RANGELANDS CONDITION AND ASSESSMENT

VASHLOVANI NATIONAL PARK AND ASSOCIATED PROJECT AREAS

By

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in collaboration

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Photo 1: A view of the Vashlovani National Park from the Main Ranger Station

A view from the Main Ranger Station on the Vashlovani crest above the *Pistacia mutica* semi-arid forest Reserve, with Bogha-Moedani (left), the Kumuro open grassland depressions (centre left), and the Mingachevir reservoir (in Azerbaijan) on the background.

Mariginiup (Australia) – 28 July 2012

EXECUTIVE SUMMARY

From a general point of view, the Vashlovani National Park (VNP) and associated project areas pastures and rangelands are in good condition, with no real hint of degradation or desertification. Vegetation cover and standing biomass are on the high-side considering the ecological conditions, in terms of soil and climate (250-550 mm/year – marginal arid-semi-arid Mediterranean climate with spring/autumn precipitations and cold winter; mean daily temperature of the coldest month ~ 0 to -2°C). This good general condition does not mean that these pastures and rangelands are currently used under optimum and sustainable management practices. This is confirmed with our 10 days field observation, Line Intercept and biomass measurements (end of June 2012). We would consider that most are under-utilised with perhaps the exception of the Eldari *Artemisieta* lowlands.

- The **Eldari Artemisieta (*Artemisia lerchiana*) lowlands** (estimated rainfall zone: 250 mm/year) is mostly composed of winter – spring growing diversified vegetation types. These are well suited to the current winter – spring grazing. Pure *Artemisia* standing biomass ranges from 350 to 1200 kg/ha and from 1500 to 1900 kg/ha for Artemisieta associated with various *Salsola* spp. The most southern adjacent areas with halophytic vegetation are also beneficial to the small ruminants' health. It should be noted that fairly large areas of the Eldari lowland seems to be currently colonised by thick stands of *Bothriochloa*. This may be due to the current year's late spring precipitations which would favour its growth.

No urgent rangeland management action is currently required on the Eldari lowlands. However monitoring of the *Bothriochloa* colonisation-contraction may be necessary.

- The ***Bothriochloa* ("bluestem") pastures** (estimated rainfall zone: 250 to 400 mm/year). ***Bothriochloa ishaemum*** is a C_4[1] tropical perennial grass with a spring-summer vegetative and reproductive cycle. Measured standing biomass of *Bothriochloa* stands range from 2.4 tonnes (southern slopes) to 5.3 tonnes DM/ha (Kumuro and Bogha-Moedani). The *Bothriochloa* tufted structure and aggressive growth habit tends to choke and eliminate other plants (annual – ephemerals and other perennials) when not strictly under constant grazing pressure. Constant grazing is necessary to stimulate vegetative growth (new leaves and tillers) and prevent the appearance of unpalatable inflorescence, the lignification of leaves and the accumulation of dead litter. *Bothriochloa* flowering is a clear sign of under-grazing and leads to detrimental effects on the vegetation dynamic (as seen, primarily, at Bogha-Moedani and Kumuro as well as many other sites on the VNP). Its occurrence here is of no real surprise as there is currently no late-spring-summer grazing or use when all of Vashlovani's small ruminants are relocated to the high Tusheti mountain pastures and rangelands for the

[1] The perennial grasses can be classified as either C3 or C4 plants. These terms refer to the different pathways that plants use to capture carbon dioxide during photosynthesis. All species have the more primitive C3 pathway, but the additional C4 pathway evolved in species in the wet and dry tropics. The first product of carbon fixation in C3 plants involves a 3-carbon molecule, whilst C4 plants initially produce a 4-carbon molecule that then enters the C3 cycle. These differences are important because the two pathways are also associated with different growth requirements. C3 plants are adapted to cool season establishment and growth in either wet or dry environments (ex: *Stipa* spp). On the other hand, C4 plants are more adapted to warm or hot seasonal conditions under moist or dry environments (ex: *Bothriochloa* spp.). A feature of C3 grasses is their greater tolerance of frost compared to C4 grasses. C3 species also tend to generate less bulk than C4 species; however, feed quality is often higher than C4 grasses. (see http://www.dpi.nsw.gov.au/agriculture/field/pastures-and-rangelands/native-pastures/what-are-c3-and-c4-native-grass)

summer. Outside the Project area (Patara-Shiraki, Eldari village north of Vashlovani), permanently resident cattle herds seem to maintain a constant grazing pressure on *Bothriochloa* stands also during summer, with less accumulated biomass and litter, little flowering culms visible and much richer and diversified vegetation. This may confirm the fact that the *Bothriochloa* stand must be grazed during the summer to remain palatable as indicated in the literature.

- As a consequence of *Bothriochloa* under-grazing and litter accumulation, **the risk of catastrophic wild fire is possible**. Appropriate measures such as preventive prescribed burning may be necessary to reduce the amount of accumulated litter. Past literature (in Russian) and experiments are available and should be consulted so that the proper burning season (end of autumn? Low temperature fire?) be determined to limit; the area burnt, potential damage to the vegetation in place, further water erosion and risk of the fire spreading to nearby woodlands.

- The curative options (alone or combined?) to reduce the flowering and stimulate new leaves production is to maintain an acceptable grazing pressure on *Bothriochloa* pastures during the late spring – summer after the sheep flocks have left to Tusheti, by:

    - **heavy grazing** (mob grazing = high stocking rate on limited areas) the *Bothriochloa* stand **with local cattle**. A rent/head for this summer grazing may be implemented? This may not be the best option as it could result in local conflicts with shepherds owning winter grazing rights.

    - **Reintroduce Goitered Gazelles** - The fact that Goitered gazelles disappeared from the area some 15-20 years ago may have been a contributing factor of the under-utilisation/grazing of the *Bothriochloa* pastures. Reintroduction raises the question of the source of gazelles, their appropriate number (stocking rate), their initial unique or multiple location and the establishment of necessary quiet corridors to allow them to move to various vegetation types according to the season (for example from Kumuro or Bogha-Moedani to either Chiroelet-Khevi or to Eldari lowlands Artemisieta and halophytic vegetation). As an indication, the gazelles stocking rate at the Jeyran Ecocenter Reserve (~5-6000 ha) near Bukhara (Uzbekistan) in much drier conditions than Vashlovani, ranges from 8 to 12 ha /gazelle (B. Mardonov – pers. com.). Assuming that the open rangelands and pasture areas suitable for gazelle reintroduction on the Vashlovani NP could be around 30% (to be asserted with proper future mapping) of the total VNP areas (~ 8000 ha) with a possible 6-8 ha/gazelles, would amount to a total population of 300-400 heads maximum and possibly less if considering sharing the feed resources with the winter sheep flocks.

    - **Cutting the *Bothriochloa* stands for hay-making** – mostly unpalatable feed and an expensive and useless option, unless potentially used as litter by farmers in barns.

- The ***Stipa (S. lessingiana* and *S. capillata)* pastures** (associated with *Onobrychis* spp. and *Glycyrrhiza glabra*) on the plateau (Patara-Shiraki, crest of Vashlovani ranger site and beginning of Chighoelt-Khevi) exhibit large standing biomass for excellent and easy hay-making. It appears that it is actually left mostly unused and possibly wasted. Standing biomass of the *Stipa* stands in association with abundant excellent forage plants such as *Onobrychis* spp., *Medicago coerulea*, etc. reach 5 to 6 tonnes DM/ha (assuming 50% agricultural harvesting = 2.50 to 3.0 tonnes hay/ha). As an example, we met a contractor-farmer harvesting 50 ha on the crest of Vashlovani and on Patara-Shiraki at the time of our visit. He indicated that he just collected 3000 bails of 30-40 kg each, i.e. 1.8 to 2.4 T hay/ha. These real-world figures could be improved using modern hay-cutting and bailing equipment. I would anticipate that the summer re-growth could also be harvested later in the fall or possibly grazed as well.

  This hay is sold to sheep owners wintering on Vashlovani with a summer value of 3 lari/bale rising to 7 lari / bale in winter (*A. Gogotidze, Pers. com.*). Though the feed value of the *Stipa* spp. itself is arguable, it remains that the hay provided by this phytocoenosis is precious and recognised by the locals as beneficial to the sheep and cattle owners. Its use may help reducing the lamb mortality during cold and snowy winters (as experienced in the 2011-2012 winter), deferring poor mid-winter pasture grazing or limiting the winter feed gap when the vegetation is winter-dormant on the VNP. This will certainly improve the economics of small ruminant's husbandry on the VNP without altering the current local practices and transhumance.

- No specific action is urgently required on **the VNP woodlands**. However, grass and fuel wood accumulation must be monitored (and allow some grazing period?) to prevent wild and highly destructive bush fires. This is subject to the consideration of the VNP authorities.

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"In cooperation with local expertise (to be identified by GCCP) and GCCP team members;

1. *design and develop the methodology for a comprehensive survey assessing the current conditions of the grasslands of selected parts of the Vashlovani landscape in respect of livestock and wild ungulate use*
2. *conduct a 2-week trip to Georgia, in June 2012, to assess current rangeland condition in selected areas of Vashlovani PA and Samukhi in respect of:*
   i) *- plant species composition and structure*
   - annual and perennial plant biomass production on selected sites and within the limited time allocated to the field mission
   - signs of overgrazing/under-grazing using LIM
   - livestock and wild ungulate use (based on GCCP & local knowledge)
   - GPS location and spatial distribution
   ii) *current rangeland-use practices (based on GCCP & local knowledge) and their impact (negative and positive) on plant species composition, structure and annual and perennial plant biomass production (including potential hay making practice)*
3. *Develop indicators for assessing grazing pressure from a vegetation point of view*
4. *Establish a list of palatable plant species on the Vashlovani landscape for livestock and wild ungulate use, including a qualitative classification and special features of their biology*
5. *make recommendations for the management of livestock (grazing regimes) and the reintroduction of the Goitered gazelle"*

INTRODUCTION

The Vashlovani National Park (VNP) is located in the south-eastern corner of Georgia along the border with Azerbaijan (Fig. 1).

Figure 1: Location of the Vashlovani National park

The toponymy, different regions of the Vashlovani National park and surrounding areas are presented on figure 2.

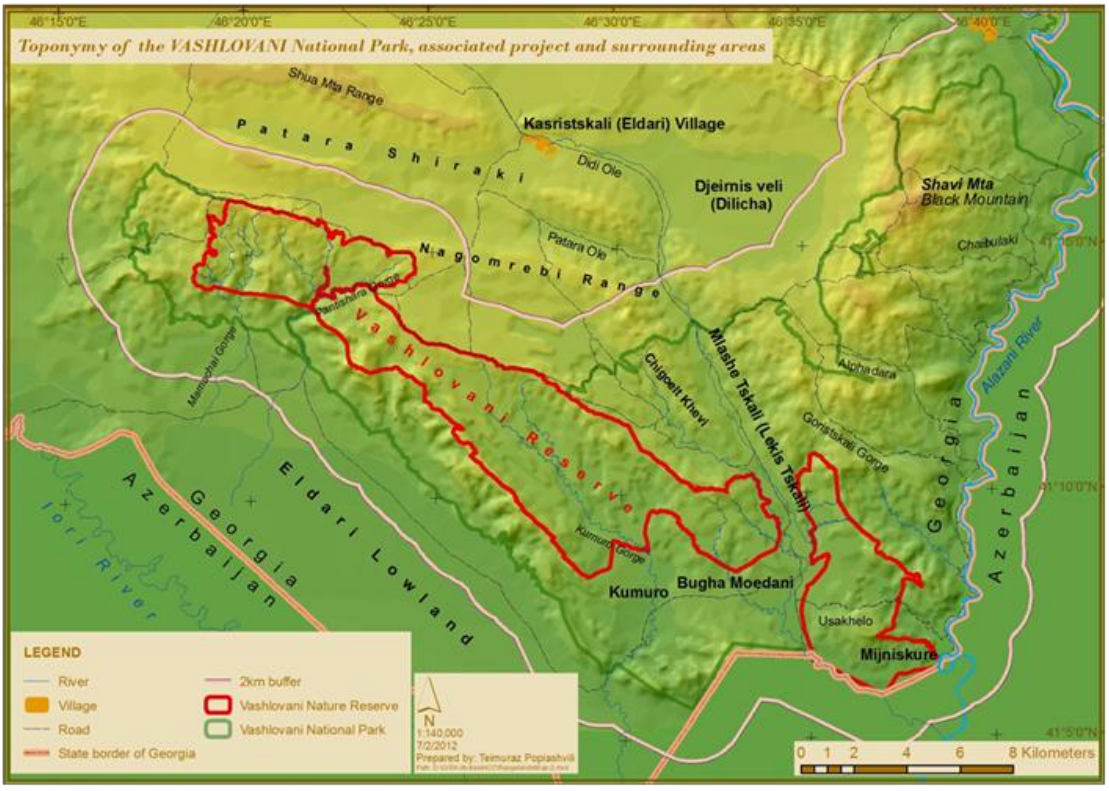


Figure 2: Toponymy of the Vashlovani National Park, associated project and surrounding areas (Map from T. Popiashvili)

The geology, geomorphology, climate, soils and vegetation details of the Vashlovani National Park and Kiziki region are extensively described in recent publications from Lachashvili et al. 2004, 2007, which includes a comprehensive bibliography.

We however felt that we could augment this information, especially with regard to climatic conditions as it has a direct impact on the vegetation phenology and growth period, and so, on the current and potential use of the Vashlovani rangeland resources.

Climate

The climate of the Vashlovani region is predominantly, though marginally, Mediterranean with precipitations occurring during the cold period of the year and a short but marked dry summer period (Fig. 3, Fig. 4) - (Ombro-thermal diagrams after Le Houérou 2005).

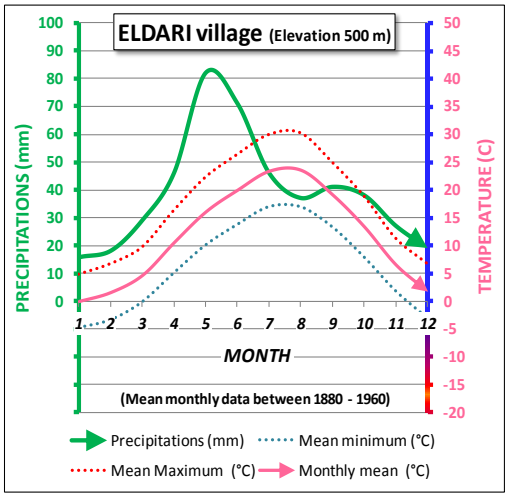


Figure 3: Eldari village ombro-thermal diagram

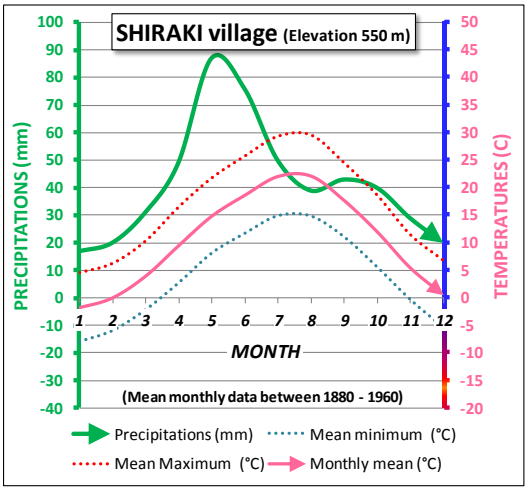


Figure 4: Shiraki village ombro-thermal diagram

From the limited meteorological data available during the mission (Handbook on Climate of USSR, 1964-1970), we could infer the following:

- The annual peak of precipitation as 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 Vashlovani Ranger main station. Our observation of the vegetation on the Eldari lowlands indicates that it may receive as little as 250 mm/year on average. We have no data to evaluate the inter- and intra-annual precipitation variability, although I anticipate that it may range from 15-20% in the highest rainfall zone and as much as 30-40% in the driest part of the region.
- From these limited precipitation and temperature data, we would expect the beginning of the vegetation growth period to 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. 5).
- The average yearly temperature is about 12°C. The daily mean minimum and maximum temperatures of the coldest month (January) are around -5°C and about +5°C respectively. This means that little growth (Fig. 5) is expected from pastures and rangelands 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. 5) 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.
- The Eldari lowland is a wind corridor strongly affected during the winter (*N. Lachashvili, pers.com.*)

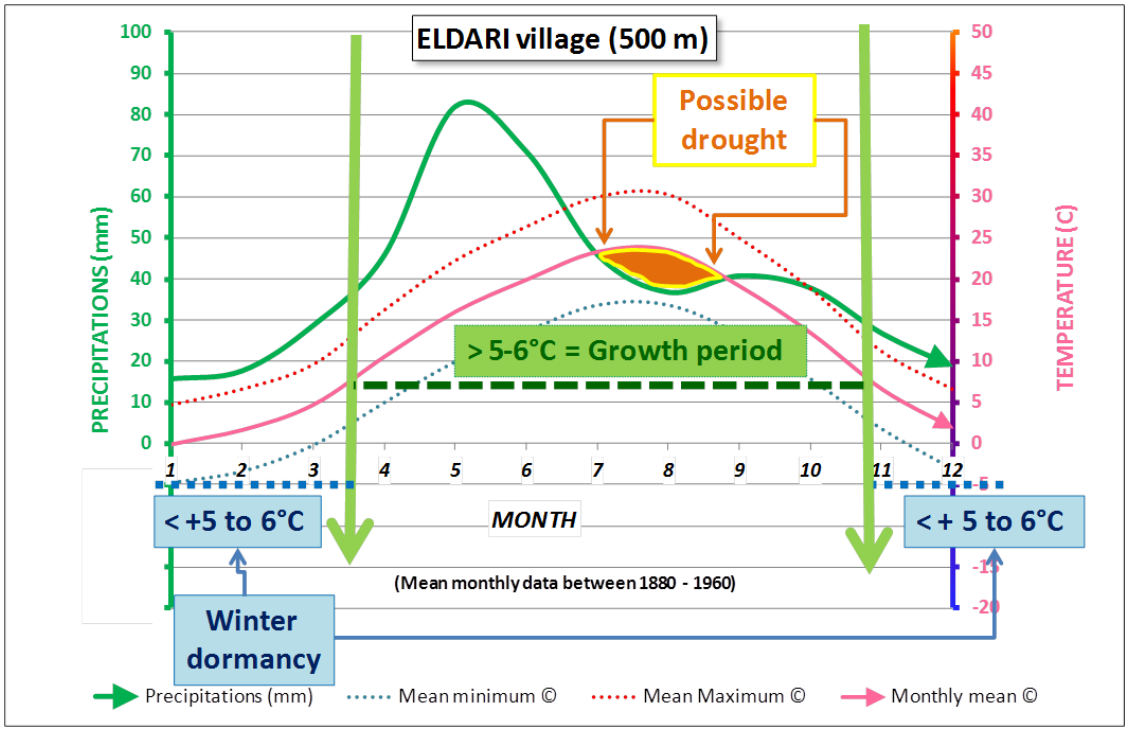


Figure 5: Biological interpretation of the Ombro-thermal diagram indicating the period for vegetation growth, possible drought and winter dormancy for the Eldari village and the Vashlovani National Park region.

A brief on the main Vashlovani vegetation types

All scientific Georgian plant names in this report are referring to the "Flora of Georgia" (1971-2003). Synonyms are available in Czerepanov (1995) and "The Plant List" site (http://www.theplantlist.org/). Author(s)' names are available in the annexes.

The term "rangeland" is used for natural landscapes and vegetation types including grasslands, scrublands, woodlands-forest, wetlands, and deserts that are either to steep, too rough, or too remote or too arid to allow permanent agricultural activities.

The term "pastures" is used here for secondary grasslands that are or were, one way or another, impacted by agricultural activities (grazing, hay cutting or post-cropping).

Both rangelands and pastures are used by small ruminants and cattle.

``All soils on the Vashlovani area are alkaline and with a heavy loam and silt texture.

The main vegetation types (adapted from Lachashvili, et al. 2004, 2007, 2010 a) are:

- **The open arid forests** (rangelands)
  Dominated by Pistacieta (*Pistacia mutica*) mixed with Juniperita (*Juniperus foetidissima* and *J. polycarpos*) all over the central depression of the Vashlovani reserve as well as the beginning of Chiroelt-Khevi. Some patches of *Celtis caucasica* especially at Mlashe-Tskali.

Photo 2: The open arid forest of *Pistacia mutica – Juniperus* spp. in the Vashlovani Reserve

- **The phrygana**[2] (rangelands) 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 *Reaumuria alternifolia, Caragana grandiflora, Colutea* spp. , *Atraphaxis spinosa, Paliurus spina-christi, Ephedra distachya, etc.* associated with tragacanthic plant communities (low spiny and thorny shrubs) dominated by *Astragalus* spp. and *Acantholimon fominii* 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., *Hippophäe rhamnoides*, and native *Punica granatum and Vitis vinifera.*

[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 Fimbos in South Africa).

Photo 3: The Phrygana on badlands (A view from the Pantishara gorge)

- **The semi-desert vegetation** (rangelands) occurs on foothills (Eldari, or Samukhi lowland).

Photo 4: The Eldari lowlands (view from Eldari 5 site)

It 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 *Salsola ericoides* (mixed with *Artemisia lerchiana* and *Noaea mucronata*) 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 *Salsola nodulosa* (gypsophytic) replacing *S. ericoides*, still with some *rare Artemisia lerchiana*.
* The lower section of the foothills is even more saline (with the appearance of solonchak - solonetz and even gley soil on bare takyr) due to water accumulation and hydromorphy. It is the domain of the azonal saline *Gamanthus pilosus* phytocoenosis (with *Aeluropus littoralis*, *Kalidium capsicum* (strong halophytes), *Bolboshoenus maritimus* (hydromorphic), *Lycium ruthenicum* (phreatophytic), etc.

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

* *Stipa lessingiana* and *S. capillata* (pastures - associated with *Onobrychis* spp. and *Glycyrrhiza glabra*) 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 *Paliurus spina-christi* and *Cotinus coggygria).* These areas are current and prime target for hay making,
* *Bothriochloa ishaemum* and B. *caucasica* (rangelands) in dense and nearly pure stand of at Kumuro and Bogha-Moedani depressions and occasionally covering large patches all over the National Park.

Photo 5: The steppe vegetation (view from the Stipa 1 site towards the Iori plateau)

For more information on the Iori plateau vegetation, see Abdaladze and M. Chiboshvili (2004)

One should also mention:

- **The Riparian forests** covering a narrow ribbon of land along the Alazani River. The landscape is shaped by the Poplars (*Populus nigra, P. canescens*) with occasional magnificent oaks (*Quercus pedunculiflora*),

Photo 6: The Alazani riparian vegetation near Mijniskure along the Azerbaijani border

- **The mountain forest** (Black Mountain – M'ta-Zilcha) - Querceta – fraxinetum with a dominance of *Quercus iberica, Fraxinus excelsior , Acer ibericum* and *Acer campestre*

Photo 7: A *Quercus iberica* in the Black Mountain forest

Notes about the most important dominant pasture and rangeland species present on the Vashlovani National Park.

- ***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 (*…it flavours the meat!...)* – winter feed reserve for small ruminants and wild ungulates when annuals and ephemerals are not available; Abdaladze and Chiboshvili (2004) report that the green shoots of *Artemisia* represent around 60% of the standing winter biomass. However, we know that *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 *Artemisia* spp. is reputed to have anthelmintic and allelopathic characteristics. The *Artemisia* rangelands on Vashlovani (mostly on the Eldari lowlands) suit the current winter spring grazing by Tush's small ruminants

- ***Stipa*** spp. (Graminaceae) – mostly *Stipa capillata*, 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 *Bothriochloa ischaemum*. The *Bothriochloa* pastures look good and plentiful on Vashlovani, but this is a deceptive resource. The reason is that *Bothriochloa* is an aggressive tufted perennial C4 grass (a tropical grass, known as "beardgrass" or "bluestem"); it unconditionally 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 Tush's small ruminants 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; this is confirmed by Sokhadze 1970 and Abdaladze and Chiboshvili (2004), the later giving a figure of 99% (?) of dead *Bothriochloa* material in winter. Even in spring, the aggressive *Bothriochloa* covers the soil and prevents the germination and growth of other plants (Lachashvili *et al* 2010 b). 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). Abundant international literature is available on the pasture management of *Bothriochloa* pastures (USA, Australia, tropical Africa, and South-East Asia). It clearly indicates 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 small ruminants but also by cattle). **During our June visit to Vashlovani, all *Bothriochloa* pastures were in full flower, displaying large standing unused (under-grazed) biomass resulting from a lack of small ruminants or wild ungulates to rejuvenate the pasture.** 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 *Onobrychis kachetica* 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 small ruminants for grazing when green but are valuable as forage for hay making when associated with *Stipa*.

- ***Medicago*** spp. (Leguminosae) – *Medicago coerulea* 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.

Useful information on the phenology of the main plants of the vegetation from eastern Georgia is available in Sokhadze (1970).

Current rangeland use

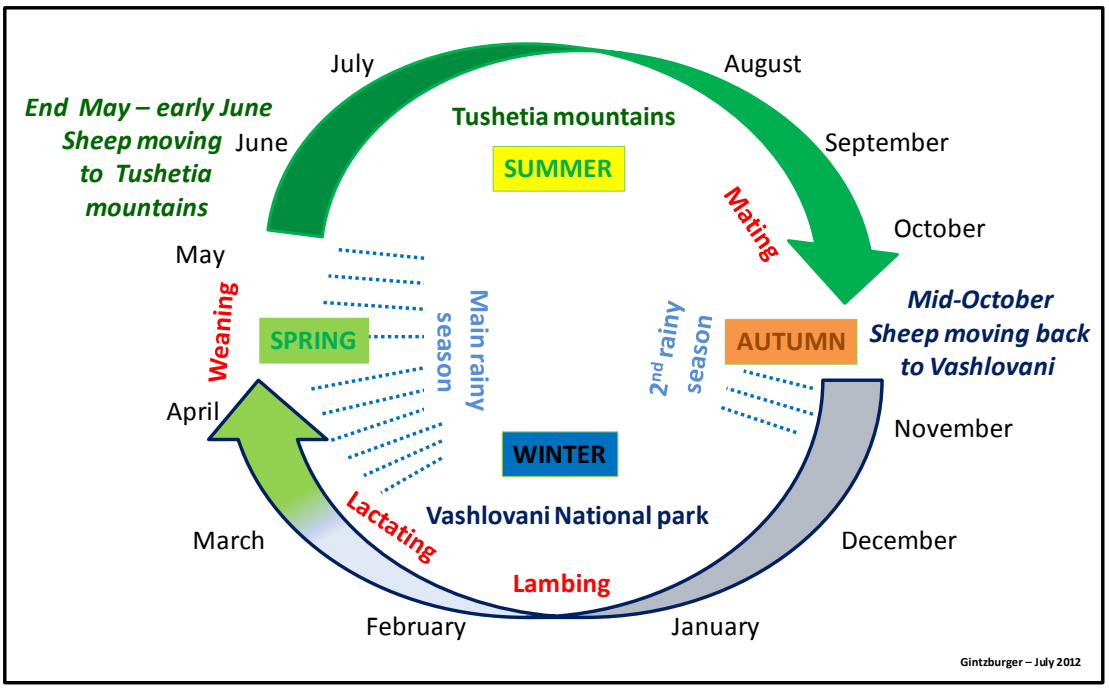


Figure 6: Schematic presentation of the current rangeland use, Tush sheep flocks location and cycle

During our field visit (June 2012), there were no Tush shepherd or small ruminants to be seen on any part of the Vashlovani NP or associated project areas. The Schematic presentation (Fig. 6) of the current rangeland use, Tush sheep flocks location and cycle is based on information collected from Mr. A. Gogotidze, director of the Tusheti Protected Areas and on discussions with colleagues from NACRES and FFI (Tbilisi Office).

The Vashlovani National Park and associated project 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, 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.

There is no cultivation or cropping within the VNP limits although some minor cereal cropping can be seen on the northern end of Patara-Shiraki outside the project boundaries.

AIMS OF THE MISSION

"Developing a comprehensive survey to assess the current conditions of the grasslands of selected parts of the Vashlovani landscape in respect to livestock and wild ungulate use"

For this, we:

"Identified the location of "pastures and rangelands of selected parts of the Vashlovani landscape in respect to livestock and wild ungulate use"

Exploration, vegetation assessment and measurement

During our 10 day visit to the Vashlovani region, we were stationed at the Vashlovani main rangers' lodge (N41 12.920 E46 25.968) and travelled a total of about 355 km (Fig. 7) throughout the park and its' surroundings. Most tracks (weather permitting, often in dry river bed, narrow gullies and gorges) are rough and require a 4x4, in good condition, especially after rain.

- The first two days were assigned to an overall reconnaissance mission for an overview of the region through the Pantishara gorge to the Eldari lowlands returning through Kumuro and Bogha-Moedani. The second day, we went to the Black Mountain (Shavi-M'ta or M'ta-Zilcha) through Chiroelet-Khevi and Mlashe-Tskali.

- The next 8 days were assigned to LIM and biomass measurements on a total of 19 selected sites (2-3 sites/day), including Eldari lowlands, the Vashlovani crest, the beginning of Chiroelet-Khevi, Patara-Shiraki, Kumuro, Bogha-Moedani, Mlashe-Tskali and Mijniskure along the Alazani River.

We focussed on open country where livestock and wild ungulates would graze without the hazards of predation by carnivores. We excluded from our survey all the dense arid forest and impenetrable phrygana areas inside the VNP and Vashlovani Nature Reserve (VNR). We also excluded most of the Mlashe-Tskali area that is covered with a maze of open arid forest, keeping only its most southern parts on the track to Mijniskure.

Open potential grazing areas are located (Fig. 7 and Fig. 8) on:

- The Eldari lowlands (approx. 11400 ha), south and partly inside the VNP
- The Kumuro (approx. 1000 ha) and Bogha-Moedani (approx. 500 ha) depressions, South-east and inside the VNP
- Part of the Chighoelt-Khevi (approx. 2000 ha) gently rolling hills outside the VNP, North-east, with an area of approximately 900 ha of the overall 2000 ha inside the VNP,
- The most southern part of Mlashe-Tskali (only a few hundred hectares) on the track to Mijniskure – Alazani river,
- Part of the Iori plateau including;
    - The Patara-Shiraki (approx. 3000 ha) rolling hills, inside and outside the VNP
    - And the pastures (approx. 1000 ha) extending south of the Nagomrebi Range from Patara-Shiraki to the northern part of the beginning of Chiroelt-Khevi, on the crest north of the Vashlovani main ranger station.

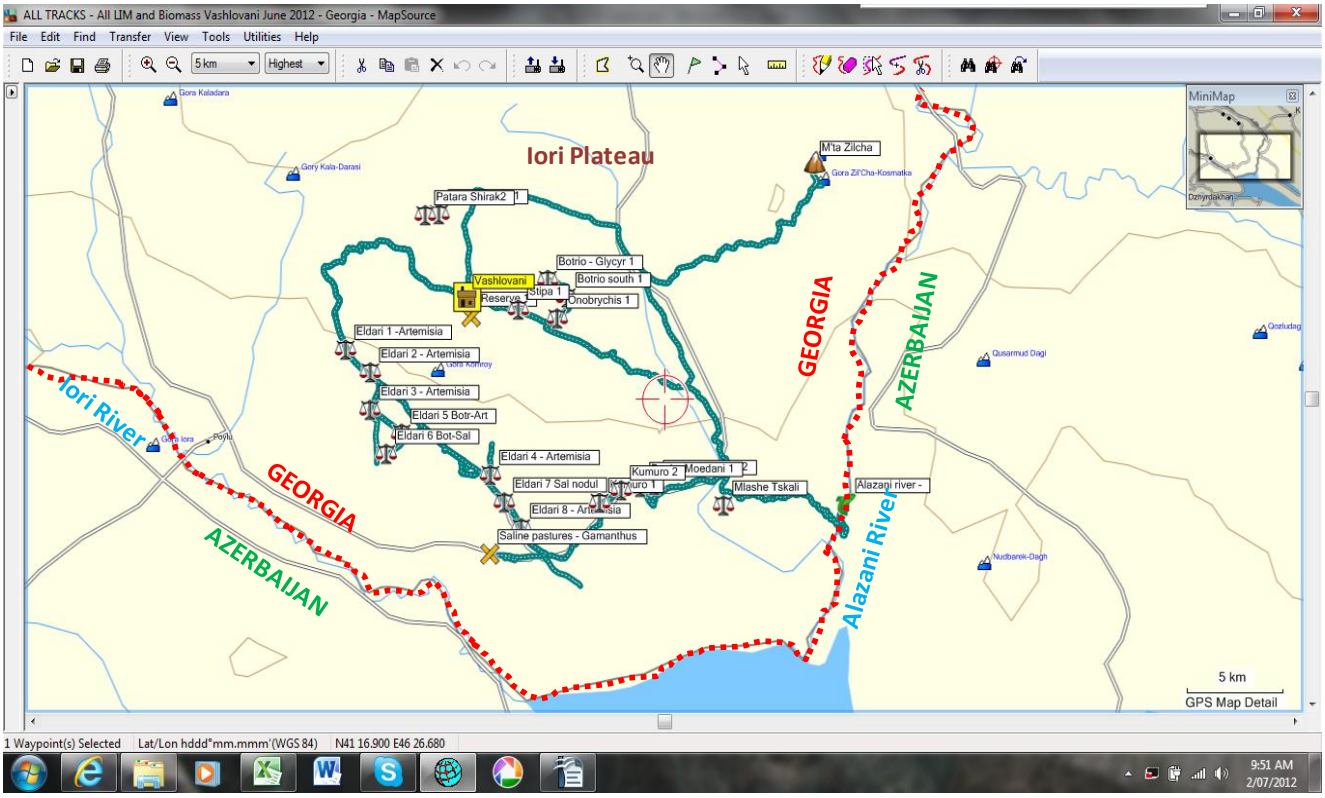
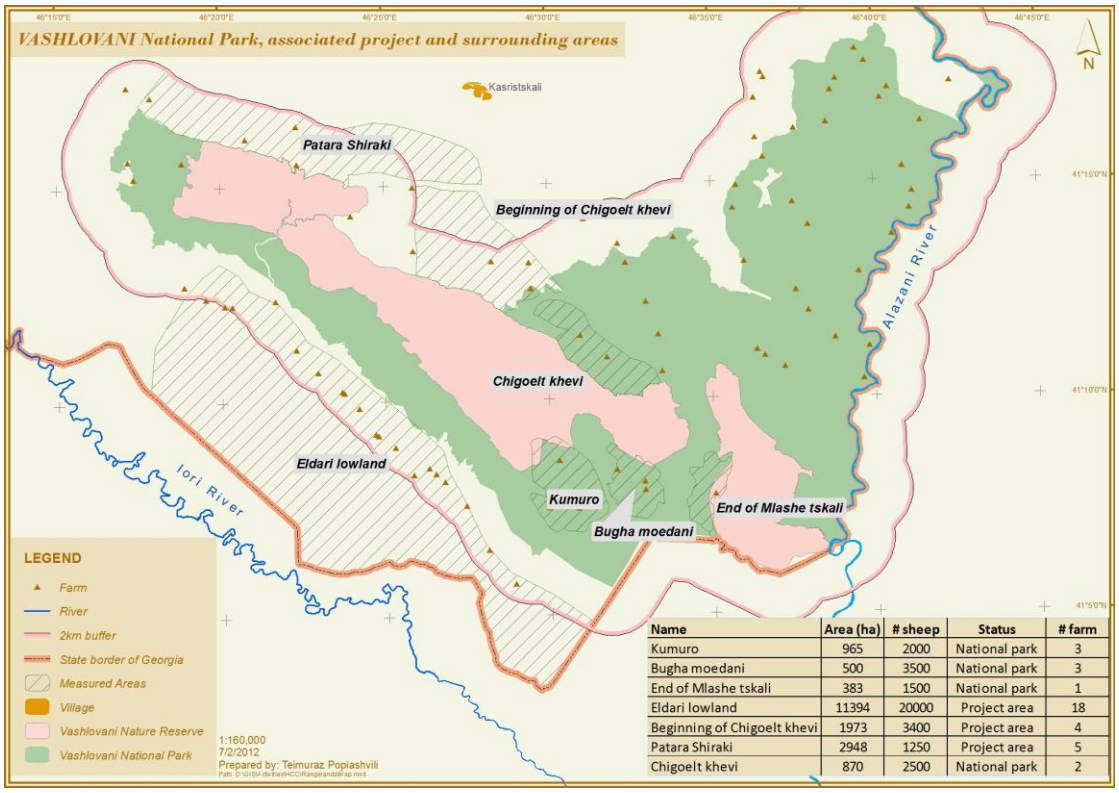


Figure 7: Reconnaissance survey and measurement sites on Vashlovani National Park region



Name	Area (ha)	# sheep	Status	# farm
Kumuro	965	2000	National park	3
Bugha moedani	500	3500	National park	3
End of Mlashe tskali	383	1500	National park	1
Eldari lowland	11394	20000	Project area	18
Beginning of Chigoelt khevi	1973	3400	Project area	4
Patara Shiraki	2948	1250	Project area	5
Chigoelt khevi	870	2500	National park	2

Figure 8: Vashlovani National Park, associated project and surrounding areas with farms location and details (Map from T. Popiashvili)

MATERIAL AND METHODS

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. When surveying a new region, the vegetation types are identified with a Correspondence Analysis and/or a Hierarchical Classification taking into consideration the list and abundance-dominance of perennial species and the annuals and ephemerals identified on each site. Vegetation mapping is then processed using a LANDSAT or SPOT satellite image in relation to vegetation groups/site location and the unsupervised image classification using GIS software, later checking the defined homogeneous polygons by ground truthing. Alternatively, when the vegetation types are already well identified (as is the case with the Vashlovani region) and known (Lachashvili et all 2004. 2007), 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'Ecologie Fonctionnelle et Evolutive, Centre National de la Recherche Scientifique, 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 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 (Fig. 9) are established and monitored at least once a year, at the end of summer or in autumn.

Each intercept (Fig. 10) 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 evaluated (and not measured) 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.

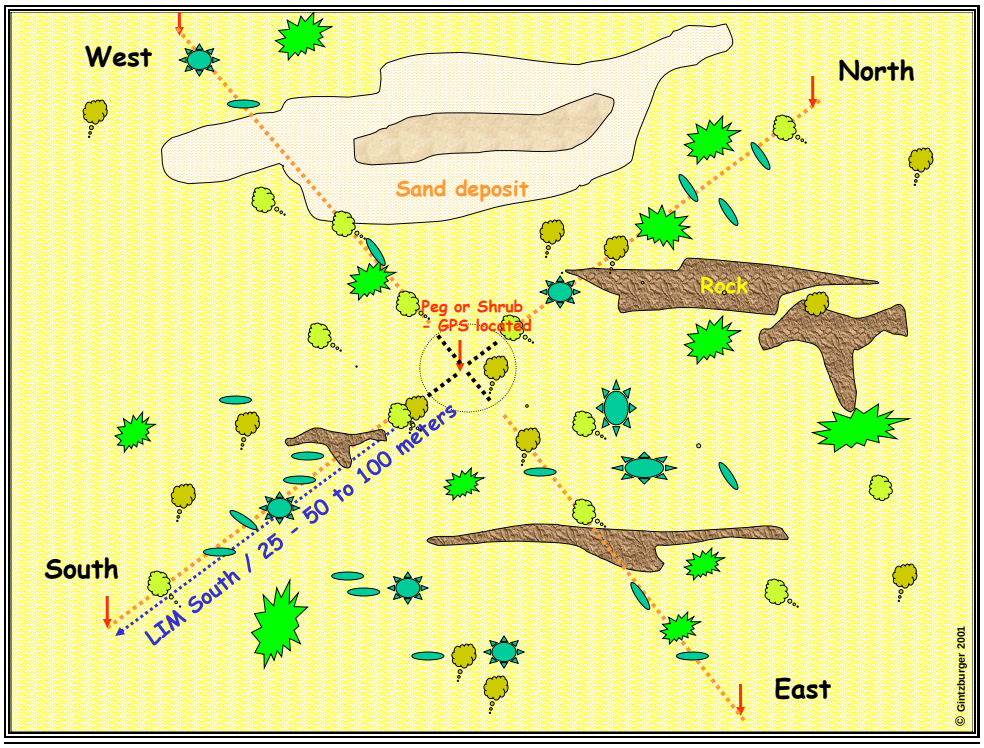


Figure 9: Field lay-out of the Line Intercept Measurement (LIM) – Gintzburger et al. 2005 – reprinted 2009)

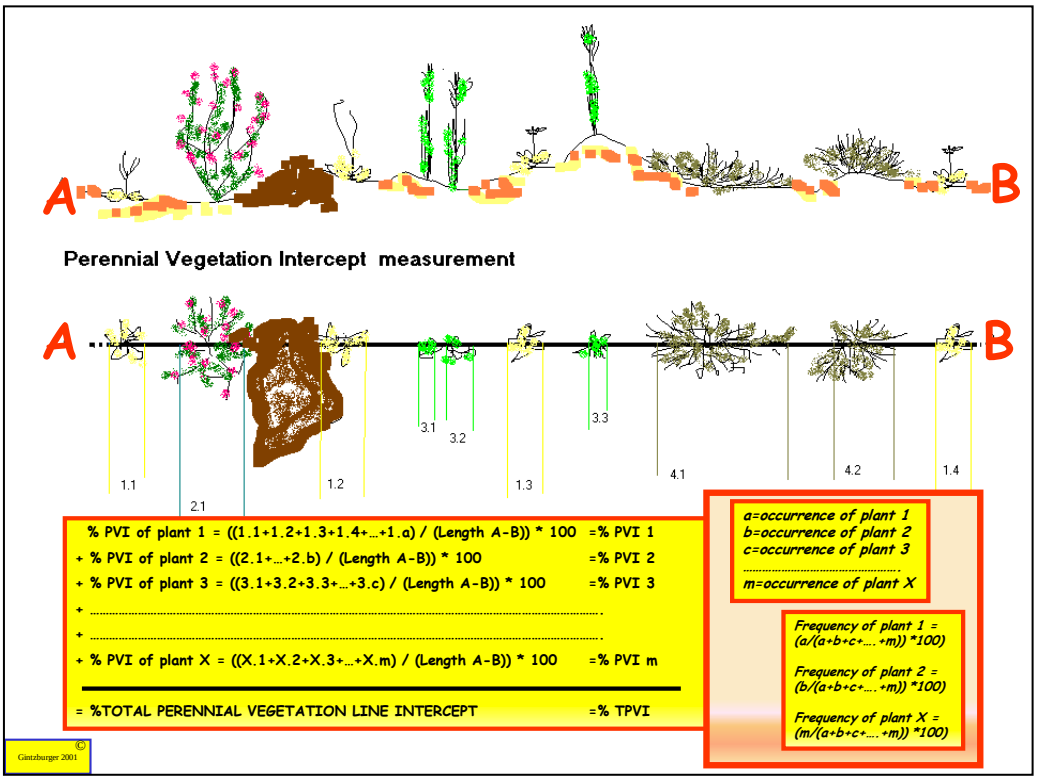


Figure 10: Perennial vegetation Line Intercept Measurement (all measurements in same units (cm, inch)) – (Gintzburger et al. 2005 – reprinted 2009)

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 (Fig. 11) 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.

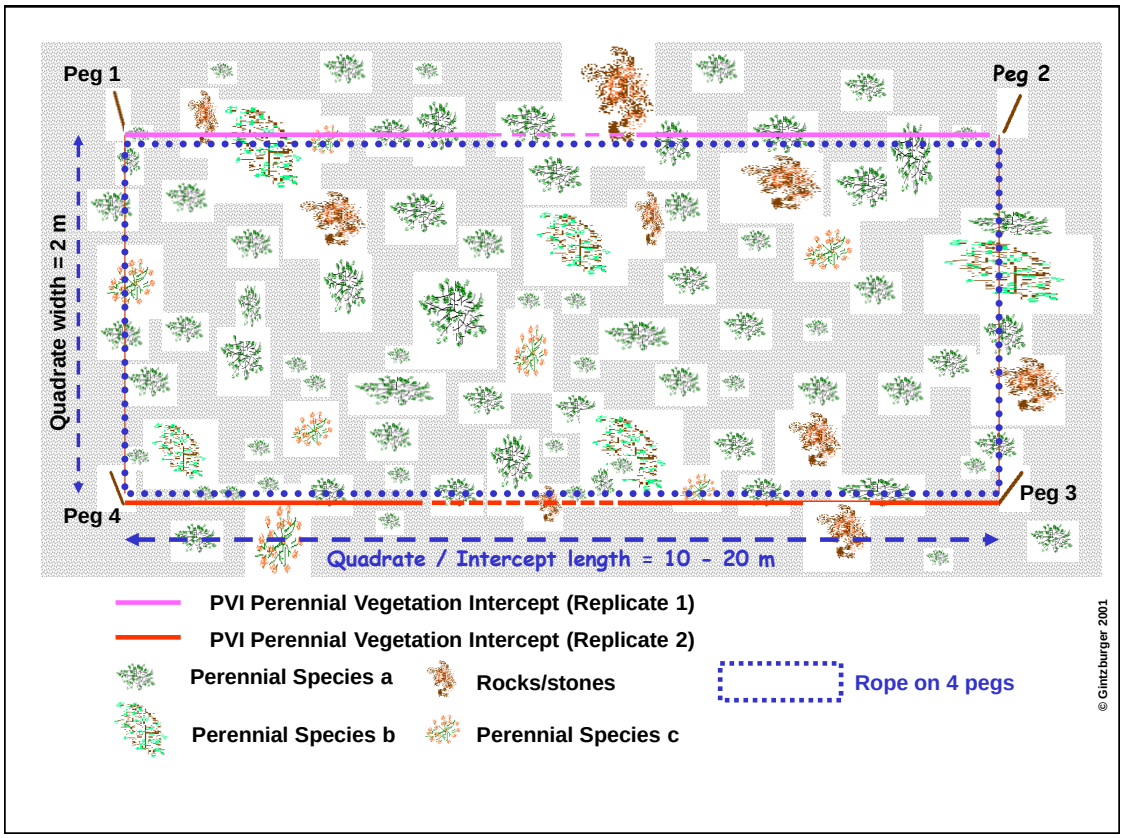


Figure 11: Quadrate measurement (QM) layout - (Gintzburger et al. 2005 – reprinted 2009)

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 (m² 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 Estimated Plant Biomass of plant n / ha = (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).

How we used these methods for the Vashlovani vegetation assessment?

For reasons of logistics and available time, we simplified the methods applied and reduced the amount of time allocated to each site. Additionally, as no recent satellite imagery was available at the time of the mission, we identified the most regionally important vegetation types during a preliminary and short (2-day) reconnaissance trip over the whole Vashlovani area. We then proceeded with either the LIM and QM or the biomass measurement on what we identified as homogenous vegetation types. This was greatly facilitated by the deep and expert topographical, botanical and ecological knowledge of the region provided by Dr N. Lachashvili and Mr. T. Popiashvili who supported me, efficiently contributing to the whole operation during my mission in Georgia.

- We used the LIM and the QM for all the *Artemisia* dominant vegetation types, either on the Eldari lowland or other parts of the region (Kumuro and Mlashe-Tskali).
- 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.
- 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 given as bulk value.
- All samples were air dried and weighed at the end of the mission when back in Tbilisi.

RESULTS AND DISCUSSION

Terms of reference:

> *Conduct a 2-week trip to Georgia, in June 2012, to assess current rangeland condition in selected areas of Vashlovani PA and Samukhi in respect of:*
>
> - *plant species composition and structure*
> - *Annual and perennial plant biomass production on selected sites and within the limited time allocated to the field mission*
> - *signs of overgrazing/under-grazing using LIM*
> - *livestock and wild ungulate use (based on GCCP & local knowledge)*
> - *GPS location and spatial distribution*

Note:

- All LIM and biomass sites are located on figure 7, and accurately located; the spatial distribution and ha available for each vegetation type within the project area could not be estimated as no accurate vegetation map is currently available or could be produced within the mission time frame and capacity (lack of recent satellite images, appropriate software and local expertise). The NACRES land cover map available to us is very crude[3] and of very little use.
- The identification (genus and species) of specimens, and their relative abundance/dominance and life form (perennials, annuals, etc) are mostly due to Dr. N. Lachashvili with some contributions from G. Gintzburger.
- The LIM and Biomass field measurements are the result of the teams field work.
- The "Abundance/Dominance" is rated on a 5 (most "abundant – dominant" plant on site), 4, 3, 2, 1, + (rare – but several specimen sighted) scale.
- The biomass measurements were only carried out on perennial plants present on the quadrate. No measurements were performed on annual or ephemeral plants as these were already dead, dried out and brittle. Their contribution to the perennial standing biomass measured in June 2012 was considered negligible in all cases.
- The biomass samples could not be sorted into woody parts and green shoots, however, the shrubs harvested at ground level displayed little lignification or old wood (with the exception of the *Salsola*) and so we assumed that the standing, harvested biomass would be close to the current seasons growth.
- The samples were bulk air-dried in a well ventilated area for a minimum of 8-10 days and weighed at the end of the mission in Tbilisi.
- A comprehensive list of all encountered plant genus and species (by N. Lachashvili), with local Georgian names (by T. Popiashvili) where available, is presented in Annex. This is the result of team work initiated by N. Lachashvili and T. Popiashvili and compiled with other information by G. Gintzburger.

- [3] The available legend on the NACRES land cover map lists only the rudimentary vegetation landscape, omitting the vegetation types that are well known from the Lachashvili's work and associated abundant literature, The map should also indicate the date of image capture, the type (LANDSAT, SPOT, etc), the path and the swath of the satellite image used to produce the map, the author(s)' name(s) and affiliation, a date of map production, It should also show a scale, a coordinate grid, the map orientation, references to elevation, the name of the main populated centres, the ranger stations, the name of the main places (Kumuro, Bogha-Moedani, Eldari, etc.), the names of the main gorges, rivers, picks-mountains, etc, the boundaries of the NVP and the SNR, the main tracks, the main water points, etc ...

Sites on ELDARI lowland

The ELDARI lowland covers about 11400 ha stretching from the VNP hills and badlands to the north-east ,fed by well watered foothills (supplied by temporary water courses) to extensive alluvial flats, and ending into saline depressions with halophytic vegetation and small bare takirs[4] to the south-east where water accumulates and ultimately flows into the Iori River subsidiaries (Fig. 12).

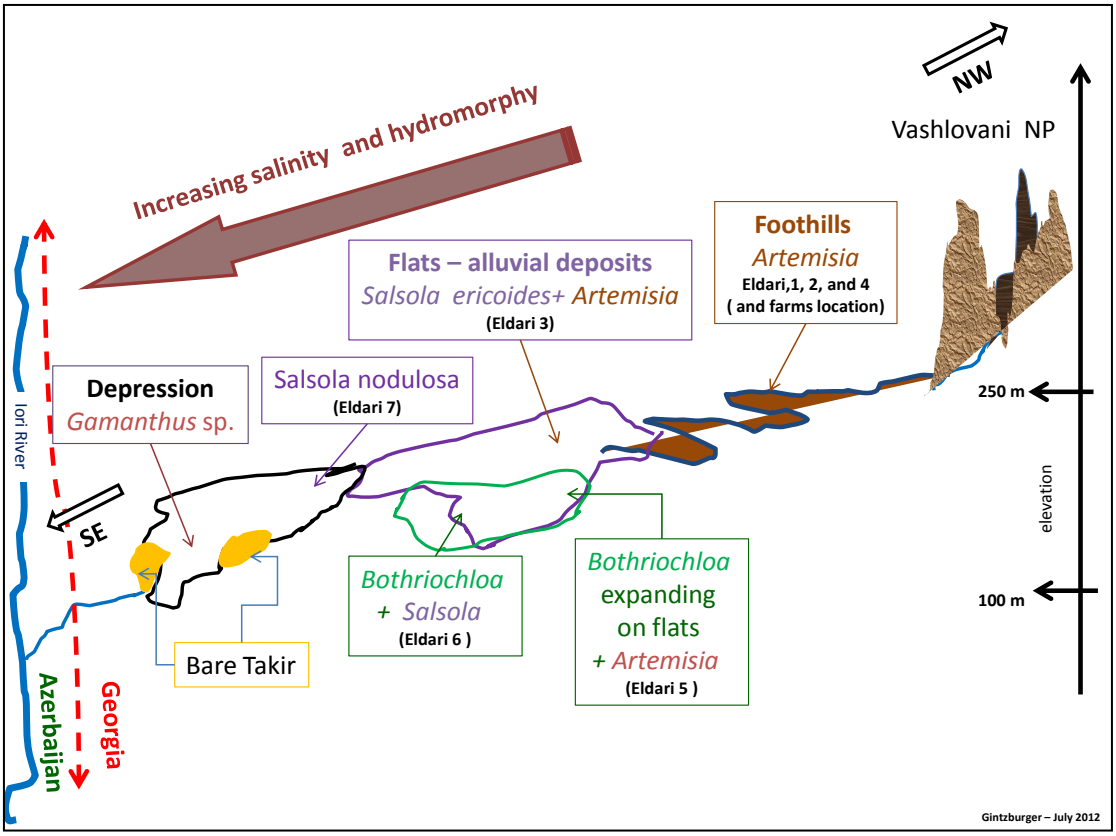


Figure 12*:* A geomorphologic and vegetation NW-SE transect of the Eldari lowland

The Eldari lowland (Fig. 8) hosts about 20000 sheep, distributed around 18 farms and grazing within a 3-4 km (maximum daily walking distance for a flock in winter) radius around each farm, returning to the farm each night.

1. **Eldari 1**
   Date: 16-JUN-12 7:23:24
   Location: N41 11.510 E46 21.837, elevation = 223 m
   Land use: Winter (mid October – mid April) grazing by sheep from Tush community
   Vegetation:
   Type: **Artemisietum lerchianae ;** dense and pure stand in good condition, poor presence/diversity and biomass of annuals – ephemerals. On foothill, on alluvial cones (with heavy grey soils) receiving water from the VNP hills and badlands to the north of site.

[4] A "Takir" is a depression where water, fine sediment and silt accumulates over years, creating a perfectly flat bare area, dry in summer and marked by polygonal cracks.

Photo 8: A view of the Eldari 1 site

N. Lachashvili is carrying out the LIM while T. Popiashvili takes notes on Eldari 1

Composition:

Species	Abundance – dominance	Life forms
1. *Artemisia lerchiana*	5	Dwarf semi-shrub
2. *Trachynia distachya*	+ (mor.)	Annual
3. *Medicago minima*	+ (seeds)	Annual

Table 1: Vegetation composition for Eldari 1

Structure and LIM: exclusively from *Artemisia lerchiana*, average LIM = 53.2% (SD = 4.7. n=4), bare soil = approx. 47%. (Fig. 13)

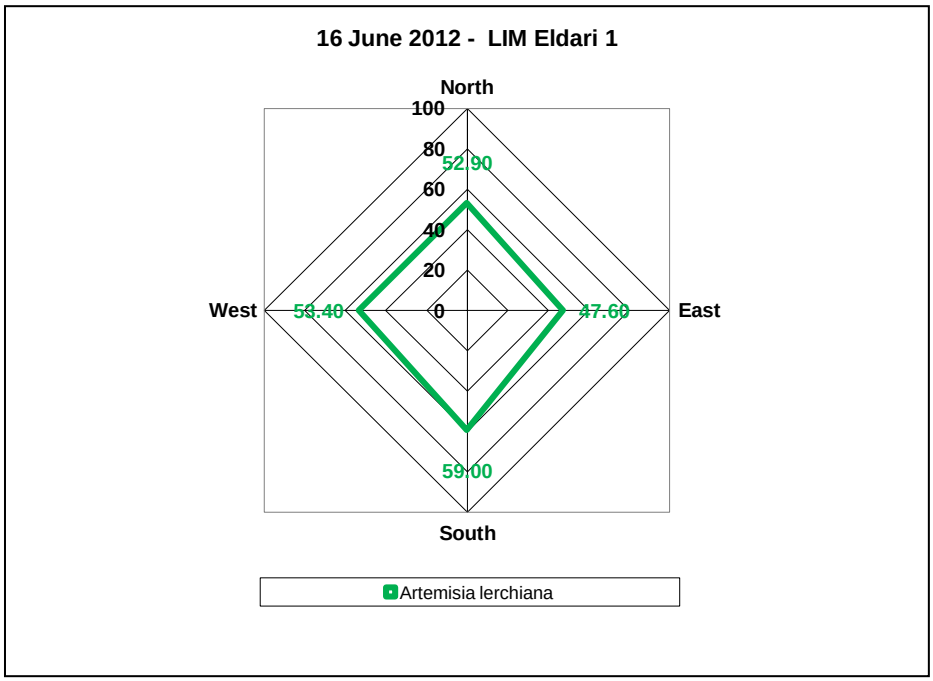


Figure 13: LIM for Eldari 1

Estimated standing biomass: The measured *Artemisia lerchiana* density is 130000 shrubs /ha (SD =16100, n=3). The average shrub weight is 5.37 g (SD = 4.0, n=10) giving an estimated mean standing biomass of 698 kg Dry Matter (DM)/ha, nearly all from the current season's growth.

Sign of overgrazing: No sign of overgrazing on the *Artemisia* shrubs which appears healthy, displaying good individual growth. However, N. Lachashvili, who last surveyed the area about 7 years ago, noted the total absence of *Poa bulbosa*, a well winter-grazed viviparous ephemeral (perennial), possibly indicating a slow overstocking trend over the past few years. This could only be confirmed with reference to earlier surveys not available at the moment of the mission.
Potential livestock and wild ungulate use: The *Artemisia* shrubs usually provide a substantial autumn–winter grazing when dry. *Artemisia* is rarely grazed in spring when green and full of "artemisine" and other essential and volatile oils that may induce diarrhoea-abortion when grazed in large quantity. During spring, providing that the precipitations are sufficient and temperature adequate to allow for their growth, the sheep (and wild ungulates) preferentially graze annuals and ephemerals found in-between the *Artemisia* shrubs.

2. Eldari 2

Date: 16-JUN-12 9:32:47
Location: N41 10.916 E46 22.682, elevation = 202 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community
Vegetation:

Type: As Eldari 1 but in better condition, **Artemisietum lerchianae;** dense and pure stand with poor presence/ diversity and biomass of annuals – ephemerals. On foothill, on alluvial cones (with heavy grey soils) receiving water from the VNP hills and badlands to the north of site.

Photo 9: A view of the Eldari 2 site

N. Lachashvili and T. Popiashvili taking measurements within a quadrat

Composition:

Species	Abundance - dominance	Life forms
1. *Artemisia lerchiana*	5	Dwarf semi-shrub
2. *Trachynia distachya*	+ (mor.)	Annual
3. *Medicago minima*	+ (seeds)	Annual

Table 2: Vegetation composition for Eldari 2

Structure and LIM: exclusively from *Artemisia lerchiana*, average LIM = 45.5 % (SD = 6.2. n=4), bare soil = approx. 65%. (Fig. 14)

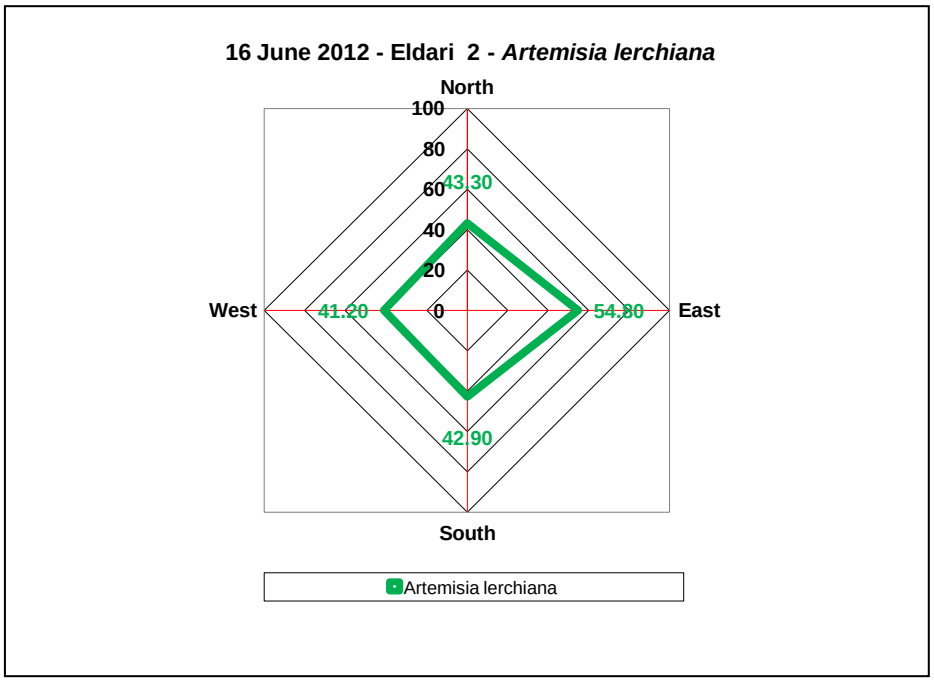


Figure 14: LIM for Eldari 2

Estimated standing biomass: The measured *Artemisia lerchiana* density is 125300 shrubs /ha (SD =7500, n=3). The average shrub weight is 9.4 g (SD = 11.2, n=10) giving an estimated mean standing biomass of 1181 kg Dry Matter (DM)/ha, nearly all from the current seasons' growth. The *Artemisia* shrubs are, on average, bigger than those at Eldari 1 with more recruitment of new *Artemisia* seedlings, as indicated by the large individual shrub-weight standard deviation. This suggests that this stand is recovering well from possible past and intensive grazing.

Sign of overgrazing: Similar to Eldari 1
Potential livestock and wild ungulate use: As for Eldari 1

3. Eldari 3

Date: 16-JUN-12 9:52:27
Location: N41 09.931 E46 22.672, elevation=169 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community

Vegetation:

Type: ***Salsola ericoides* + *Artemisia lerchiana*** on slightly saline soils. The rare presence of *Noaea mucronata* (and arid zone dwarf semi-shrub) and *Salsola dendroides* (showing patches of increasing soil salinity towards the southern part of Eldari lowland) is also noted, though too rare to contribute to the LIM and biomass on this site. A much richer site, in terms of diversity and biomass, due to water accumulation on shallow depressions on the southern part of the Eldari lowland

Photo 10: A view of the Eldari 3 site

The blue-green shrubs are *Artemisia lerchiana*, and the light green are *Salsola ericoides*.

Composition:

Species	Abundance - dominance	Life forms
1. *Artemisia lerchiana*	5	Dwarf semi-shrub
2. *Salsola ericoides*	4	Semi-shrub
3. *Noaea mucronata*	+	Dwarf semi-shrub
4. *Salsola dendroides*	+	Semi-shrub
5. *Stizolophus coronopifolius*	1	Annual
6. *Nigella arvensis*	1	Annual
7. *Anagallis foemina*	1	Annual
8. *Trachynia distachya*	1 (mor.)	Annual
9. *Medicago minima*	1 (seeds)	Annual
10. *Daucus carota*	+	Annual
11. *Bromus japonicus*	+ (mor.)	Annual
12. *Lolium rigidum*	+ (mor.)	Annual

Table 3: Vegetation composition for Eldari 3

Structure and LIM:

- The total perennial LIM (in blue on Fig. 15) average 48.7% (SD=11.3, n=4) with an *Artemisia* LIM contribution of 20.8% (SD=13.8, n=4) and *a Salsola ericoides* LIM contribution of 26.8% (SD=11.4, n=4) without the rare contribution of *Noaea mucronata* and *Salsola dendroides*.

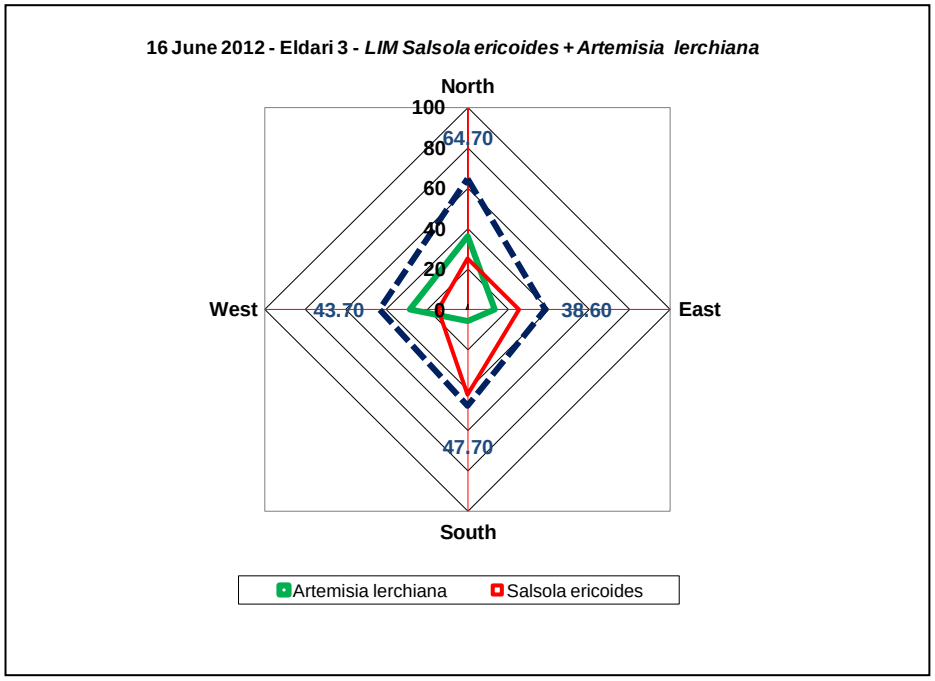


Figure 15: LIM for Eldari 3

The LIM information here shows us that this vegetation type is a mosaic of micro-topography of high, drier ground where the *Artemisia* concentrates, with slightly saline, hydromorphic micro-depressions host the *Salsola*.

Estimated standing biomass:

- The *Salsola ericoides* density average 25700 shrubs/ha (SD=3200, n=3) with an average individual shrub weight of 48.2 g (SD=66, n=6), hence an estimated biomass of 1238 kg DM/ha.
- The *Artemisia lerchiana* density average 56700 shrubs/ha (SD=5000, n=3) with an average individual shrub weight of 6.6 g (SD=3.7, n=4), hence an estimated biomass of 374 kg DM/ha.
- The total standing perennial biomass is about 1612 kg DM/ha

Sign of overgrazing: no sign of overgrazing

Potential livestock and wild ungulate use: Excellent and well balanced winter – spring pasture with contribution from perennials and annual-ephemerals. The soil salinity and presence of *Salsola* allow a necessary and beneficial supply of minerals to livestock and ungulates.

4. Eldari 4

Date: 16-JUN-12 12:16
Location: N41 08.226 E46 26.773, Elevation=156 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community

Vegetation:

Type: **Artemisietum lerchianae** (in poor condition), on a flat on the upper part of the foothill receiving little run-on, on poor gravelly – loamy compacted soils.

Photo 11: A view of the Eldari 4 site

Composition: Exclusively *Artemisia lerchiana*, no other perennial, nor annuals or ephemerals on site.
Structure and LIM: Poor *Artemisia* vegetation cover with an average LIM of 28.4% (SD=7.0, n=4). (Fig. 16)

Estimated standing biomass: The *Artemisia* shrub density on this site is 105700/ha with an average individual shrub weight of 4.5 g (SD=3.8, n=10), totalling an estimated *Artemisia* biomass of about 474 kg DM/ha.

Sign of overgrazing: none

Potential livestock and wild ungulate use: as for Eldari 1 and 2

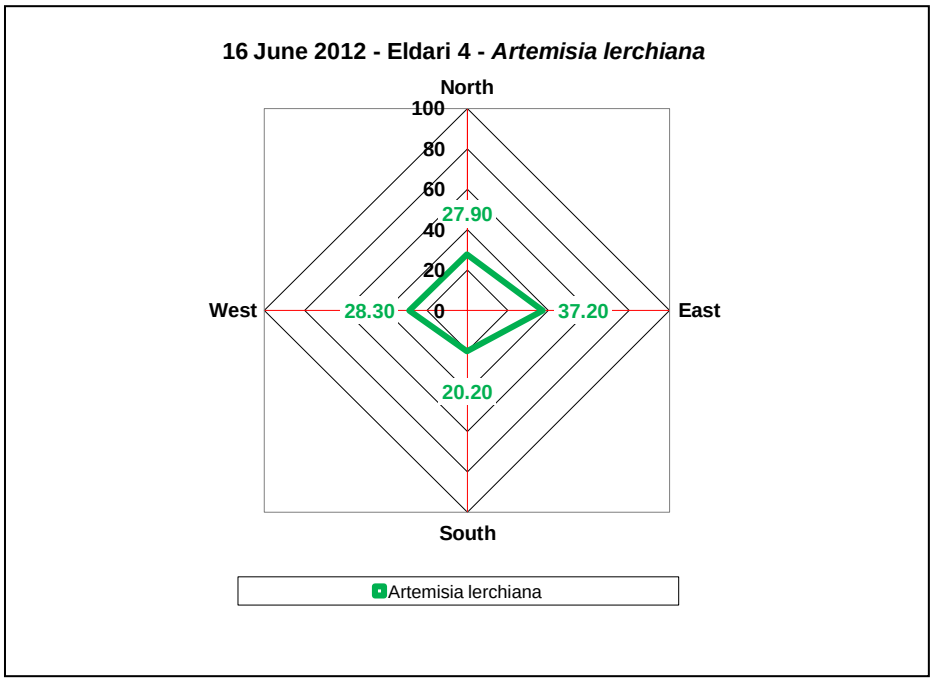


Figure 16: LIM for Eldari 4

5. Eldari 5

Date: 19-JUN-12 9:19:51
Location: N41 09.308 E46 23.746, elevation= 162 m

Land use: Winter (mid October – mid April) grazing by sheep from Tush community

Vegetation:

Type: ***Bothriochloa ischaemum + Artemisia lerchiana*** on run-on flats, *Bothriochloa* pasture expanding on these loamy flats gaining over the *Artemisia;* Abundant annuals of poor feed value.

Photo 12: A view of the Eldari 5 site

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial grass
2. *Linum corymbulosum*	2-3	Annual
3. *Sonchus sp.*	2-3	Annual
4. *Trachynia distachya*	2-3	Annual
5. *Filago pyramidata*	2	Annual
6. *Bromus japonicus*	2 (mor.)	Annual
7. *Artemisia lerchiana*	1	Dwarf semi-shrub
8. *Daucus carota*	1	Annual
9. *Nigella arvensis*	+	Annual
10. *Artemisia scoparia*	+	Annual
11. *Filago arvensis*	+ (mor.)	Annual
12. *Salsola iberica*	1 specimen	Annual

13. Carthamus lanatus	1 specimen	Annual

Table 4: Vegetation composition for Eldari 5

Structure: No LIM was performed on this site as the vegetation cover is close to 100%. Number of species including perennial and annuals on 1 m^2 = 6-7; Number of *Bothriochloa ischaemum* on 1 m^2 = 8-10 to 15-18 individuals

Estimated total standing biomass: 3247 kg DM/ha (SD=1070, n=3)

Sign of overgrazing: No sign of overgrazing

Potential livestock and wild ungulate use: Little use in winter as *Bothriochloa* is totally dormant and dry, and poorly palatable in summer once flowering and reaching maturity. An early, heavy spring grazing would maintain the *Bothriochloa* in vegetative stage (continuous production of soft palatable leaves) and delay its unwelcome flowering. However, this would be to the detriment of flowering and fruiting annuals, preferred by all livestock and potential ungulates.

6. Eldari 6

Date: 19-JUN-12 9:41:29
Location: N41 08.776 E46 23.225, elevation= 144 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community
Vegetation:

Type: ***Bothriochloa ischaemum* + *Artemisia lerchiana*** (similar to Eldari 5) with rare occurrence of ***Salsola ericoides*** due to increased soil salinity.

Composition:

Species	Abundance - dominance	Life forms
1. Bothriochloa ischaemum	5	Perennial grass
2. Bromus japonicus	2	Annual
3. Filago pyramidata	2	Annual
4. Linum corymbulosum	2	Annual
5. Artemisia lerchiana	1-2	Dwarf semi-shrub
6. Daucus carota	+	Annual
7. Pterotheca sancta	+	Annual
8. Camelina microcarpa	+	Annual
9. Artemisia scoparia	+	Annual
10. Stizolophus coronopifolius	+	Annual
11. Nigella arvensis	+	Annual

12. Sonchus sp.	+	Annual
13. Thymelaea passerina	+	Annual
14. Cousinia orientalis	1 specimen	Perennial grass
15. Salsola ericoides	1 specimen	Semi-shrub
16. Allium rubellum	1 specimen (mor.)	Perennial grass (G)

Table 5: Vegetation composition for Eldari 6

Structure and LIM: As for Eldari 5

Estimated standing biomass: No measurement available due to equipment failure

Sign of overgrazing: as for Eldari 5

Potential livestock and wild ungulate use: As for Eldari 5

7. Eldari 7

Date: 19-JUN-12 10:38:23
Location: N41 07.506 E46 27.246, elevation = 132 m

Land use: Winter (mid October – mid April) grazing by sheep flocks from Tush communities

Vegetation:

Type: ***Salsola nodulosa* + *Artemisia lerchiana*;** the abundance-dominance of *Salsola nodulosa* indicate that the soil salinity has drastically increased when compared to the previous sites on higher ground. Annuals and ephemerals are poor.

Photo 13: A view of the Eldari 7 site

Composition:

Species	Abundance - dominance	Life forms
1. *Salsola nodulosa*	5	Semi-shrub
2. *Artemisia lerchiana*	1	Dwarf semi-shrub
3. *Eragrostis starosselskyi*	1	Annual
4. *Tragus racemosus*	1	Annual

Table 6: Vegetation composition for Eldari 7

Structure and LIM: The total LIM average 18.2% (SD =4.2, n=4) with 13.3% (SD=4.8, n=4) for the *Salsola nodulosa* and 4.9% (SD=6.7, n=4) for the *Artemisia lerchiana*. The LIM shape indicates mosaic pattern vegetation with a micro-spatial distribution similar to that observed on the *Salsola ericoides – Artemisia lerchiana* (Eldari 3). (Fig. 17)

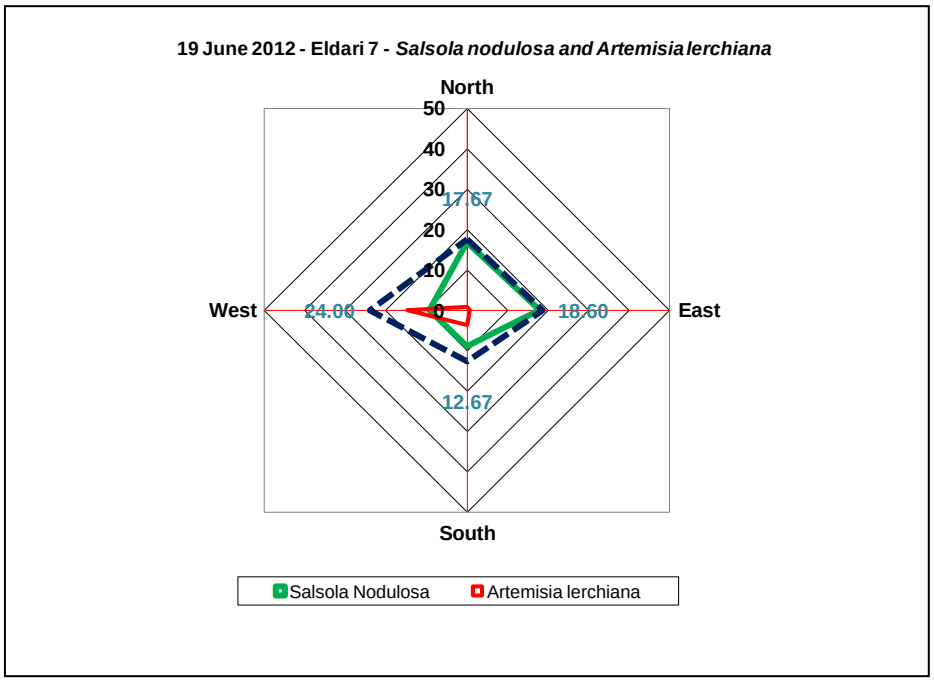


Figure 17: LIM for Eldari 7

Estimated standing biomass: *Salsola nodulosa* density is about 17700 shrubs/ha (SD =1200, n=3) with an average individual weight of 97.8 g (SD=69.3, n=10). The shrub density of Artemisia has dropped considerably compared to other sites with 33700 *Artemisia* /ha with an average weight of about 6 g (detailed data missing). The total standing biomass of perennials is estimated to 1930 kg DM/ha, mostly from *Salsola nodulosa* with 1728 kg DM/ha and a mere 202 kg DM/ha for the *Artemisia lerchiana*.

Sign of overgrazing: no sign of overgrazing

Potential livestock and wild ungulate use: Same as for Eldari 3; Excellent and well balanced winter – spring pasture with contribution from perennials but poor occurrence of annual-ephemerals. The soil salinity and presence of *Salsola* allow a necessary and beneficial supply of minerals to livestock and ungulates.

8. Eldari 8

Date: 19-JUN-12 12:01:35
Location: N41 06.829 E46 27.822, elevation = 123 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community
Vegetation:

Type: ***Artemisietum lerchianae***, pure and poor stand

Composition: *Artemisia lerchiana* only with no annuals or ephemerals. The soil is loamy and heavily compacted due to the proximity of a sheep farm.

Structure and LIM: The *Artemisia* LIM on this site is 20.1% (SD =3.1, n=4) leaving some 80% of the soil bare with no annuals when visited. (Fig. 18)

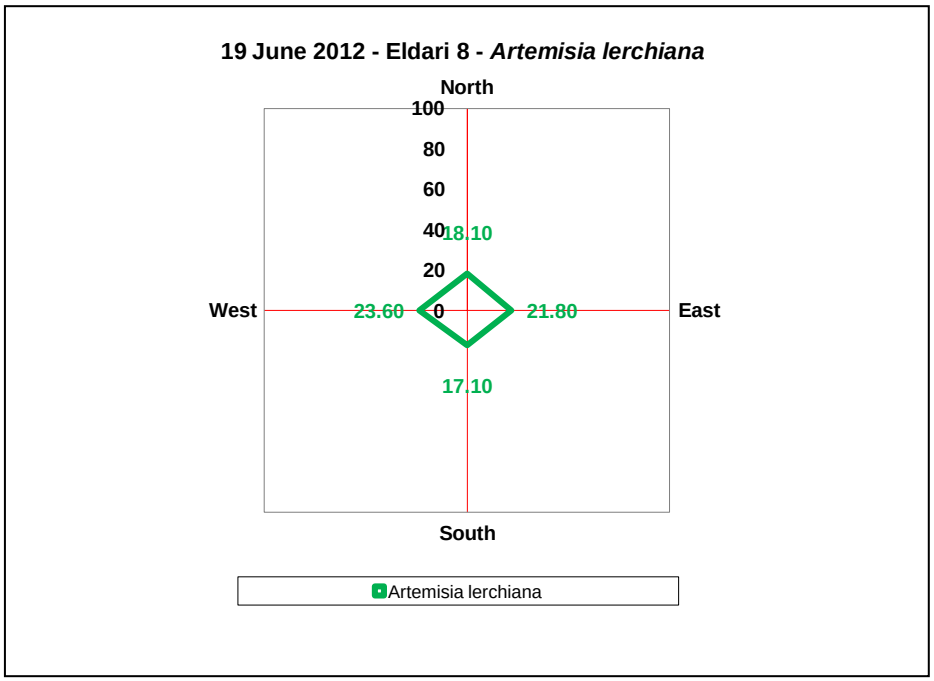


Figure 18: LIM for Eldari 8

Photo 14: A view of the Eldari 8 site (pure *Artemisia lerchiana*)

Estimated standing biomass: The *Artemisia lerchiana* shrub density is 116300/ha (SD = 18400, n=3) is less that other *Artemisia* pure stands on Eldari foothills. Individual shrub weight is low and close to 3.0 g (SD = 3.6, n=10) giving an estimated standing *Artemisia* biomass of 348 kg DM /ha. The large STD for shrub weights indicates an evolving *Artemisia* population possibly

slowly recovering from earlier damage from grazing or occasional edaphic drought.

Sign of overgrazing: no sign of overgrazing but the individual shrubs are small and stunted due to poor soil conditions.

Potential livestock and wild ungulate use: as for other Artemisia stands (Eldari 1 and 2)

Sites on KUMURO

Kumuro is a large depression of nearly 1000 ha with some gently rolling hills mostly covered with *Bothriochloa ischaemum*. It is used in winter exclusively by Tush sheep totalling about 2000 head and belonging to 3 farms; a relatively high stocking rate for such a small area, possibly in relation to controlling the *Bothriochloa* spring growth.

The rainfall on Kumuro is estimated to be around 300-350 mm/year.

9. Kumuro 1

Date: 21-JUN-12 8:09:19
Location: N41 07.496 E46 30.491, elevation=185 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community – no summer grazing by sheep.
Vegetation:

Type: ***Artemisia lerchiana + Salsola dendroides + Bothriochloa ischaemum*** on upper terraces with some patches of mild salinity on grey steppic soils.

Photo 15: A view of the Kumuro 1 site

Composition:

Species	Abundance - dominance	Life forms
1. *Artemisia lerchiana*	5	Dwarf semi-shrub
2. *Trachynia distachya*	5 (mor.)	Annual
3. *Medicago minima*	3-4 (seeds).	Annual
4. *Bromus japonicus*	2 (mor.)	Annual
5. *Salsola dendroides*	1-2	Dwarf semi-shrub
6. *Bothriochloa ischaemum*	1-2	Perennial
7. *Salsola ericoides*	+	Semi-shrub

8. *Medicago orbicularis*	+ (seeds)	Annual
9. *Lolium rigidum*	+ (mor.)	Annual
10. *Malvalthaea transcaucasica*	+ (mor.)	Annual
11. *Allium pseudoflavum*	+	Perennial
12. *Daucus carota*	+	Annual
13. *Allium rubellum*	+ (mor.)	Perennial
14. *Hirschfeldia incana*	+	Annual
15. *Artemisia scoparia*	+	Annual
16. *Carthamus lanatus*	+	Annual

Table 7: Vegetation composition for Kumuro 1

Structure and LIM: The total LIM is 56.7% (SD=12.2, n=4). The dominant species *Artemisia lerchiana* contribute with 43.7% (SD=8.6, n=4), the lesser present *Bothriochloa* and *Salsola dendroides* for 4.9 % (SD=3.7, n=4) and 5.0% (SD=5.1, n=4) respectively; The rare presence of *Salsola ericoides* is also noted confirming the saline subsoil. (Fig. 19)

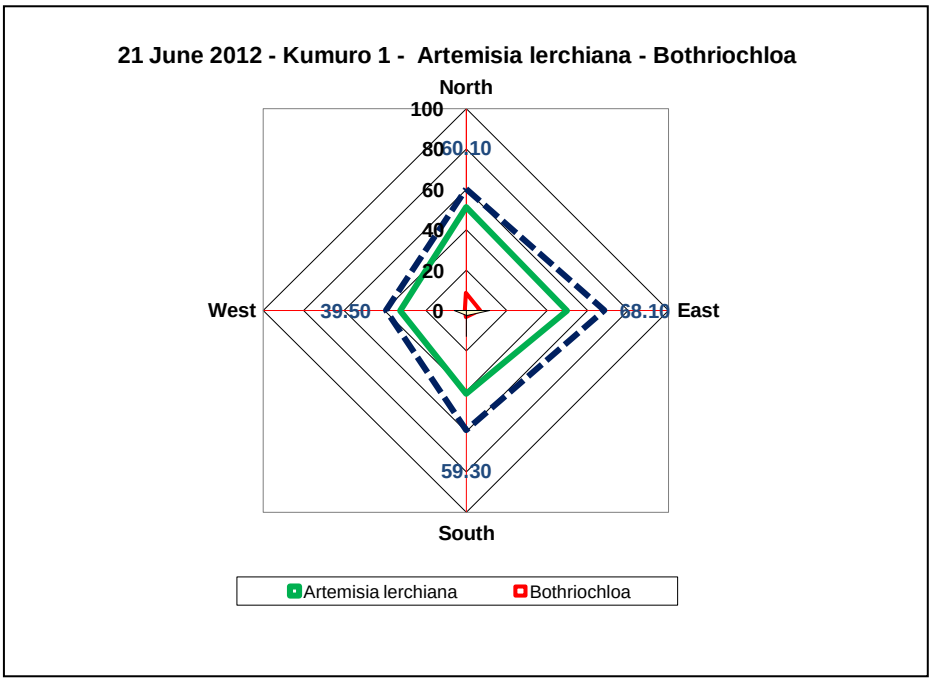


Figure 19: LIM for Kumuro 1

Estimated standing biomass:

This is a stand of 172000 (SD=18300, n=4) *Artemisia* shrubs/ha, the thickest *Artemisia* stand of all the VNP area visited. However, the shrubs are homogeneously small (stunted by the saline sub-soil?) with an average

individual weight of 3.5 g /shrub (SD=2.0, n=10) giving and estimated *Artemisia* biomass of 597 kg DM /ha.

The *Bothriochloa* density is low at about 22300 /ha (SD=4100, n=4) (i.e. 2 tufts / 10 m^2) with small and poor tufts (average diameter = 12.6 cm (SD=4.6, n=11)), making an insignificant contribution to the total standing biomass. The presence of highly palatable and nutritive annual *Medicago minima* and *M. orbicularis* indicate a good pasture potential.

Sign of overgrazing: no sign of overgrazing.

Potential livestock and wild ungulate use: As for Eldari 3; however, a limited area of well balanced winter – spring pasture with contributions from perennials and annual-ephemerals. The soil salinity and the presence of *Salsola* allow a beneficial supply of minerals to livestock and potential ungulates.

10. Kumuro 2

Date: 21-JUN-12 10:29:34
Location: N41 07.822 E46 31.228, elevation = 205 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community – no summer grazing by sheep.

Vegetation:

Type: ***Bothriocloetum ischaemum*** – as a nearly pure stand with some minor unpalatable annuals and very rare and small *Artemisia lerchiana*.

Photo 16: A view of the Kumuro 2 site

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Daucus carota*	3	Annual
3. *Xeranthemum squarrosum*	2	Annual
4. *Bromus japonicus*	2 (mor.)	Annual
5. *Artemisia lerchiana*	1	Dwarf semi-shrub
6. *Cleistogenes bulgarica*	1	Perennial
7. *Allium atroviolaceum*	+	Perennial
8. *Filago arvensis*	+	Annual
9. *Trachynia distachya*	+ (mor.)	Annual
10. *Malvalthaea transcaucasica*	+	Annual
11. *Artemisia scoparia*	+	Annual
12. *Salsola ericoides*	1 specimen	Semi-shrub

Table 8: Vegetation composition for Kumuro 2

Structure and LIM: No LIM was performed on this site as the vegetation cover is close to 100%.

Estimated standing biomass: The standing biomass is very large at 4677 kg DM/ha (SD=757, n=3), nearly exclusively composed of *Bothriochloa*.

Sign of overgrazing: No sign of overgrazing; to the contrary, clearly under-grazed as *Bothriochloa* is in flower and maturing, rendering it unpalatable to most livestock and wild ungulate.

Potential livestock and wild ungulate use: limited use due to the fact that, under the current winter grazing system, the *Bothriochloa* stand is useless (dry and dormant) in winter. It is not currently controlled when it is growing during the warm end of spring – summer seasons; for this reason, it rapidly flowers and matures to an unpalatable and wasteful stage. Even in the case of being grazed in summer by sheep, it cannot compete with the lush and rich Tusheti mountain pastures.

Sites on BOGHA-MOEDANI

This is a smaller depression than Kumuro, covering about 500 ha of *Bothriochloa ischaemum* pasture in various conditions according to the slope exposition. It is exclusively used in winter by Tush sheep totalling about 3500 (?) head and belonging to 3 winter farms; a remarkably high stocking rate (7 sheep/ha ?) for such a small area; possibly related to controlling the *Bothriochloa* spring growth.

The rainfall is similar to that of Kumuro (i.e. 300-350 mm/year).

11. Bogha-Moedani 1

Date: 22-JUN-12 11:43:39
Location: N41 07.910 E46 31.884, elevation = 253 m, 1 km North-west of the Gazelle enclosure
Land use: Winter (mid October – mid April) grazing by sheep from Tush community – no summer grazing by sheep.
Vegetation:

Type: ***Bothriocloetum ischaemum***, North exposition, – as a nearly pure stand with some minor unpalatable annuals and perennials.

Photo 17: A view of the Bogha-Moedani 1 site

The Gazelle enclosure is located at the foothills in the background.

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Cleistogenes bulgarica*	2	Perennial
3. *Xeranthemum squarrosum*	1	Annual
4. *Bromus japonicus*	1 (mor.)	Annual

5. *Daucus carota*	1	Annual
6. *Consolida divaricata*	+	Annual
7. *Eryngium campestre*	+	Perennial
8. *Artemisia scoparia*	+	Annual
9. *Achillea biebersteinii*	+	Perennial
10. *Cousinia orientalis*	+	Perennial
11. *Falcaria vulgaris*	+	Perennial
12. *Stipa capillata*	+	Perennial
13. *Nigella arvensis*	+	Annual
14. *Teucrium polium*	+	Semi-shrub
15. *Astragalus stevenianus*	+	Perennial
16. *Dianthus inamoenus*	+	Perennial
17. *Trachynia distachya*	+	Annual
18. *Cynodon dactylon*	+	Perennial
19. *Setaria viridis*	1 specimen	Annual
20. *Chondrilla juncea*	1 specimen	Perennial / Biannual
21. *Phleum paniculatum*	1 specimen	Annual
22. *Aegilops cylindrica*	1 specimen	Annual

Table 9: Vegetation composition for Bogha-Moedani 1

Structure and LIM: No LIM was performed on this site as the vegetation cover was 100%.

Estimated standing biomass: 5270 kg DM/ha (SD=3430, n=3) exclusively composed of *Bothriochloa* (the large standard deviation is due to the fact that we collected the biomass samples from the foot, to the top of a north-facing slope, instead of following a contour line. It nevertheless indicates the large biomass available on site and its spatial variability).

The number of *Bothriochloa* tufts ranged from 6-7 large adjoining tufts/m^2 (covering the whole m^2) at the foot of the slope, to 12-16 still adjoining but smaller tufts near the top of the slope. Both scenarios leave very little space for other plants to get established and grow. In all case, the abundant litter (Photo 18) composed of dead *Bothriochloa* material (not collected with biomass) is a genuine and potential problem for wild-fire.

Photo 18: A view of the Bothriochloa litter on the Bogha-Moedani 1 site

Sign of overgrazing: No sign of overgrazing; to the contrary, clearly under-grazed as *Bothriochloa* is in flower and maturing, rendering it unpalatable to most livestock and wild ungulates.

Potential livestock and wild ungulate use: limited use due to the fact that, under the current winter grazing system, the *Bothriochloa* stand is useless (dry and dormant) in winter. It is not currently controlled when growing during the warm end of spring – summer seasons; for this reason, it rapidly flowers and matures to an unpalatable and wasteful stage. Even in the case of being grazed in summer by sheep, it cannot compete with the lush and rich Tusheti mountain pastures.

12. Bogha-Moedani 2

Date: 22-JUN-12 12:05:30
Location: N41 07.960 E46 32.355, elevation, 249 m
Land use: Winter (mid October – mid April) grazing by sheep from Tush community
Vegetation:

Type: ***Bothriocloetum ischaemum*,** Southern exposition -

Photo 19: A view of the Bogha-Moedani 2 site

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Trachynia distachya*	3 (mor.)	Annual
3. *Xeranthemum squarrosum*	2	Annual
4. *Achillea biebersteinii*	2	Perennial
5. *Lagonychium farctum*	2	Semi-shrub
6. *Daucus carota*	1	Annual
7. *Bromus japonicus*	1 (mor.)	Annual
8. *Teucrium polium*	+	Semi-shrub
9. *Cynodon dactylon*	1	Perennial
10. *Cousinia orientalis*	1	Perennial
11. *Sideritis montana*	+ (mor.)	Annual

12. Consolida divaricata	+	Annual
13. Astragalus stevenianus	+	Perennial
14. Linum corymbulosum	+ (mor.)	Annual
15. Onobrychis kachetica	1 specimen	Perennial
16. Artemisia lerchiana	1 specimen	Semi-shrub
17. Helichrysum rubicundum	1 specimen	Perennial
18. Dianthus inamoenus	1 specimen	Perennial
19. Thymelaea passerina	1 specimen	Annual

Table 10: Vegetation composition for Bogha-Moedani 2

Structure and LIM: No LIM was performed on this site as the vegetation cover is close to 100%.

Estimated standing biomass: 2383 kg DM/ha (SD=268, n=3) exclusively composed of *Bothriochloa*.

The number of *Bothriochloa* tufts ranges from 12-14 tufts / m^2. The *Bothriochloa* tufts here are smaller than Bogha-Moedani 1, leaving room for other annuals and perennial plants to establish and grow. In all cases, the litter from dead *Bothriochloa* material (not collected with biomass) is a potential problem for wild-fire.

Sign of overgrazing: No sign of overgrazing; to the contrary, clearly under-grazed as *Bothriochloa* is in flower and maturing, rendering it unpalatable to most livestock and wild ungulates.

Potential livestock and wild ungulate use: limited use due to the fact that under the current winter grazing system, the *Bothriochloa* stand is useless (dry and dormant) in winter. It is not currently controlled when growing during the warm end of spring – summer seasons; for this reason, it rapidly flowers and matures to an unpalatable and wasteful stage. Even in the case of being grazed in summer by sheep, the Kumuro and Bugha-Moedani pastures and grasslands cannot compete with the lush and rich Tusheti mountain pastures.

Sites on the southern part of MLASHE-TSKALI

13. Mlashe-Tskali (beginning of the Lekis-tskali gorge)

Date: 22-JUN-12 1:59:39PM

Location: N41 07.425 E46 34.717, elevation = 197 m

Land use: Occasional winter (mid October – mid April) grazing by sheep from Tush community

Vegetation:

Type: ***Artemisia lerchiana* + *Salsola dendroides*** on flat terraces along a water course

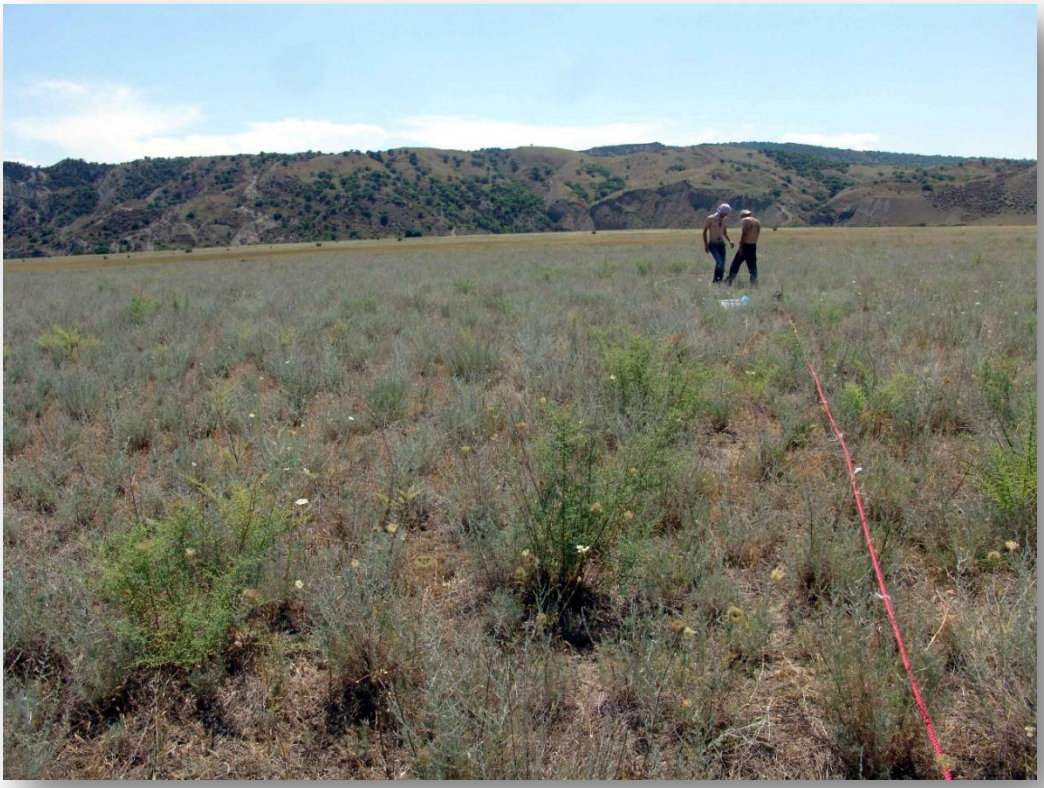


Photo 20: A view of the Mlashe-Tskali site

Composition:

Species	Abundance - dominance	Life forms
1. *Artemisia lerchiana*	5	Dwarf semi-shrub
2. *Salsola dendroides*	2	Dwarf semi-shrub
3. *Medicago minima*	2-3 (seeds)	Annual
4. *Trachynia distachya*	1-2 (mor.)	Annual
5. *Bothriochloa ischaemum*	1	Perennial
6. *Daucus carota*	+	Annual
7. *Sideritis montana*	+ (mor.)	Annual
8. *Bromus japonicus*	+ (mor.)	Annual
9. *Sonchus sp.*	+	Annual
10. *Euphorbia helioscopia*	+	Annual
11. *Salsola ericoides*	+	Semi-shrub
12. *Consolida divaricata*	+	Annual

13. Stizolophus coronopifolius	+	Annual
14. Hirschfeldia incana	+ (mor.)	Annual
15. Artemisia scoparia	+	Annual
16. Medicago orbicularis	+ (seeds)	Annual
17. Camelina microcarpa	+ (mor.)	Annual

Table 11: Vegetation composition for southern part of Mlashe-Tskali

Structure and LIM: The average total LIM is 53.6% (SD=4.7, n=4) with a contribution of *Artemisia lerchiana*: 43.7 % (SD=4.8, n=4), *Salsola dendroides:* 7.8% (SD=2.1 n=4), and rare but still present *Bothriochloa*. There is enough bare soil between the shrubs to allow for the proper establishment and growth of annuals and ephemerals. (Fig. 20)

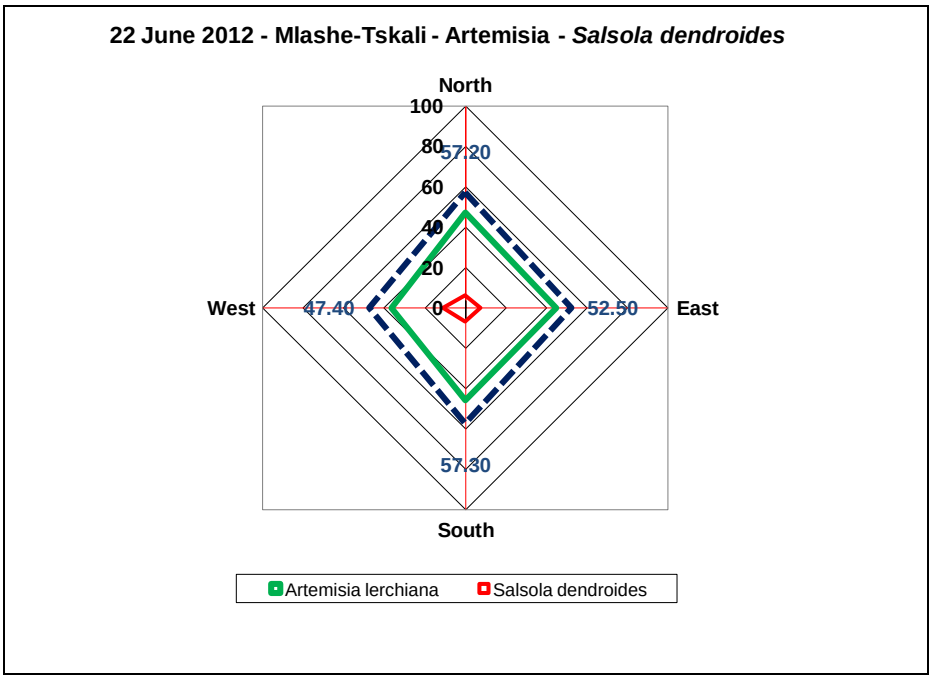


Figure 20: LIM for Mlashe-Tskali

Estimated standing biomass: The *Artemisia lerchiana* shrub density is 143300/ha (SD = 7100, n=3) with individual shrub weight of 9.9 g (SD = 7.7, n=10) giving a standing *Artemisia* biomass of 1416 kg DM /ha. The biomass contribution from the Salsola (about 2 shrubs / 10 m^2 or less) is minor.

Sign of overgrazing: No sign of overgrazing – Artemisia stand in good condition

Potential livestock and wild ungulate use: Good autumn –winter pasture site (nonetheless a small) area for sheep grazing and well protected from the wind. May not be so attractive to shepherds as there are many trees and shrubs which offer potential cover for predators (Rigg and Sillero 2010)?

Sites on PATARA-SHIRAKI

The rainfall on these high grounds could be around 500-550 mm/year allowing lush vegetation and cereal cropping in wide inter-hill valleys, increasing westward to Mallye-Shiraki.

14. Patara-Shiraki 1 (Southern slope)

Date: 20-JUN-12 7:20:41 am
Location: N41 15.066 E46 25.018, elevation = 653 m
Land use: Year–round, occasional grazing by resident cattle herds from farms near the Pantishara gorges
Vegetation:

Type: ***Bothriochloa ischaemum +Teucrium spp. + Thymus sp.*** on dry slope exposed to south; soil with stones/gravel (conglomerate) in a black (rich in organic matter) humus is a loamy matrix.

Photo 21: A view of the Patara-Shiraki 1site

Composition: One of the richest sites visited in terms of biodiversity due to abundant precipitation, good soil and continuous grazing.

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Trachynia distachya*	5	Annual
3. *Cleistogenes bulgarica*	4	Perennial

4. *Teucrium polium*	4	Dwarf semi-shrub
5. *Thymus tiflisiensis*	3	Dwarf semi-shrub
6. *Galium verum*	3	Perennial
7. *Helianthemum salicifolium*	3	Annual
8. *Medicago coerulea*	2	Perennial
9. *Xeranthemum squarrosum*	2	Annual
10. *Chondrilla juncea*	2	Perennial / Biannual
11. *Eryngium campestre*	2	Perennial
12. *Euphorbia seguieriana*	2	Perennial
13. *Aegilops triaristata*	2	Annual
14. *Carex liparocarpos subsp. bordzilowski*	1	Perennial
15. *Stipa capillata*	1	Perennial
16. *Centaurea ovina*	1	Perennial
17. *Astragalus bungeanus*	1	Perennial
18. *Bilacunaria microcarpa*	1	Perennial
19. *Cousinia orientalis*	1	Perennial
20. *Dianthus inamoenus*	+	Perennial
21. *Onobrychis kachetica*	+	Perennial
22. *Teucrium nuchense*	+	Dwarf semi-shrub
23. *Poterium polygamum*	+	Perennial
24. *Alcea rugosa*	+	Perennial
25. *Convolvulus cantabrica*	+	Perennial
26. *Carthamus lanatus*	+	Annual
27. *Daucus carota*	+	Annual
28. *Bromus japonicus*	+	Annual
29. *Centaurea reflexa*	+	Perennial
30. *Linum corymbulosum*	+	Annual
31. *Scabiosa micrantha*	+	Annual
32. *Reseda lutea*	+	Annual/ Biannual

33. Allium pseudoflavum	+	Perennial (G)
34. Achillea biebersteinii	+	Perennial
35. Scorzonera biebersteinii	+	Perennial
36. Carduus hamulosus	2 specimen	Biannual
37. Herniaria incana	1 specimen	Perennial
38. Stachys atherocalyx	1 specimen	Perennial
39. Erysimum repandum	1 specimen	Annual
40. Ononis pusilla	1 specimen	Perennial
41. Astragalus caucasicus	1 specimen	Shrub
42. Tragopogon tuberosus	1 specimen	Perennial

Table 12: Vegetation composition for Patara-Shiraki 1

Structure and LIM: No LIM was performed on this site as the vegetation cover was close to 100%.

Estimated standing biomass: A total of 1610 kg DM/ ha (SD=113, n=3)

Sign of overgrazing: No sign of overgrazing; the current grazing regime, by small, passing herds of cattle (25-30 heads), does not appear to be damaging the range whilst keeping a good diversity of vegetation and standing biomass on site.

Potential livestock and wild ungulate use: current use of these southern slopes is appropriate

15. Patara-Shiraki 2

Date: 20-JUN-12 1:59:54 PM
Location: N41 15.038 E46 24.555, elevation = 672 m
Land use: No visible use at the time of the mission.
Vegetation:

Type: ***Bothriochloa ischaemum + Onobrychis kachetica*** – rich and thick grassland with a diversity of plants with good palatability and feeding value

Photo 22: A view of the Patara-Shiraki 2 site

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Cleistogenes bulgarica*	5	Perennial
3. *Onobrychis kachetica*	5	Perennial
4. *Galium verum*	4	Perennial
5. *Stipa capillata*	4	Perennial
6. *Teucrium polium*	3	Dwarf semi-shrub
7. *Potentilla recta*	3	Perennial
8. *Phleum phleoides*	2	Perennial
9. *Medicago coerulea*	2	Perennial
10. *Chondrilla juncea*	2	Perennial / Biannual
11. *Trachynia distachya*	1-2	Annual
12. *Eryngium campestre*	1	Perennial

13. *Convolvulus cantabrica*	1	Perennial
14. *Cousinia orientalis*	1	Perennial
15. *Xeranthemum squarrosum*	1	Annual
16. *Daucus carota*	+	Annual
17. *Crupina vulgaris*	+	Annual
18. *Malabaila dasyantha*	+	Perennial
19. *Bromus japonicus*	+	Annual
20. *Scabiosa micrantha*	+	Annual
21. *Delphinium cyphoplectum*	+	Perennial (G)
22. *Thymus tiflisiensis*	+	Semi-shrub
23. *Polygala transcaucasica*	+	Perennial
24. *Euphorbia seguieriana*	+	Perennial
25. *Trigonella spicata*	+	Annual
26. *Linum nodiflorum*	+	Annual
27. *Linum corymbulosum*	+	Annual
28. *Astragalus bungeanus*	+	Perennial
29. *Koeleria cristata*	+	Perennial
30. *Aegilops cylindrica*	+	Annual
31. *Allium atroviolaceum*	+	Perennial (G)
32. *Centaurea ovina*	+	Perennial
33. *Linum austriacum*	+	Perennial
34. *Hordeum crinitum*	+	Annual
35. *Inula germanica*	+ gr.	Perennial
36. *Falcaria vulgaris*	+	Perennial
37. *Plantago lanceolata*	+	Perennial
38. *Achillea nobilis*	+	Perennial
39. *Vicia pannonica*	1 specimen	Annual
40. *Bilacunaria microcarpa*	1 specimen	Perennial
41. *Gypsophila bicolor*	1 specimen	Perennial

42. Asperula humifusa	1 specimen	Perennial
43. Teucrium nuchense	1 specimen	Dwarf semi-shrub

Table 13: Vegetation composition for Patara-Shiraki 2

Structure and LIM: No LIM was performed on this site as the vegetation cover was 100%.

Estimated standing biomass: The total biomass is about 3217 kg DM/ha (SD= 263, n=3) with a visually estimated contribution of 10-20% from legumes such as *Onobrychis kachetica, Medicago coerulea, & Vicia sp.*.

Sign of overgrazing: No sign of overgrazing

Potential livestock and wild ungulate use: **This site is a potential source of good quality hay for storage and winter feeding.** Considering the rainfall area (500 mm/year and +), it could be possible to either make a second hay cut after the summer re-growth, or simply graze the re-growth (may be a waste of good quality hay?).

Sites on the crest north of the Vashlovani main ranger station and beginning of CHIROELT-KHEVI

The rainfall on these high grounds and hills with good deep soils (pseudo-tchernozem) could receive around 500-550 mm/year allowing lush vegetation.

Photo 23: A view of the beginning of Chiroelt-Khevi towards the Iori plateau

16. **"Stipa 1" –** about 2.7 km along the crest, bearing 108° from the Vashlovani Main Range station
    Date: 17-JUN-12 8:15:44
    Location: N41 12.563 E46 27.724, elevation = 553 m
    Land use: No visible use at the time of the mission, although a farmer was hay-harvesting at the most western end of the crest.
    Vegetation:

    Type: **Stipa capillata + Bothriochloa ischaemum + various legumes** – very rich grassland in term of biomass and plant diversity

Photo 24: A view of the Stipa 1 site

Composition:

Species	Abundance - dominance	Life forms
1. *Stipa capillata*	5	Perennial
2. *Bothriochloa ischaemum*	5	Perennial
3. *Medicago coerulea*	3	Perennial
4. *Cleistogenes bulgarica*	3	Perennial
5. *Bromus japonicus*	3	Annual
6. *Potentilla recta*	2	Perennial
7. *Gypsophila bicolor*	2	Perennial
8. *Galium verum*	2	Perennial
9. *Crucianella angustifolia*	2	Annual
10. *Crupina vulgaris*	2	Annual
11. *Onobrychis kachetica*	1	Perennial
12. *Carduus hamulosus*	1	Biannual

13. Eryngium campestre	1	Perennial
14. Phleum phleoides	+	Perennial
15. Onobrychis radiata	+	Perennial
16. Phlomis pungens	+	Perennial
17. Achillea nobilis	+	Perennial
18. Koeleria cristata	+	Perennial
19. Centaurea solstitialis	+	Annual
20. Polygala transcaucasica	+	Perennial
21. Erodium cicutarium	+	Annual
22. Glycyrrhiza glabra	+	Perennial
23. Allium atroviolaceum	+	Perennial (G)
24. Dianthus inamoenus	+	Perennial
25. Scabiosa micrantha	+	Annual
26. Eryngium caucasicum	+	Perennial
27. Allium pseudoflavum	+	Perennial (G)
28. Pterotheca sancta	+	Annual
29. Cousinia orientalis	+	Perennial
30. Falcaria vulgaris	+	Perennial
31. Bilacunaria microcarpa	+	Perennial
32. Salvia nemorosa	+	Perennial
33. Hypericum perforatum	+	Perennial
34. Linum nodiflorum	+	Annual
35. Linum austriacum	+	Perennial
36. Trifolium campestre	+	Annual
37. Malabaila dasyantha	+	Perennial
38. Daucus carota	+	Annual
39. Onosma sp.	+	Perennial
40. Rumex tuberosus	+	Perennial (G)
41. Xeranthemum squarrosum	+	Annual

42. Linum corymbulosum	+	Annual
43. Camelina microcarpa	+	Annual
44. Achillea biebersteinii	+	Perennial
45. Hordeum crinitum	+	Annual

Table 14: Vegetation composition for Stipa 1

Structure and LIM: No LIM was performed on this site as the vegetation cover was 100%. Thick and bio-diverse grassland

Estimated standing biomass: The total standing biomass is 5307 kg DM/ha (SD= 1432, n=3) with possibly a visually estimated contribution of 20-30% from legumes such as *Onobrychis spp.* and *Medicago coerulea*. Excellent forage and hay species and grasses such as *Stipa* spp., and this, in spite of the dominance of *Bothriochloa*.

As indicated, a farmer was hay-harvesting at the most western end of this area. We met the contractor-farmer harvesting 50 ha of *Stipa – Onobrychis* vegetation type (invaded by *Sorghum halepense*, an aggressive post-cultural large grass and weed) on the crest of Vashlovani and towards Patara-Shiraki at the time of our visit. He indicated that he just collected about 3000 bales of 30-40 kg each (Photo 25), i.e. 1.8 to 2.4 T hay/ha. These real-world figures could be improved using modern hay-cutting and bailing equipment. I would anticipate that the summer re-growth could also be harvested later in the fall or possibly grazed as well.

Sign of overgrazing: no sign of grazing or of use – excellent condition

Potential livestock and wild ungulate use: **This site is a potential source of excellent quality hay for storage and winter feeding, especially considering the abundance of legumes** (*Medicago coerulea, Onobrychis kachetica* and *Onobrychis radiata)*. Considering the rainfall area (500 mm/year and +), it could be possible to either make a second hay cut after the summer re-growth, or simply have this area grazed in late summer/autumn (may be a waste of good quality hay?).

These large areas would be well used all year round by wild ungulates if reintroduced.

Photo 25: A stack of 1500 bales of hay harvested on the Vashlovani crest

17. **Onobrychis 1 – Northern slope,** about 4.4 km bearing 105° from the main Vashlovani ranger station

Photo 26: A view of the Iori plateau near the Onobrychis 1 site

Date: 17-JUN-12 9:08:36
Location: N41 12.331 E46 29.050, elevation = 541 m
Land use: No visible use at the time of the mission.
Vegetation:

Type: ***Bothriochloa ischaemum* + *Onobrychis kachetika* + various legumes** – very rich grassland in term of biomass and plant diversity on deep chestnut-dark brown soil. This is a variant of the Stipa 1 as here *Stipa capillata* is less abundant.

Photo 27: A view of the Onobrychis 1 – Northern slope (Iori Plateau)

Note the abundance of *Onobrychis* spp. in flower

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Onobrychis kachetica*	4	Perennial
3. *Cleistogenes bulgarica*	4	Perennial
4. *Xeranthemum squarrosum*	2	Annual
5. *Medicago coerulea*	2	Perennial
6. *Potentilla recta*	2	Perennial
7. *Stipa capillata*	2	Perennial
8. *Potentilla recta*	2	Perennial
9. *Galium verum*	2	Perennial
10. *Crupina vulgaris*	2	Annual
11. *Teucrium polium*	1	Dwarf semi-shrub

12. *Asperula humifusa*	1	Perennial
13. *Eryngium campestre*	1	Perennial
14. *Linum nodiflorum*	1	Annual
15. *Carduus hamulosus*	1	Biannual
16. *Achillea nobilis*	1	Perennial
17. *Daucus carota*	1	Annual
18. *Koeleria cristata*	1	Perennial
19. *Cousinia orientalis*	1	Perennial
20. *Polygala transcaucasica*	1	Perennial
21. *Falcaria vulgaris*	1	Perennial
22. *Astragalus bungeanus*	1	Perennial
23. *Trachynia distachya*	1	Annual
24. *Pterotheca sancta*	1	Annual
25. *Bromus japonicus*	1	Annual
26. *Hypericum perforatum*	1	Perennial
27. *Linum austriacum*	1	Perennial
28. *Thymus tiflisiensis*	1	Dwarf semi-shrub
29. *Linum corymbulosum*	1	Annual
30. *Bilacunaria microcarpa*	1	Perennial
31. *Chondrilla juncea*	1	Perennial / Biannual
32. *Allium atroviolaceum*	1	Perennial (G)
33. *Gypsophila bicolor*	+	Perennial
34. *Trigonella spicata*	+	Annual
35. *Alcea rugosa*	+	Perennial
36. *Crucianella angustifolia*	+	Annual
37. *Galium tenuissimum*	+	Annual
38. *Dianthus inamoenus*	+	Perennial
39. *Eryngium caucasicum*	+	Perennial
40. *Convolvulus cantabrica*	+	Perennial

41. Scorzonera biebersteinii	+	Perennial
42. Nigella arvensis	+	Annual
43. Linaria simplex	+	Annual
44. Onobrychis radiata	+	Perennial
45. Hordeum crinitum	+	Annual

Table 15: Vegetation composition for Onobrychis 1 – Northern slope exposition and flats

Structure and LIM: No LIM was performed on this site as the vegetation cover was 100%.

Estimated standing biomass: The total standing, highly homogeneous biomass is 6137 kg DM/ha (SD=231, n=3) with a visually estimated contribution of 20-30% from legumes such as *Onobrychis spp.* and *Medicago coerulea*, excellent forage and hay species and grasses such as *Stipa* spp.; all in spite of the dominance of *Bothriochloa*.

Sign of overgrazing: no sign of grazing – excellent condition

Potential livestock and wild ungulate use: **This site is a potential source of good quality hay for winter feeding**. Considering the rainfall area (500 mm/year and +), it could be possible to either make a second hay cut after the summer re-growth, or simply graze the re-growth (may be a waste of good quality hay?). These large areas would be well used all year round by wild ungulates if reintroduced.

18. Onobrychis 2 – Southern slope

Date: 17-JUN-12 10:19:17
Location: N41 12.882 E46 29.374, elevation = 475 m
Land use: No visible use at the time of the mission.
Vegetation:

Type: ***Bothriocloetum ischaemum*** - a poor and thin pasture due to the southern exposition and shallow grey-brown soils on site – common on all southern exposition of all hills at the beginning of Chiroelt-Khevi

Photo 28: A view of the Onobrychis 2 site – Southern slope

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Daucus carota*	3	Annual
3. *Bromus japonicus*	3	Annual
4. *Trachynia distachya*	3	Annual
5. *Cleistogenes bulgarica*	3	Perennial
6. *Xeranthemum squarrosum*	2	Annual
7. *Cousinia orientalis*	1	Perennial
8. *Linum corymbulosum*	1	Annual
9. *Crupina vulgaris*	1	Annual
10. *Astragalus bungeanus*	1	Perennial
11. *Medicago coerulea*	1	Perennial
12. *Achillea biebersteinii*	1	Perennial

13. *Onobrychis kachetica*	+	Perennial
14. *Trigonella spicata*	+	Annual
15. *Allium atroviolaceum*	+	Perennial (G)
16. *Pterotheca sancta*	+	Annual
17. *Allium pseudoflavum*	+	Perennial (G)
18. *Linaria simplex*	+	Annual
19. *Chondrilla juncea*	+	Perennial / Biannual
20. *Eryngium caucasicum*	+	Perennial
21. *Glycyrrhiza glabra*	+	Perennial
22. *Thymelaea passerina*	+	Annual
23. *Linum nodiflorum*	+	Annual
24. *Carthamus lanatus*	+	Annual
25. *Centaurea ovina*	+	Perennial
26. *Artemisia scoparia*	+	Annual
27. *Centaurea solstitialis*	+	Annual
28. *Sideritis montana*	+	Annual
29. *Echium sp.*	1 specimen	Perennial
30. *Onosma sp.*	1 specimen	Perennial

Table 16: Vegetation composition for Onobrychis 2 – southern slope exposition

Structure and LIM: No LIM was performed on this site as the vegetation cover was close to 100%.

Estimated standing biomass: The total standing biomass is 2987 kg DM/ha (SD= 420, n=3) with a visually estimated contribution of 5-10% from legumes such as *Medicago coerulea* and the less abundant *Onobrychis spp.*, excellent forage and hay species present in spite of the dominance of *Bothriochloa*.

Sign of overgrazing: no sign of grazing – excellent condition
Potential livestock and wild ungulate use: **This site is a also potential source of good quality hay for winter feeding**. Considering the rainfall area (500 mm/year and +), it could be possible to either make a second hay cut after the summer re-growth, or simply graze the re-growth (may be a waste of good quality hay). These large areas would be well used all year round by wild ungulates if reintroduced.

19. ***Bothriochloa - Glycyrrhiza*** **-** Northern slope exposition – about 3.9 km bearing 78° from the main Vashlovani ranger station.

Date: 17-JUN-12 10:39:57
Location: N41 13.340 E46 28.730, elevation = 506 m
Land use: No visible use at the time of the mission.

Vegetation:
Type: ***Bothriochloa ischaemum + Glycyrrhiza glabra*** – a thick pasture

Photo 29: A view of the *Bothriochloa - Glycyrrhiza* site - Northern slope

Composition:

Species	Abundance - dominance	Life forms
1. *Bothriochloa ischaemum*	5	Perennial
2. *Glycyrrhiza glabra*	4	Perennial
3. *Cleistogenes bulgarica*	2	Perennial
4. *Crupina vulgaris*	1	Annual
5. *Medicago coerulea*	1	Perennial
6. *Stipa capillata*	1	Perennial
7. *Onobrychis kachetica*	1	Perennial

8. *Daucus carota*	1	Annual
9. *Bromus japonicus*	1	Annual
10. *Eryngium campestre*	1	Perennial
11. *Crucianella angustifolia*	1	Annual
12. *Galium verum*	1	Perennial
13. *Trachynia distachya*	1	Annual
14. *Xeranthemum squarrosum*	1	Annual
15. *Cousinia orientalis*	1	Perennial
16. *Eryngium caucasicum*	+	Perennial
17. *Linum nodiflorum*	+	Annual
18. *Allium atroviolaceum*	+	Perennial (G)
19. *Thesium arvense*	+	Perennial
20. *Gypsophila bicolor*	+	Perennial
21. *Scabiosa micrantha*	+	Annual
22. *Pterotheca sancta*	+	Annual
23. *Carduus hamulosus*	+	Biannual
24. *Dianthus inamoenus*	+	Perennial
25. *Nigella arvensis*	+	Annual
26. *Malabaila dasyantha*	+	Perennial
27. *Koeleria cristata*	+	Perennial
28. *Linaria simplex*	+	Annual
29. *Veronica multifida*	+	Perennial
30. *Hordeum crinitum*	+	Annual
31. *Onosma sp.*	1 specimen	Perennial

Table 17: Vegetation composition for the *Bothriochloa - Glycyrrhiza* site

Structure and LIM: No LIM was performed on this site as the vegetation cover was 100%.

Estimated standing biomass: The total standing biomass is 4673 kg DM/ha (SD= 1106, n=3) with a visually estimated contribution of 5-10% from legumes such as *Medicago coerulea* and the less abundant *Onobrychis spp.* and other

excellent forage and hay species present in spite of the dominance of *Bothriochloa and Glycyrrhiza;* both poor forage species.

Sign of overgrazing: no sign of grazing – excellent condition

Potential livestock and wild ungulate use: **This site is a potential source of good quality hay for winter feeding**. Considering the rainfall area (500 mm/year and +), it could be possible to either make a second hay cut after the summer re-growth, or simply graze the re-growth (may be a waste of good quality hay). These large areas would be well used all year round by wild ungulates if reintroduced.

Assessment of the current rangeland condition in selected areas of Vashlovani NP and ELDARI (SAMUKHI)

The standing biomass information collected on the Vashlovani rangelands are summarized in figure 21.

The main conclusions from these biomass evaluations and LIM indicates that, from a general point of view, the rangelands of Vashlovani National Park (VNP) and associated project areas are in good condition, with no real hint of degradation.

The vegetation cover and standing biomass of the Vashlovani sites are quite high, considering the ecological conditions, soil and climate (250-550 mm/year – marginal arid/semi-arid Mediterranean climate with spring/autumn precipitations and cold winter (mean daily temperature of the coldest month ~ 0 to -2°C)). These figures are lower but comparable to those measured in winter by Abdaladze and Chiboshvili (2004) on the Iori plateau (though they do not indicate where, exactly, their measurements were taken).

This good general condition does not mean that the pastures and rangelands are currently used under optimum and sustainable management practices. Indeed, this conclusion would be challenged by our field observations, Line Intercepts and biomass measurements (end of June 2012). Conversely, we would consider that most areas are under-utilised, with perhaps the exception of the Eldari Artemisieta lowlands.

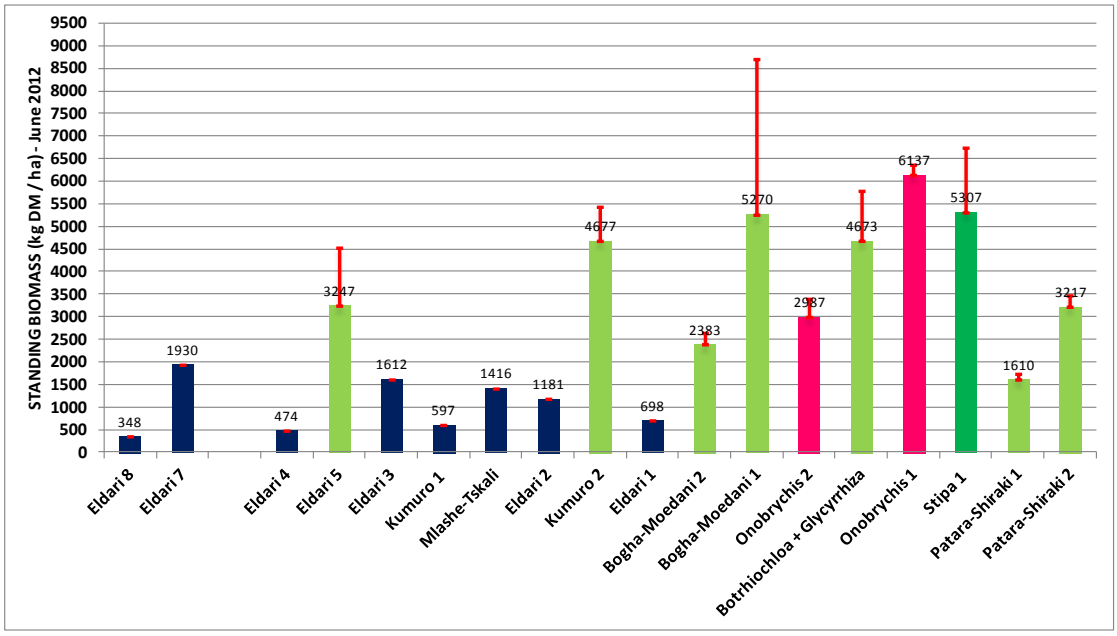


Figure 21: Standing biomass (June 2012) on the Vashlovani National Park and surrounding areas

Legend for figure 21: Standard deviation (SD **in red**) – ***Artemisia* dominant in blue**, ***Bothriochloa* dominant in light green**, ***Onobrychis* dominant in purple** and ***Stipa* dominant in dark green**.

- The **Eldari *Artemisieta* (*Artemisia lerchiana*) lowlands** (estimated rainfall zone: 250 mm/year) is mostly composed of diversified vegetation types with a winter/spring growing season. These are well suited to the current autumn/winter/spring grazing system practiced by the Tush community. *Artemisia* dominated standing biomass ranges from 350 to 1200 kg/ha and from 1500 to 1900 kg/ha for *Artemisieta* associated with various *Salsola* spp. The most southern adjacent areas with halophytic vegetation are also beneficial to the health of small ruminants, providing a beneficial and timely supply of minerals. It should be noted that fairly large areas of the Eldari lowland seems to be now colonised with thick stands of *Bothriochloa*. This may be due to good late spring precipitations that favour its growth and not an event occurring every year. The apparent loss of a valuable ephemeral (*Poa bulbosa*) in this area (as noted by N. Lachashvili) is worth mentioning. This, if verified, could indicate a slow but significant degradation of the contribution of annuals and ephemerals on the *Artemisia* Eldari rangeland and could be attributed to the current high winter stocking rates of sheep.

  Some comments on the current winter stocking rate on the Eldari lowlands

  The available data (Fig. 8) indicates that about 20000 sheep (about half of the total number of sheep over-wintering in Vashlovani), belonging to 18 farms, graze 11400 ha of the Eldari lowland. That is a winter (6 month) stocking rate of around 1.75 sheep/ha, when using the whole area. Abdaladze and Chiboshvili (2004) advocate 0.2 sheep/ha: a very low and conservative stocking rate on the *Artemisia* in our opinion.

  We can refine these figures in term of rangeland use and management. In winter (cold, windy and wet conditions), each sheep flock could possibly graze, each day, within a maximum of 2.0-2.5 km distance from their associated farm, returning at night. A 2.0km grazing radius around a farm would point towards an individual territory per farm of about 1260 ha; a 2.5km radius would be a 2000 ha grazing territory/farm, with no overlapping with the near-by farm. Even with the smallest grazing radius, it would mean that the whole Eldari territory would be cover 22700 ha. In fact, with only 11400 ha available to the 18 farms, this means that each farm may use a maximum of 600-650 ha of rangeland, i.e. allowing a day of grazing within 1.4 km from the farm.

  Another serious constrain is that on Eldari, most farms are within 1-1.5 km distance from each other, i.e. the flocks can only move 500 m, on either side, from their farm towards another farm, and either move north-east towards the Vashlovani hills or south-west towards the very low rangelands along the Azerbaijani border; this would signifies that each farm-assigned grazing territory is rectangular, with a maximum width of 1km and possibly extending 2 km towards the hills and stretching 4 km towards the Azerbaijani border. Considering that the border is 7-8 km from the farms, it means there is little or no extra room left for wild ungulates in winter if re-introduced at this stage onto the Eldari lowlands. This needs further investigation with a proper mapping of the grazing territory / farm actually used by each livestock owner.

  No urgent rangeland management action is currently required on the Eldari lowlands. However two points are worth mentioning:
  - Monitoring of the *Bothriochloa* colonisation-contraction, possibly due to climate change (increasing occurrence of warm period precipitations favouring the growth and spreading out of *Bothriochloa*), may be necessary.

- A further increase in the stocking rate during the cold period on the Eldari rangelands is not advisable as the stock of annuals and ephemerals seems to be already on the lower side and the reported number of stock currently using the rangelands in winter is quite high.

- The ***Bothriochloa* ("bluestem") pastures** (estimated rainfall zone: 250 to 400 mm/year). ***Bothriochloa ishaemum*** is a C_4 tropical perennial grass with a spring-summer vegetative and reproductive cycle. Measured standing biomass of *Bothriochloa* stands range from 2.4 tonnes (southern slopes) to 5.3 tonnes DM/ha (Kumuro and Bogha-Moedani). The tufted structure and aggressive growth habit of *Bothriochloa* tends to choke and eliminate other plants (annual – ephemerals and other perennials) when not strictly under constant grazing pressure (Lashashvili *et al* 2010 b). The latter is necessary to stimulate its vegetative growth (new leaves and tillers) whilst preventing the appearance of unpalatable inflorescences, the lignification of leaves and the accumulation of dead litter. The flowering of *Bothriochloa* is a clear sign of under-grazing. Ultimately, this will have a detrimental effects on the overall vegetation dynamic (as seen, primarily, at Bogha-Moedani and Kumuro as well as many other sites within VNP) whilst there is no late spring/summer grazing. Outside the project area (Patara-Shiraki and the Eldari village north of Vashlovani), the year-round presence of cattle herds seems to maintain a constant grazing pressure on some limited *Bothriochloa* stands and there is less accumulation of biomass and litter, with few flowering culms visible and a much richer and diverse vegetation community. This seems to confirm the understanding that the *Bothriochloa* stands must be grazed during the summer to remain palatable, as indicated in the literature: (http://www.tropicalforages.info/key/Forages/Media/Html/Bothriochloa_bladhii_subsp._glabra.htm).
    - As a consequence of *Bothriochloa* under-grazing and the subsequent litter accumulation, **there is a risk of catastrophic wild fires**. Appropriate measures, such as preventive prescribed burning (Bragg 1982) may be necessary to reduce the amount of *Bothriochloa* litter accumulated. Past literature (in Russian) and experimental data are available and should be consulted so that the proper burning season (end of autumn? Low temperature fire?) can be identified.
    - The curative options (alone or combined) to reduce flowering and stimulate new leaf production is to maintain an acceptable grazing pressure on *Bothriochloa* pastures during the late spring/summer, after the sheep have left for Tusheti. This can be achieved by:
        - **Heavy grazing** (mob grazing with high stocking rates every day for a short time on a limited area and for several weeks) the *Bothriochloa* stand **with local cattle or horses**. This may also be applicable to the expanding *Bothriochloa* stands on the Eldari lowlands. A rent/head for this summer grazing may be implemented, though there could be local conflicts with shepherds owning winter grazing rights.
        - **Reintroduce Goitered Gazelles:** the fact that goitered gazelles disappeared from the area some 15-20 years ago may be a contributing factor to the under-utilisation/grazing of the *Bothriochloa* pastures. Reintroduction raises the question of the source of gazelles, their appropriate number (stocking rate), the location(s) of release site(s) and the establishment of corridors to allow for their movement to various vegetation types, according to the season (for example from Kumuro or Bogha-Moedani to either Chiroelet-Khevi or to Eldari lowlands Artemisieta and halophytic vegetation). As an indication, the gazelles stocking rate at the Jeyran Ecocenter Reserve (~5-6000 ha) near Bukhara (Uzbekistan), in much drier conditions than Vashlovani, ranges from 8 to 12 ha/gazelle (B. Mardonov – pers. com.). Assuming the availability of suitable open rangelands and pastures within VNP is around 30% (to be asserted with proper future vegetation mapping) of the total VNP area (~ 8000 ha), a density of 6-8 ha/gazelles would amount

to a total population of 300-400 heads, maximum and possibly less when considering the need to share resources with the wintering sheep.

- **Cutting the Bothriochloa stands for hay-making:** this would result in mostly unpalatable feed and so is an uneconomical and useless option unless there is a potentially use for it as litter in barns (however, this is unlikely as the cereal farmers of nearby Didi-Shiraki and Djeimis-Veli (Dilicha) regularly burn their excess cereal-straw).

- **The Stipa (*S. lessingiana* and *S. capillata*) pastures** (associated with *Onobrychis* spp. and *Glycyrrhiza glabra*) on the plateau (Patara-Shiraki, crest of Vashlovani ranger station site and the beginning of Chighoelt-Khevi) exhibit large standing biomass for excellent and easy hay-making. However, it appears that it is currently left largely unused and, possibly wasted. Standing biomass of the Stipa stands, in association with abundant excellent forage plants (such as *Onobrychis* spp. and *Medicago coerulea*) reach 5 to 6 tonnes DM/ha (assuming 50% agricultural harvesting and, so 2.5 to 3.0 tonnes hay/ha).

  What little hay is harvested is sold to sheep owners over-wintering in Vashlovani and has a summer value of 3 lari/bale rising to 7 lari/bale in winter (*A. Gogotidze, Pers. com.*). Though the feed value of the *Stipa* spp. itself is arguable, it remains true that the hay provided by this phytocoenosis is precious and recognised by the locals for its benefit to sheep and cattle owners. Its use may help reduce lamb mortality during cold and snowy winters, for deferring poor mid-winter pastures or for limiting the winter feed gap when vegetation is winter-dormant. This will certainly improve the economics of small ruminant husbandry within the VPN without altering the current local practices and transhumance.

  Reducing the winter feed gap

  Another possibility to alleviate the winter feed gap is to (re)introduce the highly nutritive "Sainfoin" (*Onobrychis viciifolia* – Leguminosae – see http://sainfoin.eu/) in the nearby region. Under these climatic (350-600 mm precipitation/year – cold winter) and soil conditions, it would yield large quantities of high quality forage for hay making and/or direct grazing. Sainfoin is a drought resistant perennial legume lasting 4 to 6 years under cultivation and 3-4 years under direct grazing. It is widely used to feed lactating and dairy ewes (e.g. in the Turkish highlands, the Causses in France and the highlands of Spain, Italy and Greece) even by direct grazing as it is bloat–free (as opposed to the direct grazing of green Lucerne (or Alfalfa = *Medicago sativa*). Sainfoin is well grazed by gazelles in Turkey and by other wild ungulate populations (e.g. in Continental Europe and the USA). Sainfoin is a nitrogen fixing plant, and is as good as Lucerne in rotation with cereals, reducing the need for nitrogen fertilizers. It is easy to establish, thrives even on poor shallow soils, with no need for inoculation with nitrogen fixing bacteria as native *Onobrychis* spp. are already present in the soils of the Vashlovani region. It is often associated, in sown pastures or hay mixtures, with *Sanguisorba minor* ("Salad burnet", Rosaceae; see http://ecocrop.fao.org/ecocrop/srv/en/dataSheet?id=9535), a very valuable forage and pasture plant also extensively used in the reclamation of badlands as well as in erosion control operations. Sainfoin and *Sanguisorba minor* are easy to establish and manage, despite the fact that seed production remains difficult. Suitable seed sources of commercial Sainfoin and *Sanguisorba minor* for the Vashlovani region is readily available from Turkey and Italy.

- No specific action is urgently required on **the VPN woodlands**. However, grass and fuel wood accumulation must be monitored to prevent wild and highly destructive bush fires that may critically affect the SNR's future. This is subject to the VNP authorities' allowing some strictly controlled early-spring grazing period in order to remove/reduce fire-prone grass and litter build-up.

RECOMMENDATIONS

During our mission, I identified a number of gaps that should be filled in to deliver a proper VPN vegetation / land use / gazelle reintroduction management plan.

These are:

1. An accurate (1/5000 to 1/10000) and detailed map of the VPN and associated project area vegetation types using the most recent satellite imagery with up-to-date satellite image processing and GIS technology (far different from an ordinary "automatic classification" and colouring of outdated satellite imagery). The description of the vegetation types have been, and are sufficiently detailed and described by past and current botanists and ecologists (cf. Dr N. Lachashvili's publications). We do need their exact location and area covered for each vegetation type.
2. An accurate and up-dated land tenure / lease map,
3. Resources permitting, accurately map the pasture and range 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 % available,
4. Continue surveying and monitoring each winter the number of livestock (Sheep, goats, cattle and horse) entering the VPN and associated project area; It would also be useful to monitor also the lambing % and lambing mortality.
5. Conduct a winter VPN 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; (*Contact: Dr Euan Thompson (euan.thomson@talk21.com), a leading expert on small ruminant systems management with considerable experience in Central Asian and Caucasus*)
6. Produce an accurate map (1/5000 to 1/10000) of the farm location and their allocated grazing territory (ha) limits inside the VPN and associated project area. Combined on a GIS of the biomass maps, with the number of livestock on each farm (see point 4) will help monitoring (and possibly adjusting) sustainable stocking rates. It also will assist revealing the areas (ha and location) and corridors available for potential gazelles' reintroduction,
7. Install simple and small automatic weather station (precipitations and min-Max temperatures, with possibly wind speed and direction, etc. – see at http://www.instrumentchoice.com.au/instrument-choice/weather-stations/proffesional-weather-stations/ic6152-next-next-g-davis-weather-station#productdetails) at two sites: at the Vashlovani main ranger station (high rainfall area) and the main Border Police Station at Eldari lowlands (low rainfall area). This is paramount understanding the rangeland growth cycle and biomass production on the Vashlovani region.
8. Explore the possibility of controlling the summer growth of *Bothriochloa* stands with prescribed burning during a suitable season to avoid potential catastrophic wild fire.
9. Review the grazing current regime and feed supply to tackle:
    - The lack of summer grazing on *Bothriochloa* rangelands by re-introducing resident gazelles on the VNP.

- The winter feed gap by creating economic incentives (Government subsidies on hay-harvesting farm machinery and forage seed supply ?) for hay harvesting on the Vashlovani crest, Patara-Shiraki, Northern part of Chiroelt-Khevi, and establishing appropriate forage crops for hay making established on the Eldari village land.

The qualification, quantification and location of the vegetation resources, current leased grazing territories and users (mainly livestock owners), an accurate and up-dated livestock census, an economic stimulus on hay and forage production must be integrated in the National park management plan. It will undoubtedly lead to a sustainable co-habitation of current land users, herbivorous and carnivorous sharing the Vashlovani National Park and associated project land resources.

CONCLUSIONS

Generally speaking, the vegetation and the environment on the Vashlovani area are in good to excellent condition. There is no evidence of desertification threat or damaged landscape due to human activities, even on pristine badlands and arid forests.

Excluding the Vashlovani Strict Nature Reserve (strictly protected), the pastures and rangeland resources of the peripheral areas, including the seasonal sheep farms (Kumuro, Bugha-Moedani, and the plateau of Chiroelet-Khevi / Patara-Shiraki) are mostly under-utilized and under-grazed (the Eldari lowlands could also be potentially excluded from this categorisation);

This under-utilisation is:

- confirmed on the large areas of ***Bothriochloa* pastures** (Kumuro, Bogha-Moedani, many other places and even on some limited areas of Eldari) that display a 100% vegetation cover, a largely unused and useless standing biomass of flowering - fruiting individuals, all on a thick litter of dead material, the later prone to potential wild fire.
- obvious on the ***Stipa lessingiana* and *S. capillata* pastures** (associated with *Onobrychis* spp. and *Glycyrrhiza glabra*) on the plateau (Patara-Shiraki, crest of Vashlovani ranger site and beginning of Chighoelt-Khevi), that display large standing biomass for excellent hay-making and that are left mostly unused and wasted.

We confirm the good general condition, vegetation cover and standing biomass of the **Artemisieta rangelands** on Eldari (when compared to many other parts of the semi-arid and arid old world Mediterranean regions). However, there is a need to closely monitor, in the near future, the amount of annual and ephemeral vegetation that appears to be quite low (at the time of our visit – June 2012). This possibly indicates that the current winter/spring small ruminant stocking rate applied to the Eldari rangelands is reaching its upper sustainable limit.

All these observation are coherent with the current and limited winter use of the vegetation resources of the VNP and project areas (2 km area around the whole VPN).

The re-introduction of a limited number of goitered gazelles on the VNP appears quite reasonable considering the large open grassland areas, the vegetation biodiversity and the unused summer standing biomass. The re-introduction plan must establish and maintain some quiet circulation corridors for the gazelles to freely access the different vegetation types according to their seasonal needs. This may be challenging considering the number of sheep farm leases on the VNP and associated areas. The large sheep population present on most areas in winter may also be a deterrent to gazelles re-introduction, possibly leading the wild ungulates migrating during the winter to quieter environments.

A review of the sheep farm leases, carefully taking into consideration socio-economic aspects on the VNP and associated project areas, may be necessary to accommodate any future gazelle re-introduction plan. Economic incentives made available to sheep owners and Eldari villagers (also to create employment) for hay-harvesting and potential forage cropping (with Sainfoin = *Onobrychis viciifolia*) may help reducing the number of sheep on the Vashlovani rangelands in winter, leaving more room for gazelles. While this could have a stimulating effect initially on the *Bothriochloa* grasslands, it could help better managing them once gazelles are re-introduced and grazing the *Bothriochloa* areas during the summer.

ANNEXES

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List of plants encountered on the Vashlovani open rangelands

				Seasonal palatability (G. Gintzburger)				
	***Species* (N. Lachashvili)**	**Georgian local names (T. Popiashvili)**	**Life forms**	**Spring**	**Summer**	**Autumn**	**Winter**	**Comments**
1	*Achillea biebersteinii*	farsmanduki	Perennial	+-	+-	+-	+-	
2	*Achillea nobilis*		Perennial	+-	+-	+-	+-	
3	*Aegilops cylindrica*		Annual	+++	-	++	+++	
4	*Aegilops triaristata*		Annual	+++	-	++	+++	
5	*Aeluropus littoralis*	mlaSe glerta	Perennial	+++	-	++	+++	Halophyte +++
6	*Alcea rugosa*		Perennial	+-	+	+	+-	
7	*Allium atroviolaceum*	yanis niori	Perennial (G)	+-	+-	+-	+-	
8	*Allium pseudoflavum*		Perennial (G)	+-	+-	+-	+-	
9	*Allium rubellum*		Perennial (G)	+-	+-	+-	+-	
10	*Anabasis aphylla*		Semi-shrub	+++	+++	+-		
11	*Anagallis foemina*		Annual	+-	+-	+-	+-	
12	*Artemisia lerchiana*	avSani	Dwarf semi-shrub	+-	+++	+++	+-	Heavy soils
13	*Artemisia scoparia*	samwvana	Annual	+-	+-	+-	+-	
14	*Asperula humifusa*		Perennial	+-	+-	+-	+-	
15	*Astragalus bungeanus*		Perennial	+-	+-	+-	+-	
16	*Astragalus caucasicus*	glerZi	Shrub	+-	+-	+-	+-	
17	*Astragalus stevenianus*		Perennial	+-	+-	+-	+-	
18	*Bilacunaria microcarpa*	qarqveta	Perennial					
19	*Bolboshoenus maritimus*	lelqaSi	Perennial	+-	+	+	+-	Halo-hygrophyte
20	*Bothriochloa ischaemum*		Perennial	+	+-	+-	--	C4 grass
21	*Bromus japonicus*	*Svriela*	Annual	+	-	+-	+	
22	*Camelina microcarpa*		Annual					
23	*Carduus hamulosus*	narSavi	Biannual	-	-	-	-	
24	*Carex liparocarpos subsp. bordzilowski*		Perennial	+++	+++	+++	+++	
25	*Carthamus lanatus*		Annual	-	-	-	-	
26	*Centaurea ovina*		Perennial	-	-	-	-	
27	*Centaurea reflexa*		Perennial	-	-	-	-	
28	*Centaurea solstitialis*	ekalcocxi	Annual	-	-	-	-	
29	*Chondrilla juncea*		Perennial / Biannual	+-	+-	+-	+-	
30	*Cleistogenes bulgarica*		Perennial	+	-	+-	+	
31	*Consolida divaricata*		Annual	+-	+-	+-	+-	
32	*Convolvulus cantabrica*		Perennial	+-	+-	+-	+-	
33	*Cousinia orientalis*		Perennial	-	-	+-	++	
34	*Crinitaria villosa*		Perennial	+-	+-	+-	+-	
35	*Crucianella angustifolia*		Annual	+-	+	+	+-	
36	*Crupina vulgaris*		Annual	+-	+-	+-	+-	
37	*Cynodon dactylon*	glerta	Perennial	+++	+++	+++	+++	Excellent hay
38	*Daucus carota*	feriscvala	Annual	-	-	-	-	Invasive
39	*Delphinium cyphoplectum*		Perennial (G)	-	-	-	-	
40	*Dianthus inamoenus*		Perennial	+-	+	+	+-	
41	*Echium sp.*		Perennial	-	-	-	-	
42	*Elytrigia repens*		Perennial	++	++	++	++	
43	*Eragrostis starosselskyi*		Annual	+++	+++	+++	+++	
44	*Eremopyron orientale*		Annual	+++	+-	+-	+++	
45	*Eremopyron triticeum*		Annual	+++	+-	+-	+++	
46	*Erodium cicutarium*	savarcxela	Annual	+++	++	++	+++	Excellent hay
47	*Eryngium campestre*		Perennial	-	-	-	-	
48	*Eryngium caucasicum*	lurji nari	Perennial	-	-	-	-	
49	*Erysimum repandum*		Annual	+++	+++	+++	+++	
50	*Euphorbia helioscopia*		Annual	-	-	-	-	
51	*Euphorbia seguieriana*		Perennial	-	-	-	-	
52	*Falcaria vulgaris*	kofrCxila	Perennial	-	-	-	-	
53	*Filago arvensis*		Annual	+-	+-	+-	+-	
54	*Filago pyramidata*		Annual	+-	+-	+-	+-	

55	*Galium tenuissimum*		Annual	+-	+-	+-	+-	
56	*Galium verum*	mindvris nemsa	Perennial	+-	+-	+-	+-	
57	*Gamanthus pilosus*		Annual	+	-	-	+	Halophyte +++
58	*Glycyrrhiza glabra*	Zirtkbila	Perennial	-	-	-	-	
59	*Gypsophila bicolor*		Perennial	+-	+-	+-	+-	
60	*Helianthemum salicifolium*		Annual	+++	+++	+++	+++	
61	*Helichrysum rubicundum*		Perennial	+-	+-	+-	+-	
62	*Herniaria incana*		Perennial	+-	+-	+-	+-	
63	*Hordeum crinitum*		Annual	++	-	+-	++	
64	*Hypericum perforatum*		Perennial	T	T	T	T	Toxic - Solarization
65	*Inula germanica*		Perennial	-	-	-	-	
66	*Kalidium caspicum*		Perennial	+-	++	+-	+-	Halophyte +++
67	*Koeleria cristata*	*kewewura*	Perennial	+	+-	+-	+	
68	*Lagonychium farctum*		Semi-shrub	-	-	-	-	
69	*Limonium meyeri*	Soroqani, mlaSe cocxi	Perennial	+-	+-	+-	+-	Halophyte +
70	*Linaria simplex*	*seliWa*	Annual	+-	++	+-	+-	
71	*Linum austriacum*	*seli*	Perennial	+-	++	+-	+-	
72	*Linum corymbulosum*		Annual	+-	++	+-	+-	
73	*Linum nodiflorum*		Annual	+-	++	+-	+-	
74	*Lolium rigidum*	namkala	Annual	+++	+++	+++	+++	Excellent hay
75	*Lycium ruthenicum*		Perennial	-	-	+-	+-	Phreatophyte
76	*Malabaila dasyantha*		Perennial	-	-	-	-	
77	*Malvalthaea transcaucasica*	balbatuxti	Annual	-	-	-	-	
78	*Medicago coerulea*		Perennial	+++	+++	+++	+++	Excellent hay
79	*Medicago minima*		Annual	+++	+++	+++	+++	
80	*Medicago orbicularis*	mrgvali ionja	Annual	+++	+++	+++	+++	
81	*Melica transsilvanica*		Perennial	+++	+++	+++	+++	Excellent hay
82	*Nigella arvensis*		Annual	+-	+-	+-	+-	
83	*Onobrychis kachetica*	kaxuri esparceti	Perennial	+	+-	+-	+++	Excellent hay
84	*Onobrychis radiata*		Perennial	+	+-	+-	+++	Excellent hay
85	*Ononis pusilla*		Perennial	+++	+++	+++	+++	
86	*Onosma sp.*		Perennial	-	-	-	-	
87	*Petrosimonia brachiata*	xvarxvara	Annual	+-	++	++	+++	
88	*Phleum paniculatum*		Annual	++	++	++	++	Excellent hay
89	*Phleum phleoides*		Perennial	++	++	++	++	Excellent hay
90	*Phlomis pungens*	jinWara	Perennial	-	-	-	-	
91	*Plantago lanceolata*	lanceta mravalZarRva	Perennial	+++	+++	+++	+++	Excellent hay
92	*Polygala transcaucasica*		Perennial	++	++	++	++	
93	*Polygonum argylocoleon*		Annual	++	++	++	++	
94	*Potentilla recta*		Perennial	++	++	++	++	
95	*Poterium polygamum*	*uraSa*	Perennial	++	++	++	++	
96	*Psilurus incurvus*		Perennial	++	+-	+-	++	Halphyte ++
97	*Pterotheca sancta*		Annual	+-	++	++	+++	
98	*Reseda lutea*	yanis rezeda	Annual/ Biannual	+++	+++	+++	+++	
99	*Rumex tuberosus*		Perennial (G)	+-	++	++	+++	
100	*Salsola dendroides*	yarRani	Dwarf semi-shrub	+-	++	++	+++	Halophyte ++
101	*Salsola ericoides*	Carani	Semi-shrub	+-	++	++	+++	Halophyte +
102	*Salsola iberica*		Annual	+-	++	++	+++	Halophyte +
103	*Salsola nodulosa*	xuruxuma	Semi-shrub	+-	++	++	+++	Halophyte +++
104	*Salvia nemorosa*		Perennial	-	-	-	-	
105	*Scabiosa micrantha*		Annual	++	++	++	++	
106	*Scorzonera biebersteinii*		Perennial	++	++	++	++	
107	*Setaria viridis*	mwvane Zurwa	Annual	++	++	++	++	
108	*Sideritis montana*	sayvïTlo	Annual	+-	++	++	+-	
109	*Sonchu ssp.*		Annual	++	++	++	++	
110	*Stachys atherocalyx*	*dedafutkara*	Perennial	+-	++	++	+-	
111	*Stipa capillata*	wuruwma	Perennial	+++	++	++	+++	
112	*Stipa lessingiana*		Perennial	+++	++	++	+++	
113	*Stizolophus coronopifolius*		Annual	-	+-	+-	-	
114	*Suaeda microphylla*		Perennial	+++	++	++	+++	Halophyte

								+++
115	*Tamarix ramosissima*	*ialRuni*	Perennial	-	-	-	-	Phreatophyte
116	*Teucrium nuchense*		Dwarf semi-shrub	+-	++	++	+-	
117	*Teucrium polium*	kuti balaxi	Dwarf semi-shrub	+-	++	++	+-	
118	*Thesium arvense*		Perennial	-	-	-	-	
119	*Thymelaea passerina*		Annual	-	-	-	-	
120	*Thymus tiflisiensis*	*begqondara*	Dwarf semi-shrub	+++	+++	+++	+++	
121	*Trachynia distachya*		Annual	+++	+-	+-	+++	
122	*Tragopogon tuberosus*		Perennial	+++	+++	+++	+++	
123	*Tragus racemosus*		Annual	+++	+++	+++	+++	
124	*Trifolium campestre*		Annual	+++	+++	+++	+++	Excellent hay
125	*Trigonella spicata*		Annual	+++	+++	+++	+++	Excellent hay
126	*Veronica multifida*		Perennial	+-	++	++	+-	
127	*Vicia pannonica*		Annual	+++	+++	+++	+++	Excellent hay
128	*Xeranthemum squarrosum*		Annual	-	-	-	-	

Mission time table

- 1-8 June 2012: Mission preparation with FFI-UK and FFI-Tbilisi
- 9 June 2012: Fly Perth (22h30)– Dubai (05h30)
- 10 June 2012: Fly Dubai (13h10) – Arrival Tbilisi 19h15
- 11 June 2012: Office work at NACRES with Gareth Goldthorpe (Project coordinator) and Teimuraz Popiashvili (Field officer) – field trip preparation and acquiring field equipment,
- 12 June 2012:
    - Field trip preparation (Acquiring field equipment),
    - Meeting and discussion with Dr N. Lachashvili (Consultant botanist)
- 13 June 2012:
    - Field trip preparation (Acquiring field equipment and supply)
    - Departure to Vashlovani (13h00)
    - Visit to Vashlovani National park authorities and Border Police (at Dedoplistskaro) for necessary authorisations ,
    - Arrival at 19h00
- 14 June 2012 : field trip 1 – Field reconnaissance of western part (North and South) – through Pantishara Gorges (Paliuretum) – Eldari lowlands (Artemisietum - Bothriochloa) – Kumuro – Bogha-Moedani (Gazelles enclosures – *Bothriochloa*) – Chiroelet-Khevi (Pistacia forest)
- 15 June 2012 : Field trip 2 - Field reconnaissance of North Eastern part through Mlashe-Tskali to Shavi-M'ta (Black Mountain)
- 16 June 2012: Field trip 3 – through Pantishara to Eldari - LIM and biomass measurement at Eldari
- 17 June 2012: Field trip 4 – Chiroelet-Khevi – Biomass measurements on *Bothriochloa* – Stipa
- 18 June 2012: Data processing - Report writing – T. Popiashvili to Dedoplistskaro (for fuel and supply)
- 19 June 2012: to Eldari – *Bothriochloa* – *Artemisia* communities and visit to *Artemisia* – *Salsola* / Halophytic plant communities along Azerbaijani border
- 20 June 2012: Central part of protected area – Biomass at Patara-Shiraki – visit to Eldari village and Botany Station - heavy evening rain.
- 21 June 2012: LIM and Biomass at Kumuro – Alazani river
- 22 June 2012: LIM and Biomass at Bugha-Moedani and Mlashe-Tskali
- 23 June 2012: Return to Tbilisi (17:00)
- 24 -26 June 2012: Report writing
- 27 June 2012: Worked at the Tbilisi Institute of Botany
- 28 June – 2 July 2012: Report writing and preliminary report summary handed over to FFI and NACRES,
- 29 June 2012: Debriefing - Discussion on preliminary report summary with G. Goldthorpe, Irakli Shavgudlize and NACRES team (Copy sent to D. Mallon and FFI – UK for info)
- 30 June – 2 July: Report writing
- 3 July 2012: Fly Tbilisi – Dubai – ETD 7:00 am
- 4 July 2012: Fly Dubai – Perth (Australia) – ETA 17:45
- 19 July 2012: Draft report - submitted to G. Goldthorpe (FFI-Tbilisi) for comments and editing,
- 28 July 2012: Final report completion

Meetings

- **Gareth GOLDTHORPE**, Project coordinator, Georgian Carnivore Conservation project, FAUNA and FLORA International (FFI), Tbilisi
- **Irakli SHAVGUDLIZE**, Chair, Governing board NACRES, Tbilisi
- **Nikolos LACHASHVILI,** Dr/Ph.D., Associated explorer (LEPL) Ilia State University, Institute of Botany, and Senior scientist, National Botanical Garden of Georgia, Tbilisi
- **Teimuraz POPIASHVILI,** Human-carnivore conflict field officer, Georgian Carnivore Conservation Project, NACRES, Tbilisi
- Ms **Nino MARKOZASHVILI**, assistant coordinator (GCCP, Tbilisi)
- **Merab PIROMANASHVILI**, Director Vashlovani National Park, Dedoplistskaro
- **Zaza BOSTASHVILI,** Resource specialist - Veterinarian, Vashlovani Protected Area Administration, Dedoplistskaro
- **Anzor GOGOTIDZE**, Director TUSHETI Protected Area / National Park,
- **Kakha ARTSIVADZE,** Ex-NACRES board of directors, Desertification specialist

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