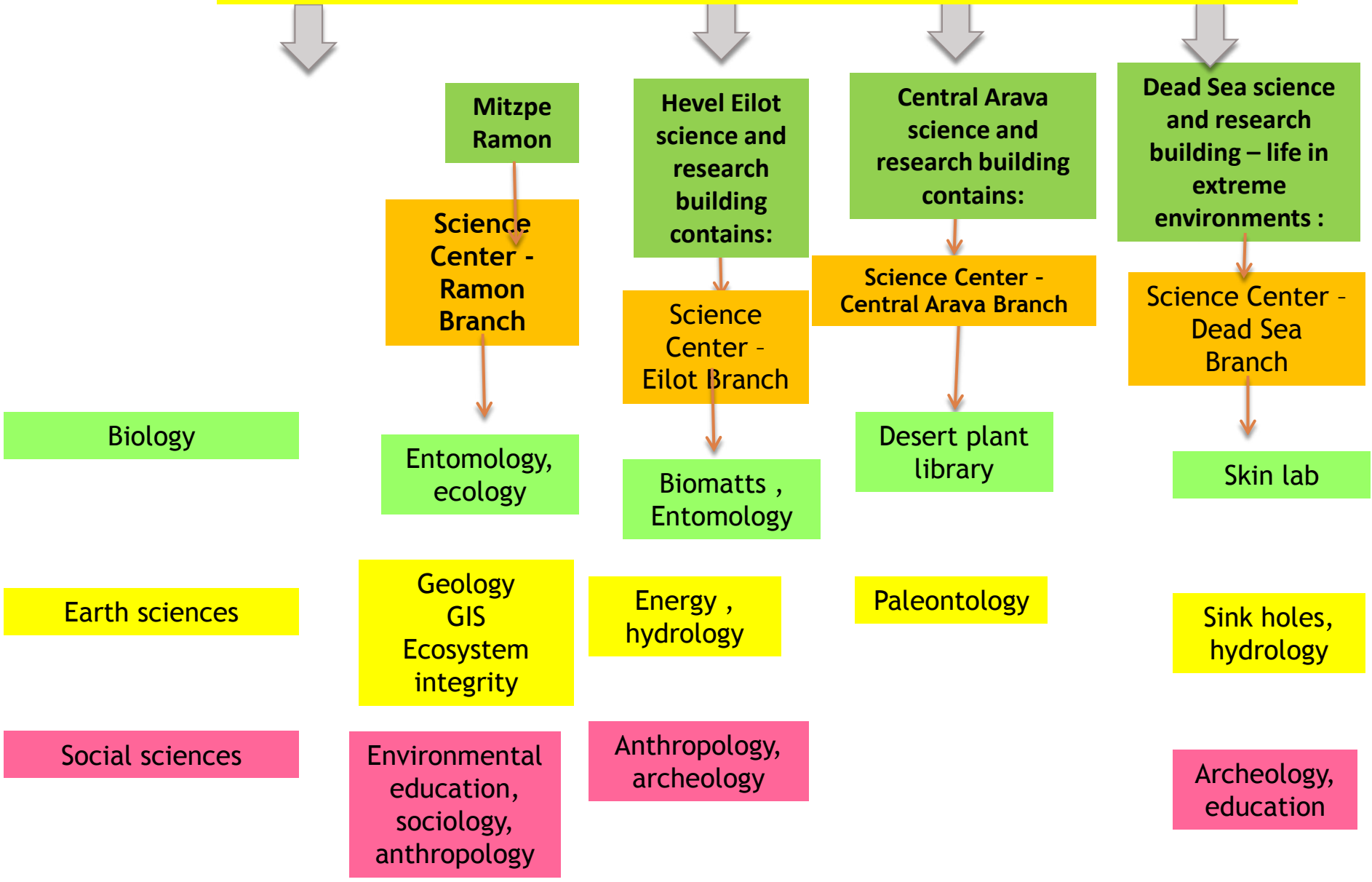




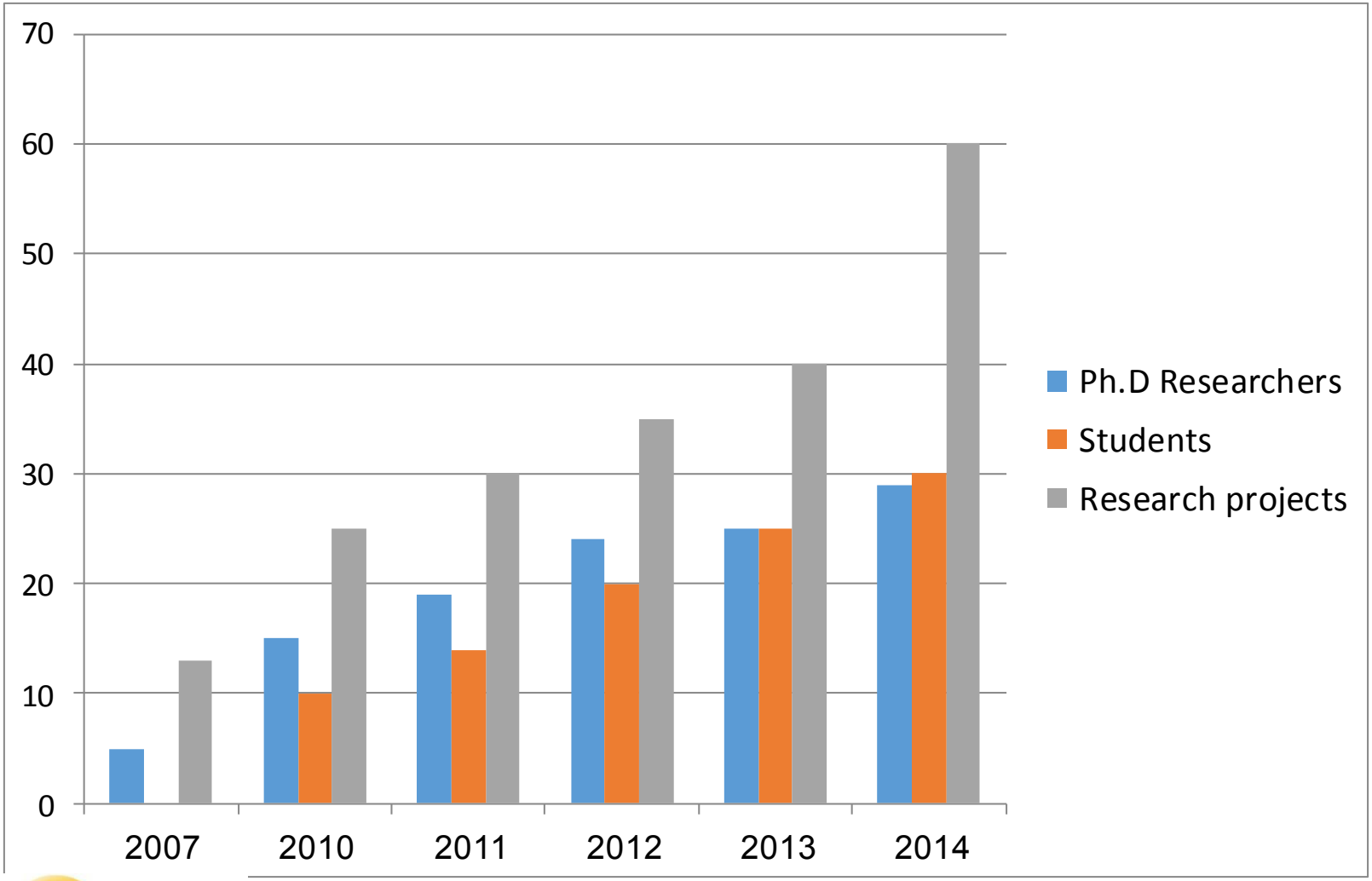





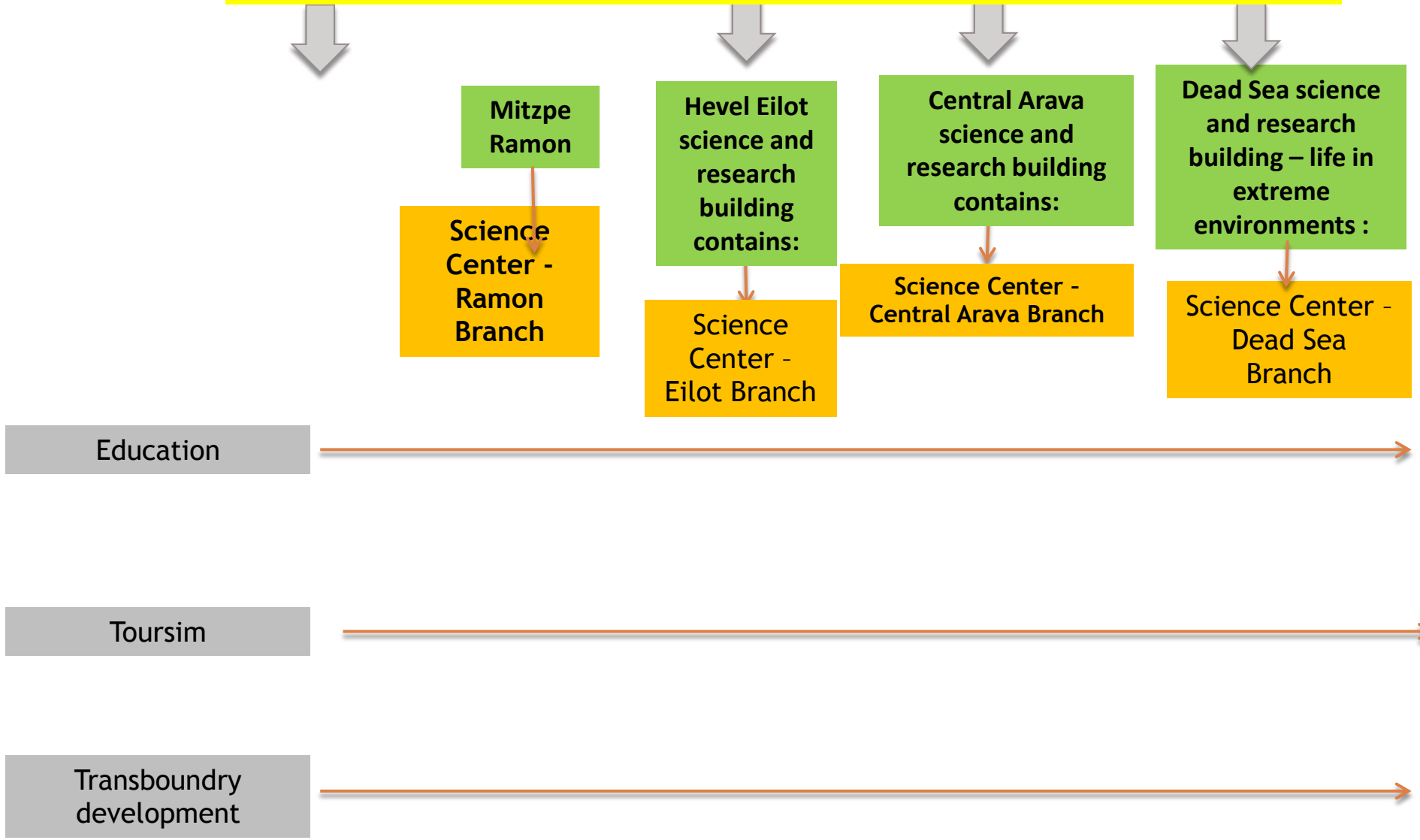

Multi Disciplinary Regional Research Center
Disciplines and branches



Researchers, research and students



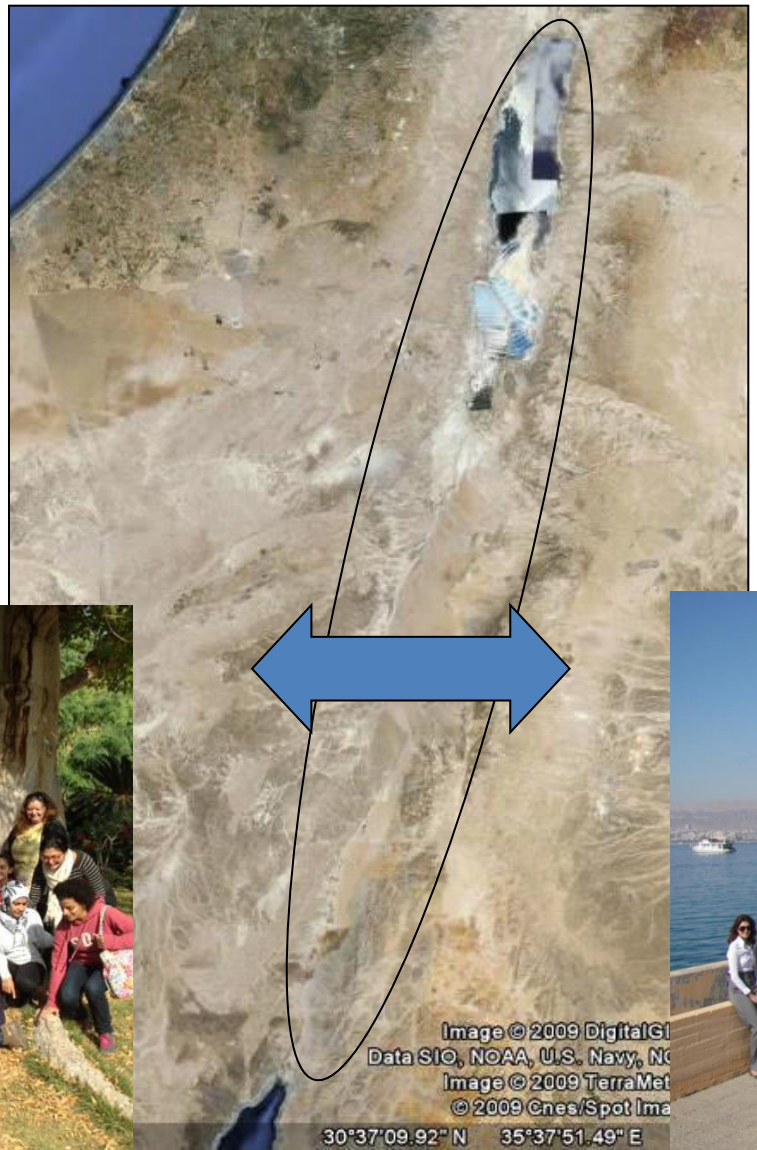
Multi Disciplinary Regional Research Center
Disciplines and branches



Collaboration with researchers from Jordan and from the Palestinian Authority

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

Israeli Platform



Jordanian Platform

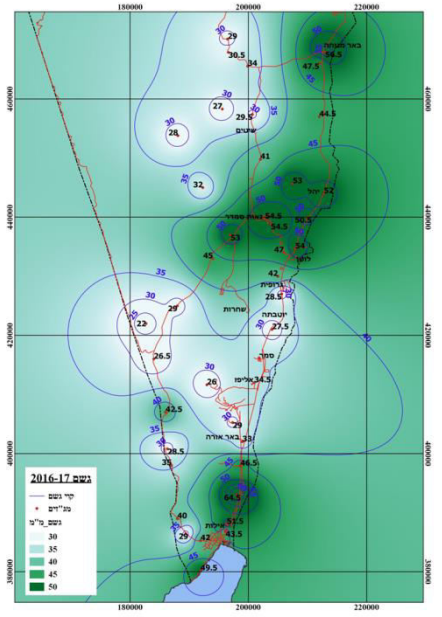
Dead Sea Branch
and the Main Office of ADSSC

Science Center Activity Centers

- Historical Routes Cathedra
- Acacia Research Center
- Instructional and teaching center for the Dead Sea, Arava and Mitzpe Ramon
- **Dead Sea & Arava Science Center**
- Computerized Information Center: Arava-Dead Sea-Mitzpe Ramon Portal
- Trans-boundary Env. Cooperation
- Scientific Literacy Unit in the community
- Educational Tourism, Special Interest Tourism

Research and monitoring

- The science center monitors several parameters which are not hypothesized driven to asses the state of the nation
- These include: floods, ecosystem health, Acacia populations, etc
- The science center also maps and surveys parameters like geology, fossils found, biomass etc

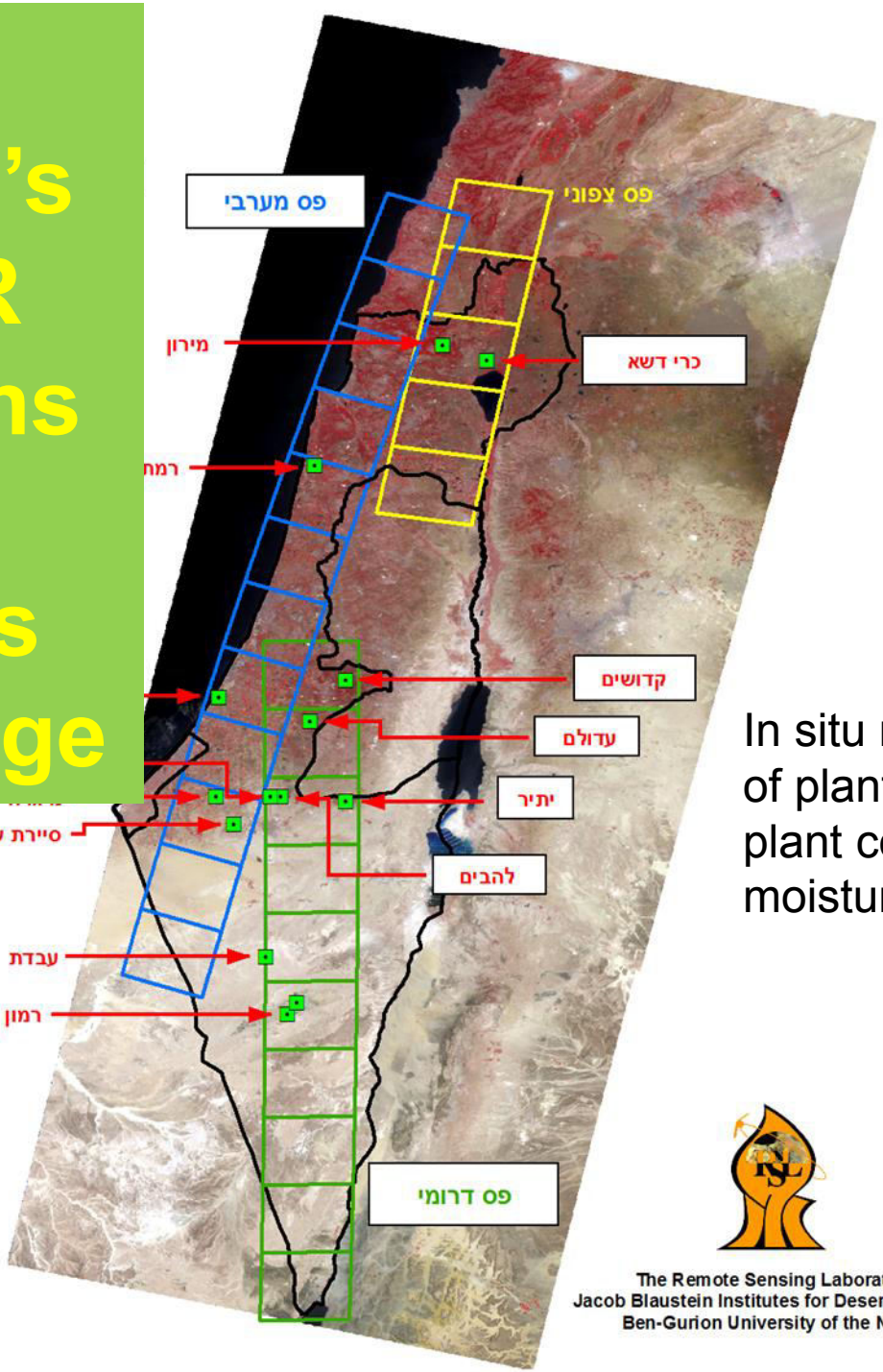


Ramat Hanadiv

Lehavim

Avdat

Israel's LTER stations and Venus coverage



Long Term Ecological Research

In situ monitoring of plant diversity, plant cover, soil moisture

The Remote Sensing Laboratory
Jacob Blaustein Institutes for Desert Research
Ben-Gurion University of the Negev

Dead Sea & Arava Science Center
under the auspices of Ben Gurion University of the Negev
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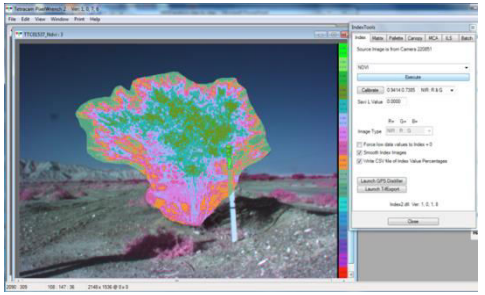
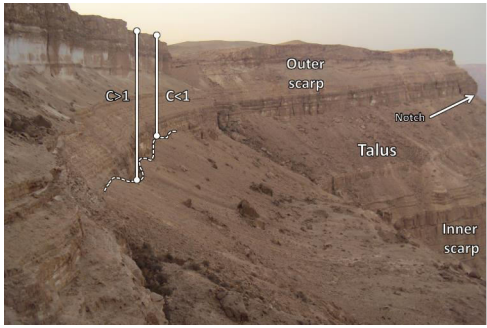
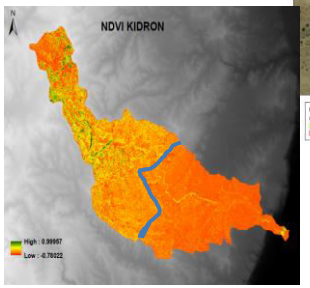
בחסות אוניברסיטת בן גוריון בנגב

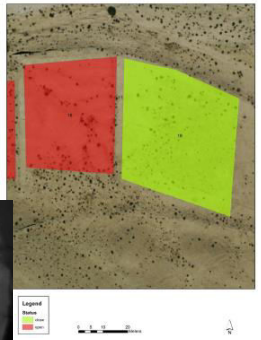
Remote sensing activities at the science center



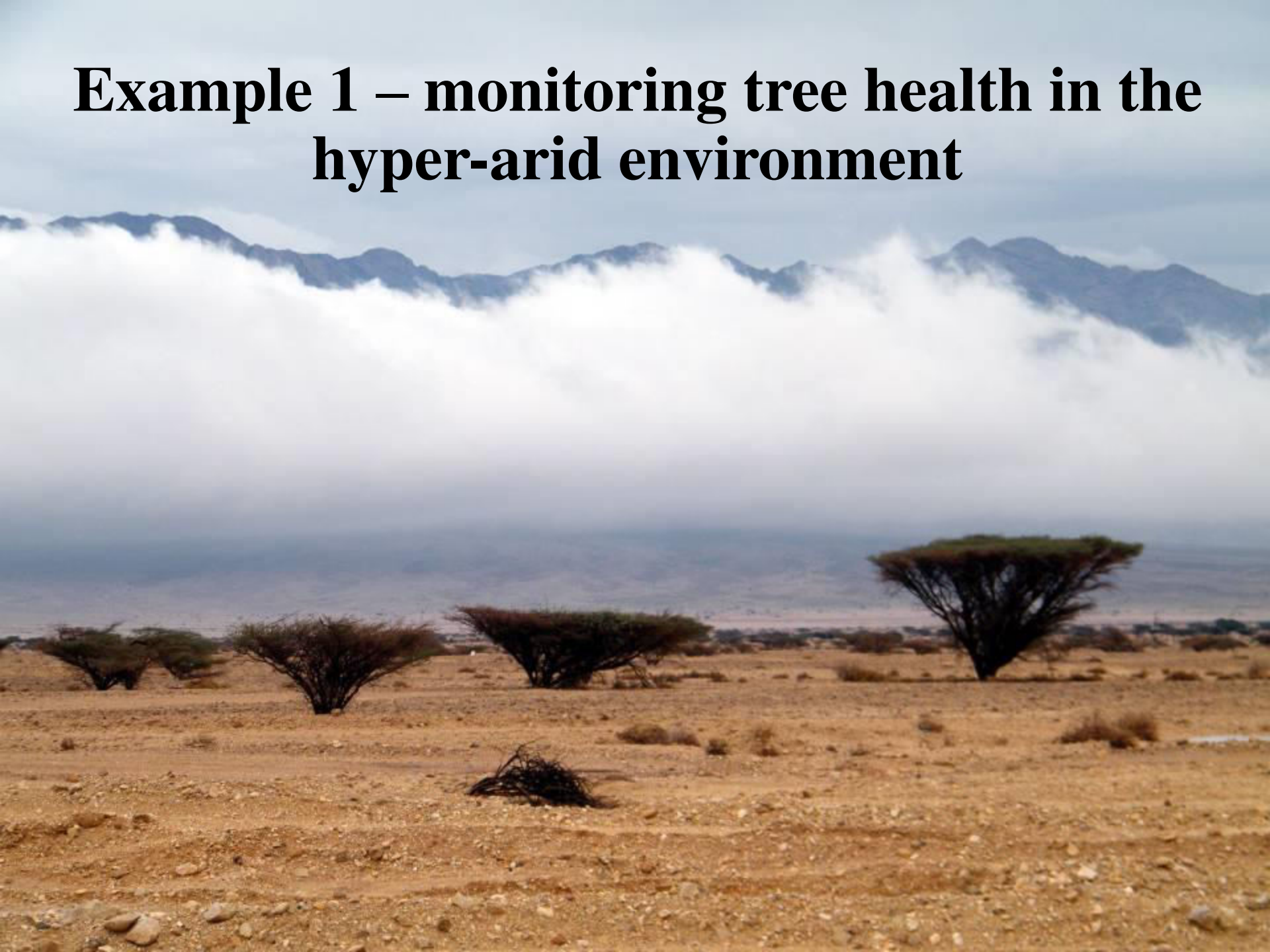
1. Using NDVI and RGB to asses Acacia tree size and health
2. Using LIDAR to map trees in cities
3. Using photo aerials to map shrubs studying pattern formation
4. Usign GIS layers of topography to calculate cliff retreat.
5. Mapping the hyper-order border



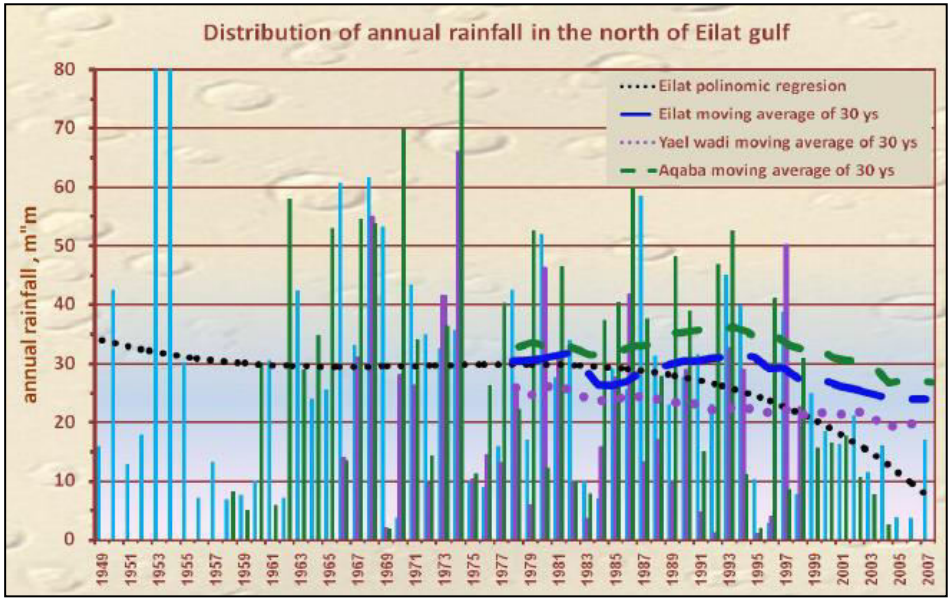




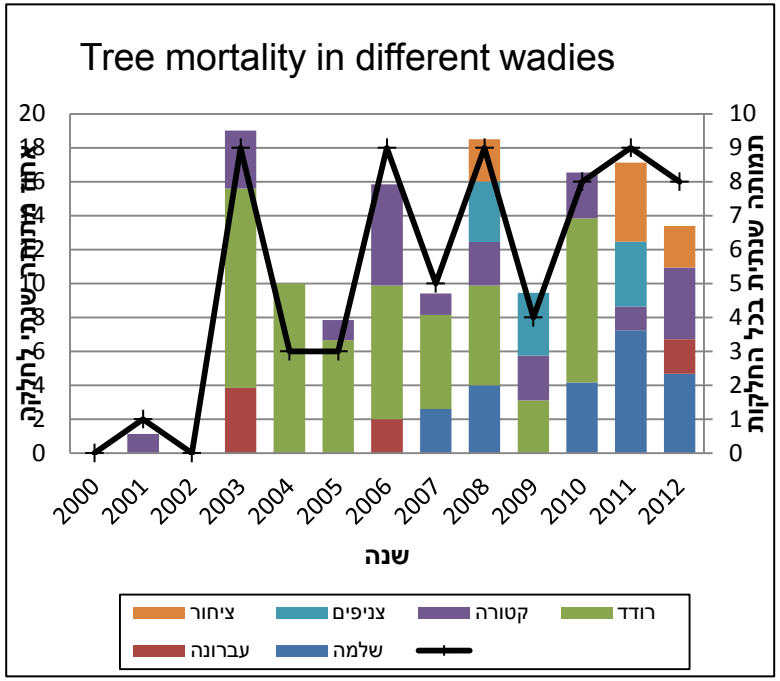
Example 1 – monitoring tree health in the hyper-arid environment



Climate change is being suspected to cause a population decline in trees



Ginat and Shlomi 2011



Shalmon and Issacson . 2014

Collaboration with Sivan Issacson, Michael Sprinsin, Tamir Klein,

Collaboration LTERM

BGU

DSASC

Jordan LTER

INPA

KKL

MAARAG

Gidron
Idan
Sheizaf
Zeelim

Every year

Fedan
Quaraqira
Abu Kshoibeh
Qatar

2013

South Arava
7 sties

Every year

North Arava

Started 2014 every year

Wadi shita

New, every season

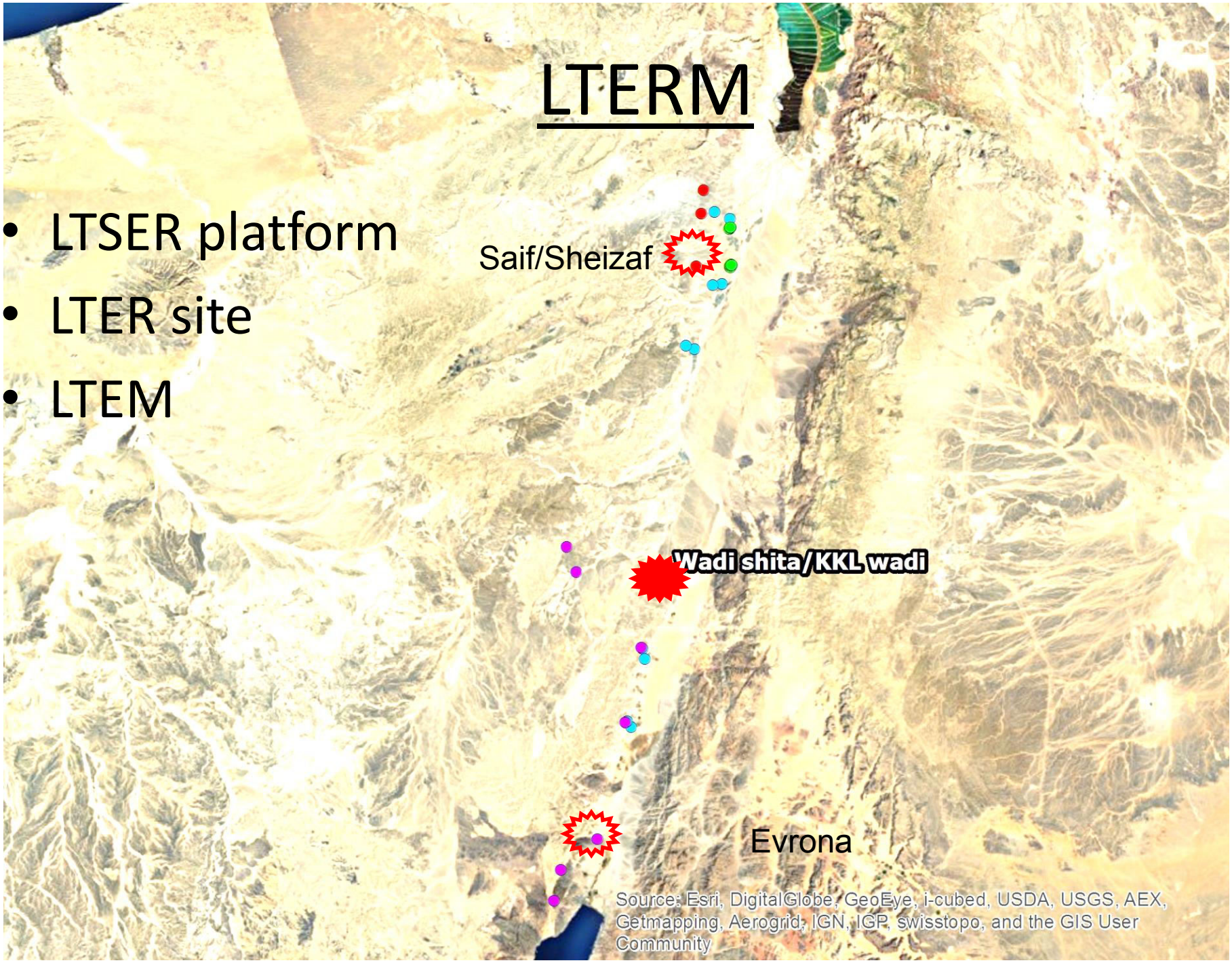
5 pairs

2013

Evrona
Ashalim

LTERM

- LTSER platform
- LTER site
- LTEM

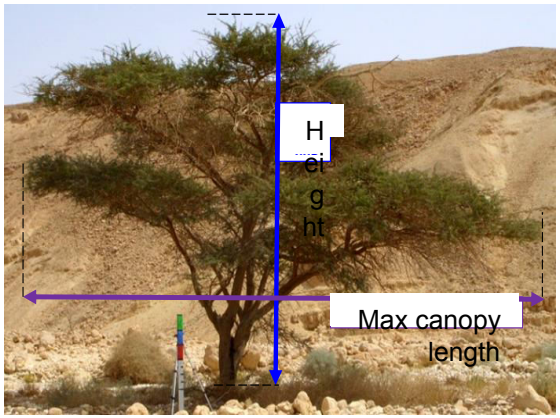


- tress status
- DBH
- tree height
- % leaves
- “greenes”
- available leaves
- Mistletoe
- Flowers
- Fruits

The old method

The “Benny” way

Size

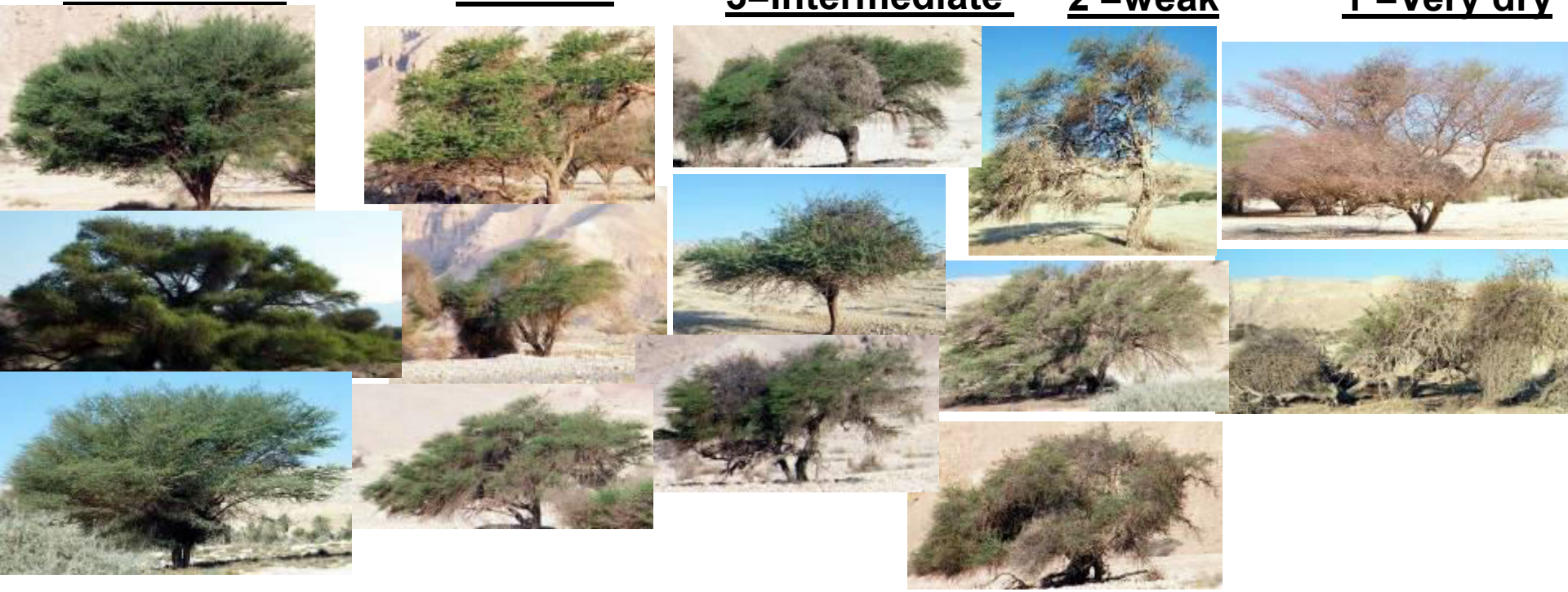


Health

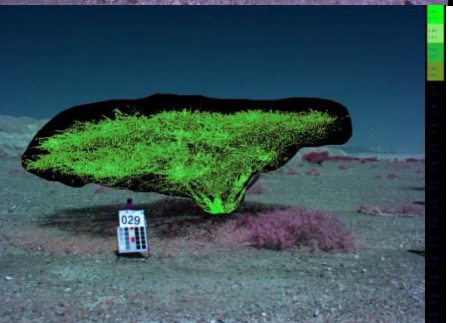
Foliage

- % leaves - the percentage of tree covered with leaves. This is calculated as a subjective measure of what % of what could be green is actually green: 0- no leaves, 1- less than 20% is covered, 2- upto 50% is covered, 3- more than 50% is covered, 4- more than 80% is covered, 5- all the tree is covered, around 100%

5 =excellent **4 =Good** **3=Intermediate** **2 =weak** **1 =Very dry**

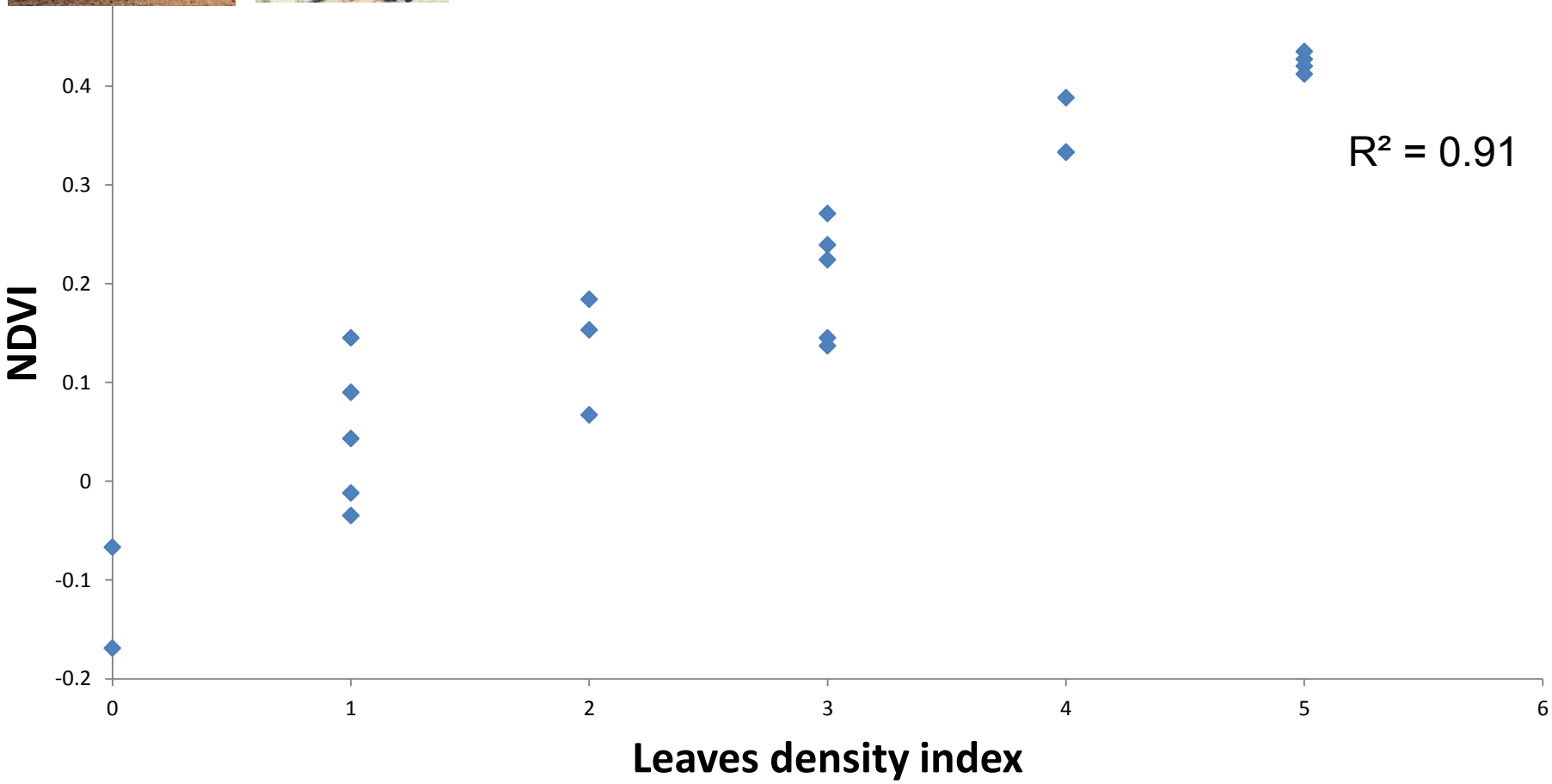


Measuring NDVI



The level of NDVI is an indicator of the productivity of the tree (how green it is) hence its health

NDVI and eye estimation of tree leaves



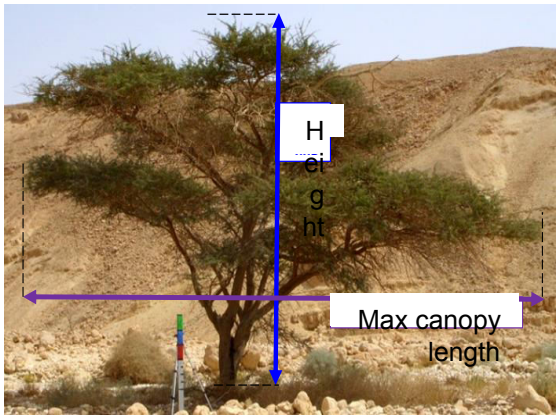
- tress status
- DBH
- tree height
- % leaves
- “greenes”
- available leaves
- Mistletoe
- Flowers
- Fruits

Replacing the old method with a new one without disturbing the LTEM the overlap years

The “Benny” way

The new way

Size



Health

Growing

Healthy

0.2

NDVI

0.15

Good history but bad healthy

Young

0.1

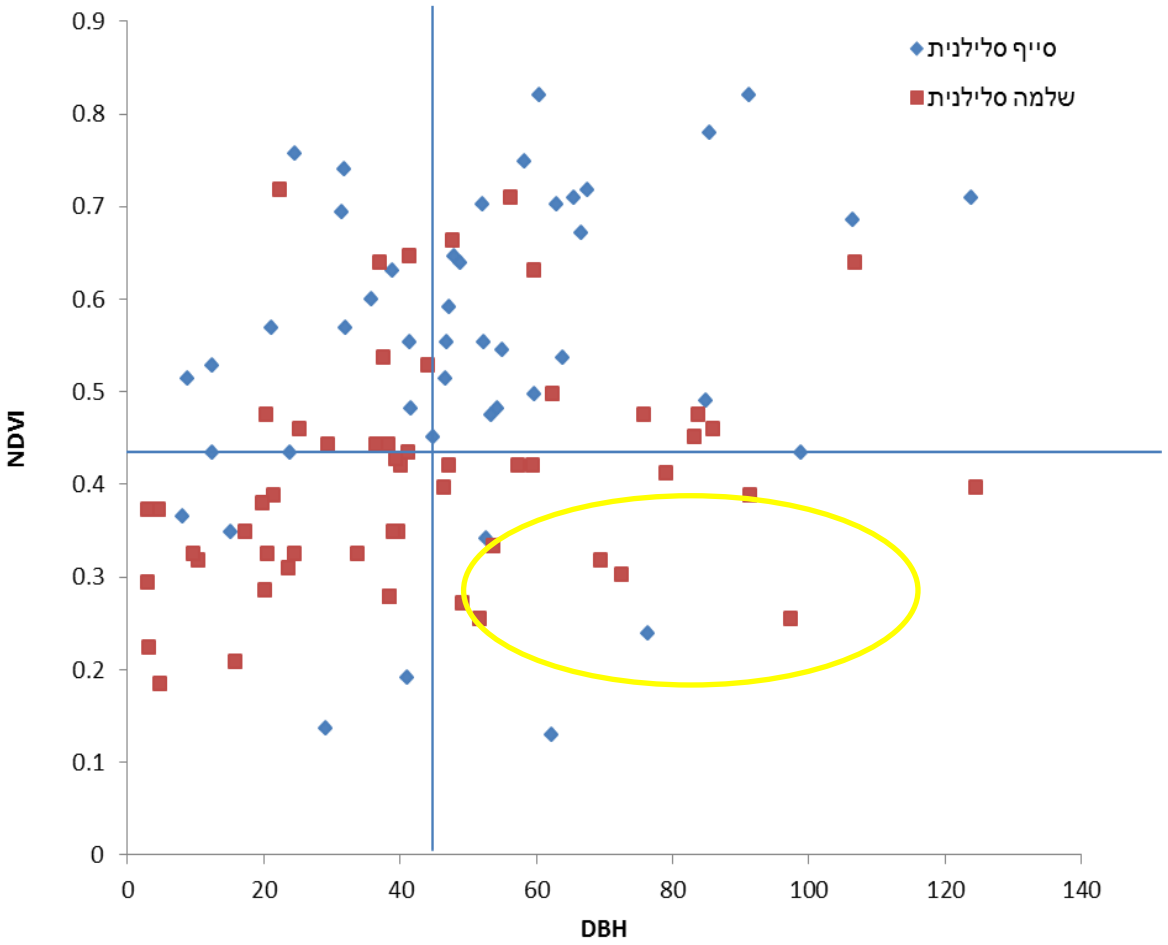
0

0 5 10 15 20 25 30 35 40

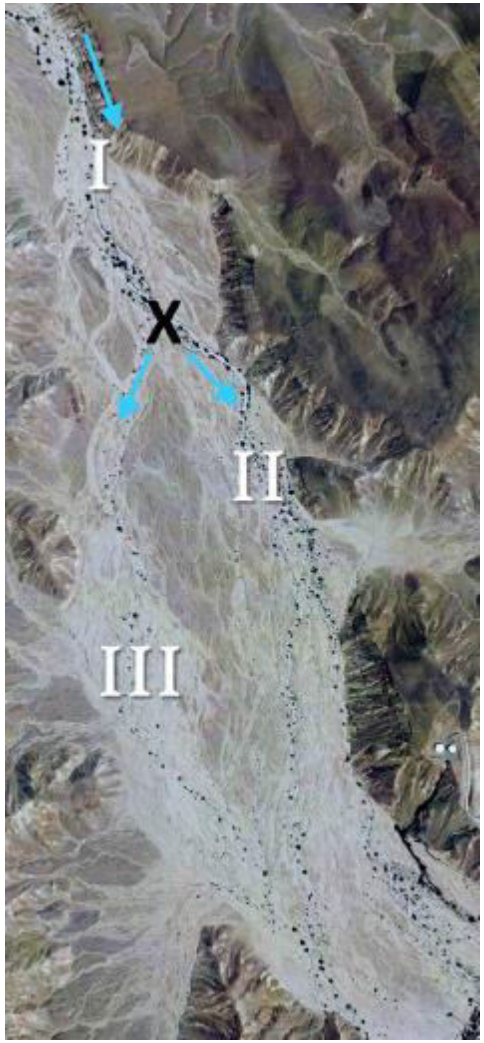
DBH cm

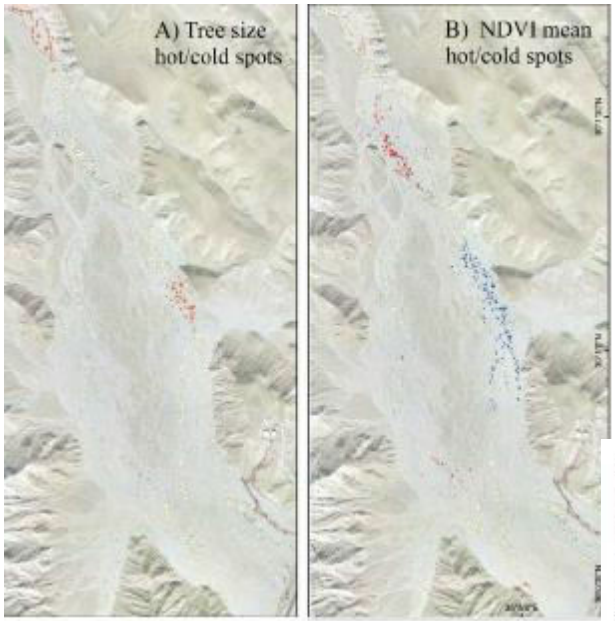
History

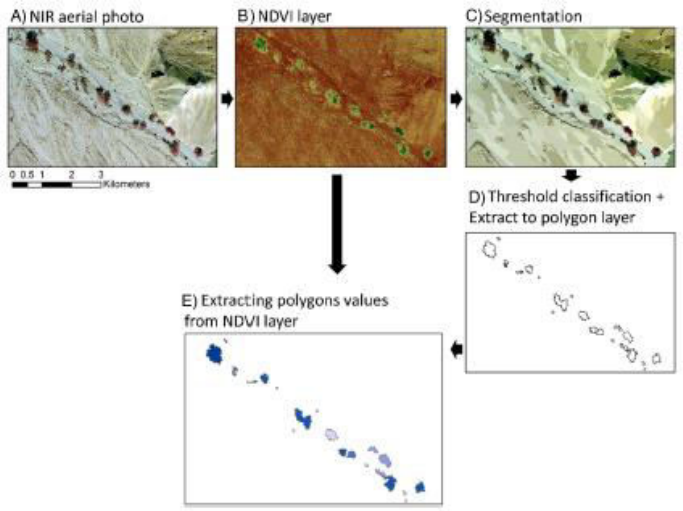
Tree health state



Moving from hand camera NIR to satellite NIR



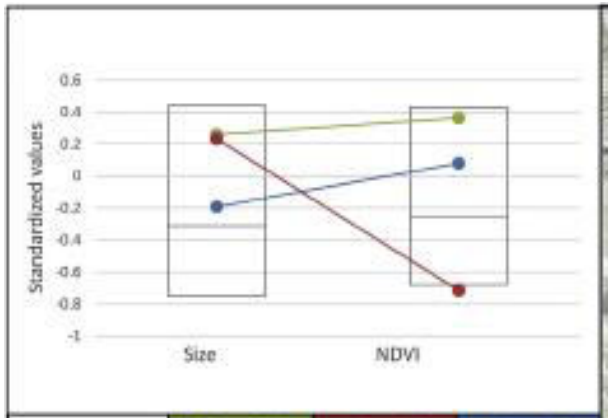




Long and short term population dynamics of acacia trees via remote sensing and spatial analysis: Case study in the southern Negev Desert

S. Isaacson [a,*], J.E. Ephrath [b], S. Rachmilevitch [b], S. Maman [d], H. Ginat [c], D.G. Blumberg [a]

Moving from hand camera NIR to satellite NIR



	Group 1: main channel before splitting	Group 2: main channel after splitting	Group 3: braided channels
Mean canopy Size (m^2)	29.3	28.7	19.3
Mean NDVI Value (stretched)	132	126.3	130.5
Mean Distance to Nearest neighbor (m)	7.3	7.7	12
Mortality % (accumulative)	21	75	60

Long and short term population dynamics of acacia trees via remote sensing and spatial analysis: Case study in the southern Negev Desert

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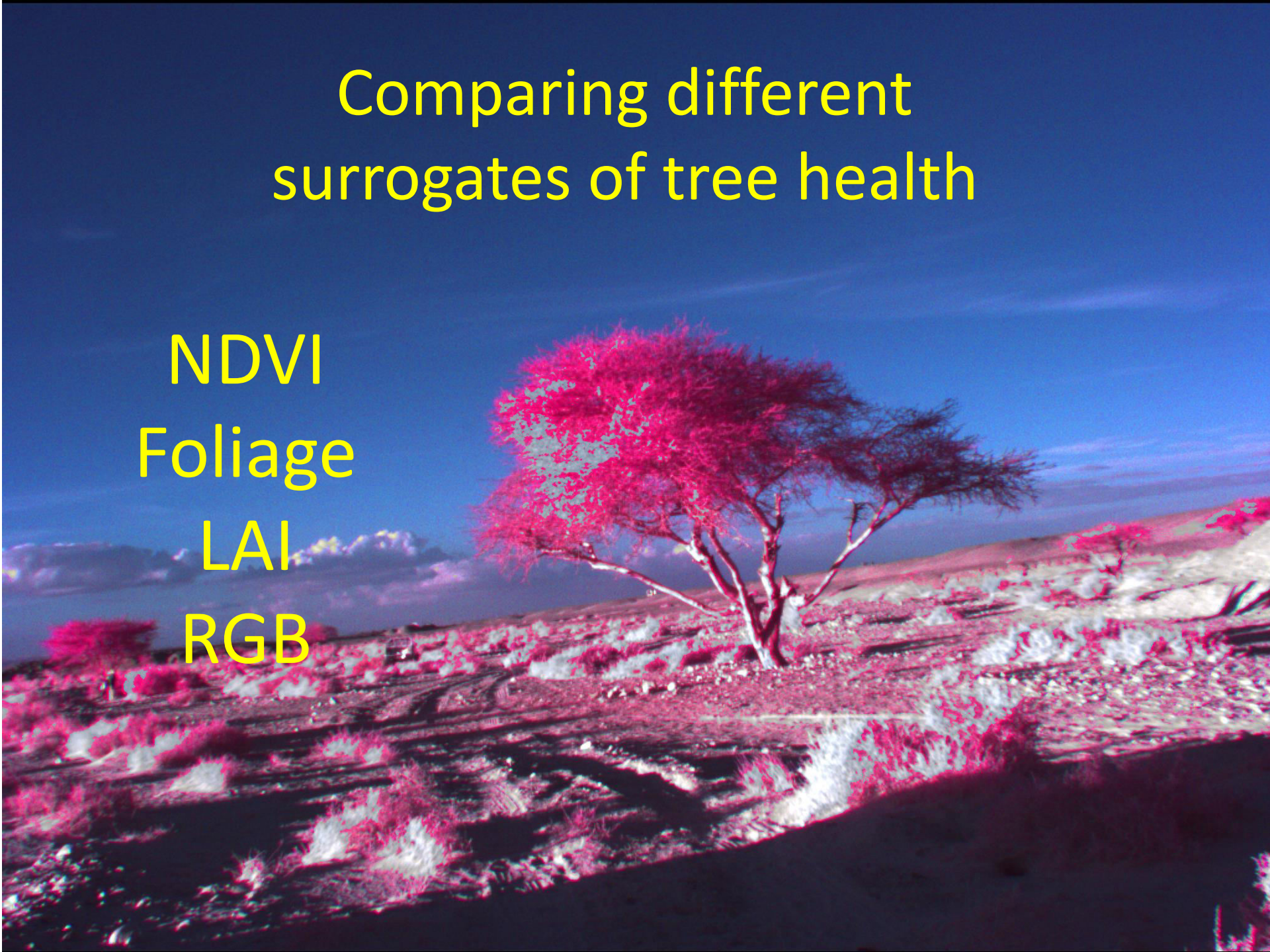

Comparing different surrogates of tree health
NDVI
Foliage
LAI
RGB

LAI device

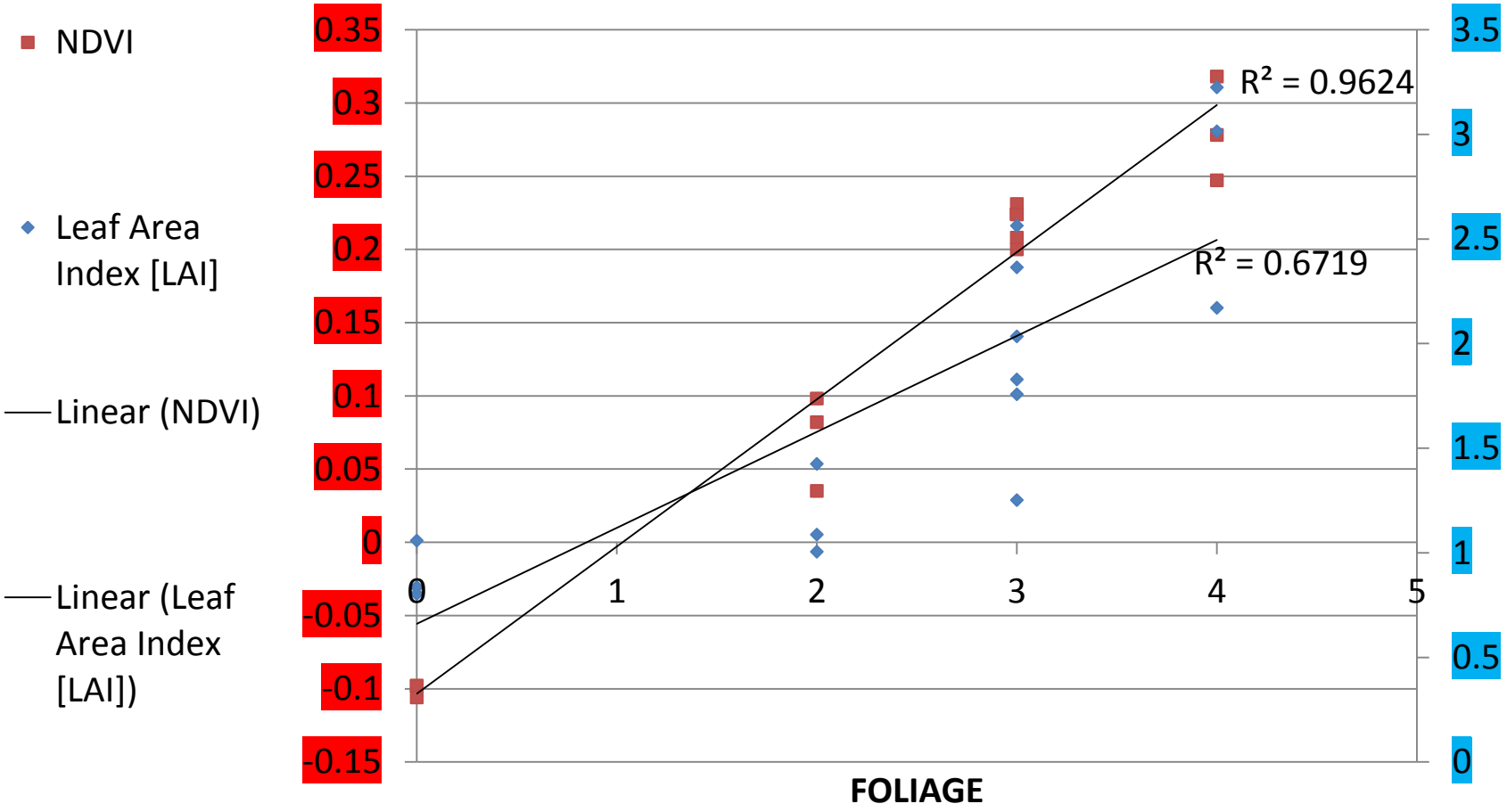
- Decagon AccuPAR Ceptometer LP-80

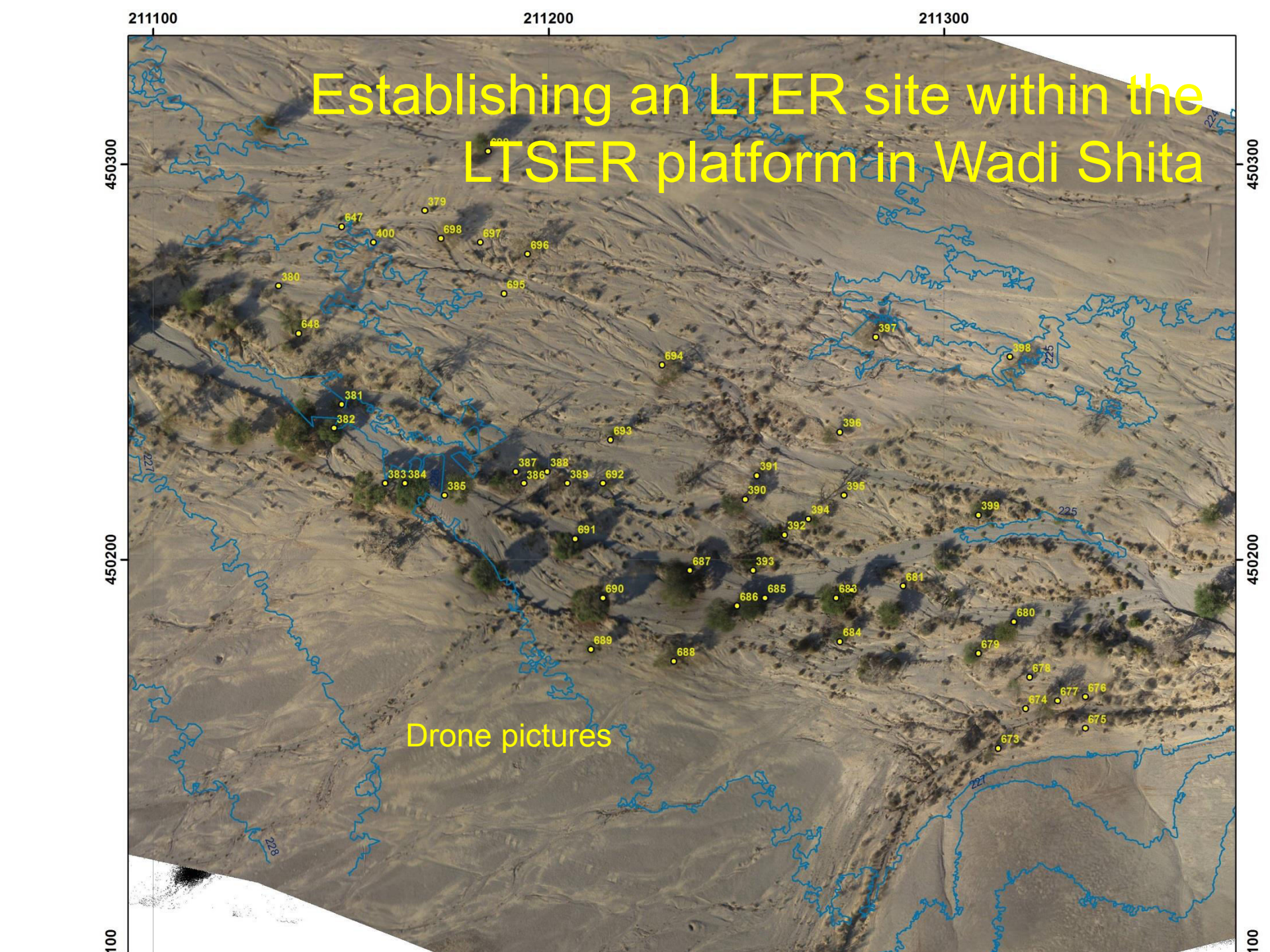
Measuring LAI

Above canopy

Below canopy

LAI and NDVI with foliage (greenness)




Establishing an LTER site within the LTSER platform in Wadi Shita
Drone pictures
211100
211200
211300
450300
450200
450100
379
647
400
698
697
696
380
695
648
694
397
398
381
382
693
396
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681
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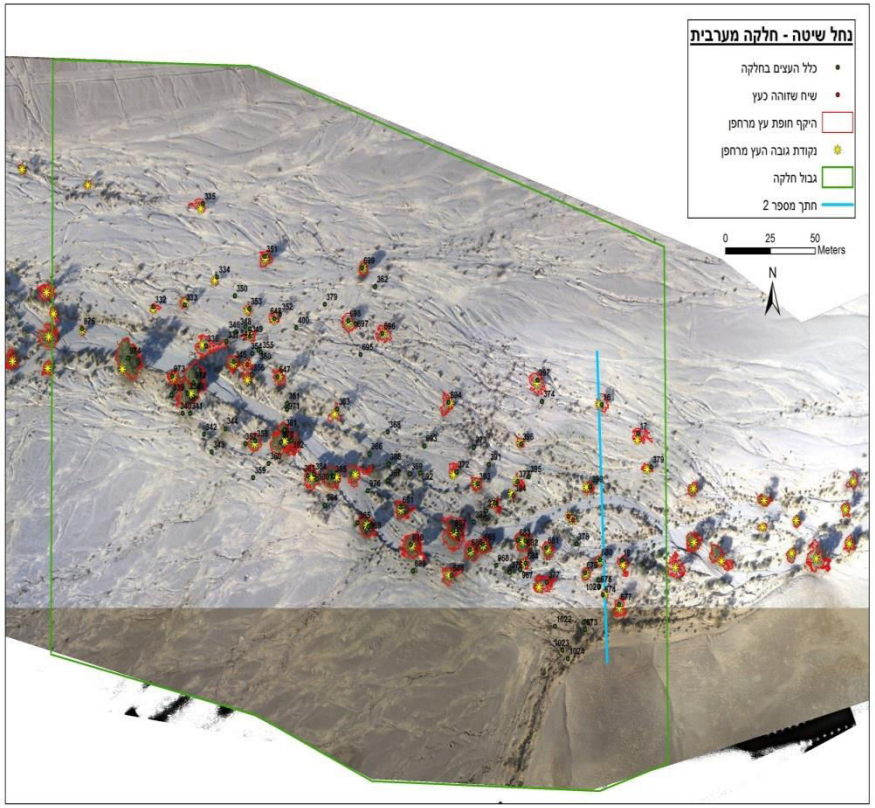
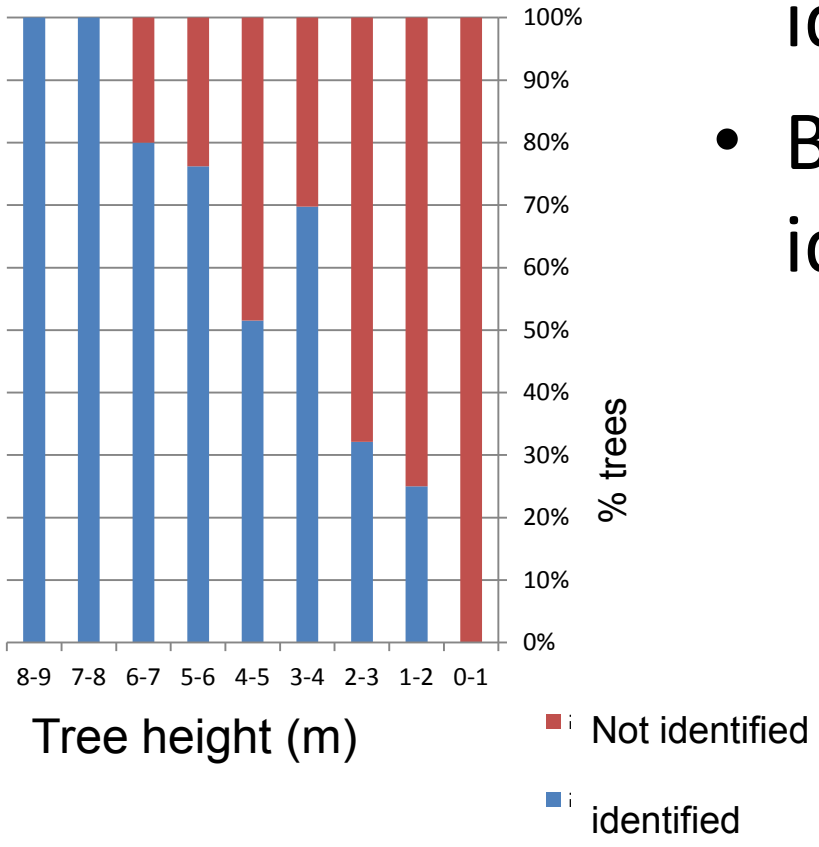
674
675
673
227
228
225

Using a drone to estimate tree size and health in Wadi Shita

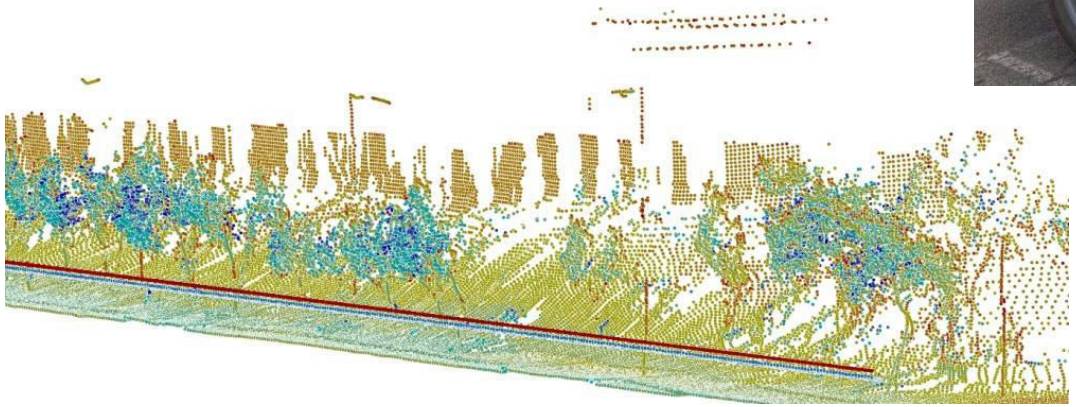


Validation of tree presence



- Above 5 m tall trees, identification is 75%
- Below 3 m tall identification is 27%.

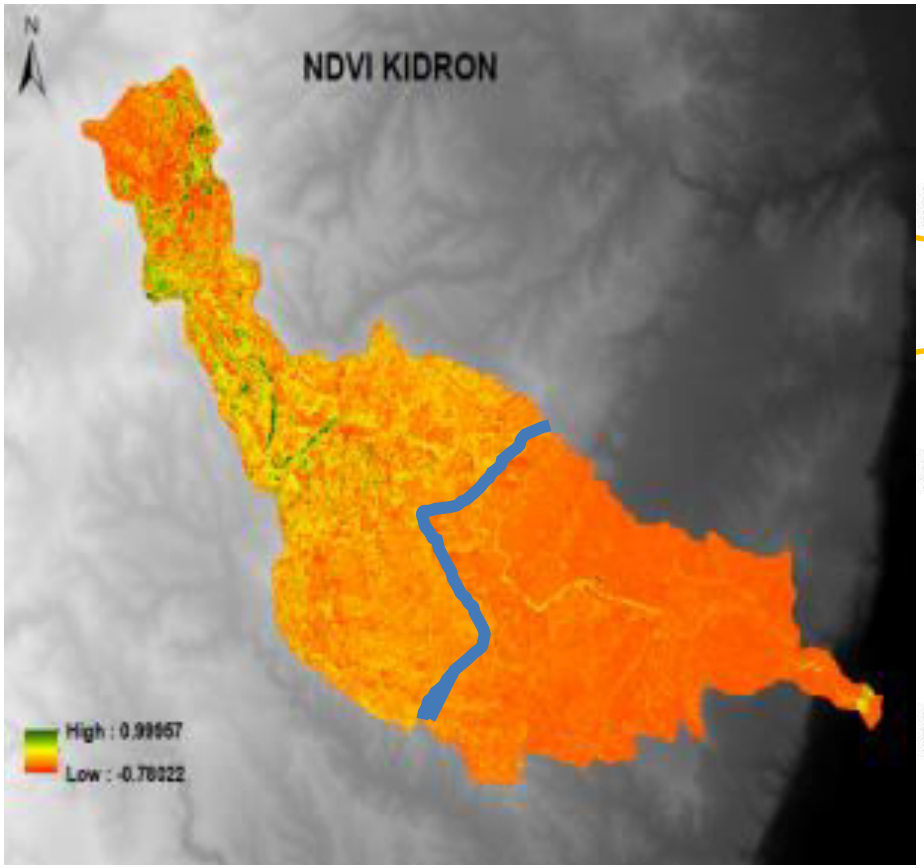
Using LIDAR to produce 3 D map of trees in cities

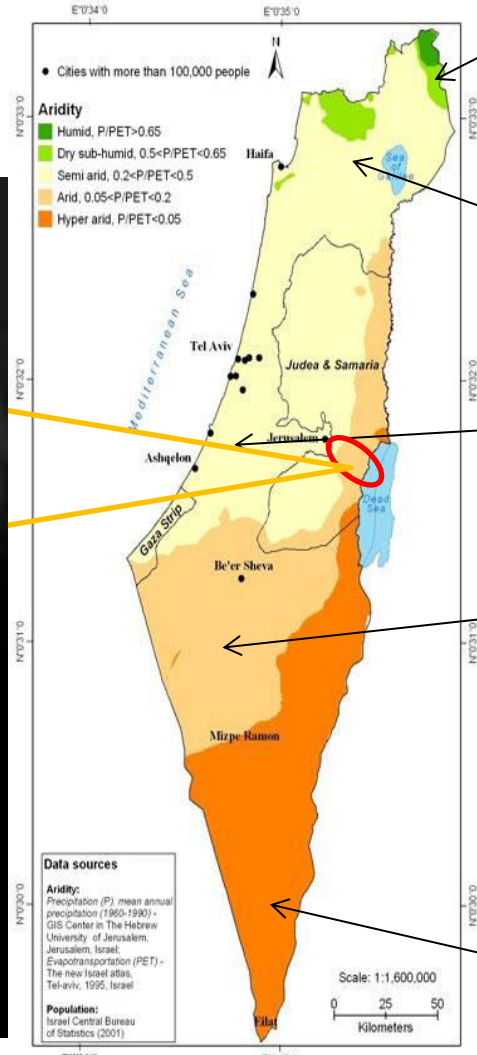


Dr Aviva Peeters

TerraVisionLab

Mapping the hyper-arid border using NDVI

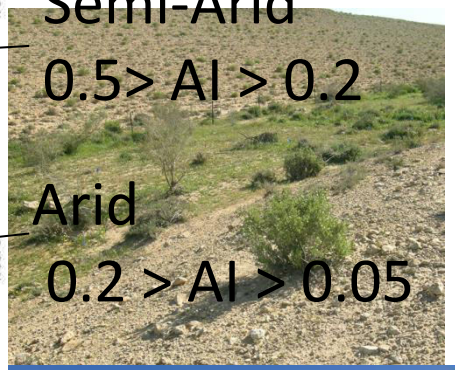




Humid
AI >0.65

Sub-Humid
0.65>AI >0.5

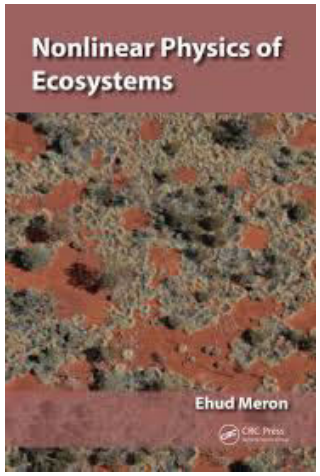
Semi-Arid
0.5> AI > 0.2

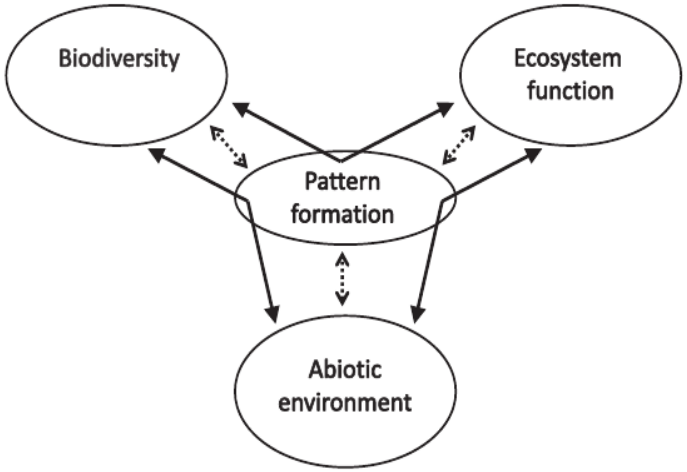


Arid
0.2 > AI > 0.05

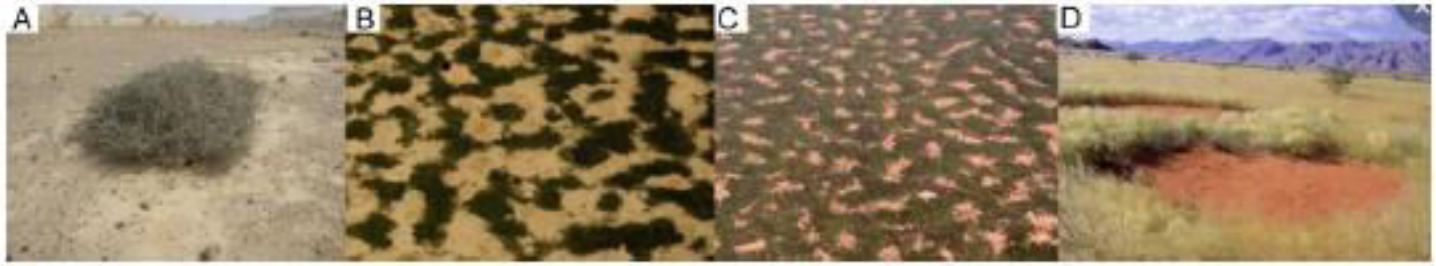
Hyper-Arid
0.05 > AI

Landscape integrity

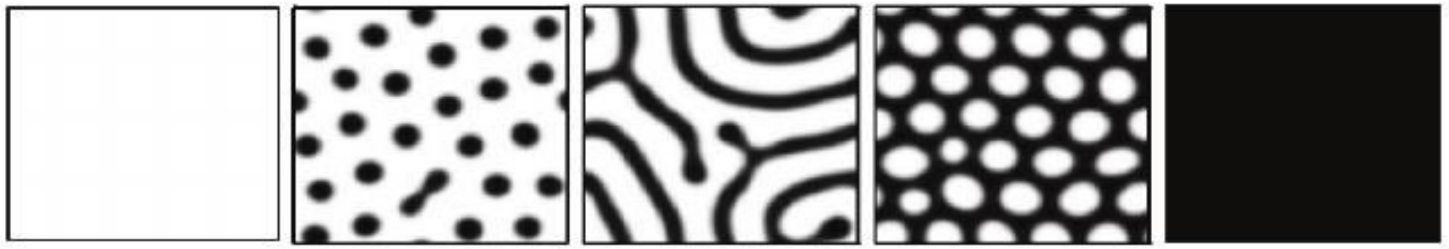




Competition for water creates organized distributions



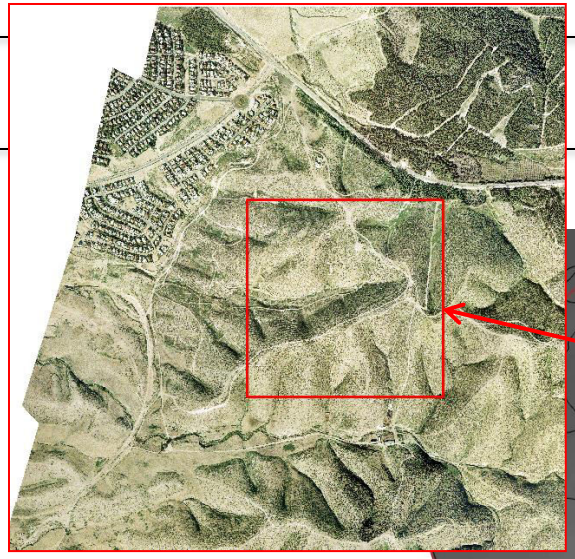
bare soil spot pattern stripe pattern gap pattern uniform veg.



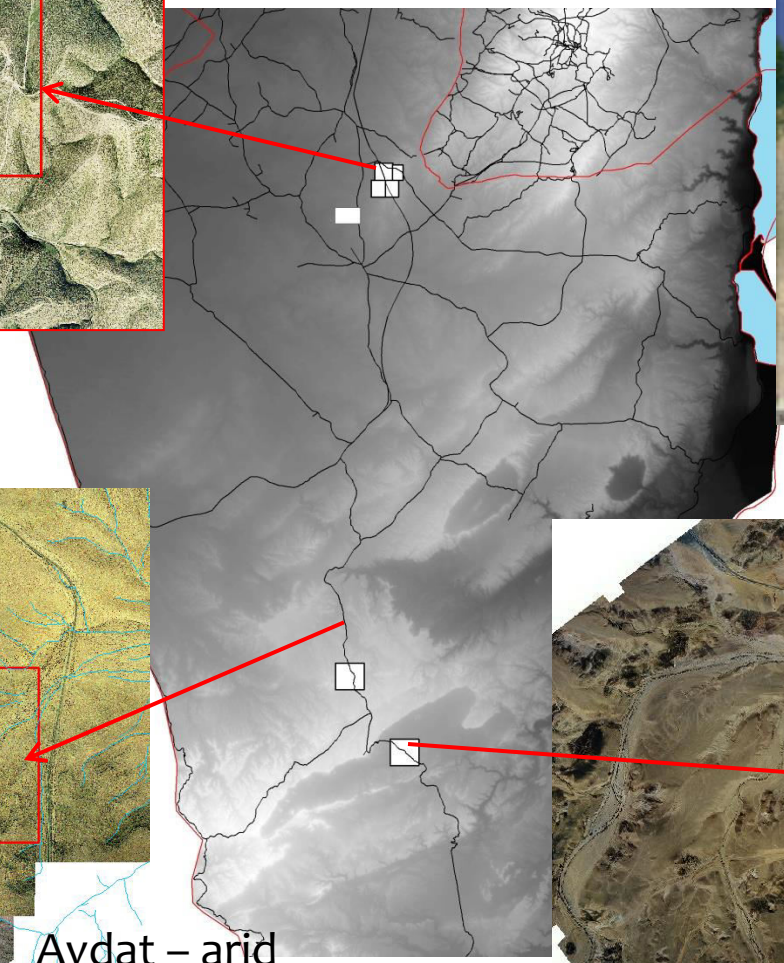
precipitation

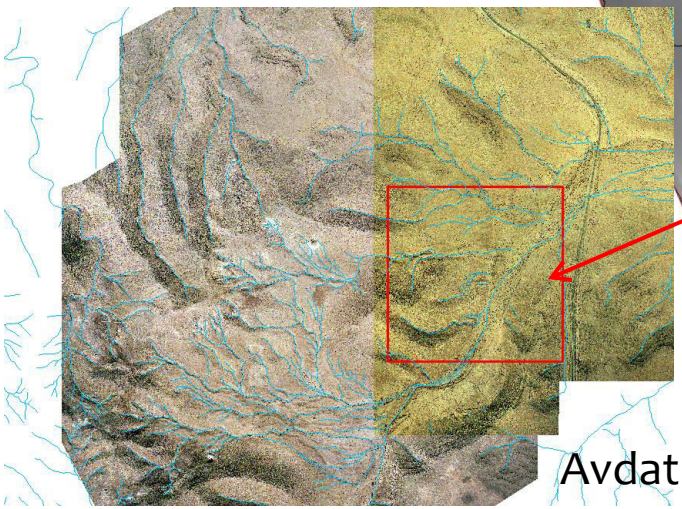
Meron 2005

3Case studies

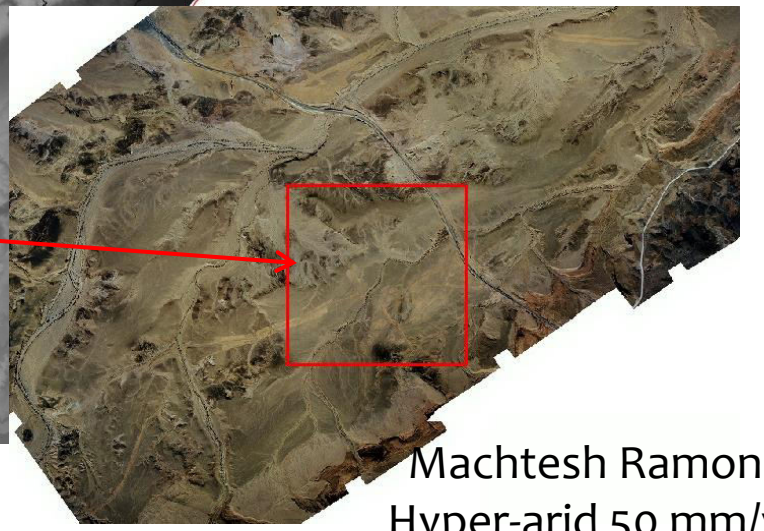


Lehavim – semi-arid
200 mm/y





Avdat – arid
90 mm/y

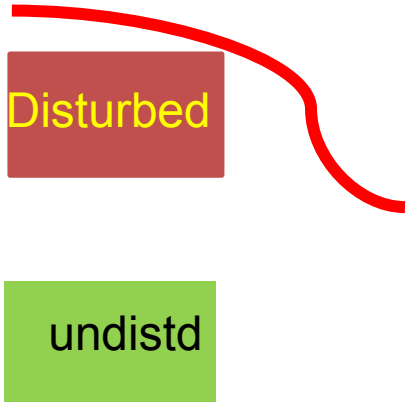


Machtesh Ramon
Hyper-arid 50 mm/y

Experimental setup

Human disturbance → Water distribution → Community I, Ecosystem I, Landscape I

Lehavim

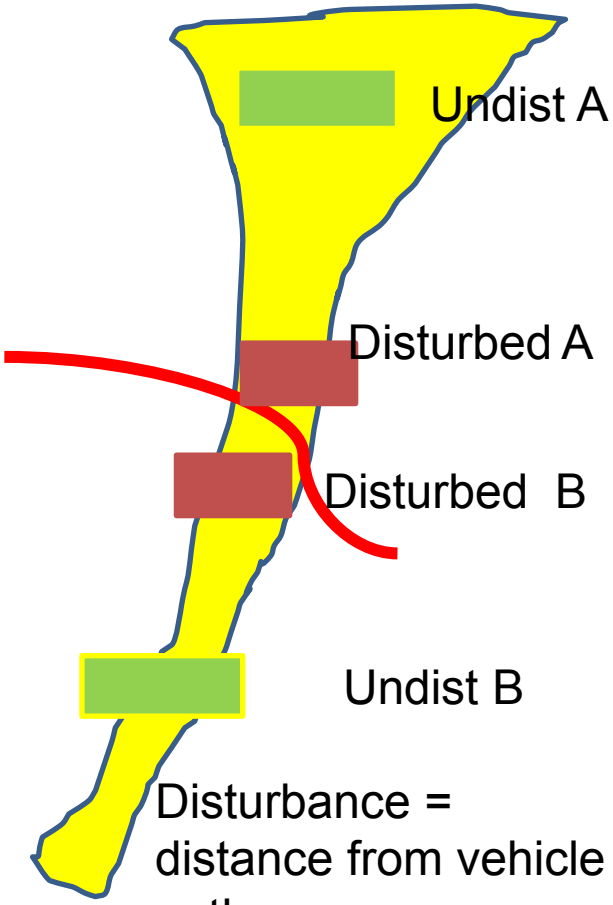


Disturbance = distance from vehicle path

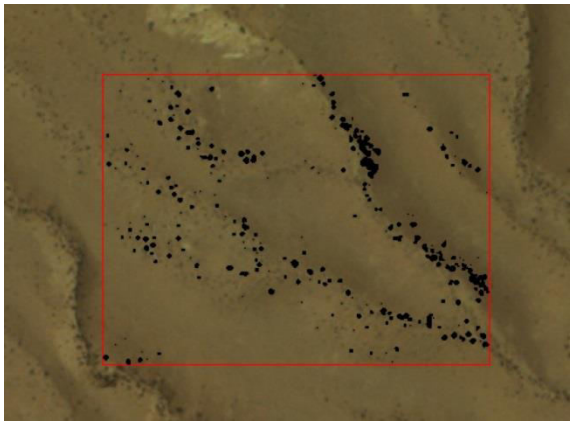
Avdat

Disturbance = broken incomplete terraces

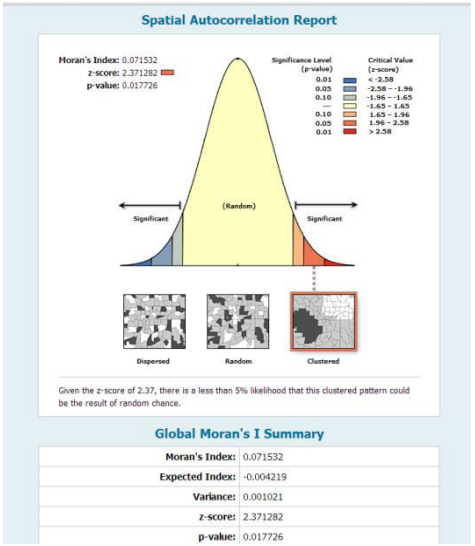
Ramon

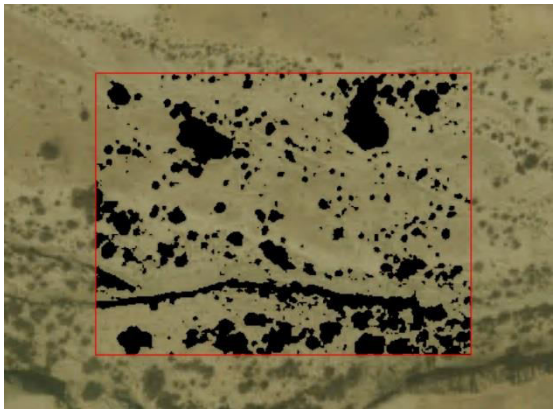


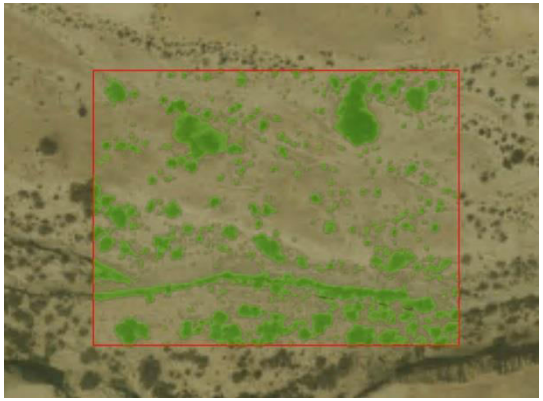
Disturbance = distance from vehicle



A moran I index was adopted to assess pattern formation







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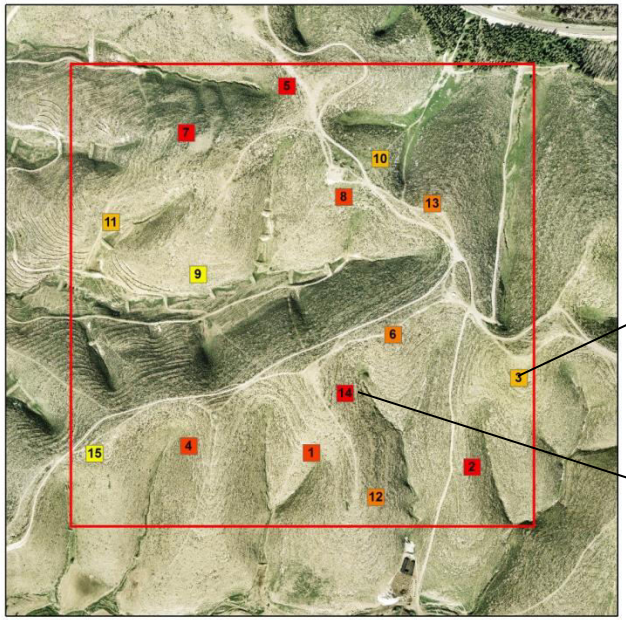
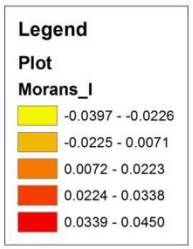
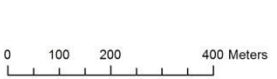
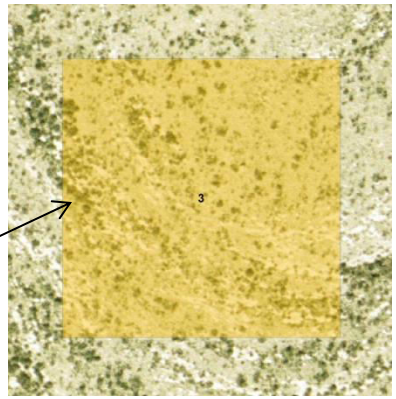
Quantifying autocorrelation using the Global Moran's *I* statistic

- Study plots of 1000 m² in Lehavim symbolized by their extent of clustering i.e. value of Moran's I statistic

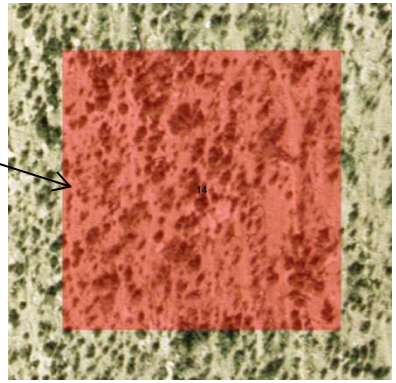








Plot with lower Moran's *I* value (disturbed)



Plot with higher Moran's *I* value

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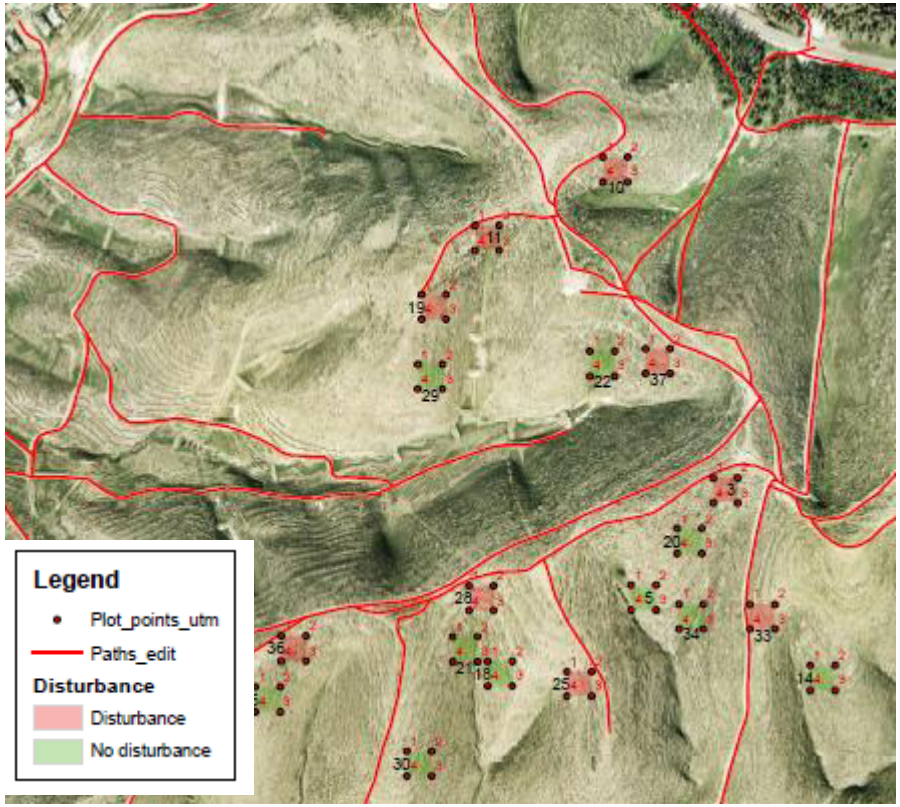
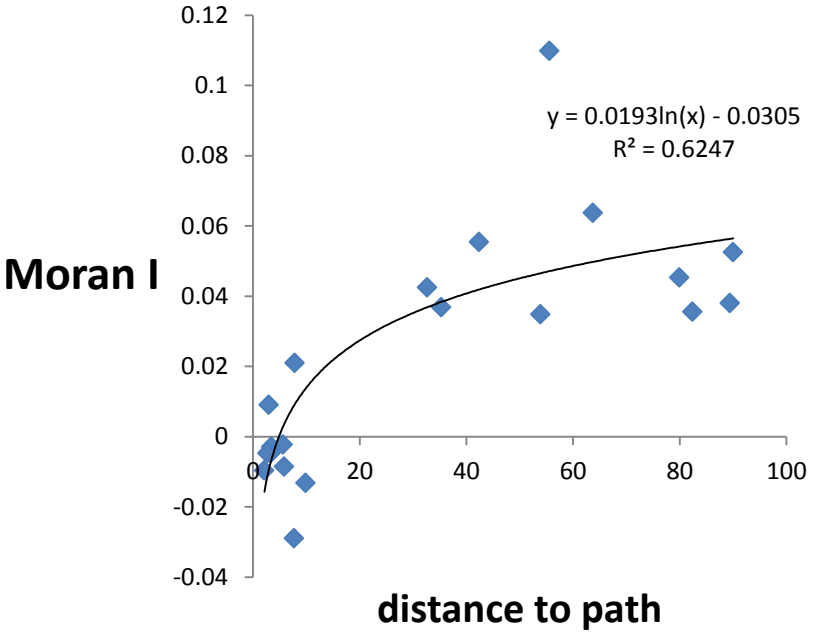


The impact of off-road vehicle paths on water flow and ecological integrity

Dr Aviva Peeters

Developing landscape integrity

- Using a GIS tool called Moran I as an indicator of pattern formation
- Measuring Moran I versus distance from disturbance



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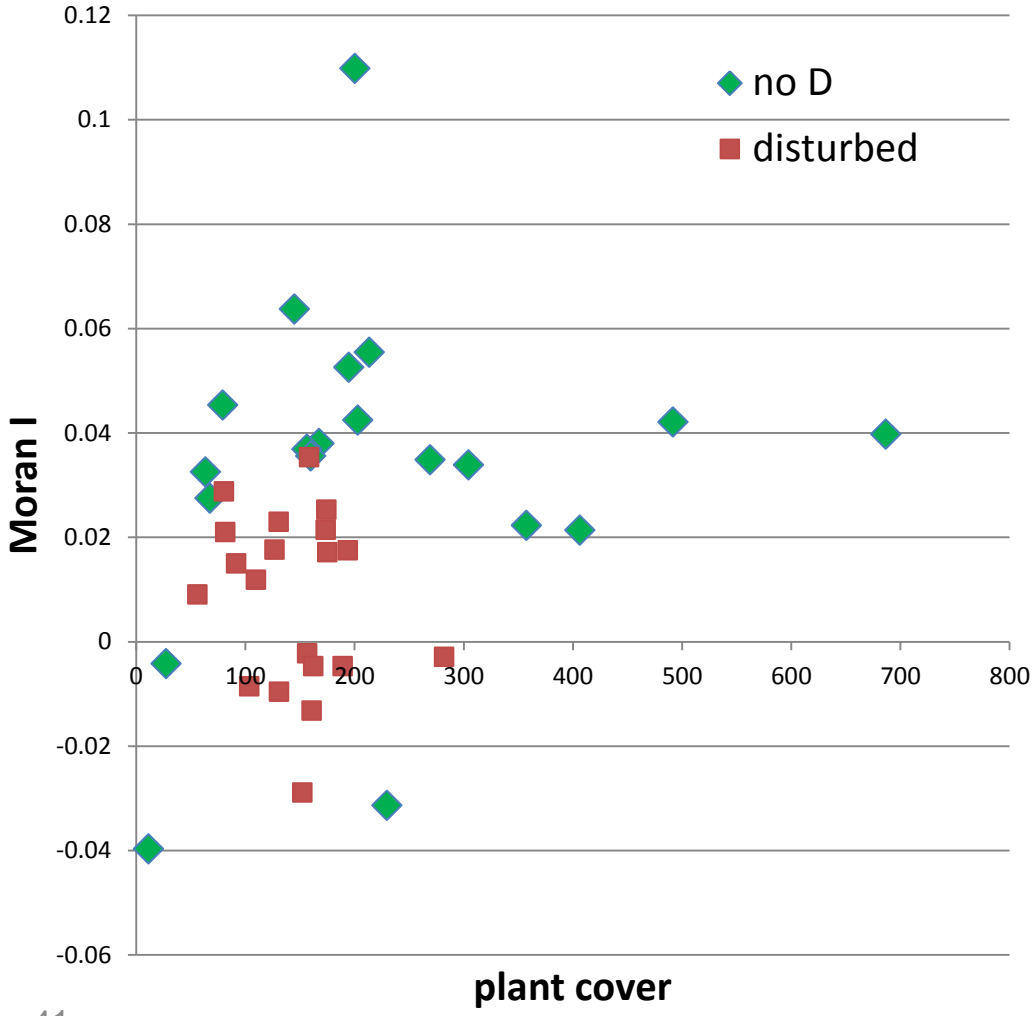
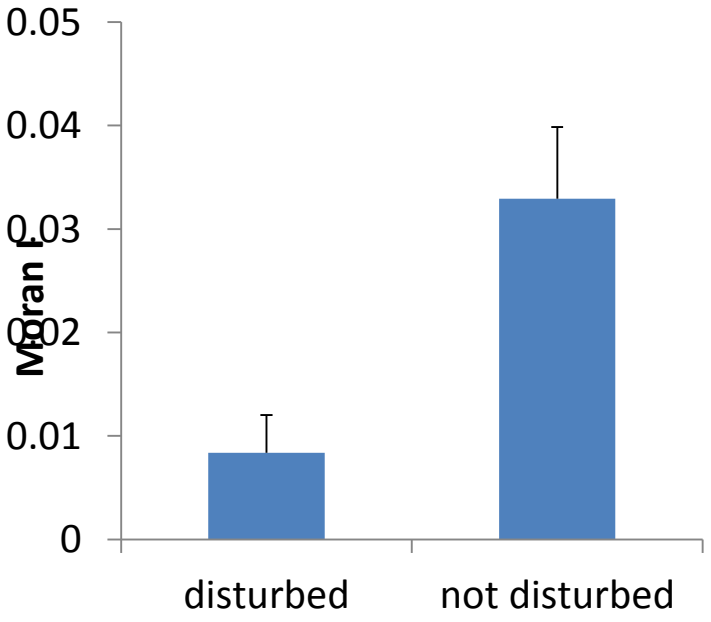
Landscape Integrity

Disturbance reduces landscape self-organisation in Lehavim



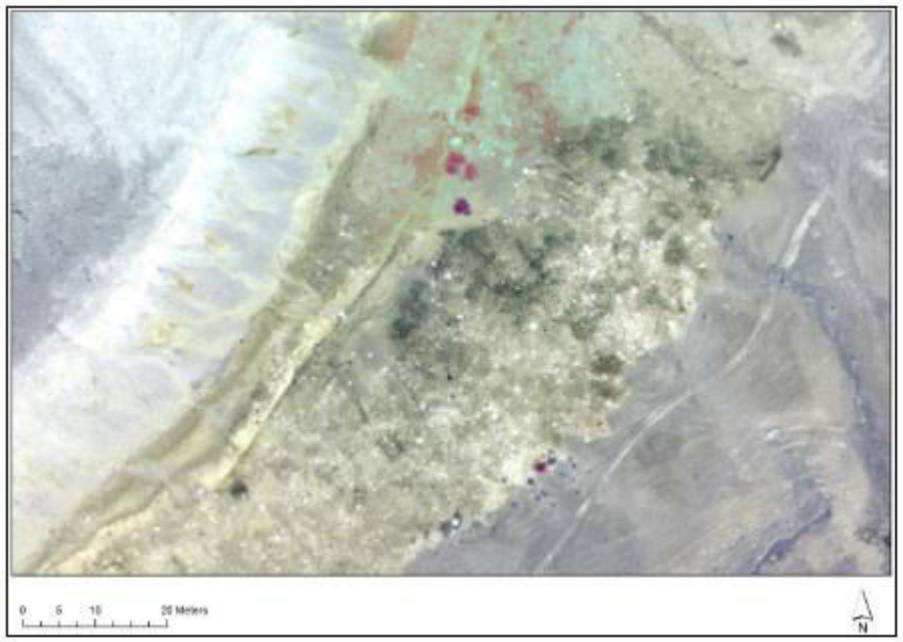
Spatial organisation as measured by Moran I is reduced by vehicles



Using NDVI to map shrubs in Ramon Creator

Photo aerial of the ramon creator using RGB

NDVI from drone of the ramon creator



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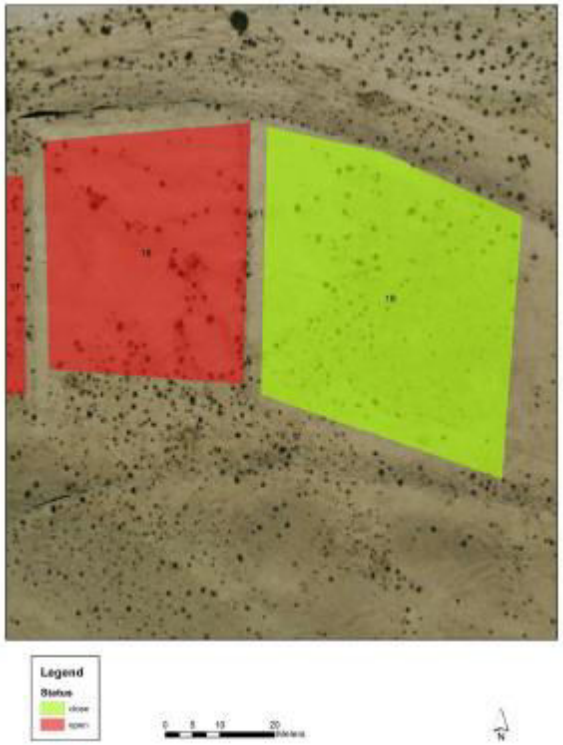
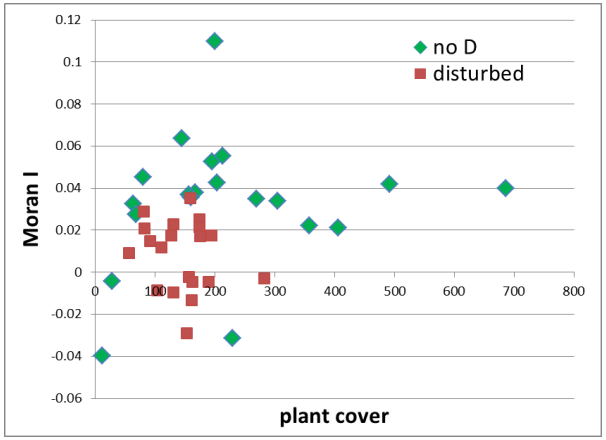
Pattern formation of shrubs in the desert (Ecosystem Integrity)

The distance and location of shrubs in relation to each other is an indication of self organization





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Geomorphology 271 (2016) 65–73

Contents lists available at ScienceDirect

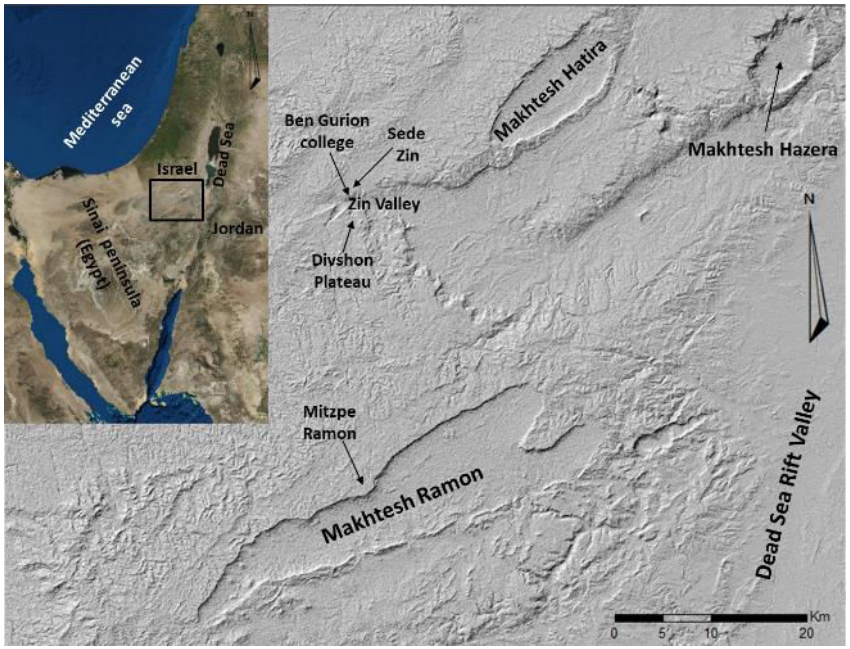
Geomorphology

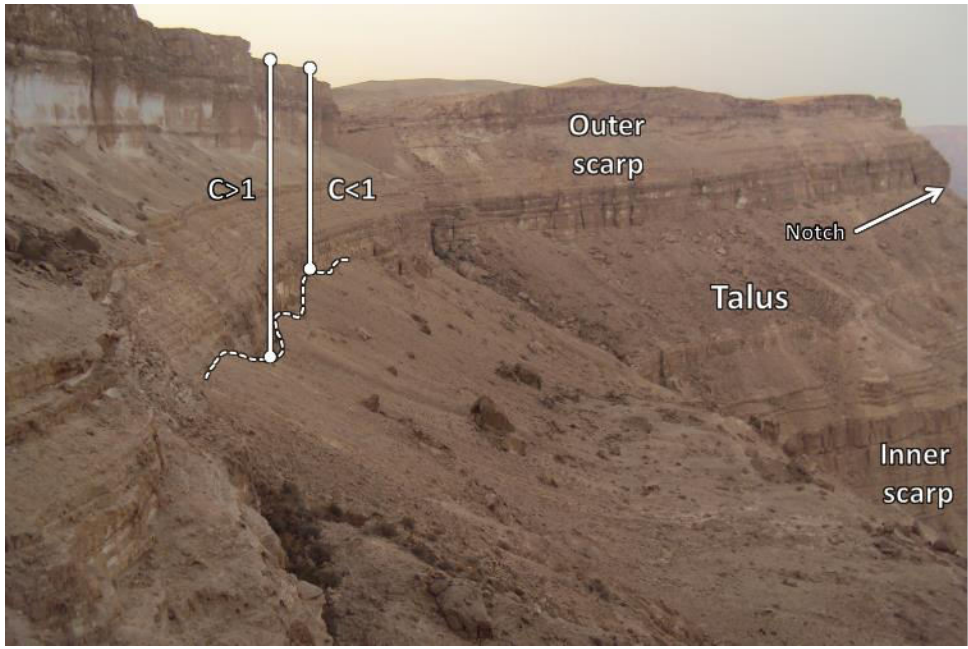
journal homepage: www.elsevier.com/locate/geomorph

A regional approach for modeling cliff retreat rate: The Makhteshim Country, Israel

Yaron Finzi, Noam Harlev *

Remote sensing - Regional analysis of partly inaccessible terrain

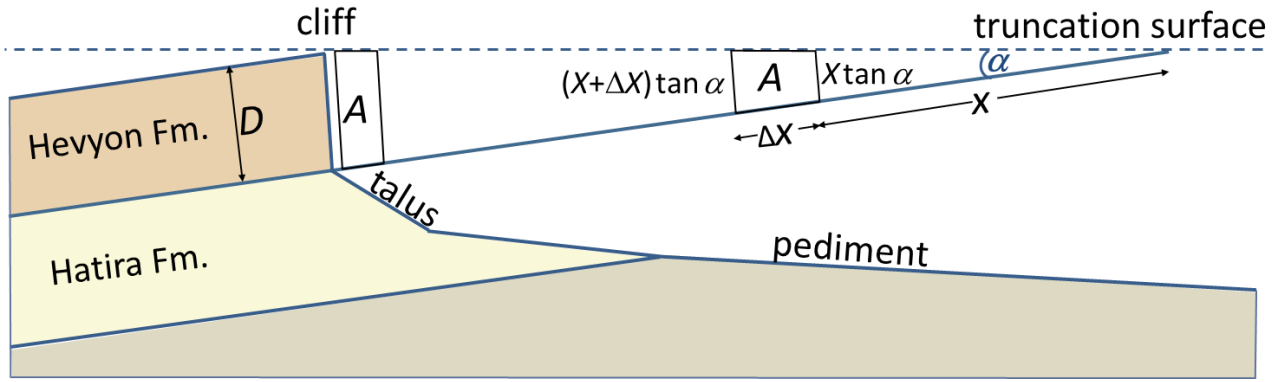




Model and Remote Sensing input

Improved model

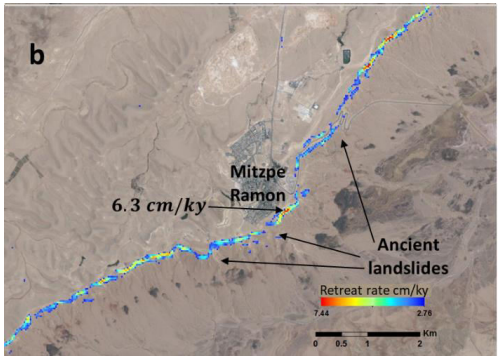
Effect of talus cover:
h – local cliff height
h_{max} – max height
h_{notch} –overhang/cover



$$\Delta X_m = \Delta X \frac{h}{h_{max} - h_{notch}}$$

$$\Delta X = \frac{-D + \sqrt{D^2 + 2tan(\alpha)}}{tan(\alpha)} * cos(\alpha)$$

Using a digital topographic model and spatial geologic data we formulate a cliff retreat model and apply in the Makhteshim Country to estimate cliff retreat rates. Using available satellite data and GIS calculations, we enable wide spread analysis of cliffs, many of which are inaccessible and all but 3 never had their retreat rate estimated.



Cliff site	Modified incremental retreat (ΔX_m)[m]	Retreat rate. Calibrated based on Avni (1990) [cm ky^{-1}]
Makhtesh Ramon	0.010 – 0.025	3 – 7
Makhtesh Hatira	0.005 – 0.016	1 – 4
M. Hazera inner	0.005 – 0.015	1 – 4
M. Hazera outer	0.003 – 0.010	1 – 3
Divshon Plateau	0.005 – 0.014	1 – 4
Sede Zin	0.418 – 0.841	125 – 250

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

העתיד כאן !

The future is here!

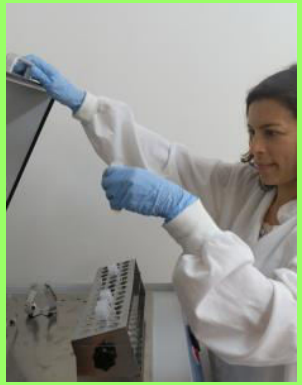
"We will do what is necessary, we will strive what is possible and then we will find that we are doing the impossible."

Thank you very much

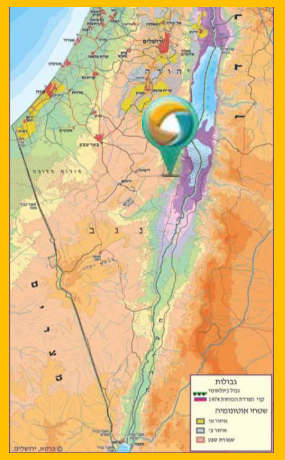
Biology

The Skin lab, Dead Sea branch

- Zvi Bentovitz – medicine
- Guy Cohen - the psoriasis model
- Shiri Eshar - Isolation and characterizing bioactive compounds and development of drugs. Leishmenasis.
- Amir Steinberg - Bioinformatics
- Ashraf Al Ashab -Genetics of micro-organisms
- Navit Stern – physiology of miro-organisms



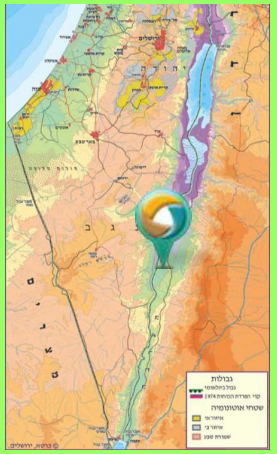
The environmental unit
Dead Sea branch



- Carmit Cohen Ish-shalom – Geology, hydrology
- Eli Raz – conservation of the dead sea, sink holes
- Ofir Katz – ecology
-

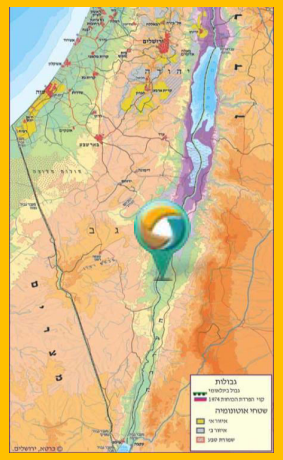
Biology

The Biology lab, Central Arava branch

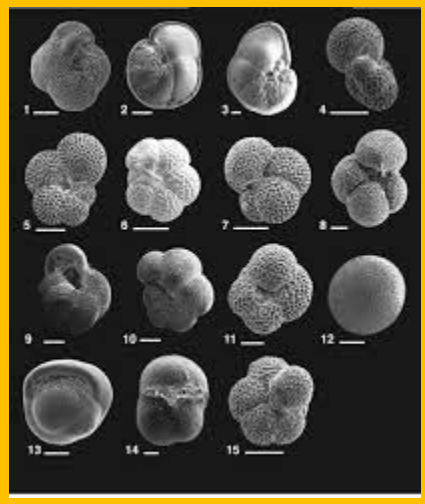


- Rivki Ofir – Using local desert plants to search for potential drugs and essential molecules. Nematocides, antimicrobial compounds.
- Niva Bloom - Neuropathology and degeneration in ALS: using the zebrafish platform
- Gidon Winters – Identification of new stress-resistant bacteria with potential biotechnological assets . Population Genetics of plants. Plant physiology
-

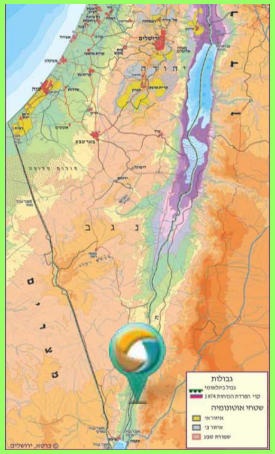
The environmental unit Central Arava



- Oded Kainan – ornithology, animal behaviour, conservation, agro-ecology
- Gidon Winters – Acacia tree populations, genetics and physiology. Climate change. Sea grass biology in the red sea.
- Sarit Ashkenazi – Paleogeogeology, foraminefers, geology

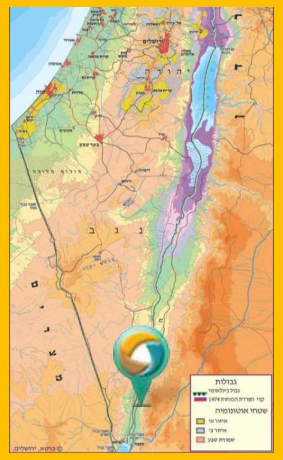


The Biology lab Eilot



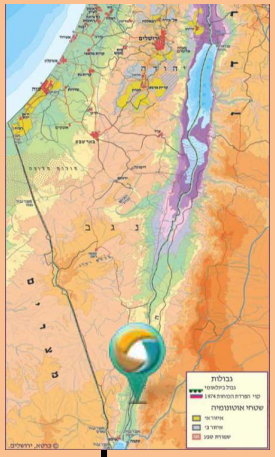
- Gabi Bannet – algea and microbiology
- Malki Spodek – entomolgy
- Elli Groner – Ecology

The environmental unit Eilot



- Ilan Stavi – Geomorphology, soil quality in agriculture and natural areas. Geodiversity, grazing.
- Racheli Zvooloni– hydrology
- Uzi Avner – Archeology
- Hanan Ginat - Geology

Renewable Energy
Eilot

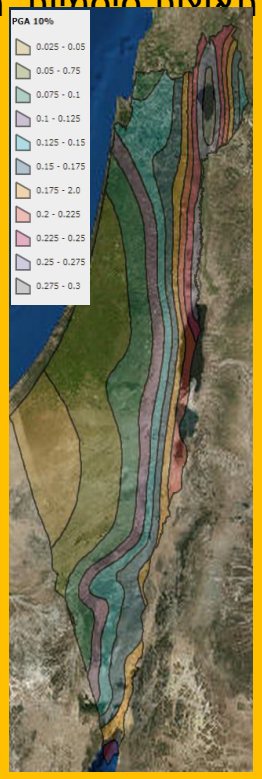


- Tareq Abu Hemed – chemistry. Using hydrogen and Boron for renewable energy, Cooling photo-voltaic pannels
- Alex Gusarov – physics. Reverse osmosis, solar desalination, Modification of bulk crystalline silicon by means of femtosecond laser pulses
- Ilan Stavi - Biochar

The environmental unit Mitzpe Ramon

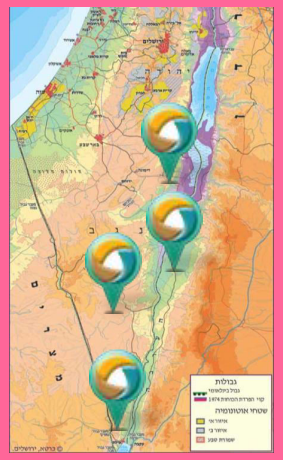
- Noa Avrial-Avni – Socio-ecology, environmental education, sociology, stresses on desert farming.
- Yaron Finzi – Geology
- Elli Groner – Ecology
- Aviva Peeters – remote sensing and GIS
- Avshalom Babad – Hydrology
- ? - Astronomy and space

מפת תאוצות סיסמיות, תקן



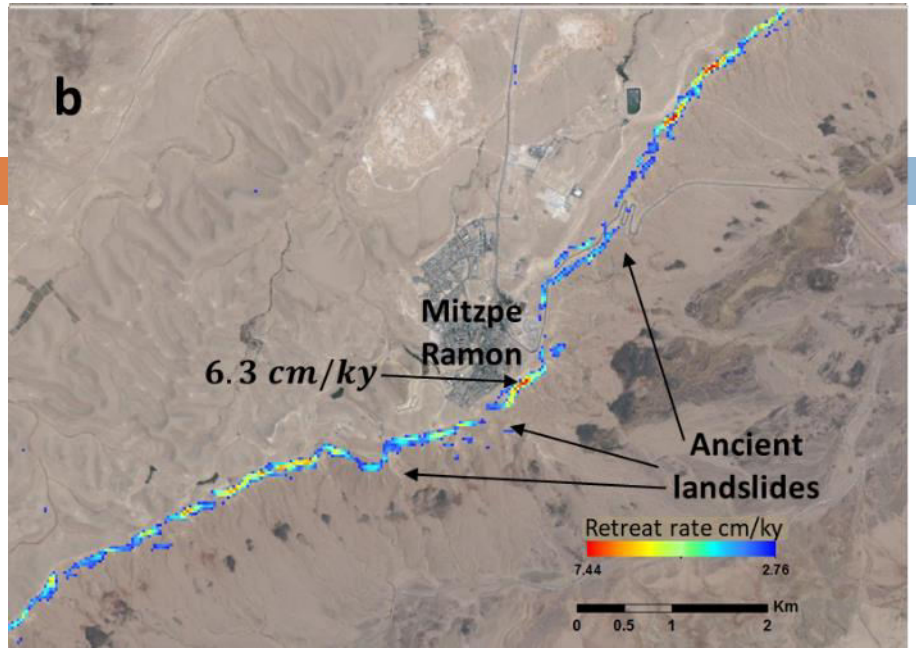
תאוצות קרקע
מרביות ב-500

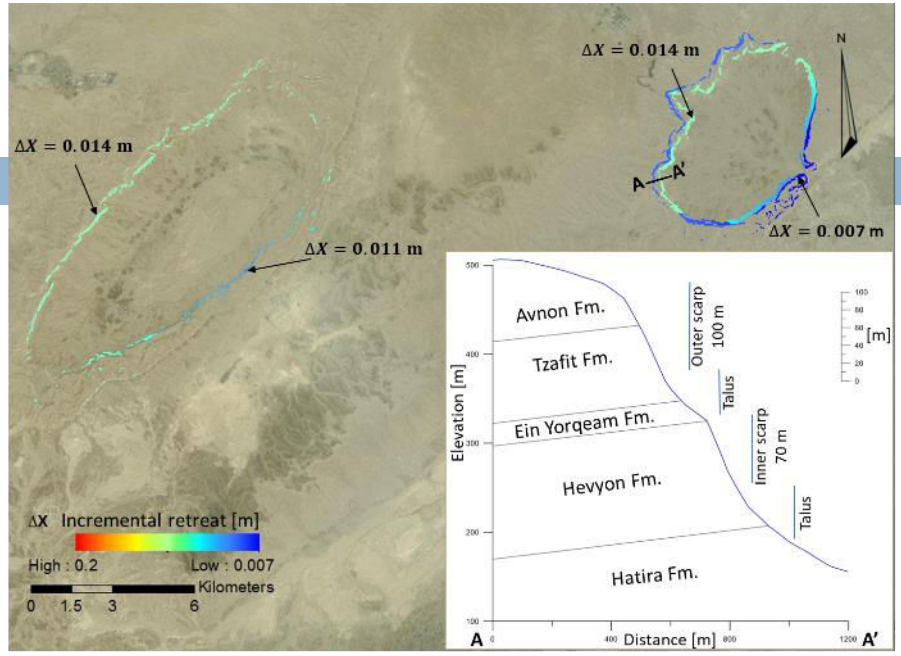
Social sciences at the science center

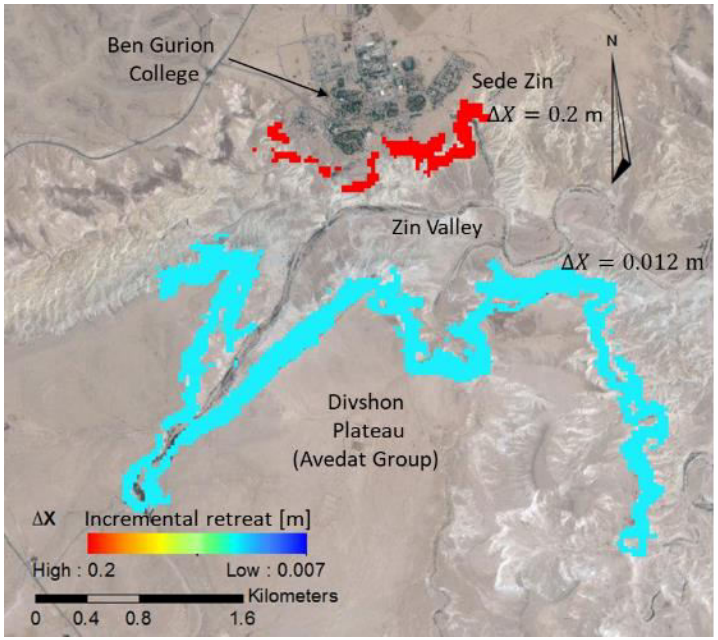


- Avigail Morris – anthroplogy, ecosystem services, the 3rd age
- Joshua Schmidt – anthropology, rock painting, society's dealing with crises.
- Noa Avrial-Avni – Socio-ecology, environmental education, sociology
- Gidon Hadas – archeology
- Uzi Avner - archeology
-

Results – cliff retreat rates







Cliff site	Modified incremental retreat (ΔX_m)[m]	Retreat rate. Calibrated based on Avni (1990) [cm ky^{-1}]
Makhtesh Ramon	0.010 – 0.025	3 – 7
Makhtesh Hatira	0.005 – 0.016	1 – 4
M. Hazera inner	0.005 – 0.015	1 – 4
M. Hazera outer	0.003 – 0.010	1 – 3
Divshon Plateau	0.005 – 0.014	1 – 4
Sede Zin	0.418 – 0.841	125 – 250

Central Arava Branch

Eilot Region- Main Building

Eilot Region- Labs

Dead Sea Branch
Skin Institute Research

Mitzpe Ramon Branch

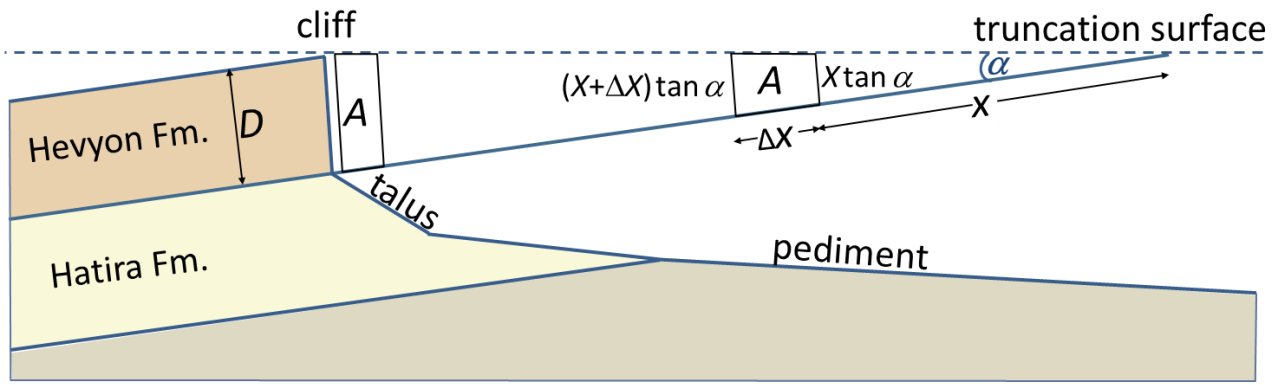
Staff Field Activity

We are currently working on upgrading the model to incorporate the effect of runoff (floods forming waterfalls over the cliffs). This will incorporate remote sensing of basin parameters such as vegetation, soil, slope etc to calculate annual runoff over the cliff.

Model and Remote Sensing input

Basic model

Retreat as a function of:
D – thickness of hard layer
α – layer inclination



Improved model

$$\Delta X = \frac{-D + \sqrt{D^2 + 2tan(\alpha)}}{tan(\alpha)} * cos(\alpha)$$

Effect of talus cover:
h – local cliff height
h_{max} – max height
h_{notch} –overhang/cover

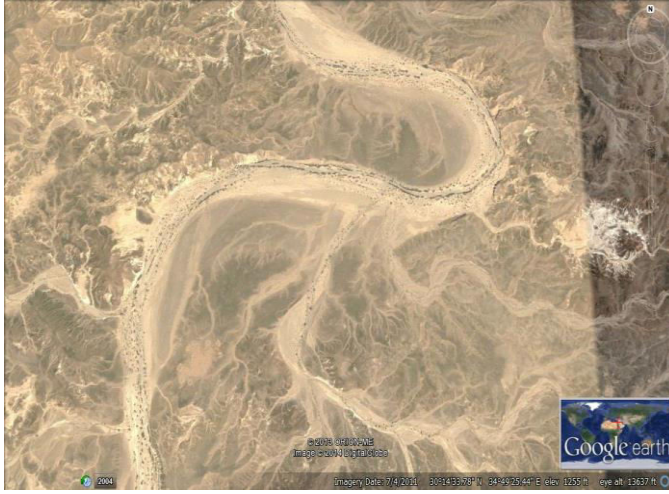
$$\Delta X_m = \Delta X \frac{h}{h_{max} - h_{notch}}$$

GIS layers based on Remote sensing:
h , h_{max} , h_{notch}

GIS layers not based on RS:
D , α

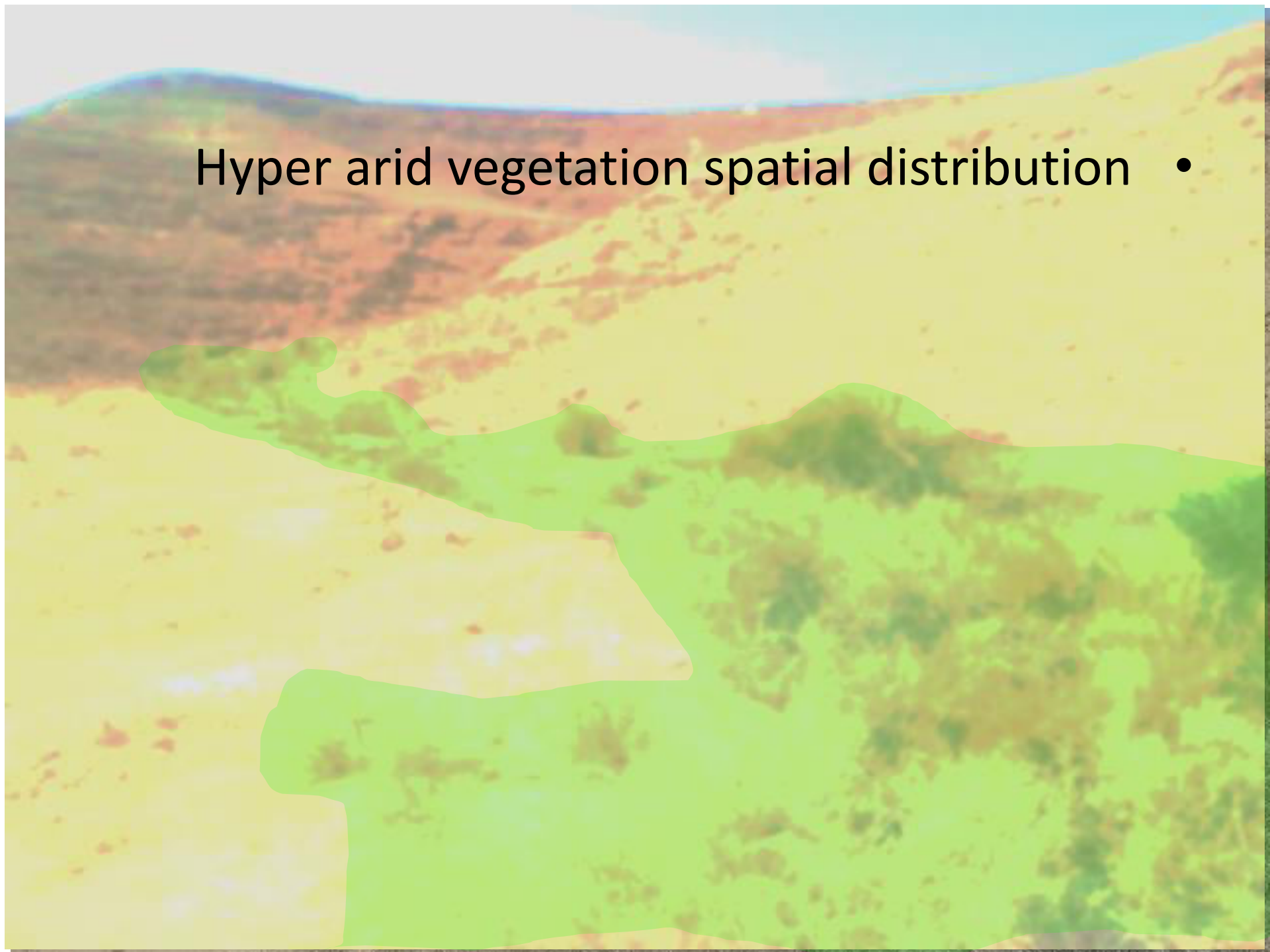
In the middle of the hyper arid desert

Spatial distribution of vegetation in hyper-arid deserts



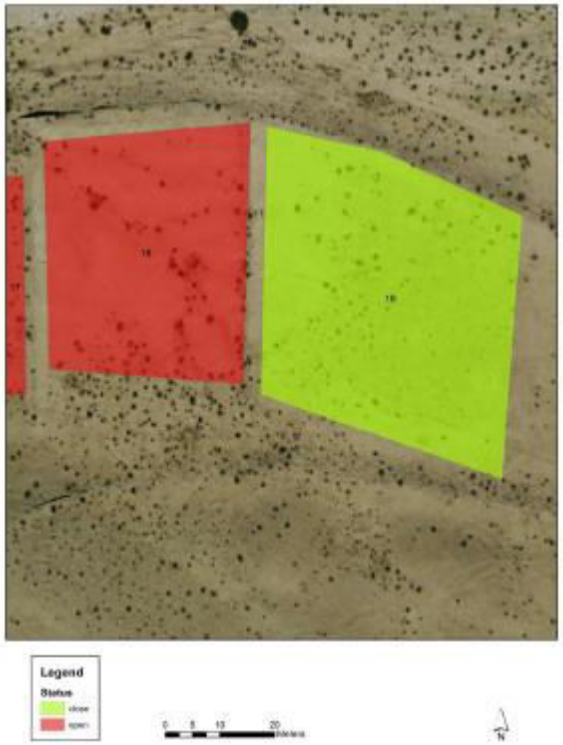
Vegetation in hyper-arid areas is concentrated in the wadies. It covers a very small area and (unless disturbed) the rest of the area has no plants.

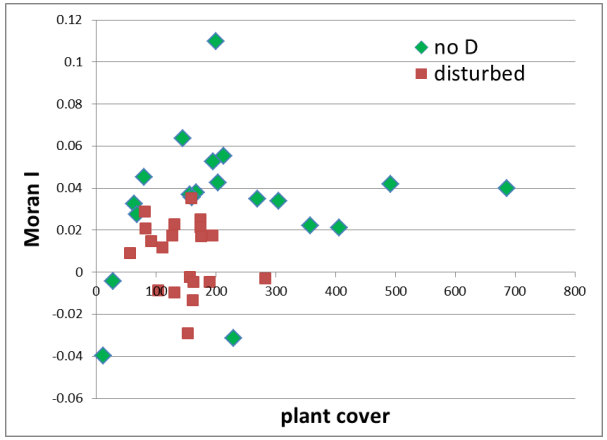
Does it have animals ?


Hyper arid vegetation spatial distribution •

Pattern formation of shrubs in the desert (Ecosystem Integrity)

The distance and location of shrubs in relation to each other is an indication of self organization





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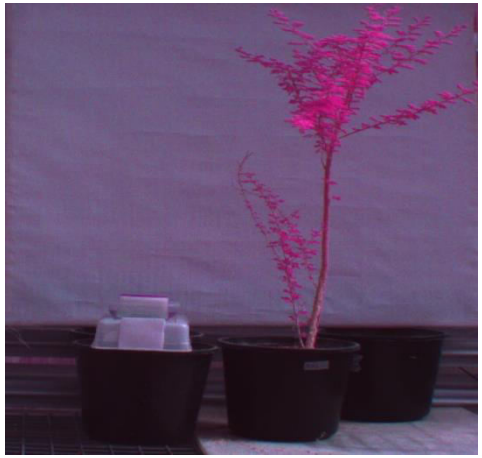
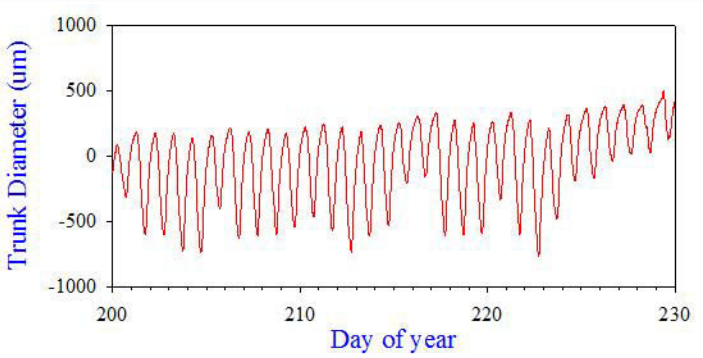
The Arava landscape

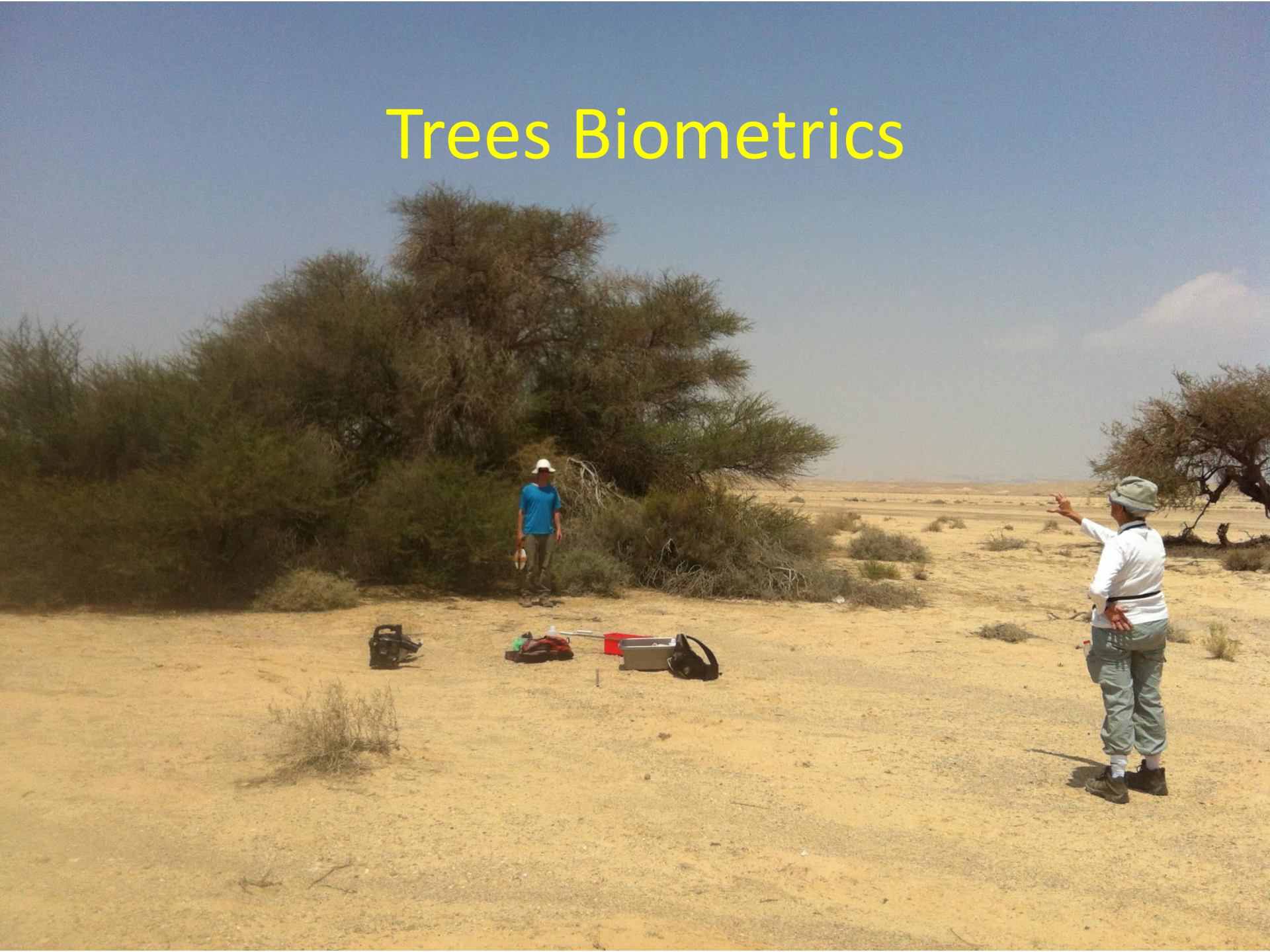
Size and tree health

"greenes" – using the near infra red camera and measuring NDVI we will measure how green the tree is.



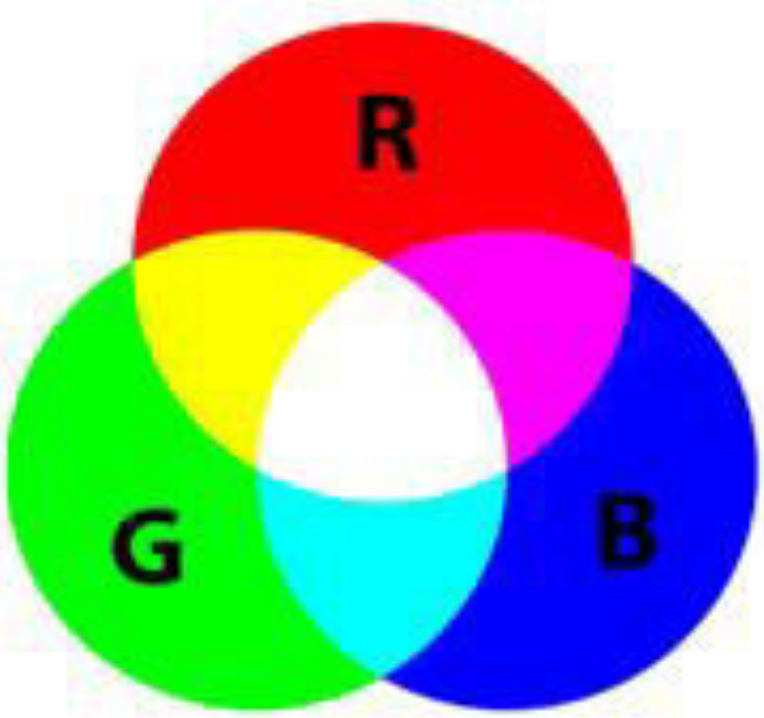


Trees Biometrics



Clolor spaces:

RGB color space or RGB color system, constructs all the colors from the combination of the Red, Green and Blue colors.



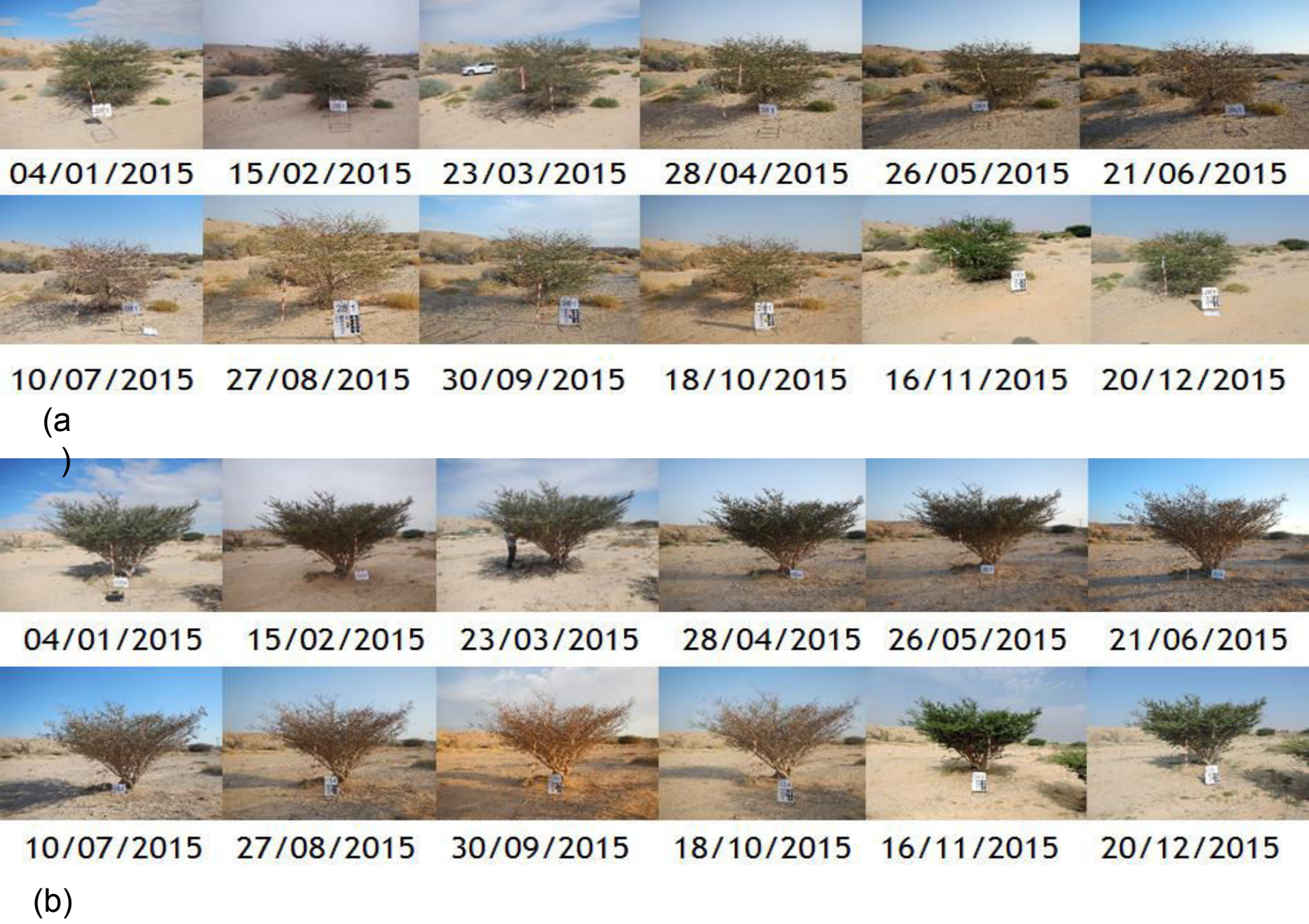
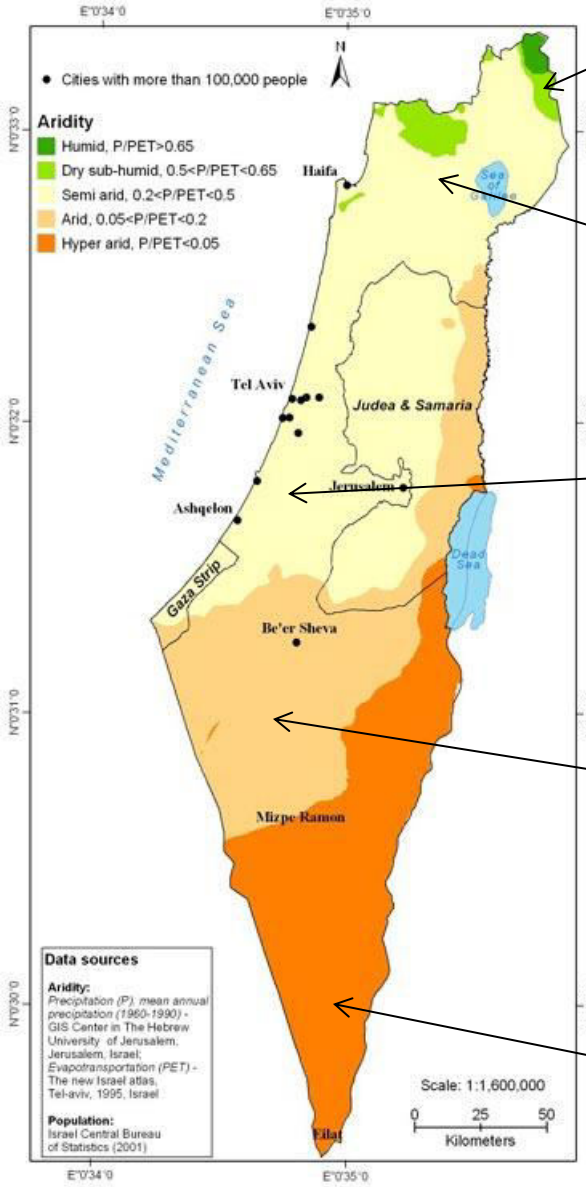


Fig.1: Tree phenology. Monthly photographs of *Acacia raddiana* (a) and *A. tortilis* (b) taken at Wadi Sheizaf Jan-Dec 2015

Aridity Index in Israel



Humid
AI >0.65

Sub-Humid
0.65>AI >0.5

Semi-Arid
0.5> AI > 0.2

Arid
0.2 > AI > 0.05

Hyper-Arid
0.05 > AI

- הנה ממחקר נסיגת מצוקים.
- חמר רקע עבורך:
- נתוני טופוגרפיה, נטיות שכבות וכו אפשרו לנו לחשב קצב נסיגת מצוקים איזורי גם עבור מצוקים לא נגישים.
- בעתיד – נתוני אגן, קרקע, צמחייה, נחלים יעזרו לנו לשדרג את

Science Center's Main Objectives

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

1. Perform applied research based on the uniqueness of the region for the benefit of economic development and welfare of the residents.
2. Collect scientific knowledge through monitoring and analyses, and disseminate this information to the public.
3. Serve the local community- science in the community and scientific literacy - reinforce resident's connection with the place.
4. Contact with local industry, tourism and agriculture– promote applied research and provide professional support.
5. Promote cooperation with research fellows from Jordan and the Palestinian Authority
6. Employ researchers –the young generation and returning scientists

Climbing these steps requires perseverance, patience and sensitivity

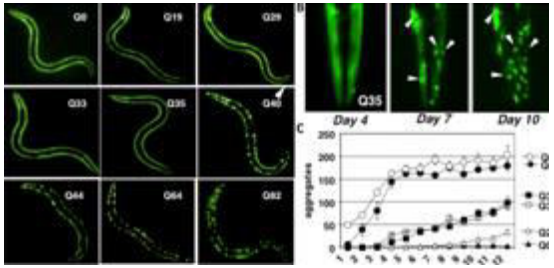
Pooling Knowledge

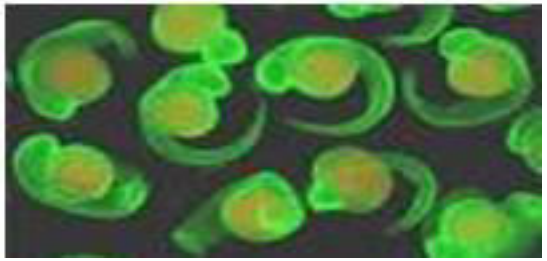
Mapping, developing, and disseminating scientific knowledge to all interested members of the various communities: university students, researchers, school children and the general public, through conferences, meetings, databases, courses, instructional materials, journals and more, in Israel and abroad.

The center operates six laboratories of diverse disciplines:

1. **Skin microbiology and biochemistry lab in Ein Gedi** – *specializing in developing new methods of growing skin tissue for skin researchers*.

2. **Desert plants and herbs lab in Hatzeva** – *seeking active ingredients to fight diseases – a unique plant library is located here*.





3. Zebra fish lab - *research to model diseases*

4. Nematodes study lab - *modeling and scanning of material*

5. Renewable Energy Lab - *specializing in hydrogen fuel development in Kibutz Ketura*

6. Renewable Algae-based Energy Laboratory - *in Ma'ale Shacharut school*

Multi Disciplinary Regional Research Center
Southern Mega-R&D Institution– Labs and Facilities

Science Center - Ramon Branch

- Geologic research center
- Research center for socio-ecological studies

Hevel Eilot science and research building contains:

Science Center - Eilot Branch

- **Agriculter sustanable Lab**
- **Renewable photovoltaic energy lab**
- **Renewable algae energy lab**

Central Arava science and research building contains:

Science Center - Central Arava Branch

- **Therapeutic desert plants lab**
- **Bio-modeling lab for biotechnology**
- **Seagrass lab**
- **Acacia genetics lab**

Dead Sea science and research building – life in extreme environments center contains:

Science Center - Dead Sea Branch

- **Skin modelling lab**
- **microbiology lab**
- **Ecology and hydrology of the Dead Sea basin and its surroundings**

Applicable R&D

Technologic incubator

Research authority

Scientific literacy unit

Dead Sea, Arava and Mitzpe Ramon computerized information center

Dead Sea, Arava and Ramon Education Center – under the auspice of academic institute

Scientific activity - 2015

Scientific publications

- Articles published – **50 articles**

Ongoing research projects: 60

Grants accepted: 30

Staff

- Researchers with PhD – **30**
- Research assistants – **20**
- Graduate students - **30**

Number of researchers, 2007-2015

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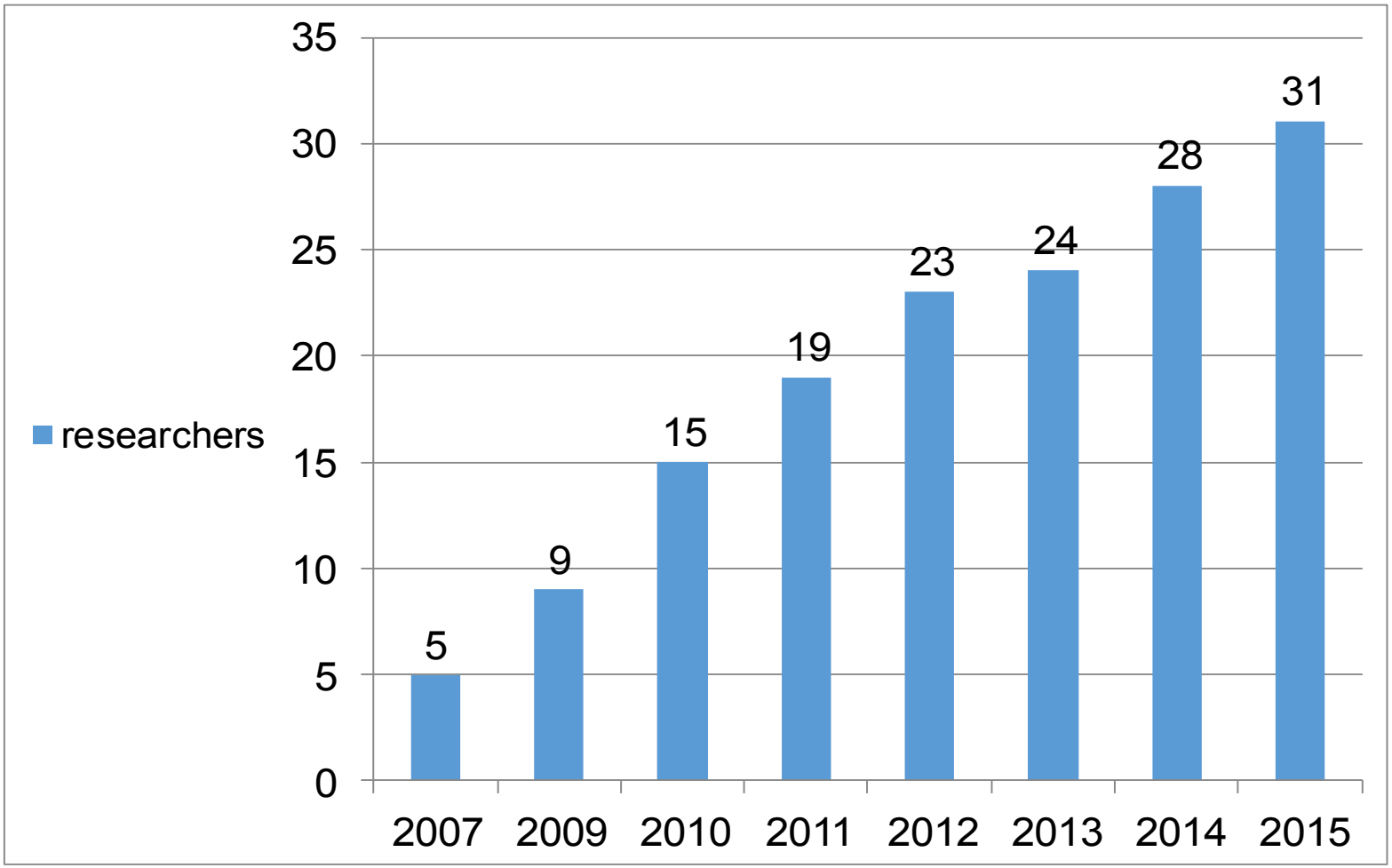

The increase in manpower at the science center indicates it may become an extensive organization that meets the criteria of a "mega R & D“ institute.

Aqaba Conference in Nov, 2015

Work shop in Ein Gedi with students from Safi