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Assessment of Pastures in Vashlovani National Park

Sustainable Management of Pastures in Georgia to Demonstrate Climate Change Mitigation and Adaptation Benefits and Dividends for Local Communities (UNDP/EU).

Prepared by

NACRES - Centre for Biodiversity Conservation & Research

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Executive summary

This report describes the results of a rapid assessment of pastures in Vashlovani National Park (VNP) conducted for the project: **Sustainable Management of Pastures in Georgia to Demonstrate Climate Change Mitigation and Adaptation Benefits and Dividends for Local Communities** (UNDP/EU).

The assessment was carried out during 7 May to 17 June, 2013 and covered VNP as well as five other sites previously proposed as potential alternative pastures for some of the sheep farms currently using VNP.

The study had major time limitations and the timing and period of the contract implied that the assessment could begin in the second half of May i.e. during the time when there is no grazing on the pastures of Vashlovani national park (VNP). Therefore, the assessment does not take into account the situation in autumn or winter during which time there are sheep on VNP.

The primary objectives were(i) to identify the most degraded sections and classify all VNP pastures according to their current status (degradation/productivity), (ii) to propose rehabilitation/management measures for priority sections, (iii) to identify potential alternative pastures outside VNP and propose relevant recommendations.

The assessment relied on existing information combined with new field data; using ground data, GIS technology and Landsat TM imagery 2010, we developed a primary model of pastures in Vashlovani.

As expected from its geographical location, terrain features and high diversity of habitats/physical conditions, the aboveground biomass appears to be unevenly distributed throughout VNP. However, a general pattern can be detected: the productivity of pastures tends to decrease toward the south while the best pastures are in the northern parts of VNP.

In full compliance with a previous assessment, we found that, overall, the VNP pastures are in good condition. Both the vegetation cover and standing biomass are on the high side considering the soil and climate conditions.

While nearly half of all the pastures in VNP were classified as “excellent”, a fifth of them were classified as “poor”. The latter pastures may need special attention as they may be particularly susceptible to non-sustainable grazing and/or climate change.

A significant degraded area is found in the central part of VNP and the degradation is apparently caused by intensive, unorganized and unrestricted sheep movement.

No *de facto* vacant pastures were identified and according to the local authorities no *de jure* vacant pastures are currently available in the vicinity of VNP.

Three sites in the Chachuna area may be considered as feasible alternatives for some of the VNP farms solely based on the actual status of the pastures - their geographical location and the potential for improvement through proper management or restoration measures.

Contents

1 Background

This report describes the results of a rapid assessment of pastures in Vashlovani National Park (VNP) conducted for the project: **Sustainable Management of Pastures in Georgia to Demonstrate Climate Change Mitigation and Adaptation Benefits and Dividends for Local Communities** (UNDP/EU).

The assessment was carried out during 7 May to 17 June, 2013 and covered VNP as well as five other sites previously proposed as potential alternative pastures for some of the sheep farms currently using VNP.

Although intended and planned as a rapid assessment, this study had major time limitations. The timing and period of the contract implied that the assessment could begin in the second half of May i.e. during the time when there is no grazing on the pastures of VNP (the seasonal sheep farmers leave the area at the beginning of May). Thus all field observations and data collection were conducted when the pastures were already free of almost any grazing pressure. Therefore, the assessment does not take into account the situation in autumn or winter during which time there are sheep on VNP. This aspect was fully considered in the analysis. On the other hand, the timing coincided with that of the previous assessment carried out by Dr. G. Gintzburger in 2012[1], which provided the opportunity to also use the 2012 data for the analysis.

2 The objectives of the assessment

The primary objectives of the rapid assessment of Vashlovani pastures were(i) to identify the most degraded sections and classify all VNP pastures according to their current status (degradation/productivity), (ii) to propose rehabilitation/management measures for priority sections, (iii) to identify potential alternative pastures outside VNP and propose relevant recommendations.

3 An overview of VashlovaniProtected Areas

3.1 General information

Vashlovani Protected Areas (VPA) is situated in the district of Dedoplistkaro, in southeast Georgia (see Annex 2 for map). With a total area of 35,594.7 ha, VPA is one of the largest PAs in the country.

[1] *Rangelands Condition and Assessment: Vashlovani national park and associated project areas*, G. Gintzburger, July 2012 (prepared for Georghia Carnivore Conservation Project, FFI/NACRES).

The history of VPA begins in 1930s with the establishment of the Vashlovani Nature Reserve. The reserve originally covered only 4,000 ha,but in subsequent years it was enlarged several times. Finally, in 2003, Vashlovani Protected Areas was established which consists of the Vashlovani Nature Reserve (10,142 ha), Vashlovani National Park (24,598 ha), and three natural monuments (the Alazani floodplain forest, the Takhti-Tepa mud volcano and the Artsivi gorge).

VPA is remarkable for its landscapes and habitats, which are generally not typical of Georgia. These include juniper and pistachio arid light woodlands, semi-deserts and dry steppe. (See subchapters 3.3 and 3.4 for more detailed information on the vegetation and main plant species).

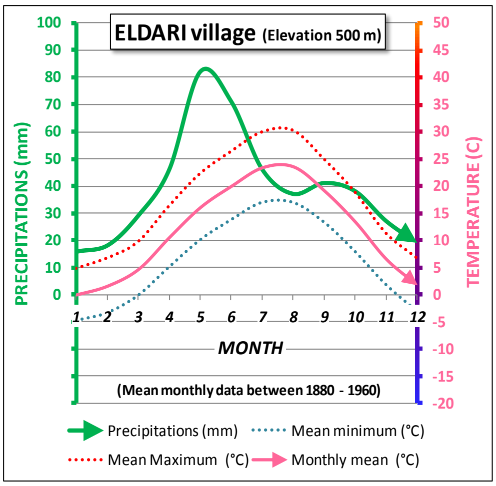
The biodiversity of VPA includes a rich community of carnivores (brown bear, wolf, leopard, lynx, golden jackal, wild cat, etc.) and is also distinguished by a high reptile diversity. Since it still harbors what seems to be the best suitable habitats, Vashlovani is one of the key sites for the planned reintroduction of the goitered gazelle, a species which became extinct in Georgia almost half a century ago.

Parts of VNP and the adjacent areas are traditionally used as winter pastures for livestock (see also subchapter 3.5). Livestock grazing is the most important of the human factors that have apparently played a huge role in shaping the Vashlovani landscapes and creating the ecological mosaic currently found throughout the park.

Over the last 10 years, Vashlovani has seen the development of protection as well as tourist infrastructure. Visitor numbers have also increased in recent years.

3.2 Climate

The climate of the Vashlovani region is predominantly Mediterranean with precipitations occurring during the cold period of the year and a short but marked dry summer period (Fig. 1, Fig. 2 -Ombro-thermal diagrams after *Le Houérou 2005*).



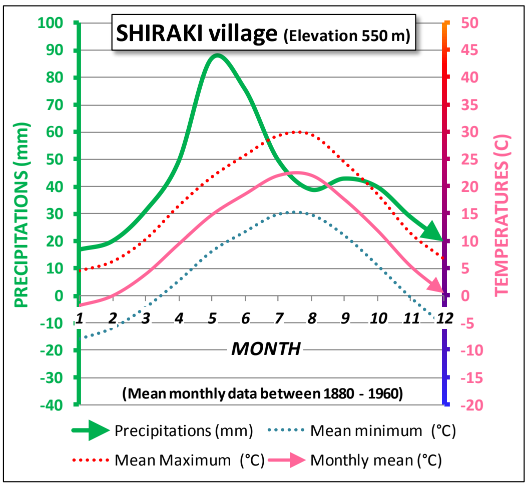


Figure 1: Eldari village ombro-thermal diagram**Figure 2:** Shiraki village ombro-thermal diagram

The annual peak of precipitation in the form of rain takes place during the spring (indicating a transitional bio-climate from "*attenuate Mediterranean*" to "*Intermediate – non-seasonal Temperate*" (Le Houérou 2004, 2005 a, 2005 b), with occasional and limited snow falls during winter. The average total precipitations received at Eldari village (elevation 500 m) ranges from 450 to 500 mm/year, and this is likely to be similar to what is falling, on average, on the northern borders of VNP. There is no precise data for the southwestern part of VNP (the Eldari lowlands) but according to expert assessment based on the vegetation this section may receive twice as little precipitation as the northernparts of VNP that is about 250 mm/year on average.

From these limited precipitation and temperature data, the beginning of the vegetation growth period should start when the mean monthly temperatures are above 5-6°C, i.e. from mid-end of March and finishing by mid-end October most years (Fig. 3).

The average yearly temperature is about 12°C. The daily mean minimum and maximum temperatures of the coldest month (January) are about -5°C and +5°C respectively. This means that little growth (Fig. 3) should be expected on the pastures during the most cold winter months (zero vegetation growth occurs at a mean monthly temperature of 5-6°C for most pasture/rangeland vegetation).

The ombro-thermal diagram detailing climatic data (Fig. 3) indicates the dry bioclimatic period, i.e. when *P (= mean monthly precipitation) < 2T (= mean monthly temperature, or when the precipitations are inferior to the evapotranspiration).* This usually lasts around 5 to 6 weeks from early July until mid august near the Eldari village; this is when crops and pasture may suffer from seasonal drought unless supplied with irrigation or receiving late spring precipitations.

In addition, the Eldari lowland appears to be a wind corridor strongly affected during the winter.

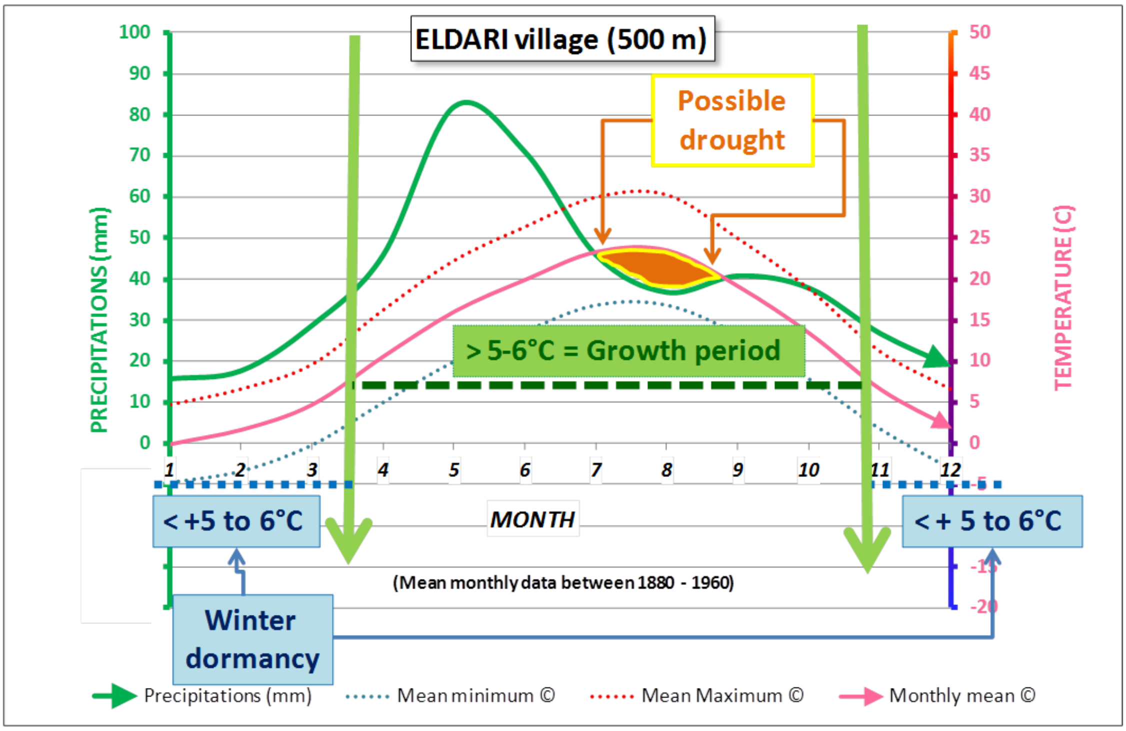


Figure 3: Biological interpretation of the Ombro-thermal diagram indicating the period for vegetation growth, possible drought and winter dormancy for the Eldari village and the Vashlovani National Park region.(G. Gintzburger, 2012).

3.3 A brief on the main Vashlovani vegetation types

All soils on the Vashlovani area are alkaline and with a heavy loam and silt texture.The main vegetation types include:

The open arid forests: Dominated by Pistacieta (*Pistaciamutica*) mixed with Juniperita (*Juniperusfoetidissima* and *J. polycarpos*)all over the central depression of the Vashlovani reserve as well as the beginning of Chiroelt-Khevi. Some patches of *Celtiscaucasica* especially at Mlashe-Tskali.

The phrygana[2]found mostly on badlands: Low and dense, drought resistant small trees and shrubs on silt /marl – on badlands deeply dissected by water erosion (all over Vashlovani, Pantishara gorge) covered with *Reaumuriaalternifolia, Caraganagrandiflora, Colutea*spp. , *Atraphaxisspinosa, Paliurusspina-christi, Ephedra distachya, etc.* associated with tragacanthic plant communities (low spiny and thorny shrubs) dominated by *Astragalus* spp. and *Acantholimonfominii*on flowing marl-clay slopes. Presence of small Labiatae (*Ziziphora* spp., *Thymus* spp. and *Teucrium* spp. is noted and all common on conglomerate, sandstone and shallow soils on steep slopes.

Landscape dissected with gullies, deep ravines and dry water course, the later especially colonised with *Tamarix* spp., *Hippophäerhamnoides*, and native *Punicagranatum and Vitisvinifera.*

[2]The phrygana is a dense sclerophytic vegetation of small trees, shrubs and aromatic plants occurring on rangelands with alkaline, poor soils in the Mediterranean regions (equivalent to the Garrigue in Southern France, Italy, Spain, Greece, the Chaparral in California, the Fimbosin South Africa).

The semi-desert vegetation: occurs on foothills (Eldari, or Samukhi lowland). This vegetation encompasses:

- the *Artemisieta*phytocoenosis (with nearly pure *Artemisia lerchiana*stands) possibly with a cover of low annuals and ephemerals on good rainy seasons, located on the upper part and loamy and shallow soils of the foothills. Some relict Artemisieta also occur on badlands;
- The Salsoleta, with occurrence of *Salsolaericoides* (mixed with *Artemisia lerchiana*and *Noaeamucronata*) on the middle part of the foothills. Some mild secondary soil salinity appears on this phytocoenosis. Increasing salinity and gypsum in lower parts sees the appearance, in larger numbers, of *Salsolanodulosa*(gypsophytic)replacing *S. ericoides,* still with some *rare Artemisia lerchiana.*

The lower sections of the foothills are even more saline (with the appearance of solonchak - solonetz and even gleysoil on bare takyr) due to water accumulation and hydromorphy. It is the domain of the azonal saline *Gamanthuspilosus*phytocoenosis (with *Aeluropuslittoralis, Kalidium capsicum* (strong halophytes)*, Bolboshoenusmaritimus*(hydromorphic)*, Lyciumruthenicum*(phreatophytic), etc.

The steppe vegetation on (deep) dark black soils - dominated by Graminaceae with:

- *Stipalessingiana* and *S. capillata* (pastures - associated with *Onobrychis* spp. and *Glycyrrhizaglabra*) on the plateau (Patara-Shiraki, crest of Vashlovani ranger site and beginning of Chighoelt-Khevi), possibly resulting from extensive and past anthropomorphic activities (tree clearing now resulting in bush encroachment with *Paliurusspina-christi*and*Cotinuscoggygria).* These areas are current and prime target for hay making.

- *Bothriochloaishaemum* and B. *caucasica* (rangelands) in dense and nearly pure stand ofat Kumuro and Bogha-Moedani depressions and occasionally covering large patches all over the National Park.

The Riparian forests covering a narrow strap of land along the Alazani River. The landscape is shaped by the Poplars (*Populusnigra, P. canescens*) with occasional magnificent oaks (*Quercuspedunculiflora*),

The Black mountain forest, a broadleaf forest(Querceta – fraxinetum) with a dominance of *Quercusiberica, Fraxinusexcelsior , Acer ibericum*and *Acer campestre*

3.4 The most important pasture species: descriptions and implications for livestock grazing

Artemisia spp. (Compositeae - Asteraceae) – *Artemisia lerchiana* - a dwarf shrub, present on arid and semi-arid rangelands from Spain to Mongolia, mostly on heavy soils, very drought tolerant but with limited tolerance for salinity; a valuable autumn – winter feed reserve for small ruminants and wild ungulates when annuals and ephemerals are not available; green shoots of *Artemisia* represent around 60% of the standing winter biomass. However, *Artemisia* is usually not touched by herbivores when green in spring, during its growth period, as it is rich in essential oils that induce diarrhoea and possible abortion when ingested in large quantities; during spring, small ruminants avoid grazing *Artemisia* but compensate with the ingestion of annuals and ephemerals when available and if usual spring rains are sufficient. The *Artemisiaspp.* is reputed to have anthelmintic and allelopathic characteristics. The *Artemisia* rangelands on Vashlovani (mostly on the Eldari lowlands) suit the current winter spring grazing patter by sheep.

Stipa spp. (Graminaceae) – mostly *Stipacapillata*, a Mediterranean perennial grass, with a growth cycle during the cool period of the year, well grazed by all small ruminants in its' vegetative stage but less accepted after flowering and fruiting.

Bothriochloa spp. (Graminaceae) – mostly *Bothriochloaischaemum*. The *Bothriochloa* pastures look good and plentiful in Vashlovani, but this is a deceptive resource as far as sheep grazing is concerned. The reason is that *Bothriochloa* is an aggressive tufted perennial C4 grass (a tropical grass, known as "beardgrass" or "bluestem"); it has its vegetative and reproductive cycle during the warm season (spring and summer) and is fully dormant and dry during the cold season (winter and early spring). Hence, the sheep moving to their Vashlovani winter quarter will find *Bothriochloa* pastures to be poor (if not useless) with limited feed resources from October until the end of the cold period. Even in spring, the aggressive*Bothriochloa* covers the soil and prevents the germination and growth of other plants. Small ruminants could make use of the *Bothriochloa* during the early vegetative spring stage when new soft leaves appear and as long as *Bothriochloa* is not in its reproductive stage (flowering in June on Vashlovani). It recommended that *Bothriochloa* must be grazed continuously to prevent reaching the flowering stage as it becomes unpalatable (low digestibility - low feed value) and often infected with stem rust after flowering, further deterring ingestion by herbivorous (not only by sheep but also by cattle). Since this is obviously not the case in Vashlovani, the consequence is that the *Bothriochloa* pastures accumulate as a thick mat of litter (old dry leaves) preventing any annuals of other valuable pasture plants to establish and grow.

Onobrychis spp. (Leguminosae) – as *Onobrychiskachetica* and *O. radiata* (both Mediterranean perennials with a growth cycle during the cool period of the year) require a minimum of 400-500 mm precipitations/year and are not well accepted by sheep for grazing when green but are valuable as forage for hay making when associated with *Stipa*.

Medicago spp. (Leguminosae) – *Medicagocoerulea* as a perennial, and *Medicago minima* and *M. orbicularis,* are annual. All Mediterranean species with a growth cycle during the cool period of the year and requiring a minimum of 300-350 mm precipitations/year. Well grazed green and dry but may induce bloating when ingested as green in large quantities.

3.5 Current pasture usein VNP

Vashlovani National Park and the adjacent areas are traditionally, though not exclusively, used by the Tush community for grazing their sheep on the rangelands. The rangeland use is conditioned by the availability of high quality summer mountainous pastures where the Tush flocks move to, in late

May or early June (depending on season), for the summer. With the first cold on the mountains by mid-October, the flocks move back to the Vashlovani rangelands for the winter and this is, then, where the lambing occurs. During this time, the *Bothriochloa*Vashlovani pastures would be totally winter dormant and dry, contributing poorly (feed gap) to the diet of lactating ewes; unless some early autumn precipitations and warm weather benefit the establishment of annual and ephemerals before the deep of the winter. The flocks grazing on the Eldari lowland may be better off as they do have access to abundant *Artemisia* rangelands. The winter feed gap coincides with the coldest period and the lambing period, possibly inducing noticeable lamb mortality and diseases outbreak. The winter feed gap on Vashlovani eases off with the rising temperatures and early rains of spring and this allows annuals and ephemerals to supplement the flocks.

The weaning of surviving lambs takes place by early April until the beginning of May. This is when the flocks move back to the Tusheti high mountain pastures, about 250 km north-east of Vashlovani.

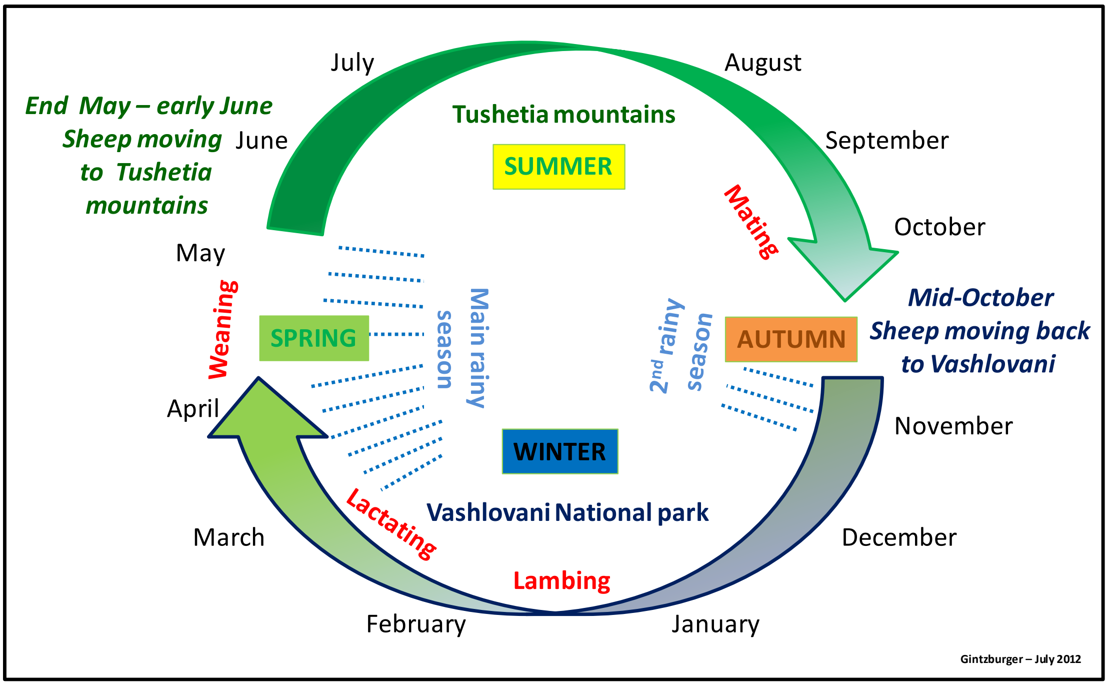


Figure 4: Schematic presentation of the current rangeland use, Tush sheep flocks location and cycle (G. Gintzburger, 2012).

4 Approach and methods

4.1 The overall approach

The assessment, field data collection and interpretation, as well as development of recommendations were conducted in full compliance with and in careful consideration of the requirements set by the conservation interests and legislationrelated to Vashlovani national park.

While we fully understand the fact that the VNP pastures are very important for the livelihoods of Tushetian and other sheep farmers and that the livestock that have grazed there for centuries have now become an important component of the ecosystem, we primarily considered those pastures as grassland habitats which are used and shared by both livestock and wildlife. Such an approach is critical when considering/planning rehabilitation and/or management measures for any degraded area. Acceptable rehabilitation measures should only be considered for those sections that have been shown to have deteriorated solely or primarily due to excessive livestock grazing. Since Vashlovani contains typical semi-arid landscapes and substantial areas of natural badlands, it is important that any judgment of degradation be solely based on scientific evidence and exclude any bias.

The current rapid assessment relied on existing information[3]combined with new field data (both data sets were collected in the same period, May-June). With the absence of standing biomass (kg DM/ha) data at different seasons (winter, spring, summer and autumn) it was clear that we would not be able to accurately map the pasture resources. However, we assumed that even if only sampled during May and June (i.e. after the spring rains and with no grazing pressure), the two main parameters, vegetation cover and standing biomass could still be used as good measures for assessing the status of pastures. Combined with visual investigation, we assumed that any significant levels of pasture degradation would show up even during or after the period of rapid plant growth.

Using ground data, GIS technology and Landsat TM imagery 2010, we developed a primary model of pastures in Vashlovani which demonstrates the conditions of various sections relative to each other. This model can be further improved with the help of higher resolution satellite imagery (not available to this assessment) and by introducing new important parameters such as pasture quality, which in addition to standing biomass would also consider plant species composition.

4.2 Ground surveys

We based our field vegetation assessments on the methods proposed by Gintzburger and Saïdi (2008). This method involves vegetation surveys focusing on the ecology, floristic composition, percentage of perennial vegetation cover (VC) using intercept data, and aboveground biomass measurements of perennials, annual and ephemerals when possible (see Annex 1 for detailed description).

Due to the limited time and resources, we simplified the method:

- We used the LIM (Line Intercept Method)and the QM (Quadrate method) for all the *Artemisia* dominant vegetation types.
- For the thick and dense homogeneous grasslands dominated by either *Bothriochloa* or *Stipa* with vegetation cover close to 100%, we simply collected the total standing biomass on three distinct 1m^2 quadrates.

[3] *Rangelands Condition and Assessment: Vashlovani national park and associated project areas*, G. Gintzburger, July 2012 (prepared for Georgia Carnivore Conservation Project, FFI/NACRES).

- We only worked on the perennial component of the vegetation as all annuals and ephemerals were already dry at the time of our field operations.
- The biomass samples collected could not be sorted and weighted in different plant families due to time restrictions and so all biomass measurements are simple totals.
- All samples were air dried and weighed.

4.3 The Soil-Adjusted Vegetation Index (SAVI) model

Vegetation Indices

Remotely sensed spectral vegetation indices are widely used and have benefited numerous disciplines interested in the assessment of biomass, water use, plant stress, plant health and crop production. The successful use of these indices requires knowledge of the units of the input variables used to form the indices, and in understanding the manner in which the external environment and the architectural aspects of the vegetation canopy influence and alter the computed index values. Although vegetation indices were developed to extract the plant signal only, the soil background, moisture condition, solar zenith angle, view angle, as well as the atmosphere, alter the index values in complex ways. The nature of these problems are explored both in an empirical and in a theoretical sense, and suggestions are offered for the effective use and interpretation of vegetation indices.

SAVI method

The Soil-Adjusted Vegetation Index (SAVI) is a vegetation index that attempts to minimize soil brightness influences using a soil-brightness correction factor. This is often used in arid regions where vegetative cover is low.

$$SAVI = ((NIR - Red) / (NIR + Red + L)) \times (1 + L)$$

NIR and Red refer to the bands associated with those wavelengths. The L value varies depending on the amount of green vegetative cover. Generally, in areas with no green vegetation cover L=1; in areas of moderate green vegetative cover, L=0.5; and in areas with very high vegetation cover, L=0 (which is equivalent to the NDVI method). This index outputs values between -1.0 and 1.0.

Reference: Huete, A. R., 1988, "A soil-adjusted vegetation index (SAVI)," Remote Sensing of Environment, Vol 25, 295–309.

Output

The output of SAVI is a new image layer with values ranging from -1 to 1 (256 classes). The lower the value, the lower the amount/cover of green vegetation. For better visualization we divided map classes by 5 conditional categories. (1-Very low; 2- Low; 3-Moderate; 4-High, 5-Very high)

For SAVI model validation we used statistical techniques such as the Geographically Weighted Regression - GWR (Regression analysis is a statistical technique for estimating the relationships among variables) which is one of several spatial regression techniques increasingly used in geography and other disciplines. GWR provides a local model of the variable or process to be understood/predicted by fitting a regression equation to every feature in the dataset. GWR constructs these separate equations by incorporating the dependent (SAVI Model) and explanatory (Field results) variables of features falling within the bandwidth of each target feature.

Landcover categories as bare soil, forest, shrub land, water bodies were removed from calculation as objects which are not associated with pastures, because they are characterized by other spectral reflectance with higher or lower values.

Existing Landcover models were used for identifying and removing non-grassland areas from the calculation.

4.4 Pasture classification

The output of the Soil-Adjusted Vegetation Index (SAVI) model was used to create a standing biomass distribution map (Annex 2). This map was used to classify all available pastures according to standing biomass and create a less detailed but more practical map with 5 classes of pastures from very low biomass ("very poor" pasture) to very high ("excellent" pasture). Relatively homogenous sections were first identified and the method of weighted scoring was used to classify each section(the 5 pasture classes were assigned values from 1 to 5, multiplied by their percent representation in a given section as determined by the SAVI model, and summed to determine that section's relative score).It is important to note that the classification (similar to the primary biomass distribution map) only reflects actual pastures – all non-grassland areas (natural badlands, forest and scrub, etc.) were excluded from the calculations.

4.5 Alternative pastures assessment

Preliminary desktop study and information gathering (from various sources including the Akhmeta municipality) was conducted to reveal any vacant pastures around VNP that could be considered as alternative pastures for some of the farms currently using VNP pastures. At the same time additional preliminary information was gathered about the alternative, supposedly still vacant, pastures that were initially proposed by Acta Consulting - Georgia in 2007.

All potential alternative pastures were mapped and assessed by means of ground surveys, using similar methods as for VNP pastures. Criteria such as accessibility and water availability were also considered.

5 Results and Discussion

5.1 Vashlovani national park

The assessment was focused on grassland areas used as pastures for livestock. It excluded the dense arid forest, impenetrable phrygana areas and badlands (collectively referred to as "non-grassland areas").

The total area of the pastures assessed in VNP was 18,000 ha.

5.2 Aboveground biomass distribution on VNP pastures

As expected from its geographical location, terrain features and high diversity of habitats/physical conditions, the aboveground biomass appears to be unevenly distributed throughout VNP (see Annex 4 for map). However, a general pattern can be detected: the productivity of pastures tends to decrease toward the south while the best pastures are in the northern parts of VNP. With respect to standing biomass, the highest amount measured was 6,000 kg and the lowest 350 kg of dry mass per hectare. In many parts, the vegetation cover was close to 100%. The lowest cover measured was 18%.

5.3 Pasture classification by biomass

As expected, the pasture classification map (Annex 5) repeats the general pattern detected by the SAVI model, with high productivity pastures mainly distributed in the northern parts of VNP. This classification map is however more practical and useful for planning further steps including pasture management activities. It also better depicts the big picture of the conditions of the pastures on VNP. As mentioned earlier, all non-grassland areas (natural badlands, forest and scrub, etc.) were excluded from the calculations. On the map, however, pasture classes are generalized over the whole rangelands. Therefore the area of each class on the pasture classification map is larger than the areas of actual pastures as indicated in the table below.

The table and chart below show the areas and percentages of each pasture class.

Table 1: Areas of major pasture classes in VNP

Pasture quality	Area (ha)
Excellent	8,478.67
Good	1,179.97
Moderate	4,748.94
Poor	3,635.71
Very poor	0
Total	*18,043.29*

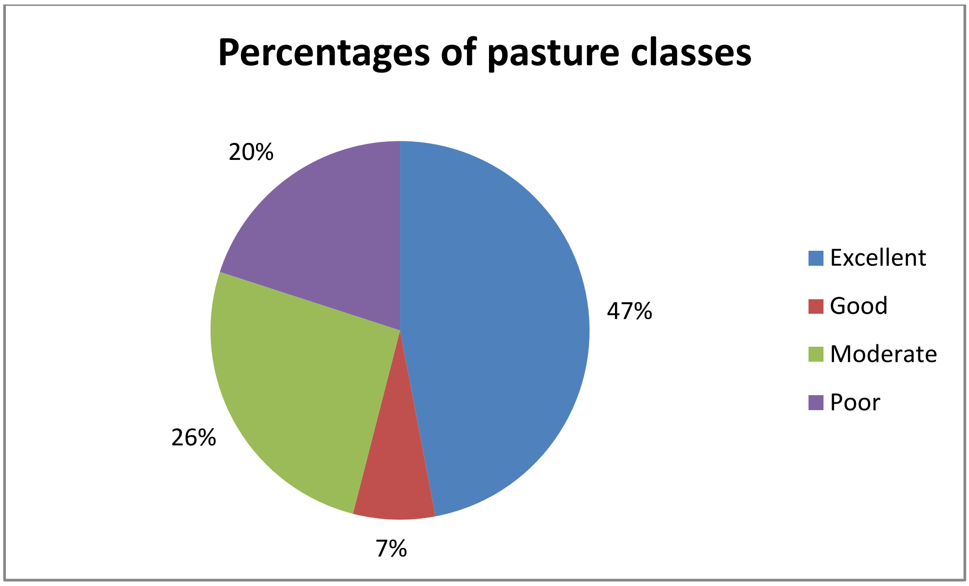


Fig. 4: The relative importance of various pasture classes in VNP.

It is notable that class "very poor" is absent from VNP and nearly half of all pastures are "excellent". However, a fifth of all pastures are classified as "poor".

These results are very much in line with the findings of previous study[4] and it can be concluded that overall, the VNP pastures are in good condition. No significant areas of degradation or desertificationare evident except for one section described below. Both the vegetation cover and standing biomass are on the high side considering the soil and climate conditions.

However, while all VNP pastures require sustainable management practices, the "poor" pastures mainly found in the southern parts (Eldari lowland)may need special attention as they may be particularly susceptible to non-sustainable grazing and/or climate change. Further studies are needed to determine the relative importance of human-induced factors in the current low productivity levels of these pastures.

Specific recommendations for the Eldari lowland section:

- A series of long-term enclosure-based experiments would help better understand the impact of grazing as well as to monitor the effect of climate change on the Eldari lowland, one of the driest areas in VNP and indeed in the entire country.
- To complement enclosure-based experiments, it is important to gather weather data, which can be achieved by installing a simple automatic weather stations at least at two sites: the Vashlovani main ranger station (high rainfall area) and the main Border Police Station at Eldari lowlands (low rainfall area).
- To monitor the *Bothriochloa*colonisation-contraction, possibly due to climate change (increasing occurrence of warm period precipitations favoring the growth and spreading out of *Bothriochloa*).

[4] *Rangelands Condition and Assessment: Vashlovani national park and associated project areas*, G. Gintzburger, July 2012 (prepared for Georgia Carnivore Conservation Project, FFI/NACRES).

5.4 Degraded areas in VNP

A more or less significant degraded area is found in the central part of VNP in the form of a narrow strap along the road from BughaMoedani toward the Lekis-tskaliriver and along this river (see Annex 5 for map).

The degradation is very evident and is clearly caused by intensive, unorganized and unrestricted sheep movement along the road and the adjacent areas on both sides.

On the one hand, the section is usedby sheep from the BugaMoedani and nearby farms to go down to the river for drinking at least every other three days. During the migration periods (autumn and spring) many of the sheep of the Eldari lowland farms (southern part of VNP and the rest of the lowland) move on that narrow strap as they come down from or go up to the mountains each year. In addition, at least during some years (especially if grass cover is not sufficient in the south) the route is also used during the winter season by the Eldari lowland farms to take all or some of their flocks to the northern parts of VNP (the Black mountain area) where pastures are expected to have more grass.

The total area of the degraded strap is 480 ha.

Various sections of the degraded strap

Possible measures:

It is evident that the degradation of this section of VNP is caused by excessive livestock movement along the relatively narrow strap. The restoration of this area may be achieved through a combination of the following measures:

Measure	Root cause addressed	Expected result	Note
Fencing either side of the road (route) with a livestock-proof fence.	Disorganized movement of sheep	Vegetation on both sides would begin self-restoration	Only materials suitable for the national park must be used.
Organize water holes for those farms that use the route for taking sheep for drinking	Intensive sheep movement during the season	Sheep movement intensity significantly reduced	
Establish a daily limit of sheep movement and/or sheep movement schedule during the migration periods.	Intensive sheep movement during the migration periods	Pressure from sheep movement distributed evenly over prolonged period of time.	May be extremely difficult to implement.
Consider alternative routes	Intensive sheep movement during the migration periods	Sheep movement intensity reduced	
Encourage vegetation recovery on the degraded sections	-	Faster recovery of vegetation	This may be achieved by active vegetation restoration techniques.

5.5 Potential alternative pastures

As expected, no *de facto* vacant pastures were identified and according to the Akhmeta municipality officials and no *de jure* vacant pastures are currently available in the vicinity of VNP. Therefore we assessed the alternative pastures initially proposed by Acta Consulting in their report prepared for Georgia Protected Areas Development Project (2007)[5]. According to that report, the proposed pastures were not under any effective lease contract and were set aside for potential use as alternative pastures by means of a memorandum between APA and the Dedoplistkaro municipality.

The above report lists pastures with their official reference numbers. The total area of 4,197 ha is indicated based on the Dedoplistskaro municipality. However, no maps are included. On the other hand, the VNP administration provided digitalized maps of those pastures (shape files). Those shape files had been created based on the old maps kept at the Dedoplistkaro municipality. This explains some of the overlaps between the pastures and the Chachuna managed reserve and also discrepancy along the state border. Thus, some corrections and better mapping would be needed if any of the alternatives sites are chosen for further activities. In addition, the total area of the polygons as per those shape files is 7,0308 ha which is significantly higher than the figure given in the Acta Consulting report. This may be due to the fact that the area of rangeland and that of actual pastures are usually different for most sectors. The official land use maps naturally have the whole of rangelands, only a fraction of which may be used as pastures. The total area provided by the

[5] *Process Framework Document and Resettlement Plan*, ACTA Consultants Georgia Ltd. 2007

Dedoplistskaro municipality to the authors of the above report probably refer to the actual pastures which were subject of lease contracts.

The proposed alternative pastures are distributed (1) at the western border of VNP and (1) in the wider Chachuna area in four sites (see Annex 3 for maps).

One of the alternative pastures the Acta Consulting report also proposes (Pasture #87)is actually within VNP. Therefore, we did not consider it as an alternative pasture but of course included it into the VNP pasture assessment and biomass modeling. Thus the total potentially available rangelands excluding this section would be 6,791 ha. It is however not clear at this point, what part of those rangelands are pastures. Some tentative figures and other relevant information is given in Annex 3.

Alternative pastures at VNP

The potential alternative pasture (official reference #61) near VNP is situated in the middle parts of the EshmakisKhevi (Davil's gorge) and covers a total area of 577 ha. The actual pasture is 435 ha according to the Dedoplistskaro municipality. Much of the territory is characterized by small hills and up to 35% of all area are badlands. The main vegetation is steppe with smaller patches of semi-desert. In the steppe, the vegetation cover appears to be as high as 80-90%. In the semi-desert sections the vegetation cover was significantly lower (10.5%).

Badlands (left) and pastures (right) in pasture #61

There is road access to all parts of the pasture. There are also the remains of a farm. A waterhole was found through visual investigation. The river Iori may be considered as a source of water for this pasture. However, the river is about 4-6 km away from various parts of the pasture.

The territory had obvious signs of grazing. As it was found out later, much of pasture #61 is also under private ownership.

NB. This pasture appears to be a private property, hence cannot be considered as an alternative site for VNP farms.

Alternative pastures in the Chachuna area

"TaribanasVeli" (pastures #40 #41 #44 #49[6])

The total area of this cluster is 1,436 ha. Actual pastures, however, only cover 1,042 ha according to the Dedoplistkaro municipality. The site is located on the Taribana lowlands, opposite to the Frontera Georgia oil field. The site is accessible by road. There are farms on pasture #49 (half-ruined) and #40. An artificial permanent water hole was found on pasture #41. This waterhole may be used by both #41 and #40. However, it is too far away too be used by the other pastures (#44 and #49).

All four pastures appeared to have been used. In some places there were also signs apparently placed to mark borders between the pastures. Some of the signs looked fairly new. It was later found out that parts of #40 and #41 are presently under private ownership.


Pasture #44 (left) and pasture #49 (right)

On the whole, the pastures are in poor condition compared to the other potential alternative sites. Erosion is evident in many places. On the other hand, the vegetation cover is quite high (60-100%) in some sections.

Pasture summary:

Pasture ID	Plant communities	Vegetation cover	Terrain/Landscape	Farm	Water source	Note
#40:	*Artemisia spp.* *Bothriochloaspp*	>60%	Hilly	Yes	Yes	Occupied at the time of field visit. The local herder would not give the name of the farm owner. When asked what areas he was using, he indicated parts of #41 in addition to #40.
#41	*Artemisia spp.* *Bothriochloaspp*	>60% 18.4%	Mosaic of flatlands and hills	No	No	
#44	*Artemisia spp.* *Bothriochloa spp.*	>60% 11.8%; 24.3%	Mostly flat	No	No	
#49	*Artemisia spp.* *Bothriochloaspp*	>60%	Mostly flat	No	No	Southern aspects very eroded.

[6]Official reference number of pasture.

"Chatma" (pasture #2)

The site is located in so-called Chatma, southwest of the Dali reservoir and covers a total area of 2,626 ha. There are deep gullies in the northeastern and eastern sections. To the south, there is a small ridge which borders Azerbaijan.

The site is accessible by road. However, the territory is within the controlled border area and can only be accessed with a special permit issued by the Border Police.

The pastures are mostly in moderate condition with areas of severe degradation and sections with poor vegetation cover (14% on average). In most places, however, the cover is 70% or even 80%. Ephemerals were common.

Bare soil segment in "Chatma"

There are six farms on the site. All appeared more or less well-maintained. It was obvious they had been used. This was also confirmed by the border police and the Dali hunting reserve rangers. Indeed, according to the information from the WWF Caucasus program Office based on unofficial data from the State Registry, much of pastures has been privatized.

"Chachuna" West (pasture #8)

The site covers 918 ha, a large part of which is badlands.The actual pastures cover 741 ha according to official data from the Dedoplistkaro municipality.More productive pastures are found to the south, at higher elevations toward the Azeri border where the vegetation is diverse and the cover is close to 100%. These sections are rather difficult to access, however, and this may in part explain their favorable status. The lower, northern parts represent a mosaic of pastures and badlands and bare areas obviously created by dead soil layers washed down from the badlands. Part of the pasture is presently within the borders of the Chachuna managed reserve.

There are a few farms on the site. Road access is available to all parts. However, as is the case with all roads south of the Ioririver,the roads become impassable in bad weather.

Pastures (left) and badlands (right) in "Chachuna West"

"Chachuna" East (pastures #15 and #16/17)

The total area of this site is 1,234 ha. The actual pastures cover 1,076.23 ha according to official data from the Dedoplistkaro municipality. A large part is badlands. Productive pasture with dance vegetation is available in the form of a narrow strap along the Azeri border. The access to that part is, however, through difficult terrain. Small sections of good pastures are also available in the lower parts near the river with estimated areas of 50 ha and 120 ha on #15 and #16/17 respectively.

Recommendations on alternative pastures

Of the above pasture clusters "Chatma" apparently cannot be considered as a feasible alternative since much of it has already been privatized. The remaining three clusters may in theory be considered, and depending on the rehabilitation and improvement effort, each has the potential to eventually become attractive to any relocated sheep farmer. It is, however, important to note that this judgment is solely based on the actual status of the pastures—their geographical location and the potential for improvement through proper management or restoration measures. The further selection process and final decision, however, should carefully consider overall cost-effectiveness of rehabilitation measures, socio-cultural aspects, and the risk of "problem displacement".

Pasture cluster	Proposed measures
"TaribanasVeli"	– Rehabilitation of these pastures is likely to be more complicated compared to the other sites. – Artificial water holes should be organized in various parts.
"Chachuna" West	– Rehabilitation of the lower parts through control of sheep movement and active vegetation restoration. – Measures against wind and water erosion may also be needed. – Establish a pasture rotation scheme effectively using better quality pastures in the higher elevations.
"Chachuna" East	– Rehabilitation of the lower parts through control of sheep movement and active vegetation restoration.

- Measures against wind and water erosion may also be needed.
- Establish a pasture rotation scheme effectively using better quality pastures in the higher elevations.
- A new planned bridge over the Ioririver would be very beneficial.

6 Conclusions

- The aboveground biomass is unevenly distributed throughout VNP; the productivity of pastures tends to decrease toward the south while the best pastures are in the northern parts of VNP.
- Overall, the VNP pastures are in good condition. The vegetation cover and standing biomass are on the high side considering the soil and climate conditions. No significant areas of degradation or desertification are evident except for one uninterrupted degraded section.
- VNP pastures require sustainable management. The southern pastures (Eldari lowland) may need special attention as they may be susceptible to non-sustainable grazing and/or climate change.
- Further studies are needed to determine the relative importance of human-induced factors in the current low productivity levels of the southern pastures.
- A significant degraded area is found in the central part of VNP in the form of a narrow strap along the road from BughaMoedani toward the Lekis-tskaliriver and along this river. The degradation is caused by intensive, unorganized and unrestricted sheep movement.
- No *de facto* vacant pastures were identified and according to the local authorities no *de jure* vacant pastures are currently available in the vicinity of VNP.
- Three sites in the Chachuna area may be considered as feasible alternatives for some of the VNP farms solely based on the actual status of the pastures - their geographical location and the potential for improvement through proper management or restoration measures.
- The further selection process and final decision on alternative sites should carefully consider overall cost-effectiveness of rehabilitation measures, socio-cultural aspects, and the risk of “problem displacement”.

7 Recommendations for future study

Further steps for more detailed pasture assessment and management planning:

- The primary SAVI model prepared for this assessment should be further improved to more accurately map the pasture resources in terms of standing biomass (kg DM/ha) at different seasons (winter, spring, summer and autumn) to attempt adjusting the stocking rates to standing biomass and edible percentage available.

- Create an accurate (1/5000 to 1/10000) and detailed map of the VNP vegetation types using the most recent satellite imagery with up-to-date satellite image processing and GIS technology.
- Create an accurate and updated land tenure / lease map for VNP pastures.
- Monitor livestock numbers including the lambing percentage and lambing mortality.
- Conduct a winter VNP farm / summer Tusheti survey to establish the current feed calendar and practices used by the livestock owners to identify the seasonal feed gaps and flock management issues.
- Produce an accurate map of the farm locations and their allocated grazing territory (ha) limits.
- Explore the possibility of controlling the summer growth of *Bothriochloa* stands to avoid potential catastrophic wild fires.
- Review the current grazing regimes.

Annex 1: Methods for ground surveys[7]

Field vegetation assessments (Gintzburger and Saïdi 2008) are based on vegetation surveys (ecology, floristic, percentage of perennial vegetation cover (VC) using intercept data, aboveground biomass measurements of perennials, annual and ephemerals when possible). These are collected for the main vegetation community type. These homogeneous vegetation types are preferably identified by a preliminary satellite image processing using unsupervised analysis, completed and supported/refined with feedback from field vegetation and ecological surveys. Alternatively, when the vegetation types are already well identified (as is the case with the Vashlovani region) and known, it is faster to process the satellite image with a supervised classification, spotting on the satellite image the identified vegetation types inside mapped polygons and searching for the polygon location displaying the same satellite sensor signature. This process is then refined by ground truthing.

The standard vegetation inventory using the phytoecological surveys or similar methods are complemented with:

- Line Intercept Measurements (LIM) of perennial vegetation cover. The LIM is used when the vegetation cover is close or less that 50-60%, a case most often found on semi-arid and arid environments
- the Quadrate Method (QM) to measure the perennial density and evaluate / measure the perennial standing biomass.
- Small quadrates (usually 1 m^2) in which all plants are harvested at ground level when the vegetation cover is above 60% and the LIM or QM is not practicable.

Perennial plants (Vegetation Cover of the perennials)

A team of field workers recorded intercept data on perennial plants, bare soil, and rocks at ground level along 10–100 m of measuring tape or rope (four replicates/site) using the LIM and simplified CEFE (Centre d'EcologieFonctionnelle et Evolutive, Centre National de la RechercheScientifique, France) techniques (Canfield 1941; Daget and Poissonet 1971; Gintzburger 1986) and the quadrate method (QM) we developed specifically. The initial purpose of this work is to document and quantify the homogeneity of vegetation and available biomass (annuals and perennials). When conducted over a number of seasons and years at a GPS-located site, these techniques document changes in species composition and the prevalence of bare ground and mobile sand, as an indication of degradation or regeneration trends. We could refine our present work on Vashlovani with satellite imagery – GIS, data processing and technologies that we specifically developed (Gintzburger et al. 2005).

The Line Intercept Method (LIM)

The LIM is a modified technique from Canfield (1941). Four permanent intercept lines (each 10–100 m long) allow the quantitative measurements of perennial vegetation. These are established on selected and representative vegetation type or sites. It gives an estimate of the measured intercept

[7] From *Rangelands Condition and Assessment: Vashlovani national park and associated project areas*, G. Gintzburger, July 2012 (prepared for Georghia Carnivore Conservation Project, FFI/NACRES).

along a line of a pre-defined length. We developed this method for Vegetation cover (VC) where micro-phanerophytes (small trees) and nano-phanerophytes and chamaephytes (tall shrubs and dwarf shrubs) are dominant, as is typical of semi-arid vegetation.

The four permanent intercept lines radiating north, east, south and west, from a GPS-located central point are established and monitored at least once a year, at the end of summer or in autumn.

Each intercept consists of a 10 to 100 m long transect (in relation to the vegetation average height = as a rule of thumb, each transect length is about 50 x average height of the highest shrub in the vegetation type studied) delineated using a simple rope. The intercepts of the projections of each perennial plant (species 1, species 2, species 3,… species X) along the transect are measured and recorded on a special form and entered in an Excel file at a later stage.

This field operation usually takes about an hour/site for three operators working together; one measuring along the rope, one recording, and one moving and placing the rope.

LIM calculation

The **Percentage Perennial Vegetation Intercept (%PVI)** for each species (%PVI of species 1, %PVI of species 2, %PVI of species 3, …….., %PVI of species X) is then calculated for each transect and site according to the following:

%PVI of species 1 = [(1.1 + 1.2 + 1.3 + 1.4 + … + 1.a) / (Length A – B)] × 100 = %PVI 1
\+ %PVI of species 2 = [(2.1 + … + 2.b) / (Length A – B)] × 100 = %PVI 2
\+ %PVI of species 3 = [(3.1 + 3.2 + 3.3 + … + 3.c) / (Length A – B)] × 100 = %PVI 3
\+ ……
\+ ……
\+ %PVI of species X = [(X.1 + X.2 + X.3 + … + X.m) / (Length A – B)] × 100 = %PVI m*

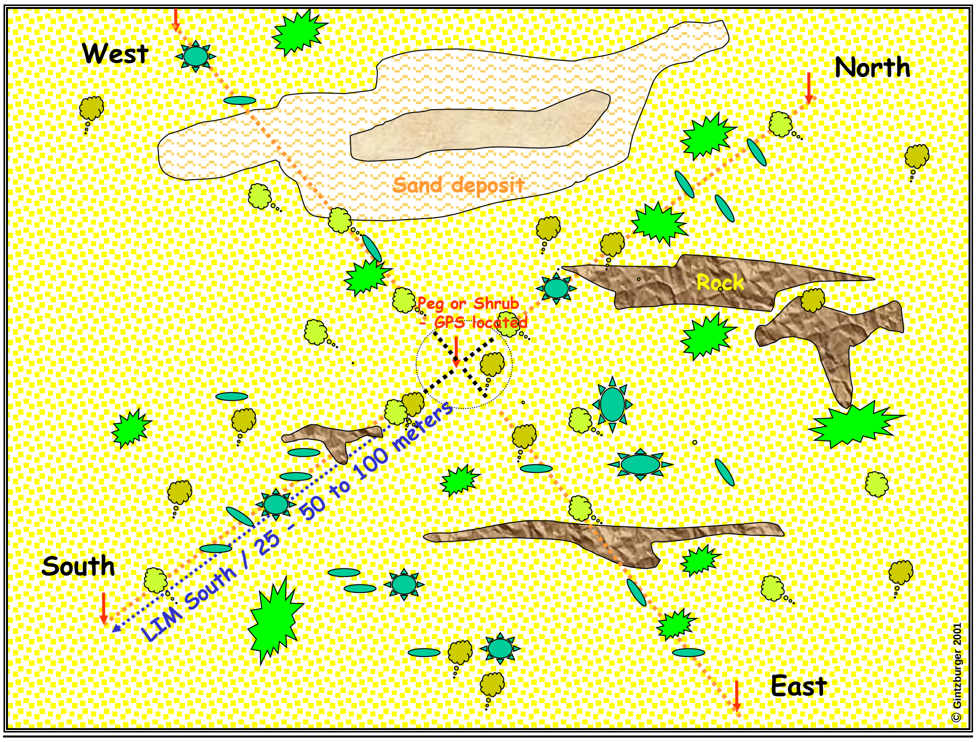
= TOTAL %PVI = Σ %PVI (1, 2, 3,…, m)

* m = species X

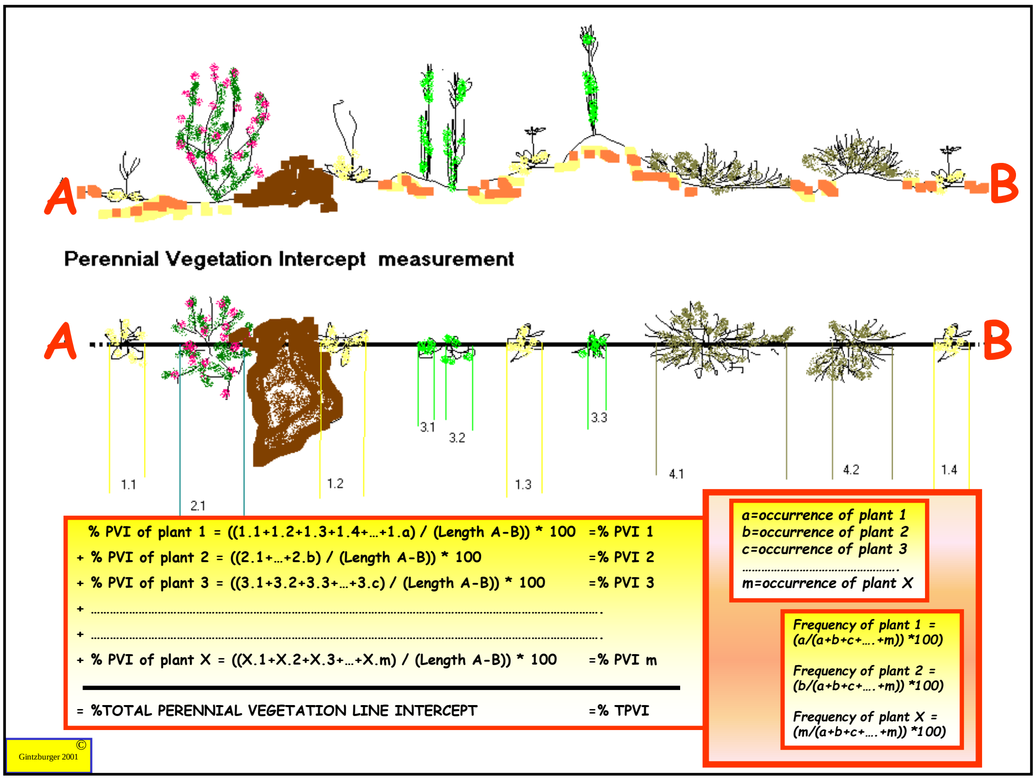
Note that the LIM is only a % linear intercept measurement and is not the % area vegetation cover. The % area vegetation cover is usually <u>evaluated</u> (and <u>not measured</u>) by surveyors introducing a large number of errors and bias. The LIM is however a swift and reliable measurement that can be easily repeated over years on the same site to monitor a semi-desert vegetation type.

Other information related to the vegetation structure is also recorded with the LIM (such as the relative **perennial species occurrence** and the **frequency)**. These were not used on the Vashlovani sites during this mission.

Seasonal measurements of perennial plants cover using the LIM are carried out at the end of the growing season, usually the end of summer, but could be performed at any season.



Field lay-out of the Line Intercept Measurement (LIM), Gintzburger et al. 2005 – reprinted 2009)

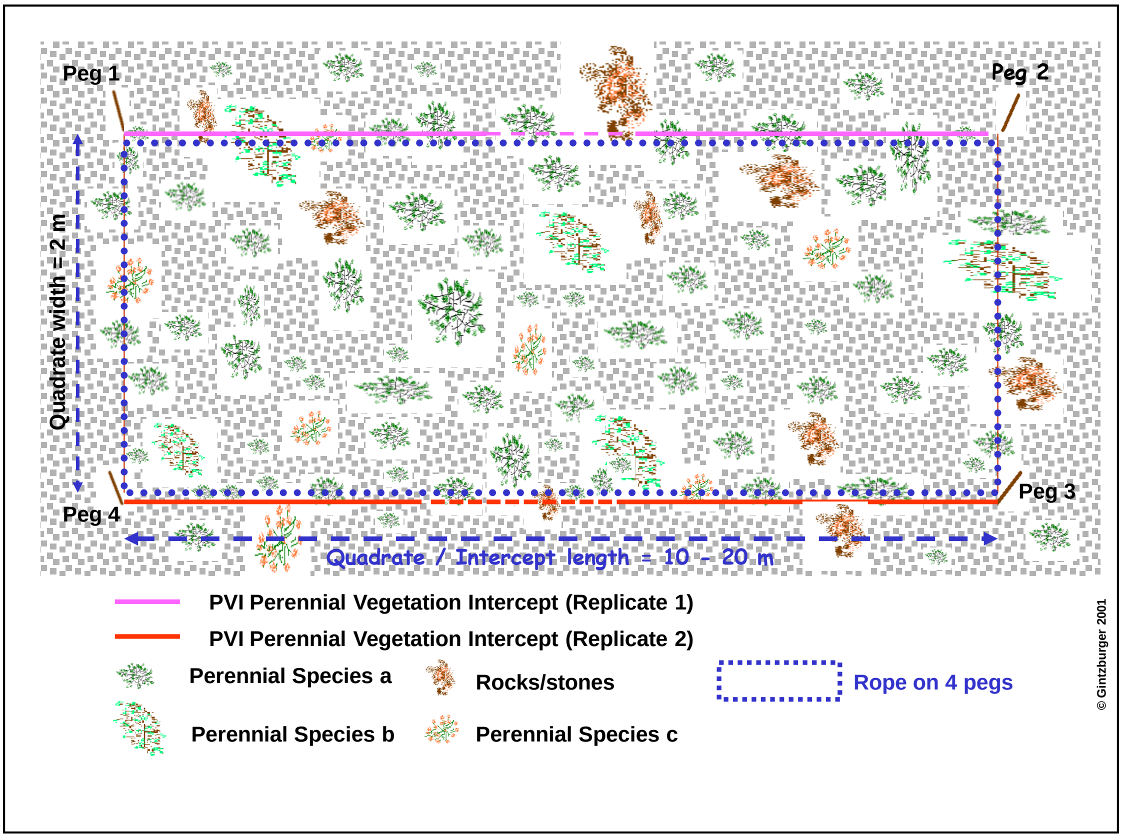


Perennial vegetation Line Intercept Measurement (all measurements in same units (cm, inch)), (Gintzburger et al. 2005 – reprinted 2009)

The Quadrate method (QM)

The QM is used for low or small perennial vegetation such as *Artemisia* spp., *Salsola* spp. or with nano-phanerophytes and chamaephytes. The QM is a combination of LIM and aboveground biomass measurement for small perennial plants. The harvesting of all perennial plants to measure the standing biomass is bulky and cumbersome, sometimes difficult, and requires a large field team (Gintzburger 1986). The QM simplifies the field operations.

The measurement is carried out with a rectangular quadrate to minimize vegetation heterogeneity. The quadrat is usually 2 m wide by up to 20–25 m long delineated by four pegs linked by a rope and GPS-located in an homogeneous vegetation type. The width of the quadrat is sufficiently narrow to easily count all perennial shrubs contained without having to walk and trample the measurement site. Individual plants on the edge / limit of the quadrate are also counted as if included in the quadrat.



Quadrate measurement (QM) layout - (Gintzburger et al. 2005 – reprinted 2009)

QM calculation

The specific plant density is estimated by counting the number of perennial plants of the same species (e.g.: Plant a = *Artemisia* sp., plant b = *Salsola*sp.) within the quadrate. The specific plant density of plant a (SPDa) is then calculated and reported as "number of plant a / unit area (m^2 or ha)". The same procedure is used for all other perennial species (b, c, d, etc.).

- Along the length (2 m × 10 m in our example) of the rope marking the border of quadrate, we:
  - * determine the LIM of each species which gives a %PVI, and the total %PVI,
  - * harvest all shrubs except those that intercept the boundary rope of the quadrate. Each shrub is individually packed in a tagged bag with biovolume information (H = height, and D = maximum diameter, or D1 and D2 = max and min diameter).
  - * In the laboratory, time permitting (not possible during this mission), the green and woody parts of each individual shrub are separated, dried and precisely weighed individually. The dry matter (DM) collected from each shrub is kept in its original bags for further checking and plants analysis if necessary. While it was not done during this mission, it may be a necessary step in future biomass measurements as all the woody – lignified standing biomass is obviously not edible.
- It is then simple to calculate from the above information the <u>Estimated Plant Biomass of plant n / ha</u> = (Average weight of plant n) × SPD n / ha.

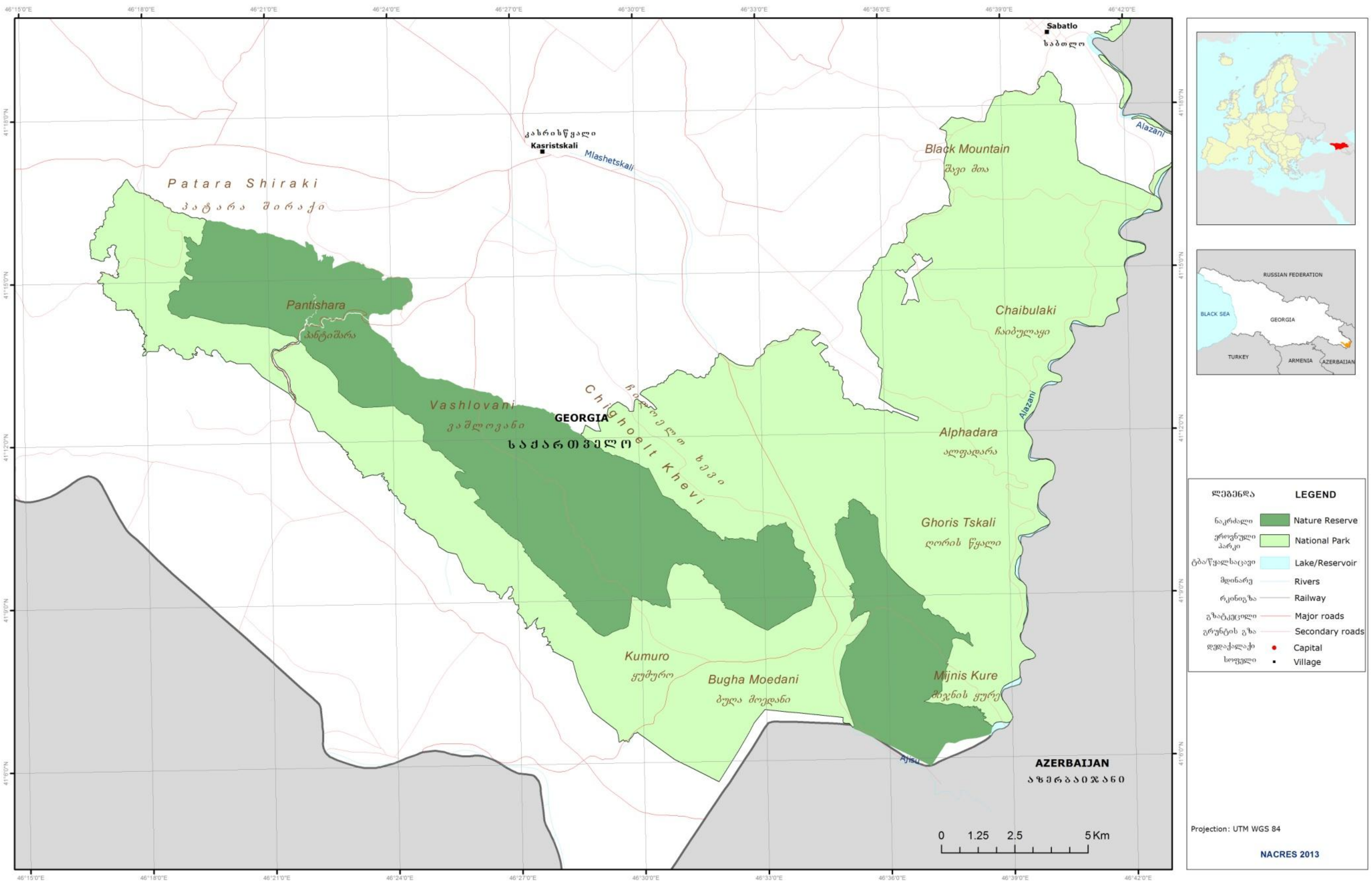
This field operation takes about 60–90 min/site for a team of three operators.

Biomass of dense perennial cover (grassland)

We used 1m^2 quadrats, replicated 3 times to sample homogeneous and dense grassland such as the Vashlovani*Bothriochloa* or *Stipa*vegetation types. All plants present inside each quadrat are cut at ground level and packed. This field operation usually requires two operators and 30-40 min/site. The individual samples are then air dried, and weighed to determine the total aboveground biomass (= Estimated standing biomass).

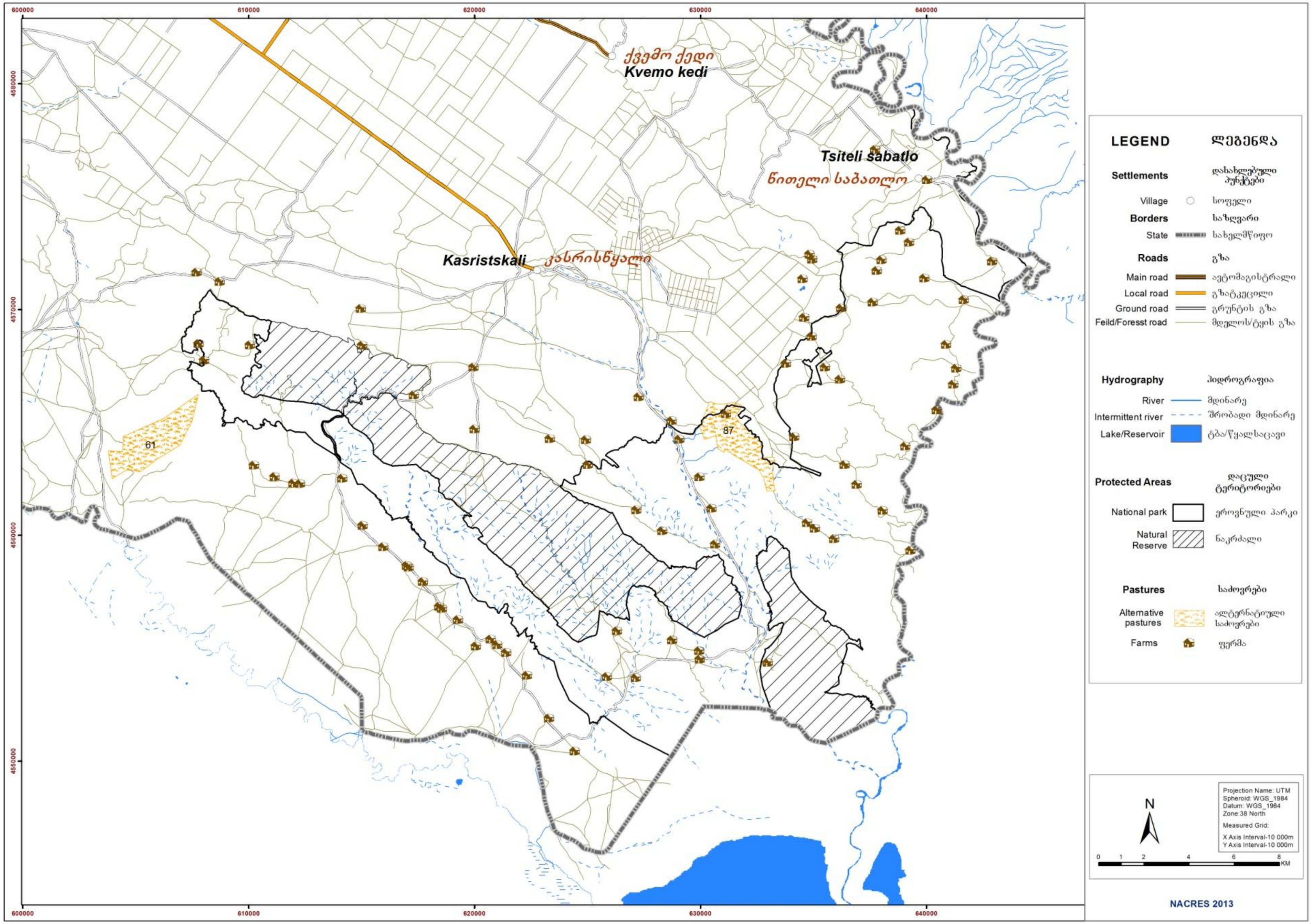
All these data could be combined with satellite imagery data, appropriate processing technology, and GIS – geomatic, and lastly scaled-up and mapped (See recommendations).

Annex 2: Vashlovani protected areas (Vashlobvani National Park & Vashlovani Nature Reserve)

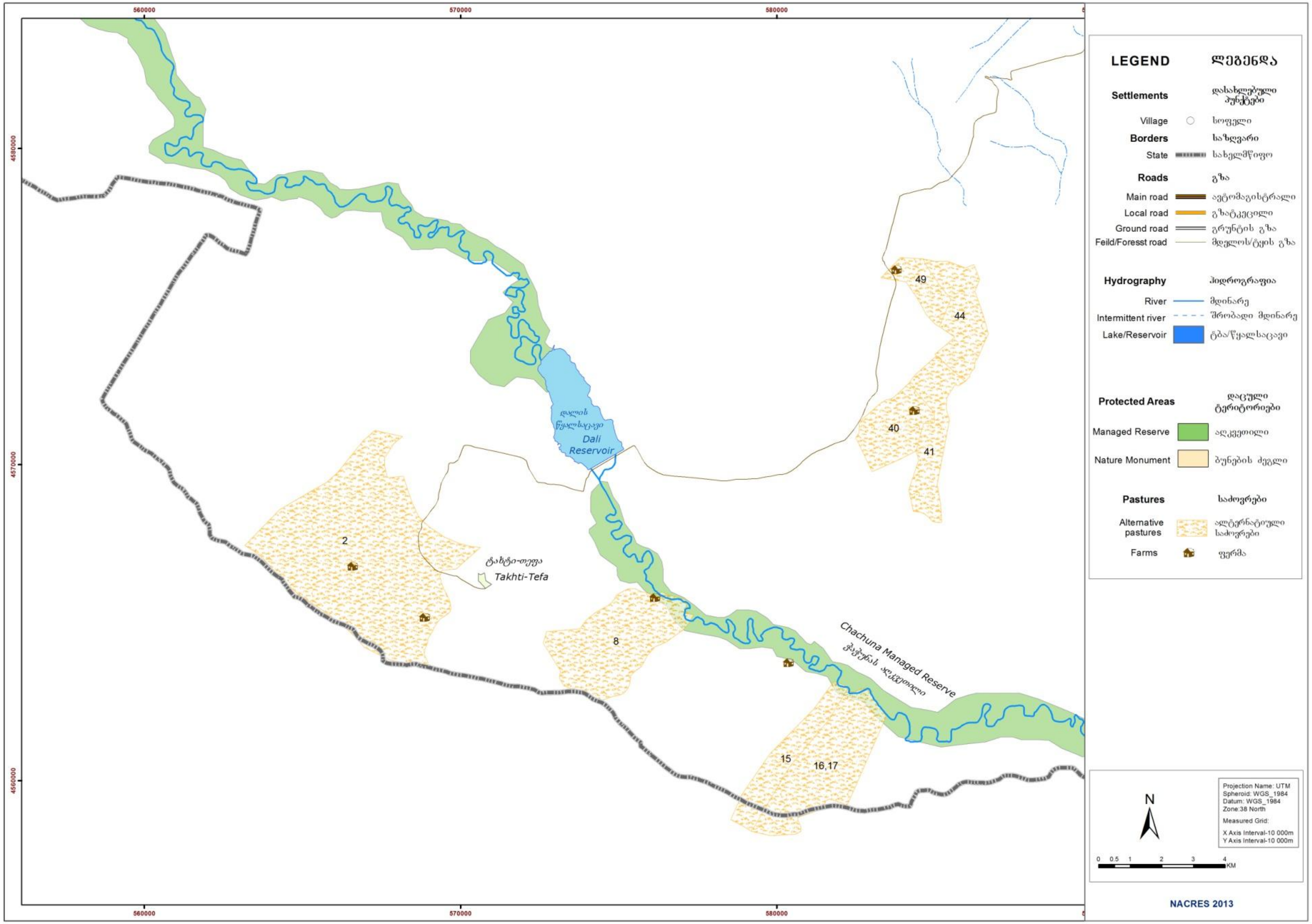

Sabatlo
Kasristskali
Mlashetskali
Alazani
Patara Shiraki
Black Mountain
Pantishara
Chaibulaki
Vashlovani
ვაშლოვანი
GEORGIA
საქართველო
Chighoelt Khevi
Alphadara
Ghoris Tskali
Kumuro
Bugha Moedani
Mijnis Kure
Ajisu
AZERBAIJAN
RUSSIAN FEDERATION
BLACK SEA
GEORGIA
TURKEY
ARMENIA
AZERBAIJAN
LEGEND
Nature Reserve
National Park
Lake/Reservoir
Rivers
Railway
Major roads
Secondary roads
Capital
Village
0 1.25 2.5 5 Km
Projection: UTM WGS 84
NACRES 2013

Annex 3:Potential alternative pastures

(a) Alternative pastures in near VNP


ქვემო ქედი
Kvemo kedi
Tsiteli sabatlo
წითელი საბათლო
Kasristskali
კასრისწყალი
61
87
LEGEND
ლეგენდა
Settlements
დასახლებული პუნქტები
Village
სოფელი
Borders
საზღვარი
State
სახელმწიფო
Roads
გზა
Main road
ავტომაგისტრალი
Local road
გზატკეცილი
Ground road
გრუნტის გზა
Feild/Foresst road
მდელოს/ტყის გზა
Hydrography
ჰიდროგრაფია
River
მდინარე
Intermittent river
შრობადი მდინარე
Lake/Reservoir
ტბა/წყალსაცავი
Protected Areas
დაცული ტერიტორიები
National park
ეროვნული პარკი
Natural Reserve
ნაკრძალი
Pastures
საძოვრები
Alternative pastures
ალტერნატიული საძოვრები
Farms
ფერმა
N
Projection Name: UTM
Spheroid: WGS_1984
Datum: WGS_1984
Zone:38 North
Measured Grid:
X Axis Interval-10 000m
Y Axis Interval-10 000m
KM
NACRES 2013

(b) Alternative pastures in the Chachuna area



560000
570000
580000
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4560000
Dali Reservoir
დალის წყალსაცავი
Takhti-Tefa
ტახტი-თეფა
Chachuna Managed Reserve
ჭაჭუნას აღკვეთილი
2
8
15
16,17
40
41
44
49
LEGEND
ლეგენდა
Settlements
დასახლებული პუნქტები
Village
სოფელი
Borders
საზღვარი
State
სახელმწიფო
Roads
გზა
Main road
ავტომაგისტრალი
Local road
გზატკეცილი
Ground road
გრუნტის გზა
Feild/Foresst road
მდელოს/ტყის გზა
Hydrography
ჰიდროგრაფია
River
მდინარე
Intermittent river
შრობადი მდინარე
Lake/Reservoir
ტბა/წყალსაცავი
Protected Areas
დაცული ტერიტორიები
Managed Reserve
აღკვეთილი
Nature Monument
ბუნების ძეგლი
Pastures
საძოვრები
Alternative pastures
ალტერნატიული საძოვრები
Farms
ფერმა
N
Projection Name: UTM
Spheroid: WGS_1984
Datum: WGS_1984
Zone:38 North
Measured Grid:
X Axis Interval-10 000m
Y Axis Interval-10 000m
0 0.5 1 2 3 4 KM
NACRES 2013

Summary of potential alternative pastures assessed

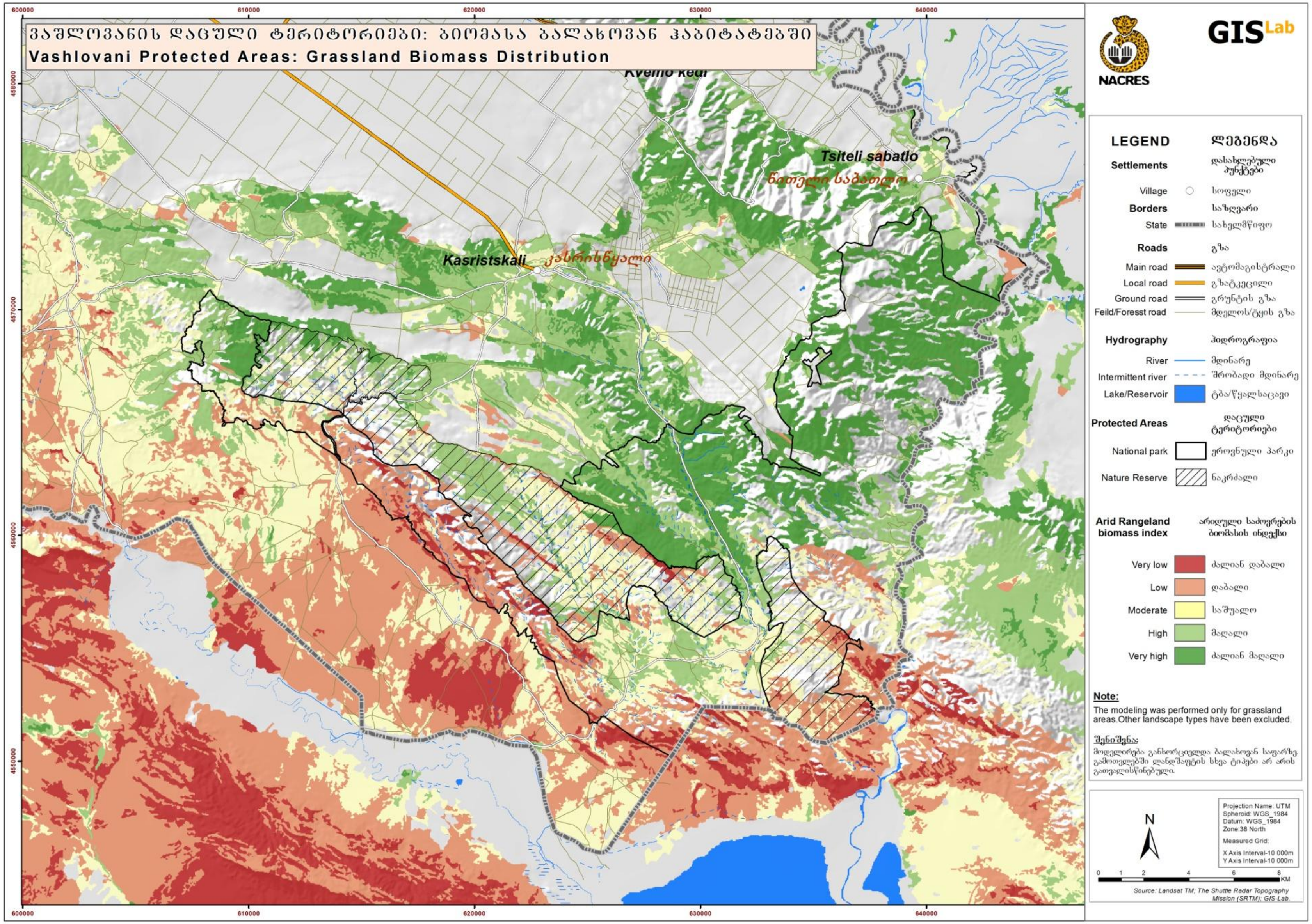
Alternative rangelands and pastures	Total area of rangelands (ha)	Actual pastures* (ha)	Under lease/private ownership** (ha)	Vacant***	Note
Near VNP					
# 87	517	433	0	433	Situated within VNP. Therefore not considered as alternative pasture
#61	577	435	435	0	
Chachuna area					
“TaribanasVeli”	1,436	1,042	240	802	
“Chatma”	2,626		1391	470 (?)	
“Chachuna” West	918	741	0	741	
“Chachuna” East	1,234	1,076.23	0	1076	

***** According to Dedoplistskaro municipality

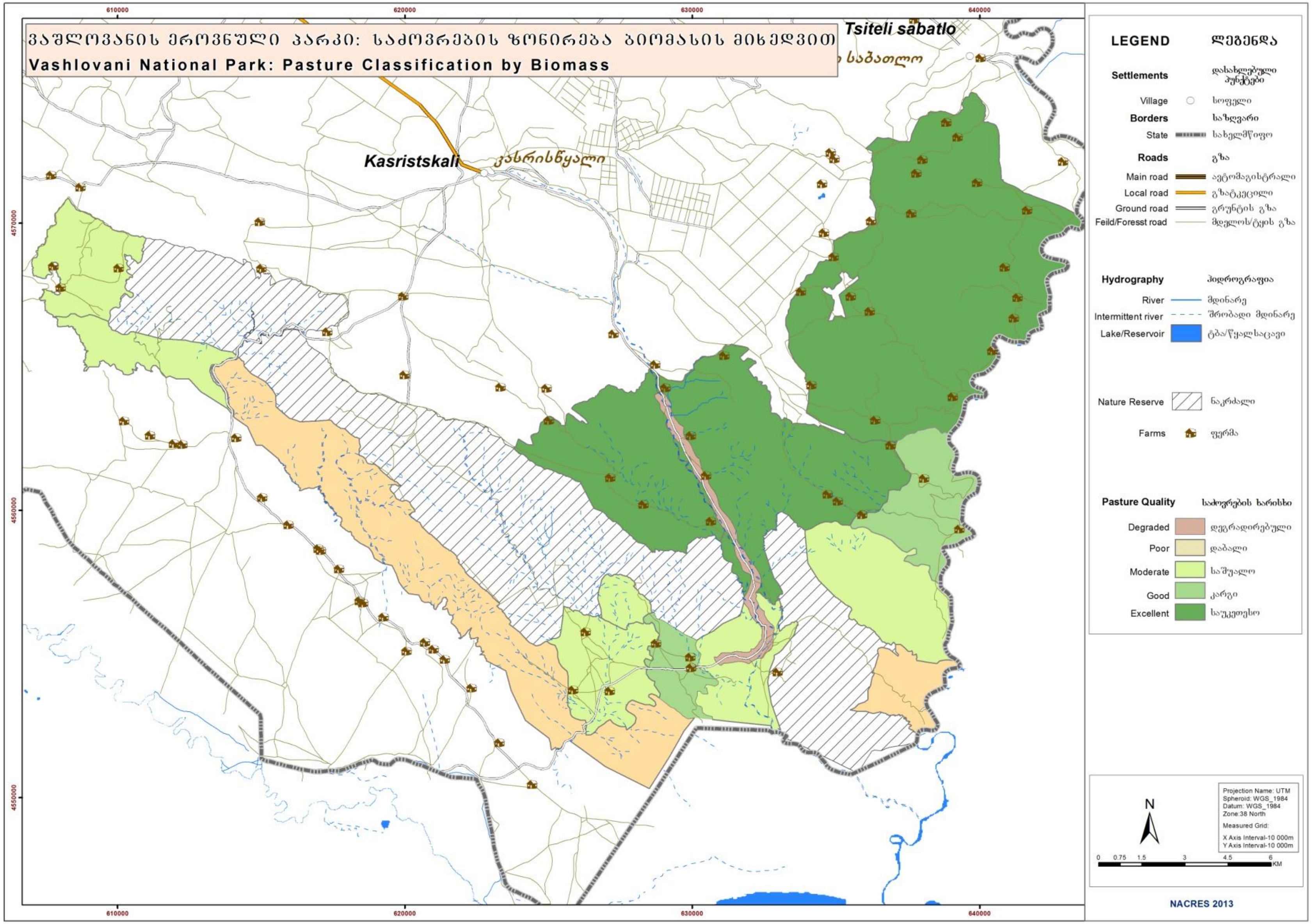
** According to unofficial information

*** Unconfirmed data

Annex 4:Grassland Biomass distribution in VNP


ვაშლოვანის დაცული ტერიტორიები: ბიომასა ბალახოვან ჰაბიტატებში
Vashlovani Protected Areas: Grassland Biomass Distribution
Kvemo kedi
Tsiteli sabatlo
წითელი საბათლო
Kasristskali
კასრისწყალი
600000
610000
620000
630000
640000
4580000
4570000
4560000
4550000
NACRES
GIS Lab
LEGEND
ლეგენდა
Settlements
დასახლებული პუნქტები
Village
სოფელი
Borders
საზღვარი
State
სახელმწიფო
Roads
გზა
Main road
ავტომაგისტრალი
Local road
გზატკეცილი
Ground road
გრუნტის გზა
Feild/Foresst road
მდელოს/ტყის გზა
Hydrography
ჰიდროგრაფია
River
მდინარე
Intermittent river
შრობადი მდინარე
Lake/Reservoir
ტბა/წყალსაცავი
Protected Areas
დაცული ტერიტორიები
National park
ეროვნული პარკი
Nature Reserve
ნაკრძალი
Arid Rangeland biomass index
არიდული საძოვრების ბიომასის ინდექსი
Very low
ძალიან დაბალი
Low
დაბალი
Moderate
საშუალო
High
მაღალი
Very high
ძალიან მაღალი
Note:
The modeling was performed only for grassland areas.Other landscape types have been excluded.
შენიშვნა:
მოდელირება განხორციელდა ბალახოვან საფარზე. გამოთვლებში ლანდშაფტის სხვა ტიპები არ არის გათვალისწინებული.
N
Projection Name: UTM
Spheroid: WGS_1984
Datum: WGS_1984
Zone:38 North
Measured Grid:
X Axis Interval-10 000m
Y Axis Interval-10 000m
0 1 2 4 6 8 KM
Source: Landsat TM; The Shuttle Radar Topography Mission (SRTM); GIS-Lab.

Annex 5: Pasture classification in VNP


ვაშლოვანის ეროვნული პარკი: საძოვრების ზონირება ბიომასის მიხედვით
Vashlovani National Park: Pasture Classification by Biomass
Tsiteli sabatlo
Kasristskali
კასრისწყალი
610000
620000
630000
640000
4570000
4560000
4550000
LEGEND
ლეგენდა
Settlements
დასახლებული პუნქტები
Village
სოფელი
Borders
საზღვარი
State
სახელმწიფო
Roads
გზა
Main road
ავტომაგისტრალი
Local road
გზატკეცილი
Ground road
გრუნტის გზა
Feild/Foresst road
მდელოს/ტყის გზა
Hydrography
ჰიდროგრაფია
River
მდინარე
Intermittent river
შრობადი მდინარე
Lake/Reservoir
ტბა/წყალსაცავი
Nature Reserve
ნაკრძალი
Farms
ფერმა
Pasture Quality
საძოვრების ხარისხი
Degraded
დეგრადირებული
Poor
დაბალი
Moderate
საშუალო
Good
კარგი
Excellent
საუკეთესო
N
Projection Name: UTM
Spheroid: WGS_1984
Datum: WGS_1984
Zone:38 North
Measured Grid:
X Axis Interval-10 000m
Y Axis Interval-10 000m
0 0.75 1.5 3 4.5 6
KM
NACRES 2013