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Data Descriptor

Open-Access Geographic Data for the Argali Habitat in the Southeastern Tajik Pamirs

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Abstract: Seven Geographic Information System (GIS) layers comprise this dataset intended for understanding the Marco Polo argali habitat in the southeastern Tajikistan Pamirs (37°33′ N, 74°09′ E). Extensive remote sensing habitat data processing and field data analysis of the Marco Polo sheep study area have yielded these layers that are now available online to download and for use by other researchers interested in studying the argali patterns and habitat suitability in the southeastern Tajik Pamirs. It is important to note that the layers were generated using a 30-m Landsat ETM image and field data from 2012.

Data Set: http://case.nmsu.edu/case/tajikistan.html

Keywords: Tajikistan Pamirs; remote sensing; Marco Polo argali; Tajik vegetation; pasture; GIS dataset

1. Summary

We generated a dataset to describe the essential geographic layers that would be used as landscape drivers for the Marco Polo argali habitat in the southeastern Tajikistan Pamirs, and to aid a paper [1] that was recently published. The dataset, consisting of layers in Geographic Information System (GIS) format, is available online for easy download through the New Mexico State University's Center for Applied Spatial Ecology (CASE) website [2] and for use by other researchers interested in studying the southeastern Tajik Pamirs. While every layer is deemed important, we put more attention and time in developing the mapping methodology of the summer pastures.

Mountain pastures are by far the greatest source of livestock forage in the eastern Pamirs. In the Food and Agriculture Organization Statistics (FAOStat) report [3], about 87% of the total pasture land is classified as mountain pasture. With a vertical transhumance herding system, the use of elevated pasture areas depends on the season. Summer pastures, located in the productive rangelands of the southeastern Pamirs, occur between 3500 to 4700 m above mean sea level (AMSL) and typically utilized between months July to September. Pastures in much lower elevations are used for winter, spring, and fall seasons. Hay fields, which are located near rivers, are used as a source of winter livestock fodder.

After the collapse of the USSR and the support mechanism for agricultural sectors beginning in 1991, the best summer pastures that are hard to access without heavy-duty trucks, are no longer used. Distance and the consequent financial constraints have limited herder's accessibility to summer rangelands. Also, there are difficulties in sustaining the existing remote watering points. The change of the herding patterns has negative consequences for the livelihoods of the herders on the area. Breu and Hurni [4] elucidated the degradation of pastures at lower elevations close to the villages. As herders consider expenses too high to make a profit from high pastures, herds are concentrated near large settlement areas resulting in overgrazing and degradation of vegetation cover [5–7].

Recent studies in the eastern Pamirs concern the extensive removal and degradation risk for teresken, a dwarf shrubby vegetation that is used as a fuel substitute [8–11]. While the dwarf shrub has been documented quite extensively, less attention is paid to the quantification of the green vegetation. An unpublished thesis [12] investigated the landcover of the Tajik Pamirs using one image of Landsat 7 acquired in 2000. Another more recent paper [6] discussed the relationships between grazing practices and pasture potentials in the eastern Pamirs. The study concluded that there is less grazing pressure on summer pastures; however, a number of distant summer pastures showed high livestock numbers during summer. A research gap remains concerning the quantitative estimate of the summer pasture cover in the eastern Pamirs.

Satellite imagery is an essential means for capturing disturbance processes and for the estimation of land cover spatial distribution [13,14]. In our efforts modeling the sheep habitat, we investigated the potential of remote sensing data to generate a summer vegetation map in an arid community that will enable us to analyze pasture dynamics and spatial changes.

The geographic layers presented in this paper are the result of our mapping efforts. The dataset could give information on the extent and the vegetation status for improving pasture management and enhancing the current knowledge of vegetation communities on the Pamirs. More importantly, the geographic layers could provide critical information needed for understanding food resources and habitat for the Marco Polo argali.

2. Data Description

The dataset is comprised of seven GIS layers: contours, possible sheep habitat, rivers and streams, slope, vegetation cover, vegetation within 1 km from stream, and water bodies. We generated the individual layers to collect essential information on argali patterns and habitat suitability in the southeastern Tajik Pamirs. Table 1 shows the type and short description of the layers.

Table 1. Layer name, type, and short description of the seven GIS layers.

Layer	Type	Description
Contours	Polyline	Contour lines with corresponding elevations
Slope	Raster	Continuous raster image of the slope
Rivers and Streams	Polyline	Rivers/streams that are non-perennial/intermittent/fluctuating
Water Bodies	Polygon	Lakes and other inland bodies of water
Vegetation Cover	Polygon	Spatial distribution of green vegetation
Vegetation Cover (1 km)	Polygon	Green vegetation near streams and rivers
Possible Sheep Habitat	Polygon	Specific locations of possible sheep habitat

2.1. Data

We have shown the habitat environment of argali in terms of the seven geographic layers: slope, distance to escape terrains and water sources, elevation, and vegetation cover. The seven layers are futher described below.

2.1.1. Contours

The mean elevation is 4430 m AMSL. The minimum and maximum elevations observed are 4133 m and 5232 m, respectively.

2.1.2. Slope

The maximum degree of slope inclination is 89.26°, indicating the presence of essentially vertical inclinations in the area. About 9% of the area is considered very steep, with slopes greater than 80°.

The minimum degree of slope inclination is 0.27° located on valleys and foothills. Nearly half of the study area (48.9%) is within 1° to 10° slope.

2.1.3. Rivers and Streams

The total length of rivers and streams combined is about 92.32 km. Of this length, 38.83 km is from the two major rivers inside the study area.

2.1.4. Water Bodies

The largest body of water is the lake located in the northeast region, which is about 3.24 km^2 in area. The rest of the inland water sources have areas that range from 0.08 km^2 to 1.04 km^2.

2.1.5. Vegetation Cover

The total summer pasture cover is about 146 km^2, which is approximately 23% of the total study area. About 8.48% of vegetation cover is located in the lower elevation of 4200 m AMSL, while 40% of the vegetation is at 4400 m AMSL. Less than 1% of the cover is at 5200 m AMSL. Overall, 97% of the areas covered with vegetation are at elevations 4600 m AMSL and below.

2.1.6. Vegetation within 1 km from Rivers and Streams

This layer shows how much percentage of vegetation cover is located near streams and rivers. Close to 50% of the vegetation cover within 1 km from the river is located at 4400 m AMSL. Nearly 90% is between elevations 4200 m and 4400 m AMSL.

2.1.7. Possible Sheep Habitat

This layer shows possible locations of sheep habitat for a specific area. The habitat layer is a result of the integration of the other layers plus the data from occupancy locations of wild sheep and the detailed field transect surveys. The total estimated area found to be possible sheep habitat is about 2.49 km^2. This potential habitat is within 1 km from the river, within the 4200 m to 4400 m elevations, and near escape terrains (about 160 m to the next 100 m elevation).

2.2. Metadata

Table 2 shows the metadata variables used for the generation of the dataset. The boundary extent of the geographic layers is also highlighted in the table. All layers carry the same metadata.

To meet the U.S. Environmental Protection Agency (EPA) and Federal Geographic Data Committee (FGDC) open data metadata requirements, we used EPA Metadata Editor (EME) [15] to generate a metadata file for each layer. The metadata files can be downloaded together with the layers.

Table 3 details the metadata of the seven geographic layers, showing the type of the data, the name used in the data, and the description of each data.

Table 2. Description of data sources and study area extent in the southeastern Tajik Pamirs.

Information	Value	Description
Data Source		
Geographic Coordinate System	WGS 1984	Location defined by World Geodetic Survey 1984
Datum	WGS 1984	Location defined by World Geodetic Survey 1984
Angular Unit	Decimal Degrees	
Extent		
West	74.166152	West longitude boundary
East	74.506520	East longitude boundary
North	37.578701	North latitude boundary
South	37.395994	South latitude boundary

Table 3. Metadata description of the seven geographic layers. Distance units are meters (m) and kilometers (km), while area is square kilometers (km^2). The unit 'na' means 'not applicable'.

Layer	Type	Unit	Description
Contours			
contour	numeric	m	elevation value
shape_leng	numeric	m	length of the contour lines within the boundary
Slope			
format	tiff	na	
pixel type	floating point	%	values varies from 0 to 90°
Rivers and Streams			
f_code_des	string	na	description of whether it is a major river or stream
hyc_descri	string	na	main description: perennial/intermittent/fluctuating
shape_leng	numeric	km	length of the river/stream
fid_rivers	numeric	na	unique identification number
Water Bodies			
area	numeric	km^2	surface area of the lake/water body
perimeter	numeric	km	perimeter of the lake/water body
Vegetation Cover			
id	numeric	na	unique identification number of polygon
gridcode	numeric	na	"0" means no vegetation, "2" means with vegetation
Vegetation Cover (1 km)			
id	numeric	na	unique identification number of polygon
gridcode	numeric	na	"0" means no vegetation, "2" means with vegetation
buff_dist	numeric	km	buffer distance from the river and stream
Possible Sheep Habitat			
gridcode	numeric	na	"0" unlikely to be a habitat, "4" highly possible to be habitat, "6" means bare soil
descriptio	string	na	description of the gridcode

3. Methods

In this dataset, contours were derived from NASA's Shuttle Radar Topography Mission (SRTM) 90 m digital elevation (DEM) dataset that is available to download through the U.S. Geological Survey (USGS) website [16]. A rescaling of the DEM was performed to the spatial resolution of the other GIS layers (30 m). The slope layer was also a byproduct of the DEM. Rivers and streams were digitized onscreen with the aid of the Landsat image, the high-resolution images from the Google Earth engine, the reconnaissance and field survey, and the expert knowledge of the area.

For the water bodies and the vegetation cover, we utilized the Landsat 7 Enhanced Thematic Mapper Plus (ETM+) image from July 2012 to map out these features. The level-1 terrain-corrected product (L1T) Landsat data was obtained from the USGS Earth Resources Observation and Science (USGS EROS) resource archive [17].

We utilized the object-based image analysis (OBIA) for our image classification, guaranteeing a much higher classification accuracy for the vegetation cover [18]. We integrated variables such as digital elevation model (DEM), Normalized Difference Vegetation Index (NDVI) [19], Principal Component Analysis (PCA) [20] utilizing the first two principal components, Modified Soil-adjusted Vegetation Index (MSAVI) [21], and texture features [22] into the OBIA. We limit the land use classes to only three: vegetation, water, and barren land as our objective was to specifically delineate the summer vegetation cover only. The image classification showed an overall accuracy of 91.8%, and a kappa statistic of 0.85. For vegetation class alone, the producer's accuracy (PA) was 90.8% and the user's accuracy (UA) was 91.6%. As for the texture features, we took advantage of ENVI software's textural filters that were based on the co-occurrence measures [23]. We integrated homogeneity (HOM), second moment (M2), dissimilarity (DIS), entropy (ENT), and contrast (CON) in the OBIA. More detailed steps of the image analysis can be read from a complementary paper by Salas *et al.* [1].

For the generation of the sheep habitat layer, we focused more on the landscape characteristics of the wet and dry meadows from our field surveys, which we believe are the good habitats for sheep. The wet meadow is popular for sheep during the winter season, while the dry upland is used in the spring. The dry upland is characterized by steep terrain, which ewes and lambs use as escape terrain. The wet meadow comprised a flatter slope compared to the dry meadow and the dry upland locations. The dry upland was located at about 4380 m AMSL; 55 m higher than the dry meadow and 76 m higher than the wet meadow. In terms of escape terrains for the sheep, the dry upland was bounded by steeper terrains in the northeast and southwest directions. The location of the dry upland community was less than 160 m to the next 100 m (higher) elevation. Using the spectral information of the pixels where the field datasets were collected, the possible sheep habitat layer was created.

The dataset resulting from this study is critical for future research of the movement of argali in the southeastern Tajik Pamirs, including their dispersal patterns and population dynamics. Additionally, the GIS layers would serve as reference information in developing a management plan for future argali habitats and how these ungulates change their preferred habitat in response to the presence of livestock competition in the area.

4. User Notes

To facilitate all remote sensing analyses, we used ERDAS Imagine [24] and ENVI software [23]. All GIS-based analyses and mapping were done by ArcGIS software [25].

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Author Contributions: Eric Ariel L. Salas prepared the datasets, preprocessed the satellite images, and drafted the manuscript. Raul Valdez and Kenneth G. Boykin conceived the study and participated in the discussion of the analyses and results. Also, Raul Valdez collected the field summer data in the Pamir Mountains in Tajikistan.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

GIS	Geographic Information System
CASE	Center for Applied Spatial Ecology
DEM	Digital Elevation Model
EPA	U.S. Environmental Protection Agency
ETM+	Enhanced Thematic Mapper Plus
FGDC	Federal Geographic Data Committee
EME	EPA Metadata Editor
OBIA	Object-based Image Analysis
SRTM	NASA's Shuttle Radar Topography Mission
USGS EROS	U.S. Geological Survey Earth Resources Observation and Science
NDVI	Normalized Difference Vegetation Index
PA	Producer's Accuracy
PCA	Principal Component Analysis
MSAVI	Modified Soil-adjusted Vegetation Index
UA	User's Accuracy
HOM	Homogeneity
M2	Second Moment
DIS	Dissimilarity
ENT	Entropy
CON	Contrast

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