KNOWLEDGE CONVERSION FOR ENHANCING MANAGEMENT OF EUROPEAN RIPARIAN ECOSYSTEMS AND SERVICES

COST EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

CONVERGES European Riparian Ecosystems

RIPARIAN VEGETATION RESPONSES TO GLOBAL CHANGES

WG 1 Workshop, Madrid (Spain), January 29-30, 2020

Afforestation of riparian forests impact on channel morphology in the Northern Negev Desert

THE SOIL EROSION RESEARCH STATION
Soil Conservation & Drainage Division

Roey Egozi, Karin Liberman, Marcelo Sternberg

Backgrond

Riparian zones

Rainfall regime gradient

Ecosystem Units

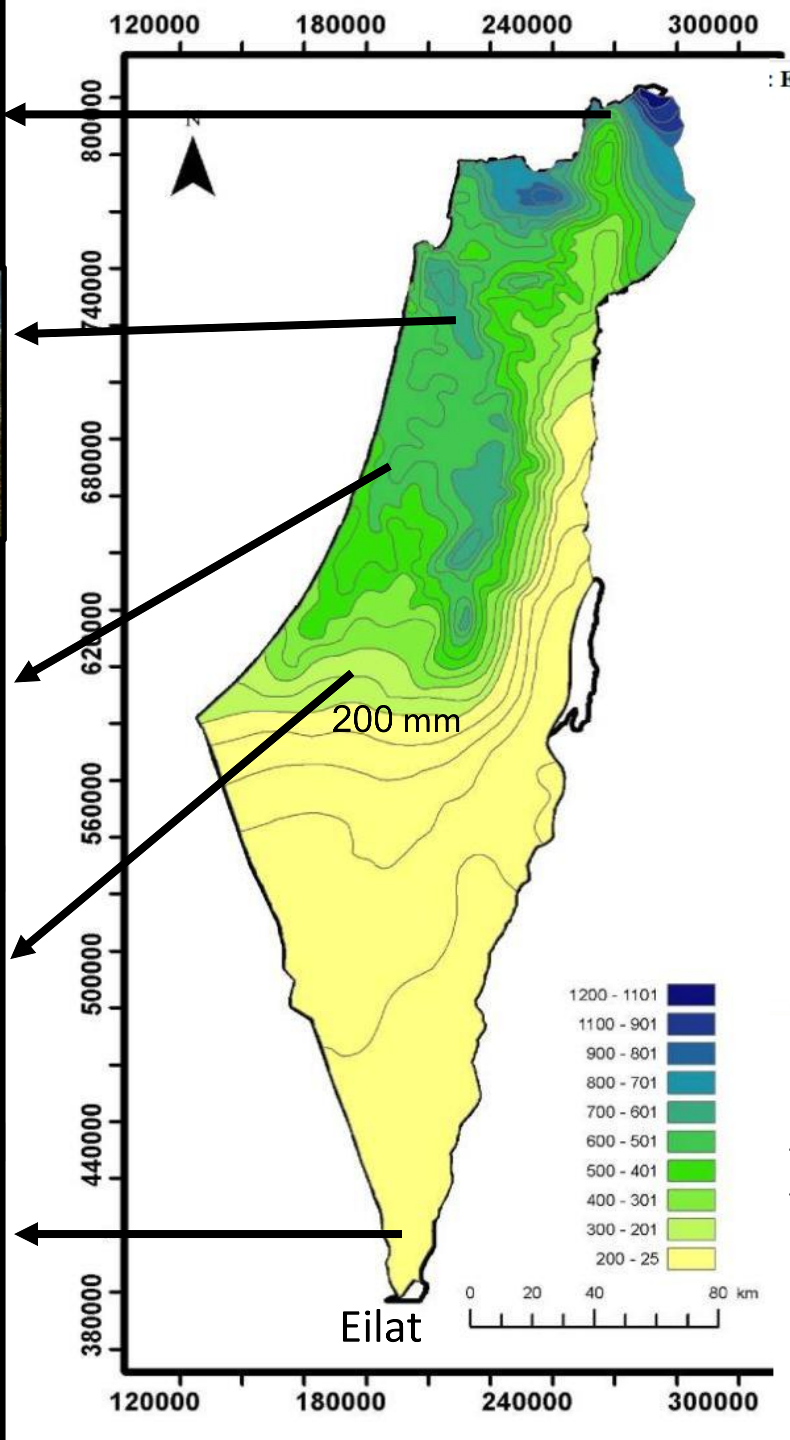
Climate change

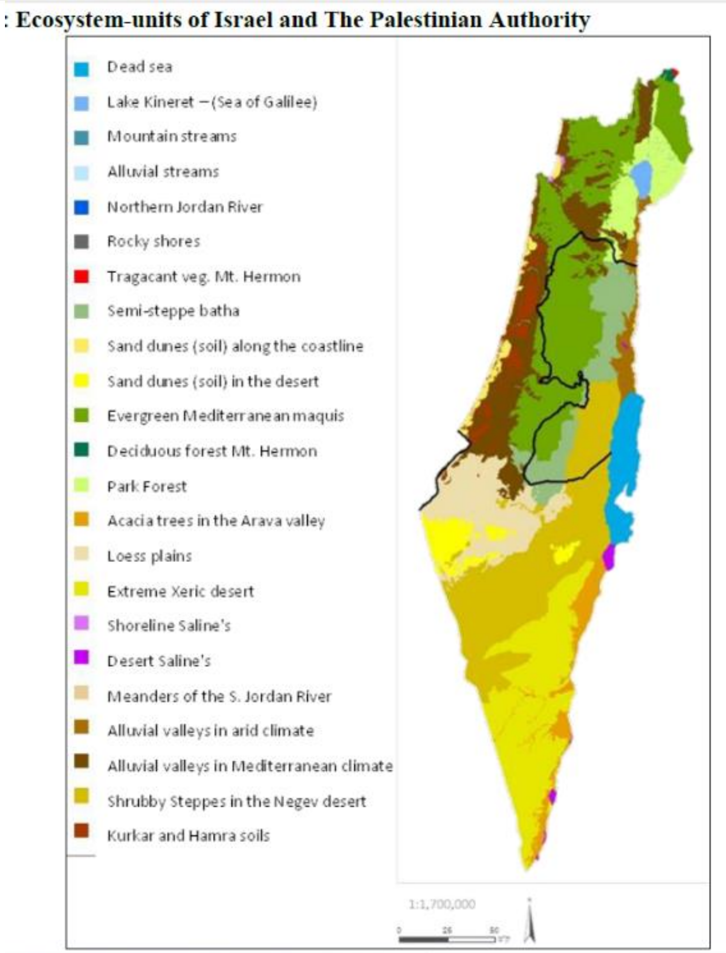
Sediment Yield

Greening the desert









Rotem, D., & Weil, G. (2014). **Natural Ecosystem-Units in Israel and the Palestinian Authority-Representativeness in Protected Areas and Suggested Solutions for Biodiversity Conservation**. *Journal of Landscape Ecology*, 7(1), 91-109.

Trends in rainfall regime over Israel

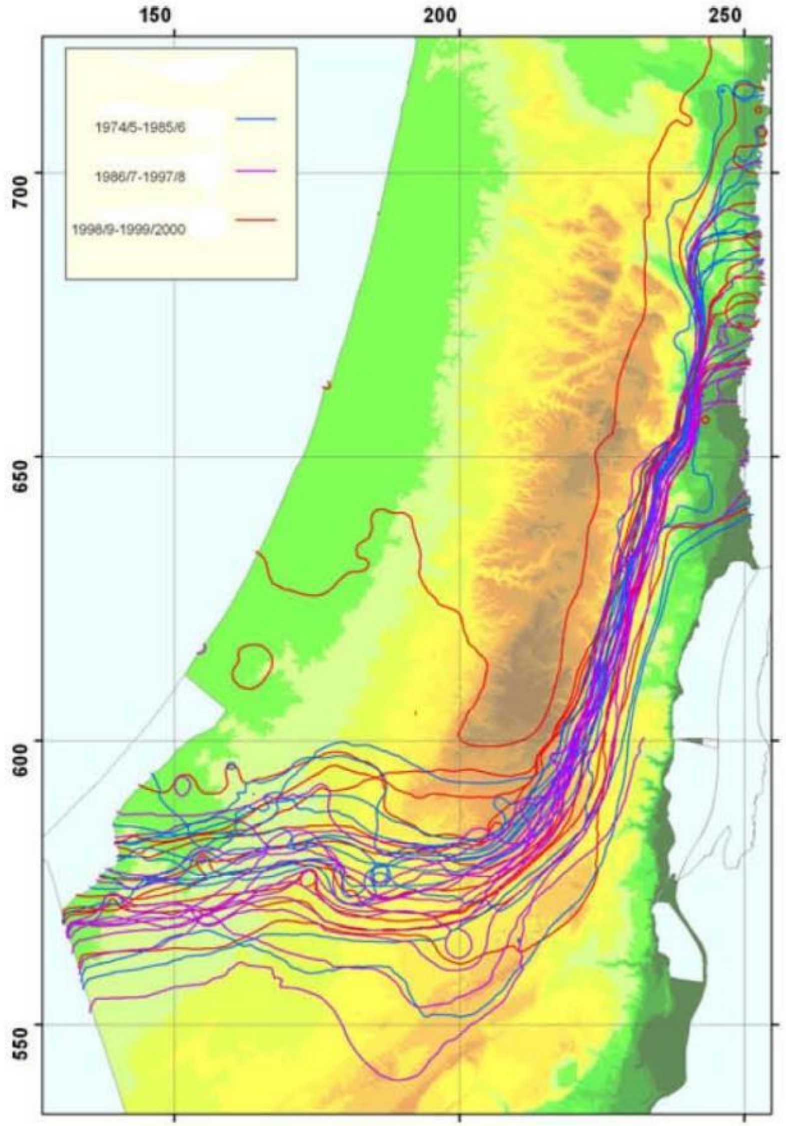
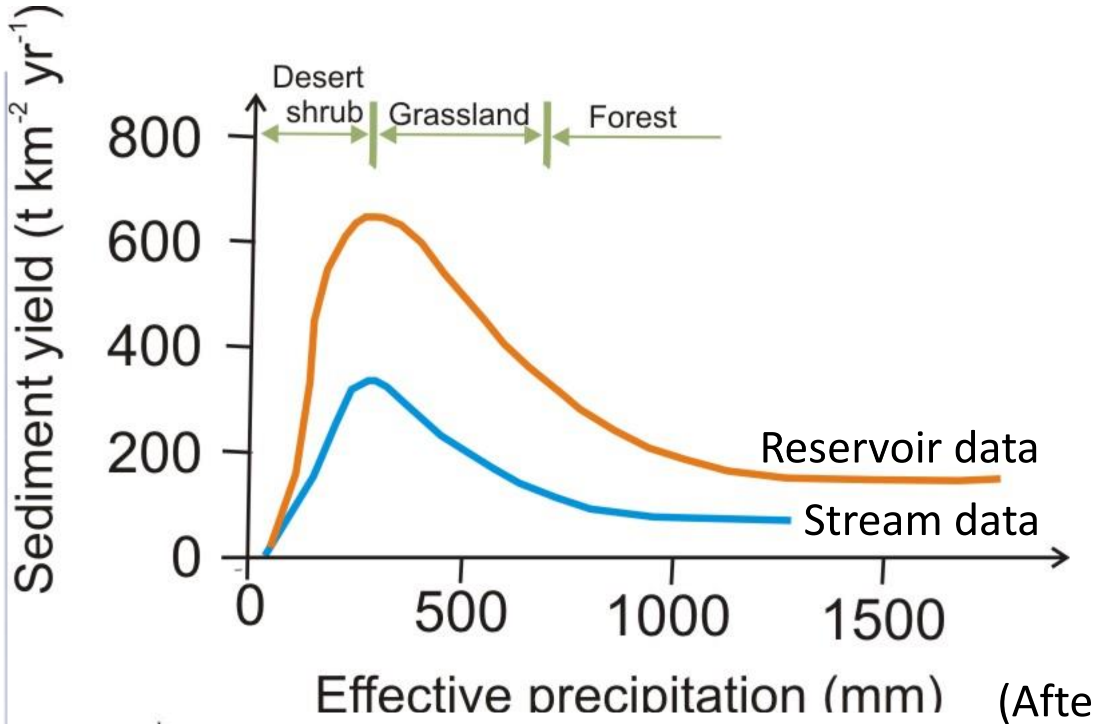
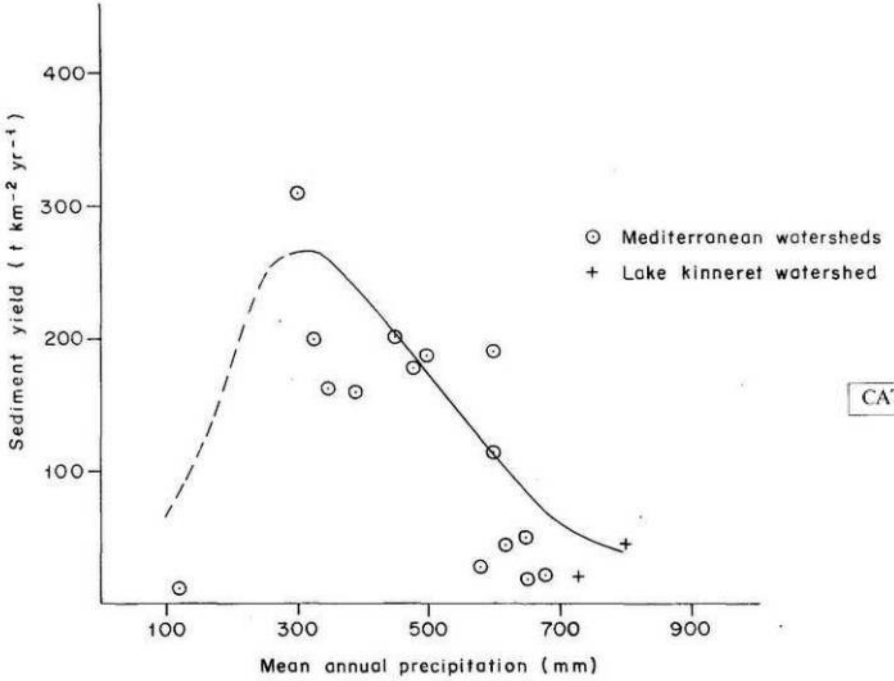


Fig. 4 The location of the 200 mm isohyet (representing the border of the arid region) for the individual years included in the study period (1975–2010)



(After Langbein & Schumm, 1958)



CATENA vol. 19, p. 393-409 Cremlingen 1992

Rates of Fluvial Erosion in Basins with a Mediterranean Type Climate

M. Inbar

Greening the Desert – Backgrond Cont.

Afforestation
vs.
Reforestation

Runoff Harvesting

Soil Conservation

Other Ecological Services

Active Restoration
vs.
Unassisted restoration (Regeneration)

Afforestation

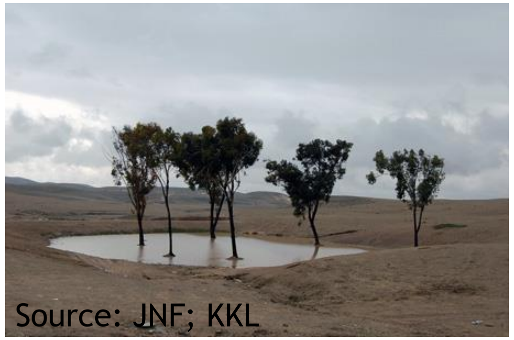
Riparian Forest (Buffer Strip)

Source: JNF; KKL

Savana Forest (Runoff Harvesting Systems)

Liman

Micro-Catchment



Contour Bench Terraces

Contour Earth Ridges

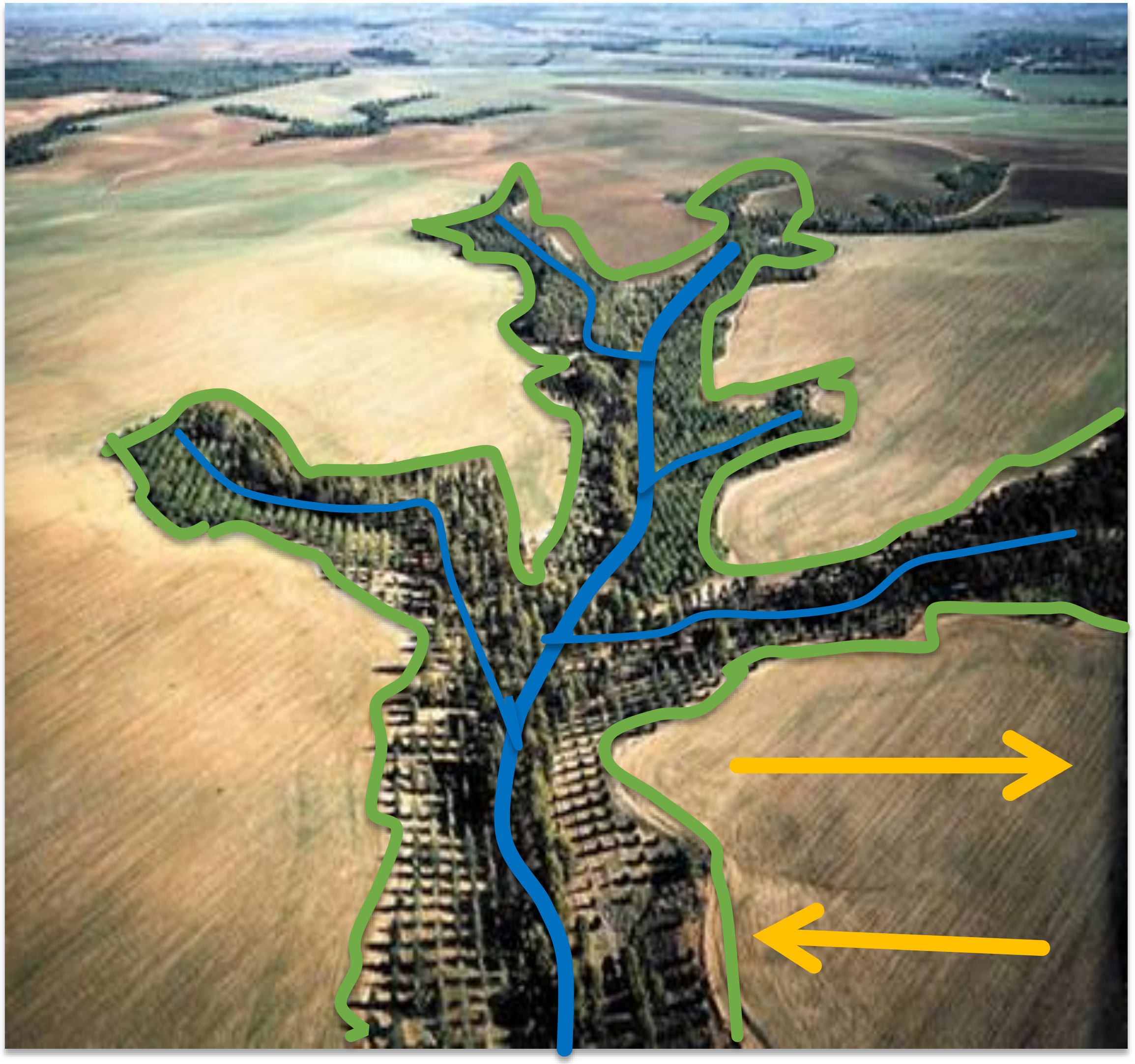
Terraces

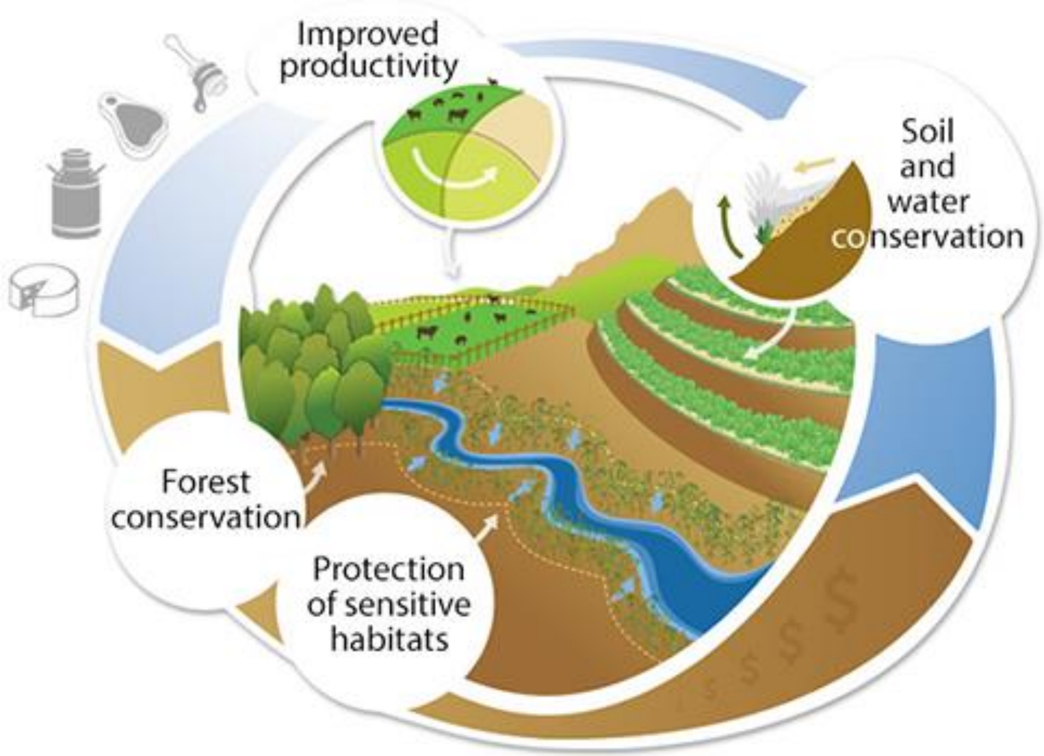
Valley Bottom Terraces





Ecosystem Services: Soil & Water Conservation, Flood regulation, NSP Regulation, Increase Biodiversity, Recreational Activity, Pollination





http://www.fao.org/land-water/overview/integrated-landscape-management/incentives-for-ecosystem-services/en/

The Problem

Afforestation of riparian forest along IRES → buffer

Type of trees

Piping → Gullies →Badlands

Gully headcut retreat

River banks collapse


Beehives
Cultivated land
Service road / Bare Soil
Eucalyptus stand / riparian zone margin


Research Questions

- So what is going on here?

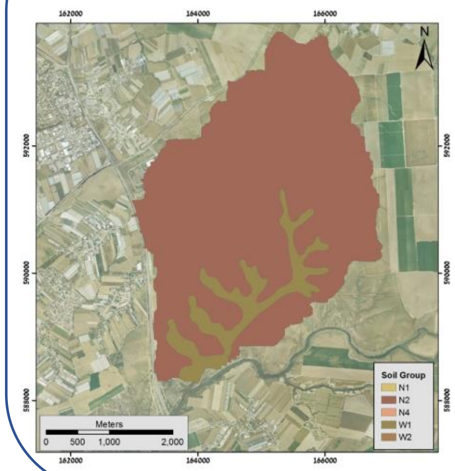
  afforestation effort along IRES to prevent soil erosion…but it clearly that soil erosion continues with active piping and gullies systems within the riparian forest zone

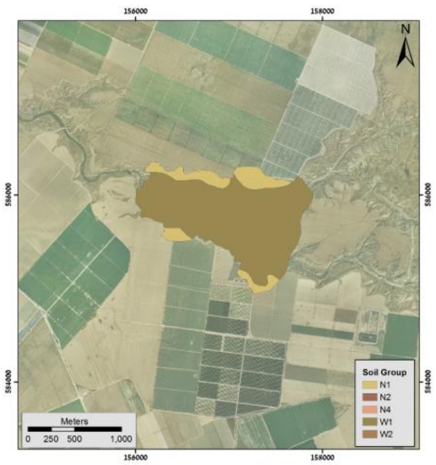
- At what rate these processes continues?

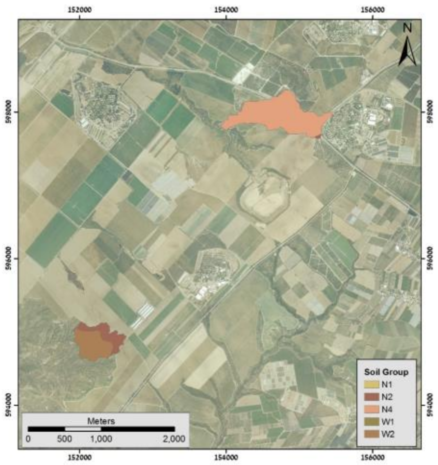
  What are the markers we can use to measure these processes which are under high anthropogenic influence

Research Sites

- Loss soils

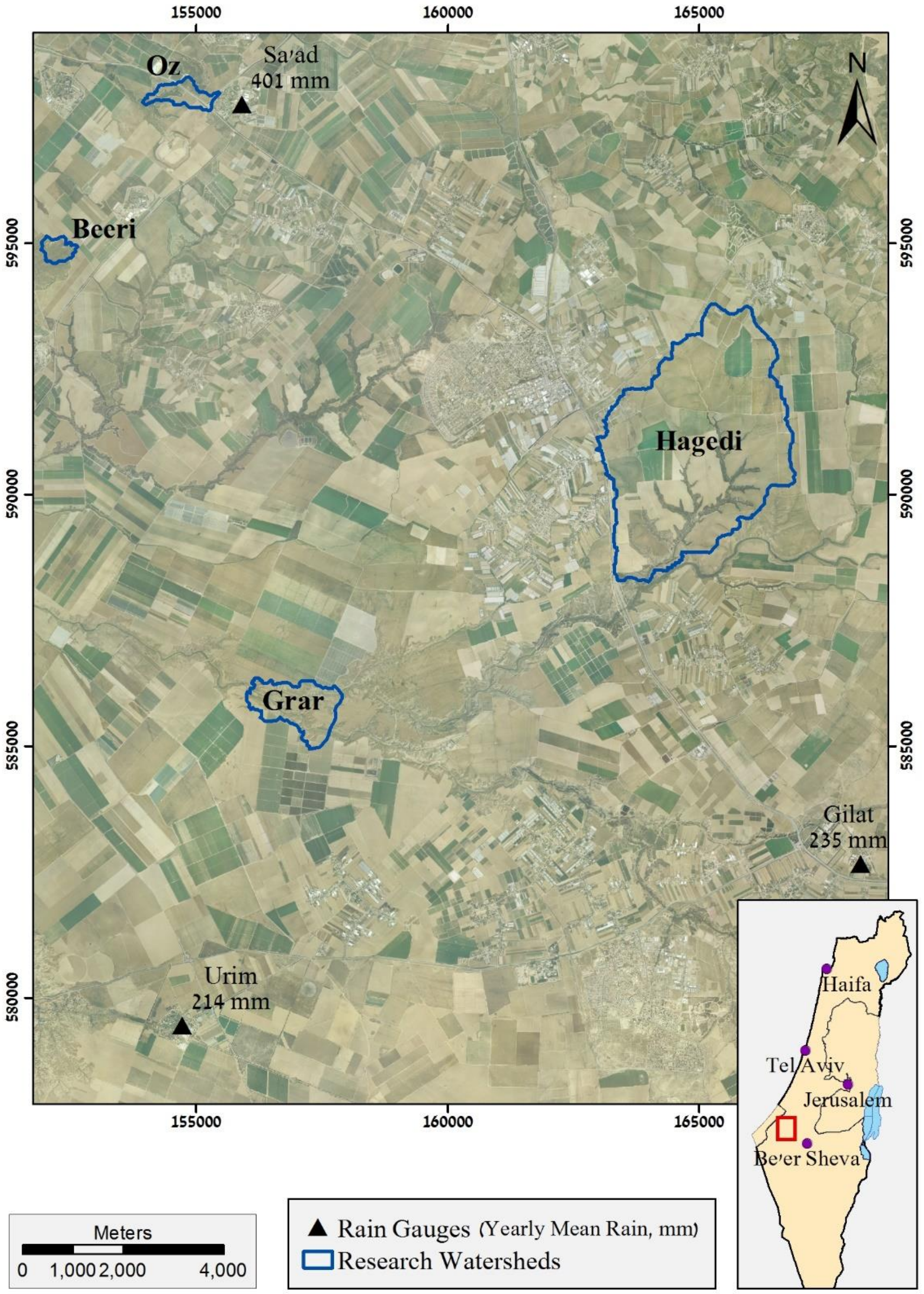






- Vegetation

Eucalyptus torquata; Eucalyptus camaldulensis; Eucalyptus spathulate; Pinus halepensis; Pinus canariensis



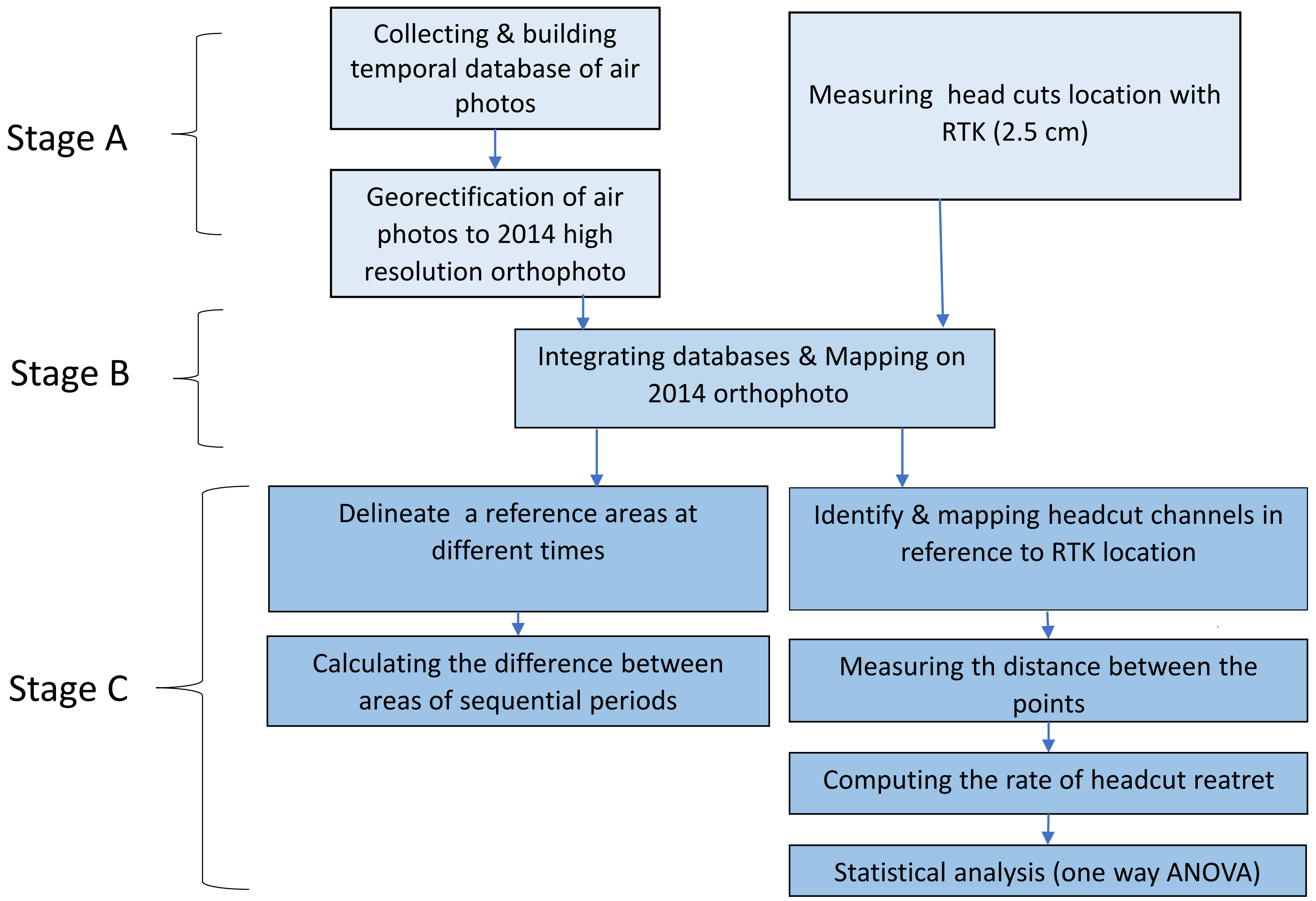
Control sites:

Natural Conservation Areas (protected)

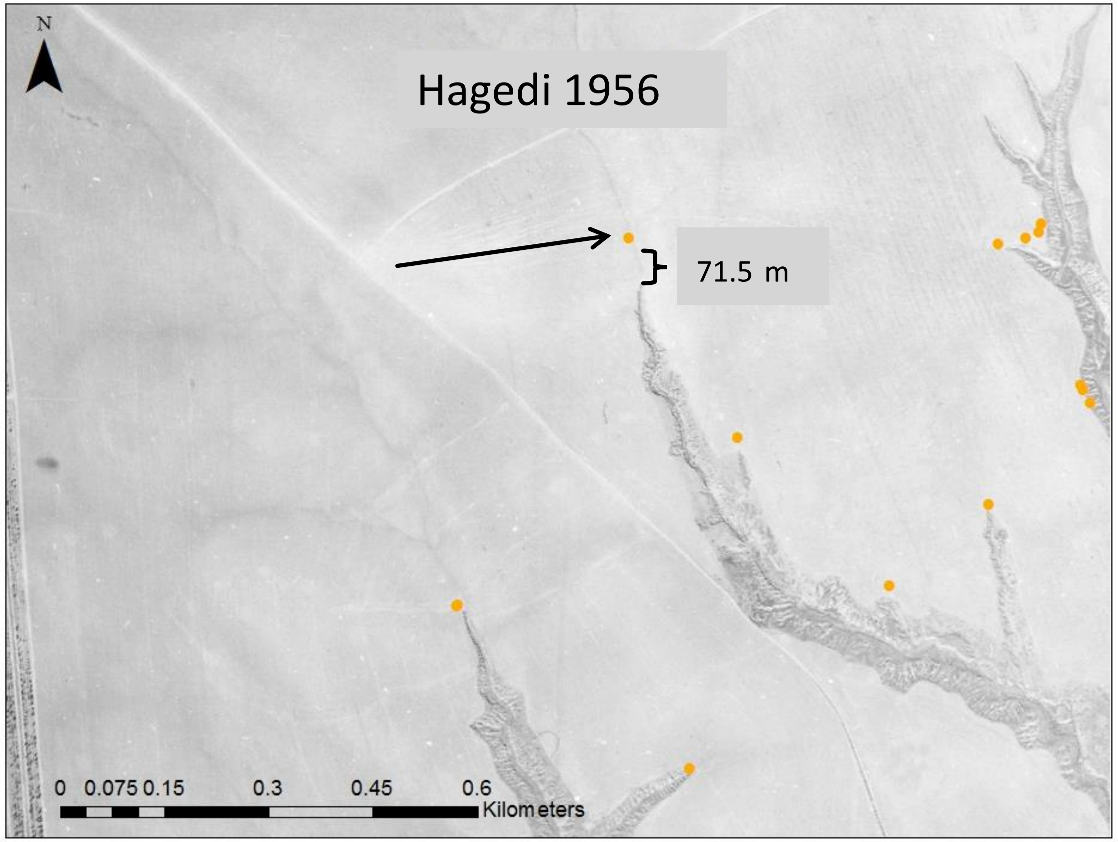
Agricultural land adjacent to vegetated badlands landscape

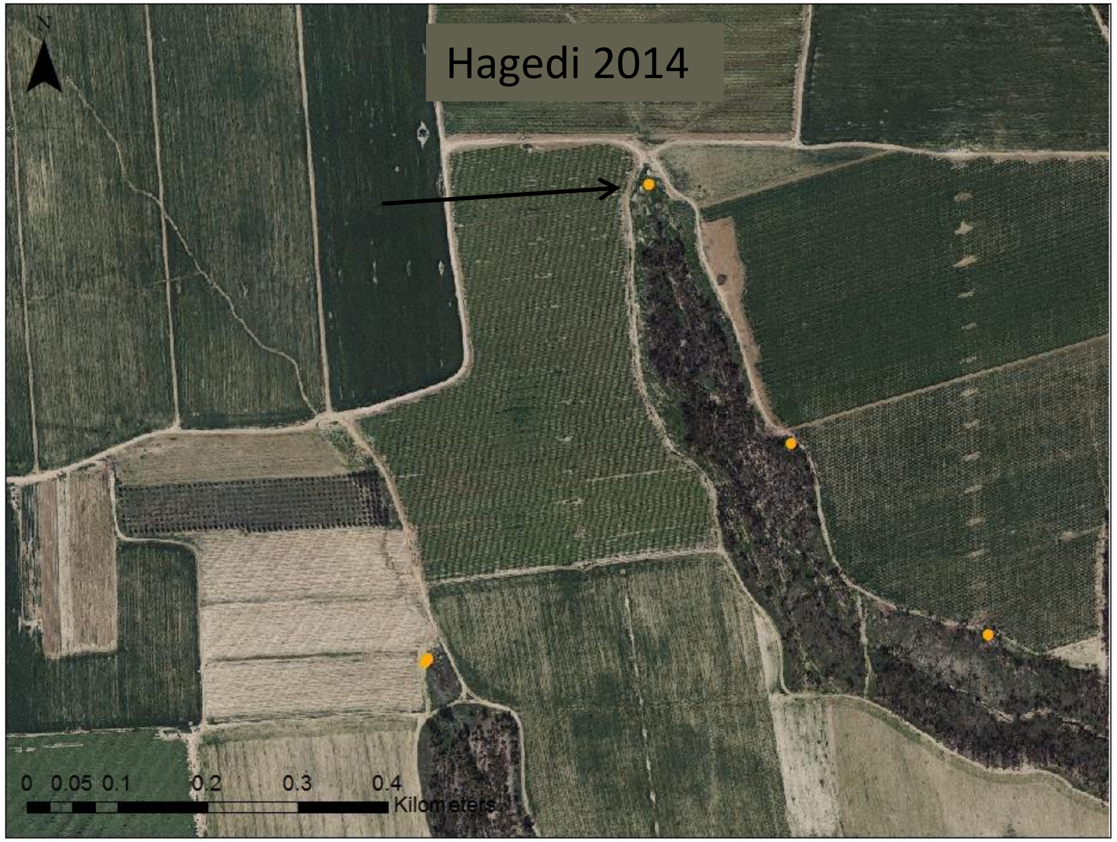
Annual herbaceous & Perennials shrubs

Methods


Stage A
Stage B
Stage C
Collecting & building temporal database of air photos
Georectification of air photos to 2014 high resolution orthophoto
Measuring head cuts location with RTK (2.5 cm)
Integrating databases & Mapping on 2014 orthophoto
Delineate a reference areas at different times
Calculating the difference between areas of sequential periods
Identify & mapping headcut channels in reference to RTK location
Measuring th distance between the points
Computing the rate of headcut reatret
Statistical analysis (one way ANOVA)

Methods

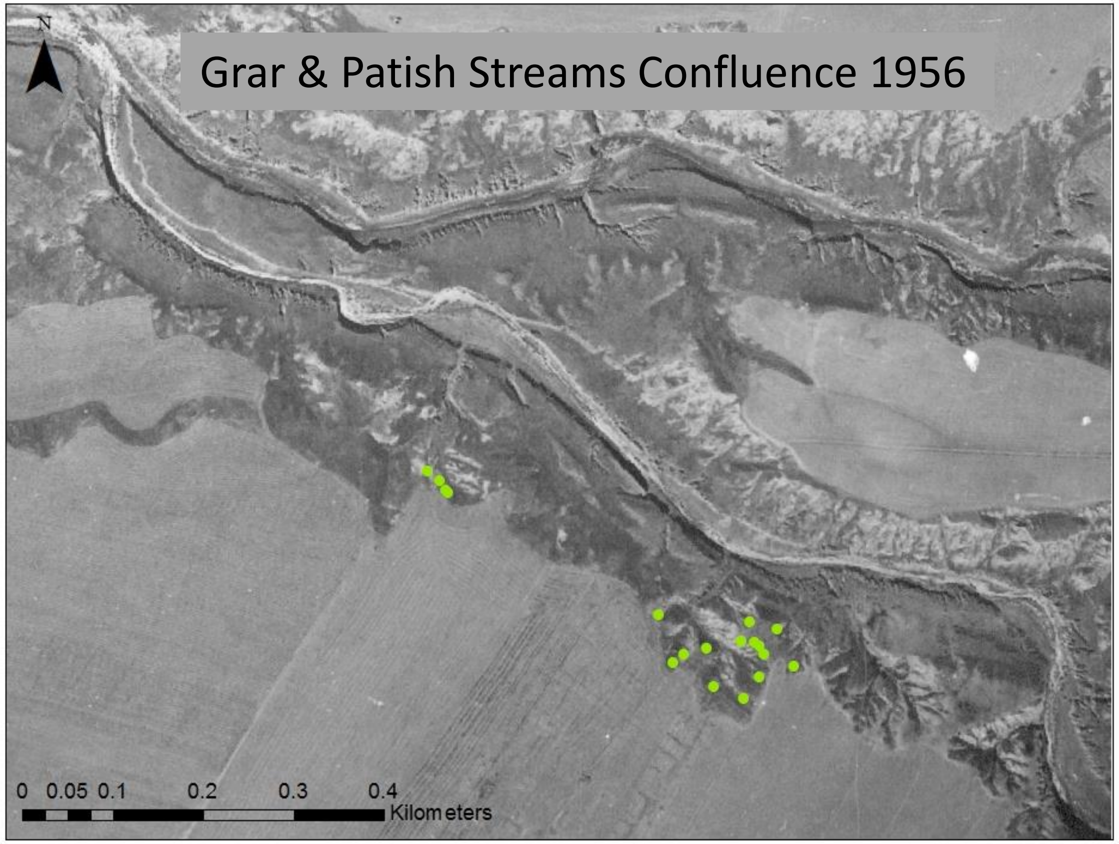


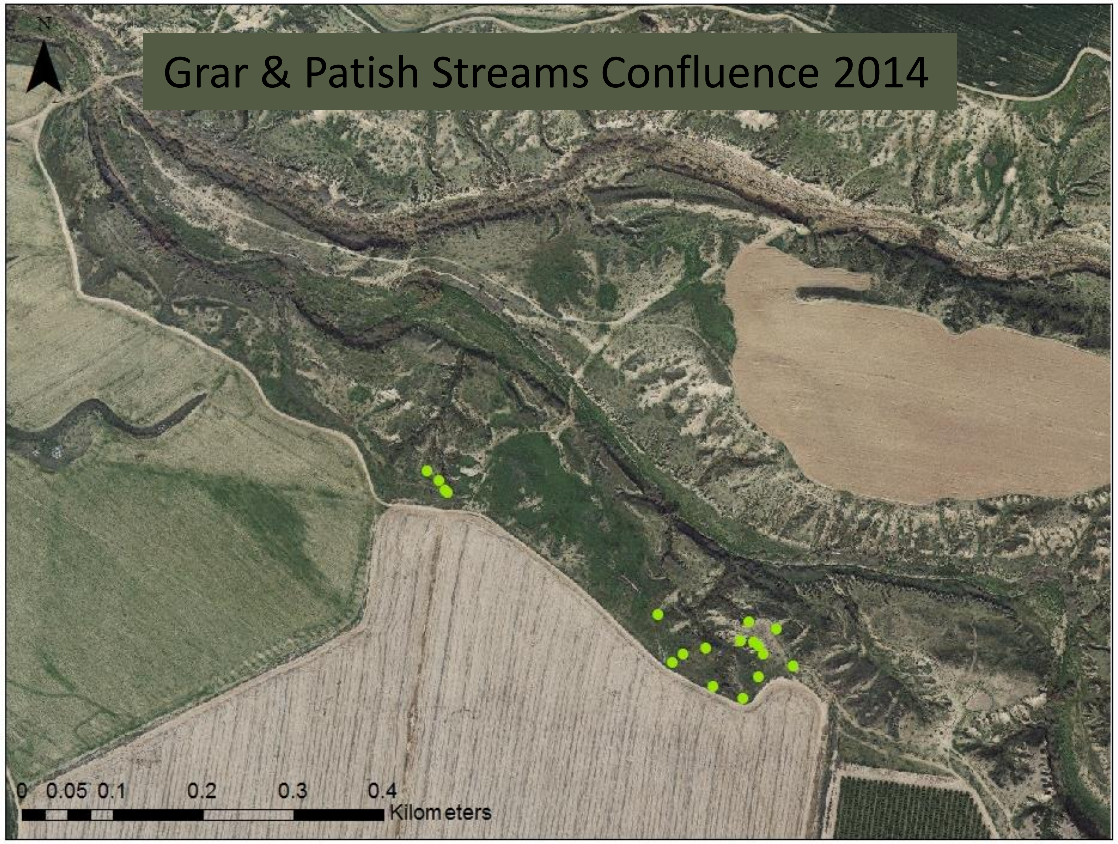


1962 → 1987 – 1994

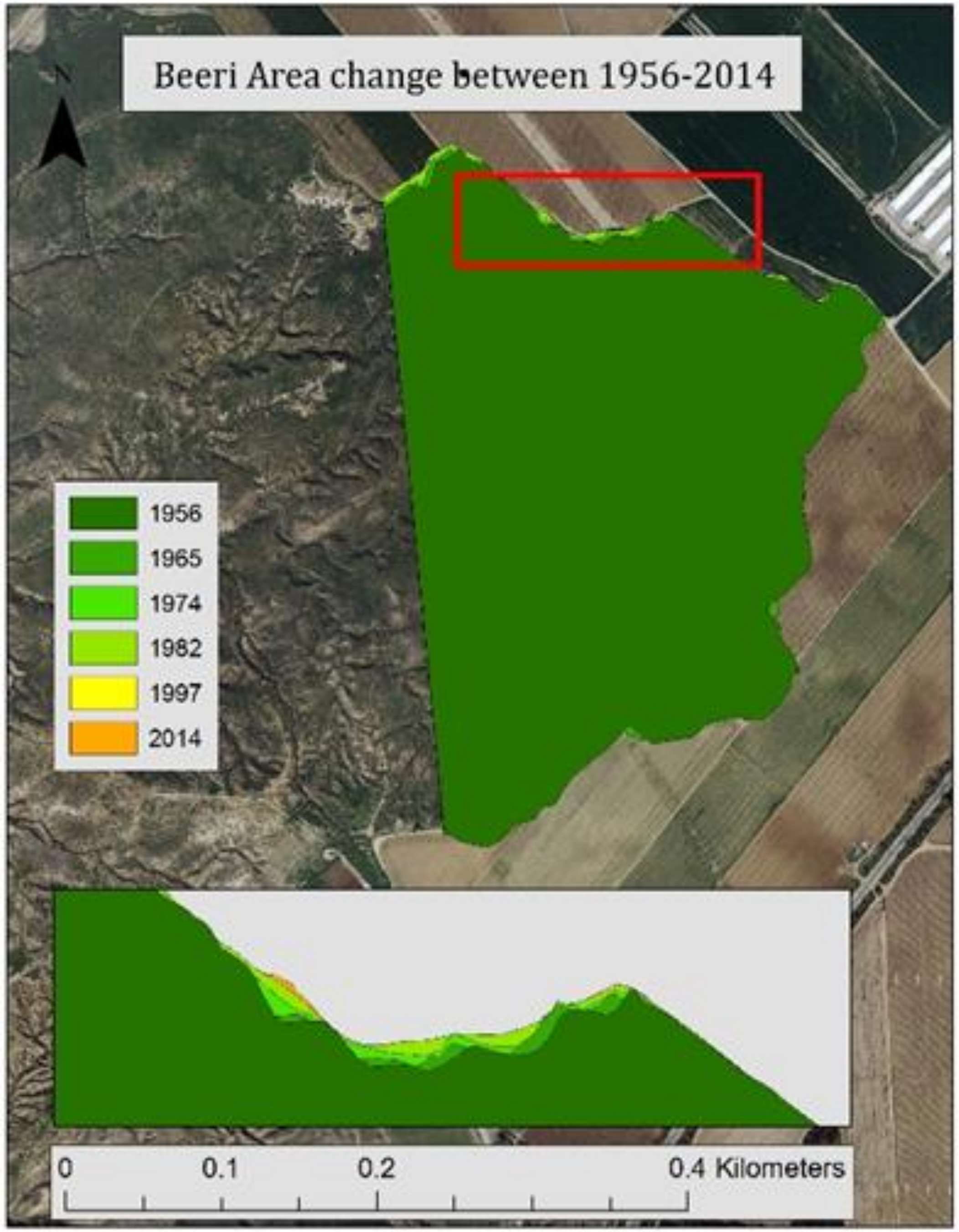
1987

Methods


N
Grar & Patish Streams Confluence 1956
0 0.05 0.1 0.2 0.3 0.4
Kilometers


N
Grar & Patish Streams Confluence 2014
0 0.05 0.1 0.2 0.3 0.4
Kilometers

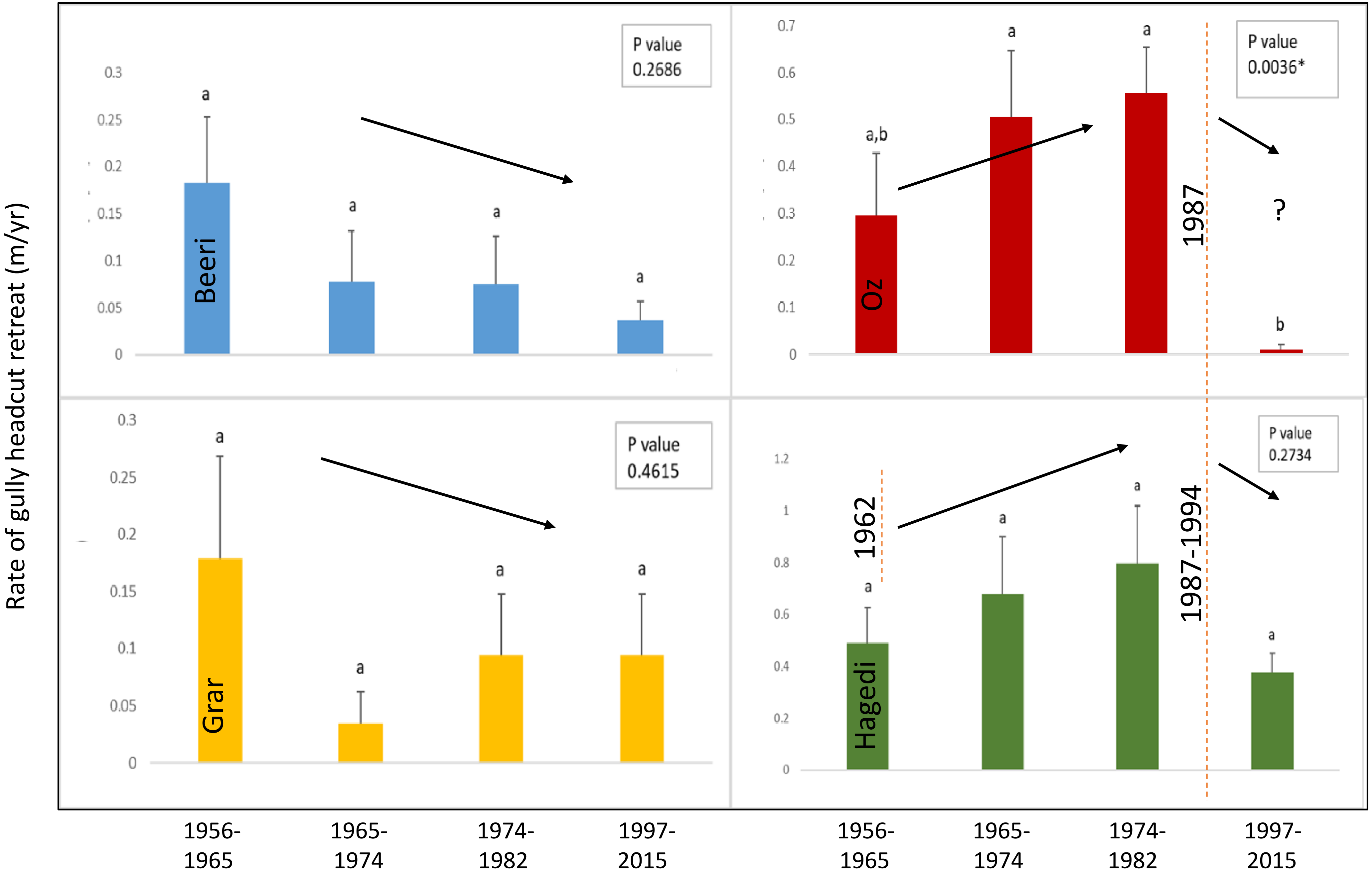
Methods


Beeri Area change between 1956-2014
N
1956
1965
1974
1982
1997
2014
0
0.1
0.2
0.4 Kilometers


Oz Area change between 1956-2014
N
1956
1965
1974
1982
1997
2014
0
0.04
0.08
0.16 Kilometers

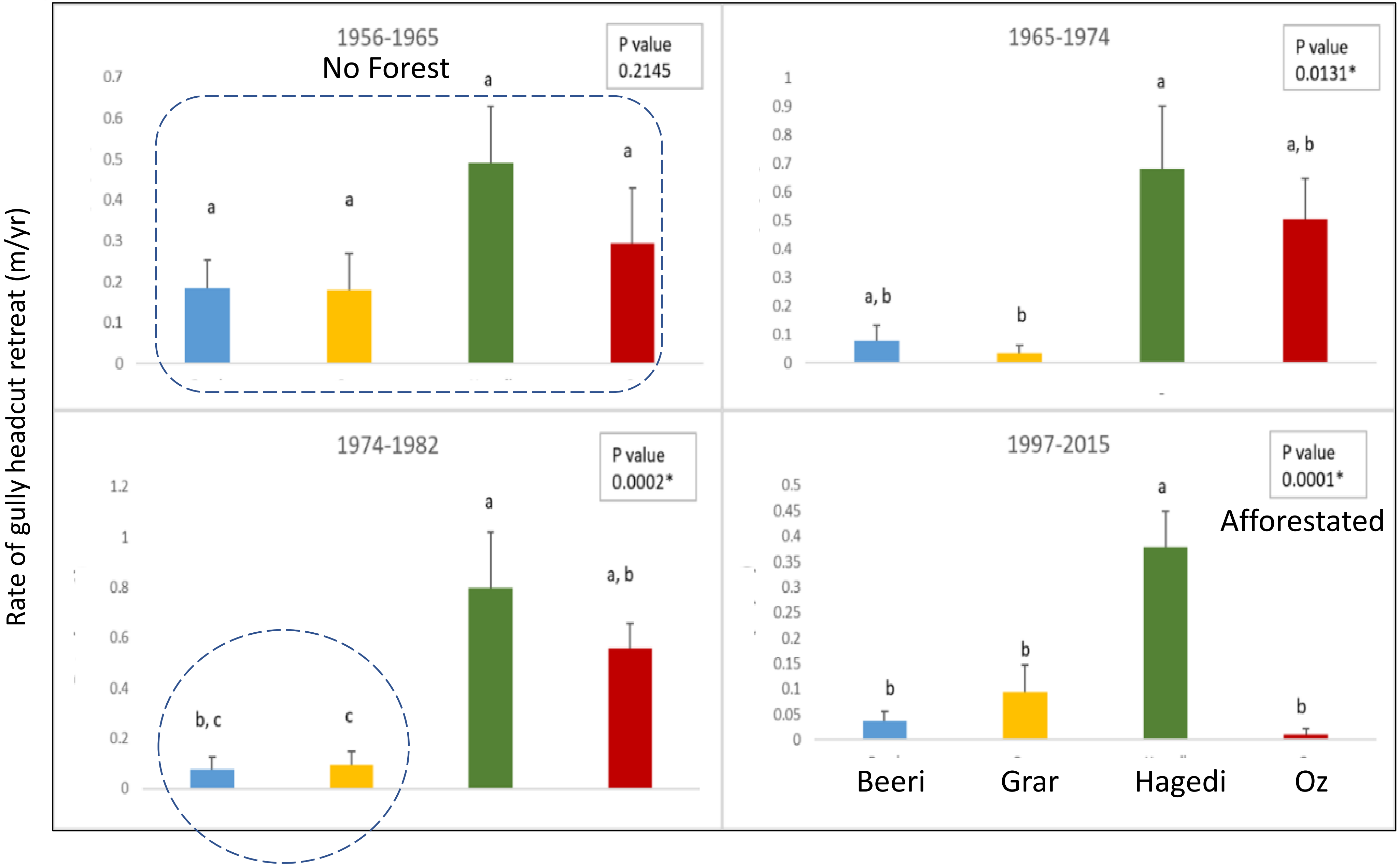
Results

Results



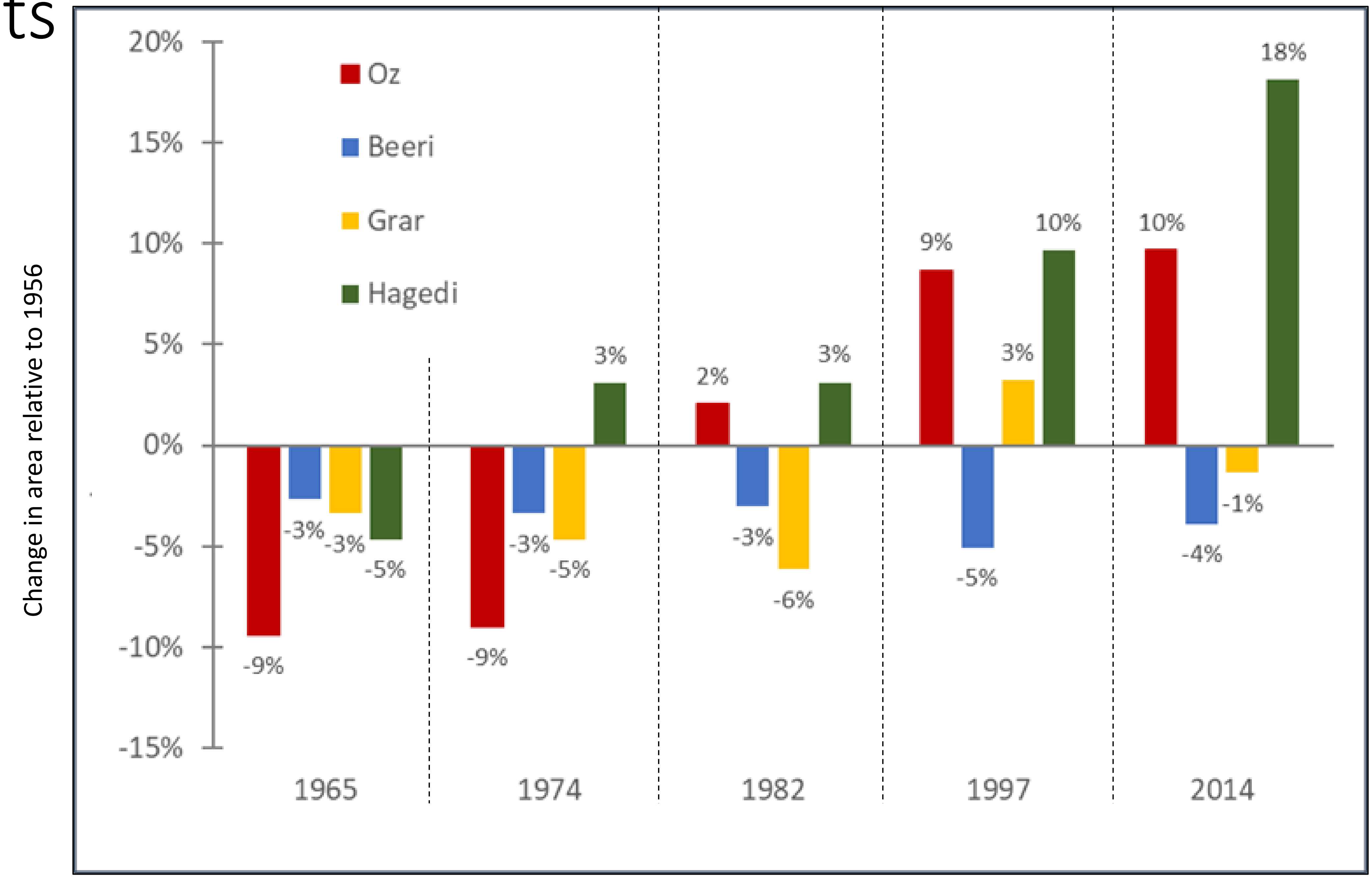
Rate of gully headcut retreat (m/yr)
Beeri
P value
0.2686
0.3
0.25
0.2
0.15
0.1
0.05
0
a
a
a
a
Oz
P value
0.0036*
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
a,b
a
a
b
1987
?
Grar
P value
0.4615
0.3
0.25
0.2
0.15
0.1
0.05
0
a
a
a
a
Hagedi
P value
0.2734
1.2
1
0.8
0.6
0.4
0.2
0
a
a
a
a
1962
1987-1994
1956-1965
1965-1974
1974-1982
1997-2015
1956-1965
1965-1974
1974-1982
1997-2015

Results



Rate of gully headcut retreat (m/yr)
1956-1965
No Forest
P value
0.2145
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
a
a
a
a
1965-1974
P value
0.0131*
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
a, b
b
a
a, b
1974-1982
P value
0.0002*
1.2
1
0.8
0.6
0.4
0.2
0
b, c
c
a
a, b
1997-2015
P value
0.0001*
Afforestated
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
b
b
a
b
Beeri
Grar
Hagedi
Oz

Results



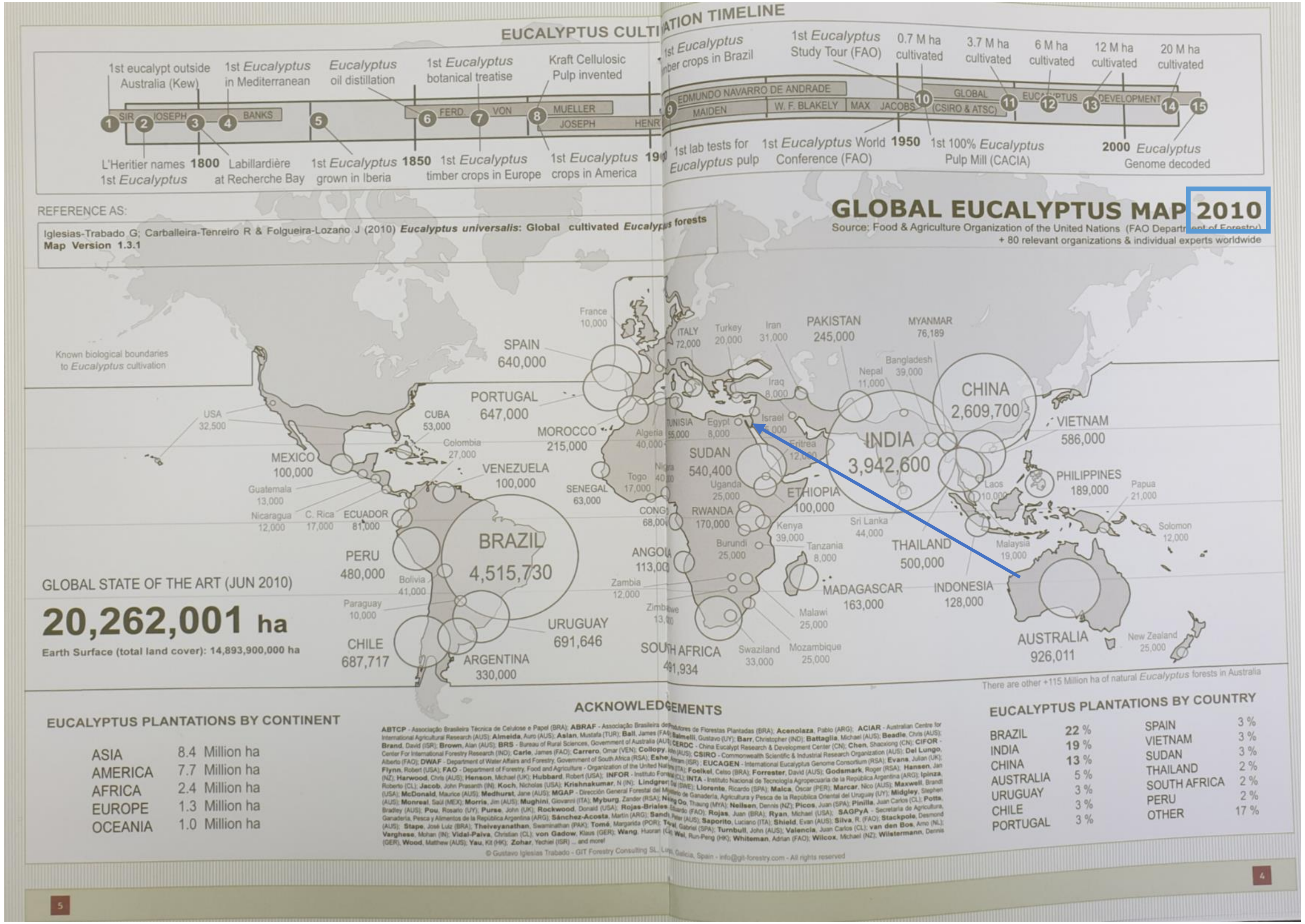
Change in area relative to 1956
20%
15%
10%
5%
0%
-5%
-10%
-15%
Oz
Beeri
Grar
Hagedi
-9%
-3%
-3%
-5%
-9%
-3%
-5%
3%
2%
-3%
-6%
3%
9%
-5%
3%
10%
10%
-4%
-1%
18%
1965
1974
1982
1997
2014

Discussion

Eucalyptus trees

Environmental conflicts

Gullies & Eucalyptus trees



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Does the developmental stage and composition of riparian forest stand affect ecosystem functioning in streams?

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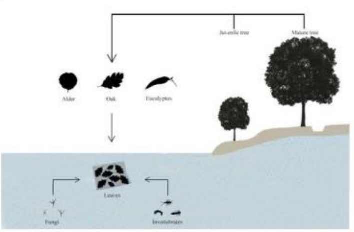
HIGHLIGHTS

- We examined if type and stage of riparian forest affect stream ecosystem functions.
- Stream litter decomposition is driven by both developmental stage and type classes.
- Stage and litter classes also influenced biomass of fungi and invertebrates.
- Fungal richness and diversity were impacted by stage classes but not by litter classes.
- Altering stand developmental stage, *via* restoration, affects key ecosystem processes.

GRAPHICAL ABSTRACT



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Mature and juvenile trees

ABSTRACT

A common watershed restoration practice to improve water quality and stream ecosystem functions and services is replanting riparian corridors with plant species that may differ from those of natural communities. This restoration practice may have consequences on the aquatic ecosystem processes because organisms obtain energy from leaf litter inputs of the riparian zones. Leaf litter decomposition in streams is a vital ecosystem-level process, which depends on the activity of microorganisms and invertebrates. In the current study, we examined whether the type and developmental stage of riparian forest affect stream ecosystem functioning. We selected three widespread tree species in the Northwest Portugal, namely alder (*Alnus glutinosa* (L.) Gaertn.), oak (*Quercus robur* L.) and eucalyptus (*Eucalyptus globulus* Labill.) and conducted stream litter decomposition experiments with leaf litter from trees differing in developmental stage to assess leaf mass loss, fungal and invertebrate biomass and diversity. Both type and developmental stage of riparian stand significantly affected leaf mass loss, biomass of fungi and benthic invertebrates, sporulation of fungi, and abundance of invertebrates. However, only developmental stage of the riparian stand had an impact on the richness and diversity of fungi, whereas invertebrate diversity and richness was influenced by both stage and type classes.

Overall our study provides the novel information that stream ecosystem processes are dictated not only by the composition but also by the developmental stage of the riparian stand. Moreover, this study provides an insight into how by altering riparian forest community composition through restoration practices may have an impact on a key ecosystem process and may have implications for successfully implementing future management strategies.

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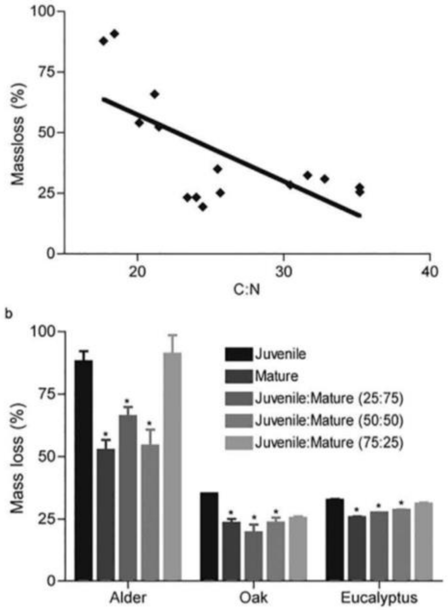

Fig. 1. Linear regression model, correlation coefficient (r) and p-value of the relationship between mass loss (%) and C:N ratio ($y = 112.47–2.74 * x$; $r = -0.688$; $p = 0.0045$); $n = 15$ (a). Percentage of mass loss of alder, oak and eucalyptus leaves with different proportions of juvenile and mature leaves. Mean ± standard error (M ± SE); $n = 4$. *Differ significantly from leaves in the ratio of 75:25 Juvenile to mature type ($p < 0.0002–0.0017$) and from juvenile leaves ($p < 0.0001–0.0003$). $p < 0.05$ was considered significant. The bars in the graph within each leaf type are arranged in a sequence similar to data label (b).

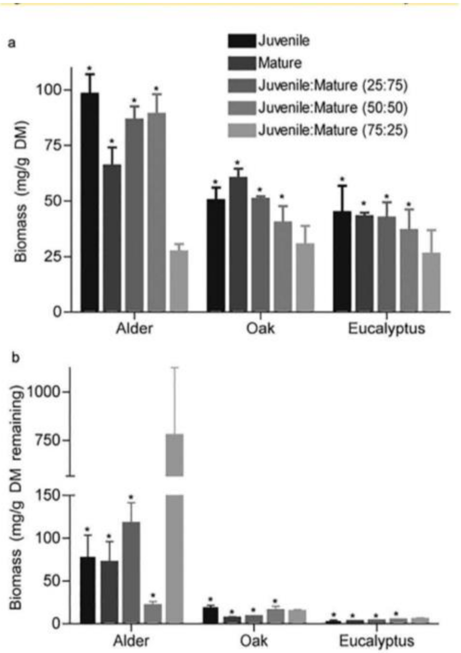

Fig. 2. Fungal biomass (mg/g DM; M ± SEM, $n = 3$, $p < 0.0002–0.0012$) (a) and invertebrate biomass (b) (mg/g DM remaining; M ± SEM, $n = 4$, $p < 0.001–0.0268$) on alder, oak and eucalyptus leaves with different proportions of juvenile and mature leaves. *Differ significantly from leaves in the ratio of 75:25 Juvenile to mature type. $p < 0.05$ was considered significant. The bars in the graph within each leaf type are arranged in a sequence similar to data label.

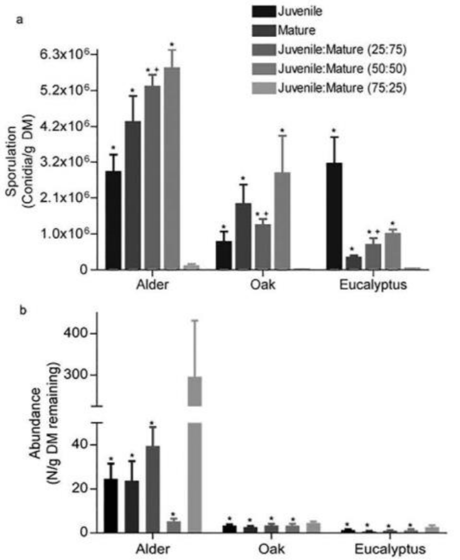

Fig. 3. Fungal sporulation [conidia/g DM; M ± SE, $n = 3$; *differ significantly from leaves in the ratio of 75:25 Juvenile to mature type ($p < 0.0001$) and $^+$from mature leaves ($p < 0.0128$)] (a) and abundance [N/g DM remaining; M ± SE, $n = 4$; *differ significantly from leaves in the ratio of 75:25 Juvenile to mature type ($p = 0.0005–0.0032$) (b) on alder, oak and eucalyptus leaves with different proportions of juvenile and mature leaves. The bars in the graph within each leaf type are arranged in a sequence similar to data label.

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Impact of piping on gully development in mid-altitude mountains under a temperate climate: A dendrogeomorphological approach

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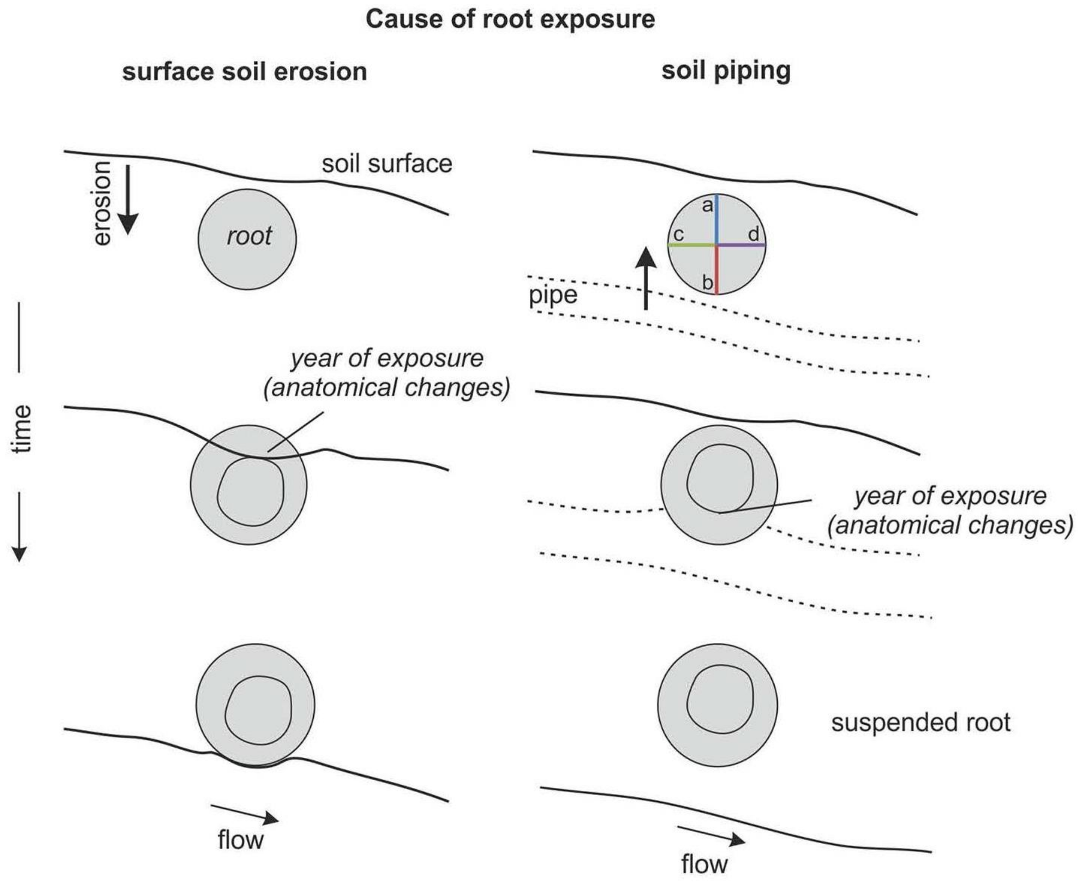
Dating
Roots exposure

ABSTRACT

Gullies are complex geomorphic systems induced and transformed not only by surface erosion processes, but also by subsurface processes such as piping. However, the transient nature of piping makes this process more difficult to observe and study, especially when a pipe roof has totally collapsed. This study aims at assessing piping impact on gully initiation and development using dendrogeomorphological analyses, which are a novel approach in piping study. The survey was carried out in a mountainous area under a temperate climate, using the Bereźnica Wyżna catchment in the Bieszczady Mts. (Eastern Carpathians) as a case study. We estimated the minimum age of pipe collapses and presented the transformation of pipe collapses in order to identify the direction of pipe and gully development. We also verified the contribution of piping to gully development by the reconstruction of gully bottom deepening. The analysis was based on changes in tree and root wood anatomy in diffuse-porous deciduous angiosperm species, i.e. common alder (*Alnus glutinosa*) and field maple (*Acer campestre*). The pipe collapses in the piping system studied are at least 19 to 23–27 years old and the pipe roof initially collapsed in the lower sections of the slope (above the gully head) and the pipe develops up the slope by headward erosion. The gully that was analysed in forest had been deepened by piping during several episodes connected with high precipitation events. In contrast, the pipe located in grasslands collapsed 1–2 years after such events indicating that dense vegetation delays pipe collapse. This study shows that dendrogeomorphological analyses based on diffuse-porous deciduous angiosperm species may be a useful tool in piping research. It provides information on pipe and gully development, as well as enabling estimates to be made of the age of pipe collapses.



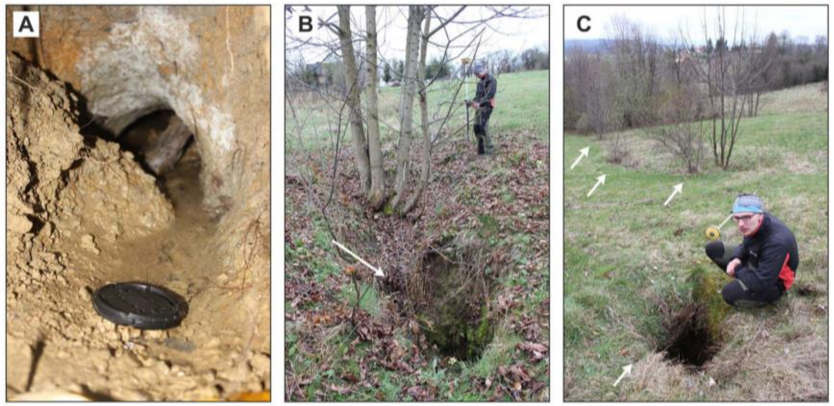


Fig. 3. Examples of a pipe (A) and collapsed pipes (B, C) in the study area (white arrows indicate pipe collapses).

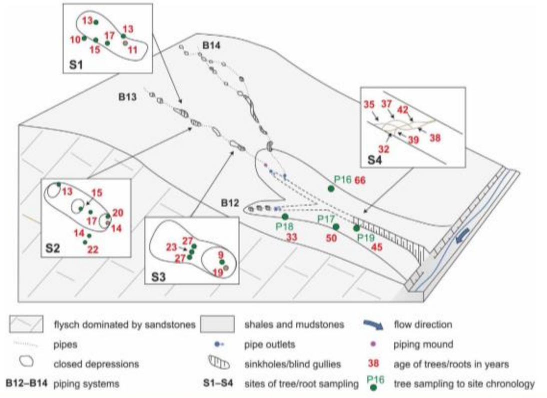


Fig. 4. Schematic diagram of selected piping systems with the location of sites where tree stem and root samples were taken. Red numbers indicate the age of trees and roots. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Implementation

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Riparian forests mitigate harmful ecological effects of agricultural diffuse pollution in medium-sized streams

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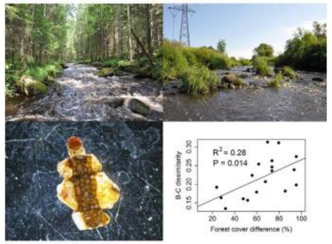
H I G H L I G H T S

- Streams and riparian forests are highly linked.
- Riparian forests can provide many ecological benefits to agricultural streams.
- Stream biota responded to riparian forests cover in the agricultural streams.
- Catchment-scale land use and pollution were the main drivers of stream communities.
- Forested riparian zones can enhance ecological recovery of agricultural streams.

G R A P H I C A L   A B S T R A C T



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Water temperature

A B S T R A C T

Agricultural pollution persists as a significant environmental problem for stream ecosystems. Uncultivated buffer zones or reforestation of riparian zones are advocated as a key management option that could compensate the harmful land use impacts. The effectiveness of riparian forests to protect ecological conditions of agricultural streams is yet inconclusive, particularly regarding the benefit of riparian buffers in streams suffering from uninterrupted agricultural diffuse pollution. We studied the effects of riparian land use on periphyton production and diatom, macrophyte and benthic macroinvertebrate communities in medium-sized agricultural streams by a) comparing 18 open field and forested agricultural stream reach pairs that only differed by the extent of riparian forest cover, and b) comparing the agricultural reaches to 15 near-natural streams. We found that periphyton abundance was higher in open reaches than in the forested reaches, but diatom community structure did not respond to the riparian forest cover. Macrophyte and macroinvertebrate communities were clearly affected by the riparian forest cover. Graminoids dominated in open reaches, whereas bryophytes were more abundant in forested reaches. Shredding invertebrates were more abundant in forested reaches compared to open reaches, but grazers did not differ between the reach types. Macrophyte trait composition and macroinvertebrate community difference between the reaches were positively related to the difference in riparian forest cover. The community structure of all three groups in the agricultural streams differed distinctly from the near-natural streams. However, only macrophyte communities in forested agricultural reaches showed resemblance to near-natural composition. Our results suggest that riparian forests provide ecological benefits that can partly compensate the impacts of agricultural diffuse pollution. However, community structure of forested agricultural reaches did not match the near-natural composition in any organism group indicating that catchment-scale management

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THE ECOLOGY OF INTERFACES: Riparian Zones

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ABSTRACT

Riparian zones possess an unusually diverse array of species and environmental processes. The ecological diversity is related to variable flood regimes, geographically unique channel processes, altitudinal climate shifts, and upland influences on the fluvial corridor. The resulting dynamic environment supports a variety of life-history strategies, biogeochemical cycles and rates, and organisms adapted to disturbance regimes over broad spatial and temporal scales. Innovations in riparian zone management have been effective in ameliorating many ecological issues related to land use and environmental quality. Riparian zones play essential roles in water and landscape planning, in restoration of aquatic systems, and in catalyzing institutional and societal cooperation for these efforts.

Conclusions

Flow regime –Sediment – Vegetation….. Continues to be challenging in a range of climatic conditions

The combine surface and subsurface erosion processes under trees canopy is hard to measure

In riparian zone go for reforestation and not afforestation

Prefer native vegetation (even if its not a tree)

Restoration is varying according time and space