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Project acronym: PastoralMod

Project title: Modelling pastoral adaptation in arid lands: an ethnoarchaeological approach

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SCIENTIFIC ABSTRACT AND RESULTS

PastoralMod has been focusing on the study of the mechanisms of pastoral adaptation in hyper-arid environments from the last 5k years. A large area set in the middle of the Sahara desert, between Libya and Algeria, has been selected to develop an innovative ethnoarchaeological approach based upon Earth Observation and modeling. The role of the ethnographic present has been taken as key to explore past dynamics from the last millennia, when the environmental and climatic conditions were similar to the present ones. PastoralMod involved training on (i) the use of geostatistical techniques on previously collected data related to current and recent human occupations, and on the (ii) adoption of Earth Observation (EO) and Geographical Information System (GIS) for the implementation of the dataset. PastoralMod was a timely and ground-breaking initiative to foster archaeology and ethnoarchaeology in regions where safety issues have been preventing archaeological research in North Africa and Middle East since the so called 'Arab Spring'.

Data collected in the course of the fellow's doctoral research on a Tuareg community from SW Libya, were subjected to geostatistical analyses and modeling to unveil spatial patterning in the distribution of domestic and livestock features at campsites. PastoralMod investigated the material outcome of specific social attitudes, showing that the latter can be spatially expressed in the arrangement of features, offering original and unexpected clue to the understanding of pastoral settlement pattern. On a broader level, the project reviewed the data on current and recent frequentations in SW Libya data under the framework of the resilience theory. This generated a different perspective on current and recent adaptive cycles in hyper-arid environment, showing the flexibility of human communities in allegedly unsuited regions.

In the course of the project, hyper-resolution imagery obtained through a grant by the DigitalGlobe Foundation (entrusted to the fellow) has allowed a remote investigation of a larger area, c. 3000 km² set between Libya and Algeria. In this region, PastoralMod has tested a remotely sensed approach to the geomorphology and archaeology/ethnography. Main characteristics of the landscape have been identified through a Digital Model of Terrain (DEM). This has allowed the reconstruction of the ephemeral hydrological network in ArcGIS environment, by standard GIS hydrology procedure. In order to differentiate active and relic riverbeds, and to shed light on land-cover dynamics in arid lands, current vegetation has been taken into account as well. Present land-cover is being taken as the most reliable proxy for the remote detection of soil humidity, and it is currently under investigation. In addition, all the anthropic signatures were remotely recorded and identified. Hyper-resolution imagery was loaded in ArcGIS 10.3™. The study area was overlaid with a grid consisting of c. 300 vertical strips of 250 meters width (West to East). Each strip underwent systematic visual inspection, from N to S. Every identified archaeological feature was digitised by means of a point located in the middle of the feature and assigned to a thematic layer. All records were classified by the fellow according to their morphological characteristics and size. Anthropic features that could be identified through visual inspection of the RS imagery consist mainly of tombs, monuments, settlements (including seasonal tented encampments and huts), forts, irrigations channels, crop fields,

and stone enclosures of uncertain use. Visual inspection has led to the identification of more than 7k anthropogenic features (Tab. 1). Almost all type of graves known in central Sahara have been identified here as well (Fig. 1). The most prominent figures are those from the 'graves' adding up to 5261 tombs, the majority of which of likely Garamantian (c. 1000 BC – AD 700) age. Graves, in the form of round stone structures (or drum shaped, or bazinas), along with other simple conical tumulus are the majority of the evidence so far recorded (Fig. 2). At a glance, data confirm the primary role of some proximity to vegetation and drainage. It is particularly notable, in figure 3, which presents an overlay of drainage, vegetation, and anthropic signatures (from the last 5k years to present times), that the scarcity of vegetation in proximity of the hydrological system of the Tadrart Acacus is marked by the almost absence of open air archaeological evidence. In contrast, areas where archaeological classes of graves and qsur are present, are clearly more vegetated with clusters of archaeological points in areas of vegetation clusters and sparser archaeological traces in less vegetated areas. This demonstrates that the procedures adopted by PastoralMod can lead to the identification of veritable hotspots for human frequentations from the last 5 millennia, when the Sahara had become dry.

Impact

One of the main challenges in the study of African landscapes in general and the Sahara desert in particular, has been the lack of baseline data on the past and present environments at relatively high spatial and temporal resolutions. As a consequence, we have, to date, a patchy understanding of the history of these anthropic landscapes. Collecting information from cultural landscapes that are in danger of disappearing due to activities such as mining and oil/gas drilling, agricultural expansion and, as of recent, conflicts, is an important aspect, not only for the preservation of the historic memory of the landscapes under study but also for future planning.

PastoralMod has demonstrated great potential for creating spatio-temporal datasets via EO and GIS at a relatively low cost and high speed, as compared to field data collection. This seems particularly true in hyper-arid Africa, where collected field data are scarce, the areas to be covered are large and the visibility of certain classes of archaeological evidence is high, since it contrasts with the background barren environment. In order to begin to create refined temporal and spatial resolution datasets that may serve as background for the study of human environment interactions in the Sahara, PastoralMod has developed a combined method for mapping a number of indicators of and drivers for the presence of human habitation in this environment. This procedure allows relatively rapid regional-scale archaeological mapping, by using direct identification of visible remains but also that of proxies of ancient environmental settings such as river networks (paleohydrological mapping) and humid areas (vegetation mapping) and are aimed at creating an analytical environment that will allow the use of spatial analysis and modeling for the understanding of the evolution of desert lifeways. One of the hallmark of PastoralMod is its exportability to other arid contexts, in order to predict or assess the intensity of past and current human occupations.

Finally, PastoralMod has promoted a deep re-evaluation of human adaptation to arid lands, fostering an ethnoarchaeological approach to the study of resilience in dry regions. The results of the project will be the main topic of the workshop organized by the fellow to be held in Barcelona 15-17 February, that will see the participation of a number of recognized scholars involved in arid lands research.

Attached (fig and tab)

Tab 1 List of the anthropic (archaeological and ethnographic) signatures recorded

Fig 1 Anthropic (archaeological and ethnographic) signatures recorded (a: regional context; b: study area)

Fig 2 Selected anthropic (archaeological and ethnographic) signatures recorded in hyper-resolution satellite imagery

Fig 3 Vegetation, rivers, and anthropic signatures recorded