Historic Water Management Infrastructure in the San Pasquale Valley, Calabria, Italy.

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The Bova Marina Archaeological Project has been documenting the temporal and spatial distribution of the construction and the physical characteristics of the original water management infrastructure as well as documenting the changes in the natural and social systems of the San Pasquale Valley (SPV) in Calabria, southern Italy.

The SPV community pooled labor resources in the first half of the 20th century to build check dams, terrace walls, and anti-erosion bulwarks out of locally available materials: stone, locally fired bricks, and lime mortar. In doing so, they formalized a particular anthropogenic landscape configuration that was tuned to the specific socio-natural conditions of that period.

How resilient has this locally developed erosion protection infrastructure been in the face of changing climate, land-use, and demographic conditions over the last ~116 years?

Data and methods:

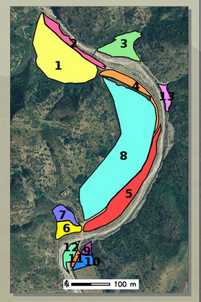
Field data were collected via geo-archaeological and archaeological field survey, interviews with landowners in the region, and archival research. Spatial data were captured by high-precision GPS, mobile tablet data recording. 2012 Quickbird satellite from the Italian Ministry of the Environment provided the reference image set, 2017 imagery was captured via aerial drone photogrammetry, and historic imagery from georeferencing 1942 RAF air photos and a 1902 property map. Historic climate data for Bova Superiore (in the SPV) and nearby weather stations were obtained from the Centro Funzionale Multirischi of Calabria, and cover the period from 1916-2017. All analysis conducted with Open Source Software tools such as Open Drone Map, QGIS, and GRASS GIS.

Quantifying historic landscape change:

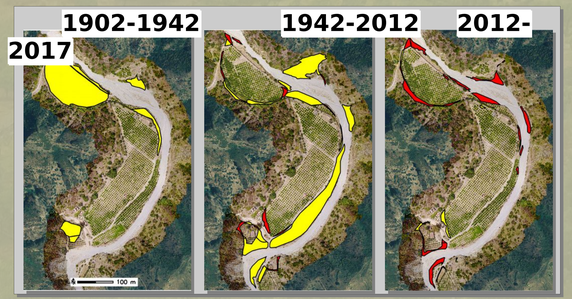
Our case study is a property known as "Peristeria," which was established in the mid-19th century.

Thirteen formalized agricultural terraces were identified at Peristeria based on the results of geoarchaeological field work conducted in the 2017 field season and our accumulated database of recorded terrace walls and other structures on the property.

A terrace chronology was created by digitizing the changing terrace geometry from historic imagery for the years of 1902, 1942, 2012, and 2017.



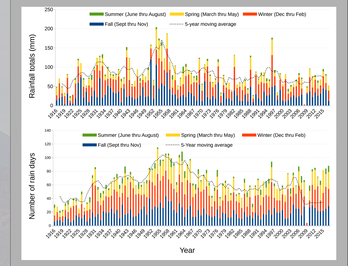
Terrace area gained and lost between each image could then be calculated via statistical overlay of digitized terrace polygons. Thusly, from the four images, three maps of terrace change were created corresponding to the time intervals of: 1902 – 1942, 1942 – 2012, and 2012 – 2017.

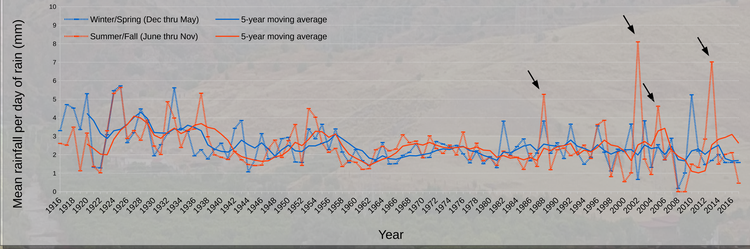


Terrace area expanded between 1902 to 1942, likely due to construction of formal terrace walls around existing alluvial terraces. Further expansion occurred from 1942 to 2012, including reclamation of newly formed alluvial terraces. From 2012 to 2017, however, terrace area is lost, indicating that the erosion protection infrastructure built in the earlier period is now beginning to fail.

Historic climate trends:

Historic weather station data for the SPV show that the period in which terrace configurations and anti-erosion bulwarks were formalized was wetter than it is today, with most of the rain falling in the Winter and Spring. However, in recent years there is an increasing for trend of intensive summer storms that likely have more erosive power than winter events. The frequency of extreme events seems likely to increase as global climate patterns continue to change.

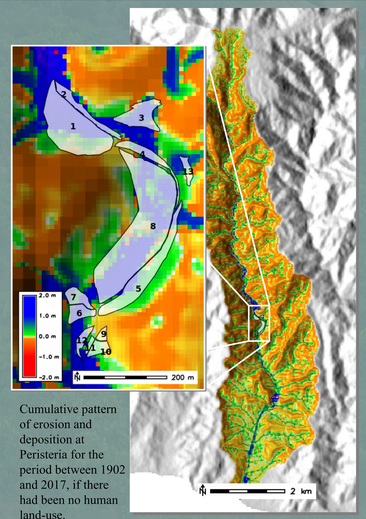




Erosion modeling:

We used the *r.landscape.evol* GRASS module to simulate the amount of erosion and deposition that would have occurred over our study time period based on the real climate record, but with no human land-use. This acts as a comparative baseline against which to assess the effectiveness and potential unforeseen impacts of the early 20th-century water management infrastructure to erosion dynamics in the SPV over time.

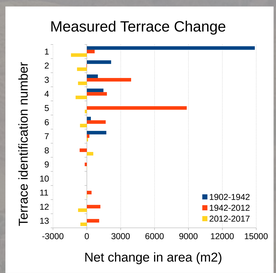
A section of the early 20th century anti-erosion bulwark at Peristeria, which has been undercut by erosion in recent years.

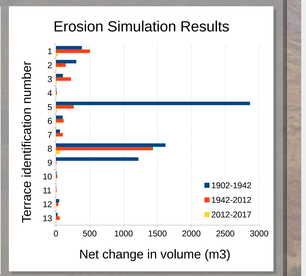


Cumulative pattern of erosion and deposition at Peristeria for the period between 1902 and 2017, if there had been no human land-use.

Failing resilience of historic water management infrastructure in the SPV:

Comparison of our measured sequence of terrace changes to the results of our simulation model suggest that early settlers in the SPV took advantage of early 20th century climate and sedimentary dynamics to expand agricultural land by encapsulating a set of naturally expanding alluvial terraces with stone and mortar walls. The simulation results suggest that while the recent changes to the rainfall regime should have slowed deposition on terraces, terraces should not be experiencing the current rates of erosion that we have measured on our image sequences.





Conclusions:

This study documents how an agricultural community "mapped onto" an advantageous set of natural conditions to build a thriving socio-natural system in the SPV in the early 20th century. As community members emigrated in the post-war period, labor resources have dwindled, and water management infrastructure that was once effective is no longer maintained. That infrastructure, built for a different set of climate conditions, under a different set of social conditions, is beginning to fail, and valuable agricultural land is being lost.

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For more information visit: http://isaacullah.github.io