ENHANCING FINANCIAL SUSTAINABILITY OF THE PROTECTED AREAS SYSTEM IN GEORGIA

TECHNICAL ASSISTANCE GRANT AGREEMENT

Monitoring of Grasslands (pastures) in Selected Protected Areas in Georgia

[Draft]

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Contents

1   Introduction

Much of Georgia's grasslands are used for livestock grazing. Pasturelands cover about 1,796,000 ha of the country's territory of which up to 200,000 ha are found within the protected areas. Hay meadows and pastures of Georgia are natural or semi-natural habitats of ecologically diverse grassland communities that vary according to altitude, moisture availability, aspect and other physical parameters and have been shaped up by past and current land use practices.

In general, grasslands are home to a range of wild flora and fauna and can support high densities of grazing animals. These biomes have many biodiversity values, including as wildlife or rare plant species habitats while also providing an array of ecosystem services such as watershed protection, and provisional services as for livestock feed, etc. Grasslandsare threatened by human factors such as unsustainable agricultural practices, overgrazing, clearing for crop production as well as by afforestation and alien species invasions. In addition, alpine, arid and semi-arid natural grasslands are particularly sensitive to climate change. Increasing global temperatures will cause a gradual shift of altitudinal belts and inevitably have a major impact on high mountain species that are adapted to low temperatures. These species may become replaced by thermophilous species whose spread is presently limited by the low temperatures at high altitudes. Pastures located in arid and semiarid ecosystems are at high risk by the predicted decrease in precipitation in that region.

The grasslands that are found in Georgian protected areas represent a mosaic of different geobotanical vegetation types. Most of them are classified as natural alpine grasslands that naturally occur above timberline in the Greater and Lesser Caucasus ranges. In addition, semi-arid natural grasslands are important parts of Vashlovani National Park and Chachuna Managed Reserve.

In recent years, a number of surveys were conducted to assess pasture conditions in PAs with the support of external donors and partner organizations and respective management plans were developed. However, the majority of those studies were focused on management issues and did not cover biodiversity assessments or conservation implications of livestock grazing.

This report describes the process and results of the assessment of ecological state of grasslands (pastures) located within Algeti, Vashlovani, Ktsia-Tabatskuri and Javakheti protected areas as well as the Eldari (Samukhi) lowland. It should be noted that all of these PAs are also designated Emerald Sites.

The ecological evaluation of pastures implied the identification of pasture habitats, evaluation of the state of vegetation cover and biodiversity, biomass, identification of types of plant communities on the pastures, assessment of the state of soil, level of degradation, and other (topographic, biophysical, erosive etc.) parameters.

2   Short Descriptions of the Target Protected Areas

2.1   Algeti National Park.

Algeti National Park is situated south-east of Tbilisi. It is characterised with humid to continental climate with moderately cold winters and long, warm summers. The average annual precipitation is

912 mm. The orography of the national park is determined by medium altitude mountains with ridges and rugged terrain. The altitudinal diversity (1100-1950 m a.s.l.) creates a mosaic of natural landscapes mostly dominated by temperate forests and by subalpine meadows at higher elevations.

The flora of the national park contains up to 1,664 species that include 90 woody plants. The primary purpose of establishing a protected area, namely a nature reserve during the Soviet times, was to protect the easternmost limits of the Caucasian spruce (*Picea orientalis*) and Nordmann fir (*Abies nordmaniana*) distribution in Georgia.

Open areas that are suitable for livestock grazing are mostly represented by forest clearings or dry, rocky slopes. The grasslands that are adjacent to the villages are commonly used by the locals for their small cattle herds. Larger pastures are bordering the national park from the north.

The total area of Algeti National Park is 8,768 ha. Based on the satellite analyses, the total area of grasslands is 1,122 ha.

2.2   Vashlovani National Park and Samukhi plains

Vashlovani national park is situated in the extreme southeast of Georgia and together with the Vashlovani Nature Reserve encompasses a wide spectrum of habitat types such as arid light woodland, steppe and semi-deserts as well as small patches of floodplain forest.

The area is characterised with dry-continental climate. The average annual temperature is about 12°C. Annual precipitation depends on the elevation and varies from 250 mm (in Eldari lowland) to 500 mm (at Black mountain).

Vashlovani grasslands that are used as winter pastures for livestock, mainly for transhumant sheep grazing, are dominated by pasture species such as: *Artemisia lerchiana*; *Stipa* spp.; *Bothriochloa ischaemum*; *Onobrychis* spp. (*O. kachetica* and *O. radiata*); *Medicago* spp. (*M. coerulea*, *M. minima* and *M. orbicularis*).

Livestock grazing is among the most important human factors that have apparently played a decisive role in shaping the Vashlovani and Samukhi landscapes and creating the ecological mosaic currently found throughout the park. A significant part of the pastures has been degraded to various extent, mostly due to overgrazing, compaction and erosion created by livestock impact.

While recognising the fact that the VNP and Samukhi pastures are very important for the livelihoods of the Tushetian and other sheep farmers and that sheep grazing have now become an important component of the ecosystem, those pastures should primarily be considered as grassland habitats that are used and shared by both livestock and wildlife.

The total area of Vashlovani Protected Areas is 25,021 ha and that of Samukhi plains is 13,339 ha.

2.3   Ktsia-Tabatskuri Managed Reserve and Javakheti Protected Areas

Ktsia-Tabatskuri Managed reserve (MR) and Javakheti protected areas are similar from the geographical and floristic points of view. Both are situated on the Javakheti plateau which abounds in wetlands including lakes and high-altitude grasslands that make excellent summer pastures with peaking vegetation and milder climatic conditions during the summer months. Grazing takes place from spring until late autumn, snow cover being the main limiting factor. Some areas that are apparently less suitable for cattle grazing are used for hay making. Such areas include very wet grasslands adjacent to the lakes and dominated by sedges. Parts of the territory is used for transit movement of sheep in spring and autumn. Grasslands that are closer to the villages are often also spared for hay-making.

Ktsia-Tabatskuri Managed Reserve (MR) is part of the Borjom-Kharagauli National Park and is situated in the southern part of the Lesser Caucasus in Javakheti region. The climate is harsh continental with less than 700 mm average annual precipitation. The altitudinal range is between 2,000-2,800 m. a.s.l. The total area of the MR is 20,476 ha (which coincided with our study area). The area of pastures is 18,278 ha.

Grassland vegetation, which is entirely of secondary origin and of different level of modifications, occupies most of the study area. The following meadow types are noteworthy: communities of lady's mantle (*Alchemilla erythropoda*), sheep's fescue (*Festuca ovina*), mat-grass (*Nardus stricta*), tufted hair-grass (*Deschampsia cespitosa*), bent (*Agrostis planifolia, Agrostis tenuifolia*), sibbaldia (*Sibbaldia semiglabra*), broad-leaved herbaceous plant and forbs (*Latifolio-mixtohorbosa*). In most cases these species form meadows jointly where they are present in a great number of syntaxonomic variants.

Javakheti Protected Areas are situated on Javakheti plateau and consist of the following territories: Javakheti National Park and the managed reserves of Bughdasheni lake, Sulda wetlands, Khanchali lake, Madatapa lake, Saghamo lake, Paravani lake and Tetrobi. Javakheti is mainly of volcanic origin and is characterized with harsh continental climate. The average annual precipitation is 500-700 mm and the peak rainfall is in spring and late autumn. The altitudinal range varies from 1,800 m. a.s.l. (Kartsakhi lake) to 2,607 m. a.s.l. (Mt. Tetrobi). There are many freshwater lakes and wetlands and much of the area is covered by steppic, subalpine and alpine grasslands. A large proportion of these grasslands are used as pastures or hay meadows.

The forest belt reaches up to 1,500 to 2,100 m. a.s.l. and is represented by birch (*Betula litwinowii*)-Caucasian rhododendron (*Rhododendron caucasicum*) woods, high mountain pine (*Pinus kochiana*) forests and artificial pine plantations. The total area of the PAs is 13,498 ha and our study area was about 8,070 ha.

3   Methodology

3.1   Grassland assessment

The field work was conducted in two phases. During the first phase we evaluated the overall situation on the ground and checked out the local habitat types as well as the road infrastructure and accessibility to various parts of the study area. This information was used to plan the second phase of field surveys, during which pasture sampling was carried out. The number and location of sample plots were planned so that they were more or less equally distributed throughout all habitat types of

interest. Additional plots were assessed in areas that were considered to be in natural or near-natural state. Such plots were used as best representatives of these habitats.

In total, 8 field surveys were conducted on the pastures of Algeti, Vashlovani, Ktsia-Tabatskuri and Javakheti protected areas during the period from March through September of 2021 and a total of 93 plots were sampled (See Appendix 1 for the locations of sampled plots):

PA	# of plots
Vashlovani NP and Samukhi plains	43
Ktsia-Tabatskuri MR	16
Javakheti PA	23
Algeti NP	11

Field data were entered into the data forms using SailForms app on a tablet device. Microsoft Excel was used for the analyses of the data sheets using the designated formulas for the index calculations.

The assessment of the state of pastures was based on the method suggested by J. Etzold and R. Neudert[1] in a pasture monitoring manual, which is in turn based on *the topographic relative moisture index* (TRMI). The method was modified in 2016-2018 within the project „Monitoring of Plant Cover and Assessment of the State of Pastures in Tusheti Protected Areas", with the involvement of international expert Dr. Hanns Kirchmeir, E.C.O. Institute. Due to this modification the approach incorporated more detailed assessment of biodiversity aspects of grasslands. The method involves the assessment of the biophysical, geological and botanical state of pasture, for which *Susceptibility to Erosion-Index* (SEI), *Pasture Degradation Index* (PDI) and summary of *State of Pasture-Index* (SPI) are calculated. Grassland (pasture) vegetation was assessed on 10x10 m plots, based on the field form and the pasture monitoring manual. All quadrants were marked using an iron nail (lower right angle of 10x10 plots), which will be used in the next monitoring assessment to locate the plots using a metal detector in combination with the location coordinates.

The method involves vegetation surveys focusing on the ecology, floristic composition, percentage of vegetation cover using intercept data, and aboveground biomass measurements. Obtained field data were processed in GIS. The biomass assessments on the grasslands provided information on the current stock volume of biomass at the given moment of extraction (May-August). This above-ground biomass was collected to be used to increase the accuracy of the GIS model by calibrating remote sensing data. Biomass, samples – whole living biomass above ground – were harvested from most frequent pasture-vegetation types on 1x1 m. quadrants (on the bottom-left corner of the 10X10 m. quadrant, adjacent to the marker needle). Those samples were sent to the Institute of Botany of Ilia State University for drying and weighting procedures.

The output of the Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI)[2] were used to create a standing biomass distribution map. Relatively homogenous sections were

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[1] **The Monitoring of Highland Pastures of South Caucasus**, Jonathan Etzold and Regina Neudert. Greifswald University. 2013-2014.

[2] The NDVI is a dimensionless index that describes the difference between visible and near-infrared reflectance of vegetation cover and can be used to estimate the density of green on an area of land. Enhanced Vegetation Index (EVI) is similar to NDVI and also can be used to quantify vegetation greenness. While the EVI is calculated similarly to NDVI, it corrects for some distortions in the reflected light caused by the particles in the air as well as the ground cover below the vegetation.

first identified and the condition of pasture was determined based on a spectral analyses (NDVI) of satellite imagery using Sentinel-2 (10-m resolution) images, with the coefficient range used for the spectral analyses -1 to 1. Based on the acquired results the condition of pastures was presented in three categories: bad, medium, good and biomass. Habitat maps were created that are generally more practical and useful for planning further steps and also better depict the big picture of the conditions of the pastures.

Based on the obtained results the preliminarily calculated indices were corrected. In the final stage, all data were incorporated in the database (including GIS shape files).

3.2 Habitat classification

Habitats were identified and mapped based on the European Nature Information System (EUNIS)[3] habitat classification and the corresponding manual, which was recently adapted to Georgia[4].

First, a preliminary evaluation of the study areas was carried out, which was based on the analysis of existing habitat maps (where available) and multi-spectrum satellite images (free Landsat and Sentinel-2. 30m and 10m resolution images). After the processing of multi-spectrum images and calculation of NDVI and EVI indices, key grassland (pasture) habitats were identified.

The preliminary data were then verified on the ground. The satellite data and the actual state were compared. The habitat maps as well as the preliminarily identified habitat types were refined based on the field data gathered through ground surveys, during which floristic composition was assessed and sampled plots were attributed to corresponding habitat classes. Finally, the boundaries of habitats were identified and mapped. The process can be schematically depicted as shown below (Figure 1):
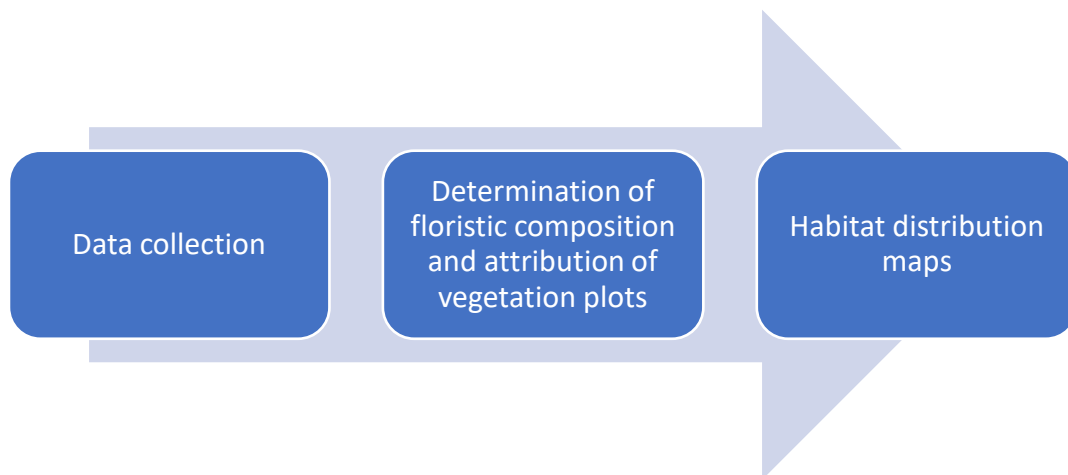
Fig. 1. The process of habitat identification and mapping.

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[3] https://eunis.eea.europa.eu/
[4] The EUNIS manual was adapted to Georgia in 2016. The descriptions were elaborated for all Georgian habitats that are protected under the Bern Convention (Resolution #4) so that the text describes Georgian variants of those habitats.

4   Results and analysis

Pasture survey results are presented below by protected areas. The results include identified and mapped habitats and their condition are depicted in the three traffic light colours: green, yellow and red categories that correspond pasture state categories: good, moderate and bad.

Field data such as above-ground biomass and numerous other variables were collected from each sampled plot using a special computer application. All field data were subsequently transferred into an *Excel* data base in which SEI, PDI and SPI indices were calculated. The database consists of the following specific information for each quadrat: location (GPS coordinates); physical characteristics such as altitude, exposition, inclination, topography, etc.; vegetation cover such as percentage cover, grazing indicators, weeds, identified species, etc. (See Appendix 2 for sample data sheet from the grasslands assessment data base).

4.1   Algeti NP

A total of 5 different habitats were identified on the grasslands of Algeti National Park (see Table 1 below). The maps showing the distribution and ecological condition of the identified habitats in Algeti national park are presented in Appendix 3.

Table 1. Non-forest habitats in Algeti NP (Habitat names and codes are as per EUNIS habitat classification).

CODE	Name of Habitat	Area (ha)
E1.7	Closed non-Mediterranean dry acid and neutral grassland	143.6
E2.1	Permanent mesotrophic pastures and aftermath-grazed meadows	746.6
E4.3	Acid alpine and subalpine grassland	216.3
E7.2	Sub-continental parkland	32.5
D2.2	Poor fens and soft-water spring mires	0.4

Photos 1 and 2. *Closed non-Mediterranean dry acid and neutral grassland* (left) and *Sub-continental parkland* (right) in Algeti NP

While much of Algeti National Park is covered by forest, diverse open areas and grassland habitats are also represented. Among them one grassland habitat – *Acid alpine and subalpine grasslands* (E4.3) –

is included in **Resolution No. 4 (1996) of the Bern Convention**[5], hence its protection and monitoring is required by the convention. Presently, the status of more than half of this habitat within the protected area is classified as "good" (see Figure 2). However, it is important to note that only a small fraction of this habitat is in fact protected as it continues well beyond the park boundaries into unprotected lands.
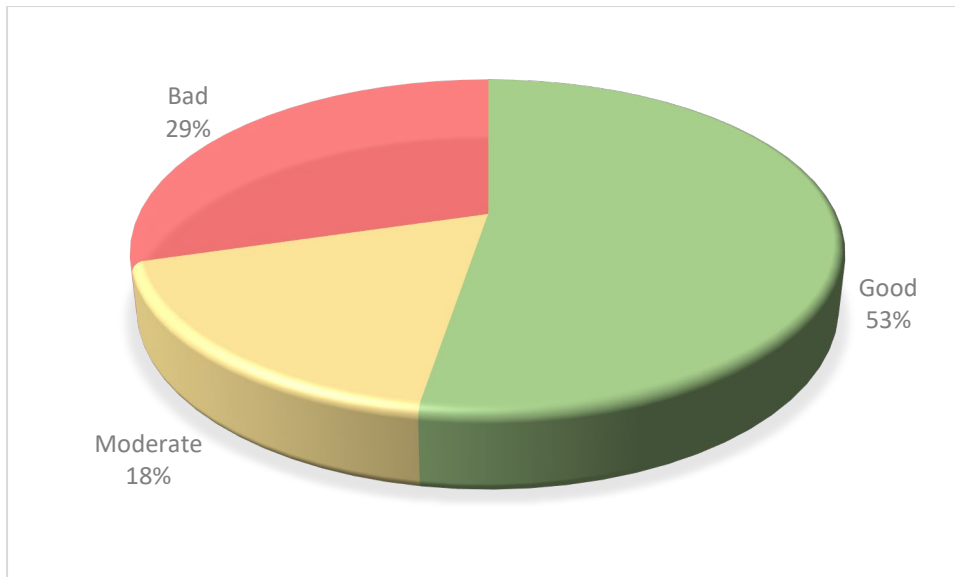
Fig. 2. The status of the Res. No. 4 habitat, *Acid alpine and subalpine grasslands* (E4.3) in Algeti NP.

The overall status of grassland habitats in Algeti NP is moderate to good – more than two thirds of the them fall under the good or moderate condition (Figure 3).
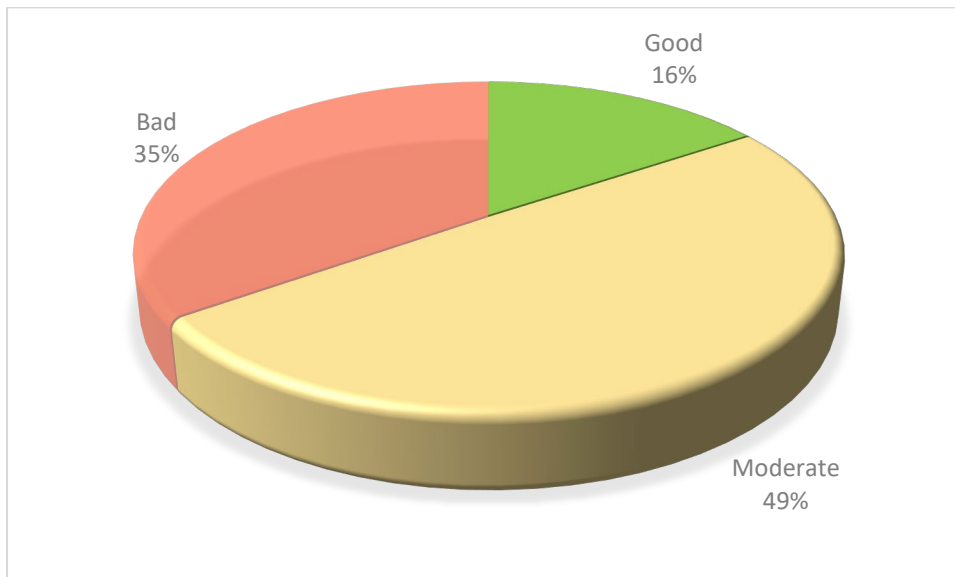
Fig. 3: The status of grasslands in Algeti NP.

While *Acid alpine and subalpine grasslands* (E4.3) are an important habitat from the Bern Convention viewpoint, *Permanent mesotrophic pastures and aftermath-grazed meadows* (E2.1) are the most

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[5] Annex I to Resolution No. 4 (1996) of the Bern Convention on endangered natural habitat types using the EUNIS habitat classification https://www.coe.int/en/web/bern-convention/resolutions

common grassland habitats in the park covering 65% of all grasslands as well as the majority of forest openings. Grazing is believed to be a crucial factor in maintaining these meadows; without constant grazing the forest may soon completely replace them. Throughout this part of the Trialeti ridge (including Algeti NP) the meadows are remarkably rich in non-wooded plant diversity[6]. This was confirmed by the results obtained through this monitoring surveys. These small-scale open habitats are a critical element of the national park, contributing to the overall habitat heterogeneity and benefiting a number of wildlife including large mammals, and probably also some insect communities. They are also important for the prospects of red deer restoration in the area. In the context of grazing being a critical factor, yet overgrazing containing risks to biodiversity – as reflected in their current not so favourable condition (see Fig. 4) – those meadows should be subject to close monitoring and special management to ensure the optimal livestock grazing intensities that would, on the one hand, sustain them, while still preventing habitat degradation and biodiversity loss.
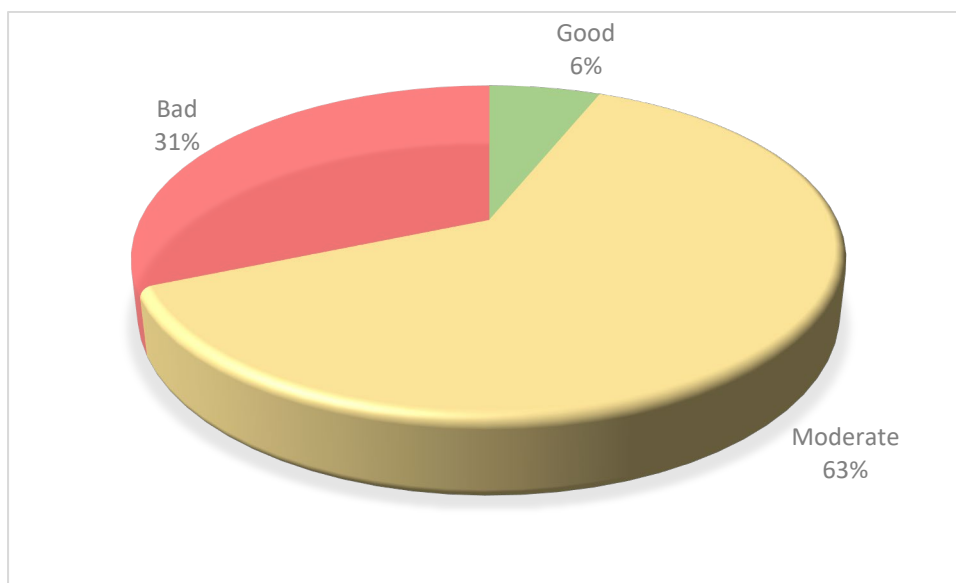
Fig. 4. The status of *Permanent mesotrophic pastures and aftermath-grazed meadows* (E2.1) in Algeti NP.

4.2 Vashlovani national park and Samukhi plains

The study area of Vashlovani national park and the adjoining Samukhi (Eldari) plains contain three major grassland habitats: *Mediterranean feathergrass steppes, Mediterraneo-Anatolian andropogonid grass steppes* and *Continental inland salt steppes*. There is also one non-grassland habitat − *Ponto-Sarmatic steppe brush* (see Table 2). Relevant maps showing the distribution and ecological condition of the major grassland habitats are presented in Appendix 4.

Table 2. Habitat types identified on Vashlovani and Samukhi study area (habitat names and codes are as per EUNIS habitat classification):

| CODE	Name of Habitat	Area (ha)
E1.432	Mediterranean feathergrass steppes	345.3
E1.4345	Mediterraneo-Anatolian andropogonid grass steppes	4 053.4
E6.2	Continental inland salt steppes	15 112

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[6] R. Gagnidze. Native Flora. Batumi, Adjara, 2000.

| F3.2471 | Ponto-Sarmatic steppe brush | 385.1 |

Photos 3 and 4. *Mediterranean feathergrass steppe* (left) and *Continental inland salt steppe* (right) in Vashlovani NP

As shown on the maps (Appendix 4) as well as on the chart below (Figure 5) *Continental inland salt steppes* are one of the most important grassland habitats in Vashlovani NP, covering 2,500 ha and mainly found on Bugha Moedani and Kumuro in the southern central parts of the park, and it is the dominant vegetation in Samukhi plains covering as much as 12,611 ha. The second most important grassland habitat in Vashlovani is *Mediterraneo-Anatolian andropogonid grass steppes* that are found in Eshmakis Khevi in the western parts, in Mlashe Tskali and Chighoelt khevi, in central parts, and as a narrow strap along the Alazani river. *Mediterranean feathergrass steppes* have a very limited distribution in Vashlovani national park, mainly confined to the Shavi Mta area on the slopes towards Dilicha plain.
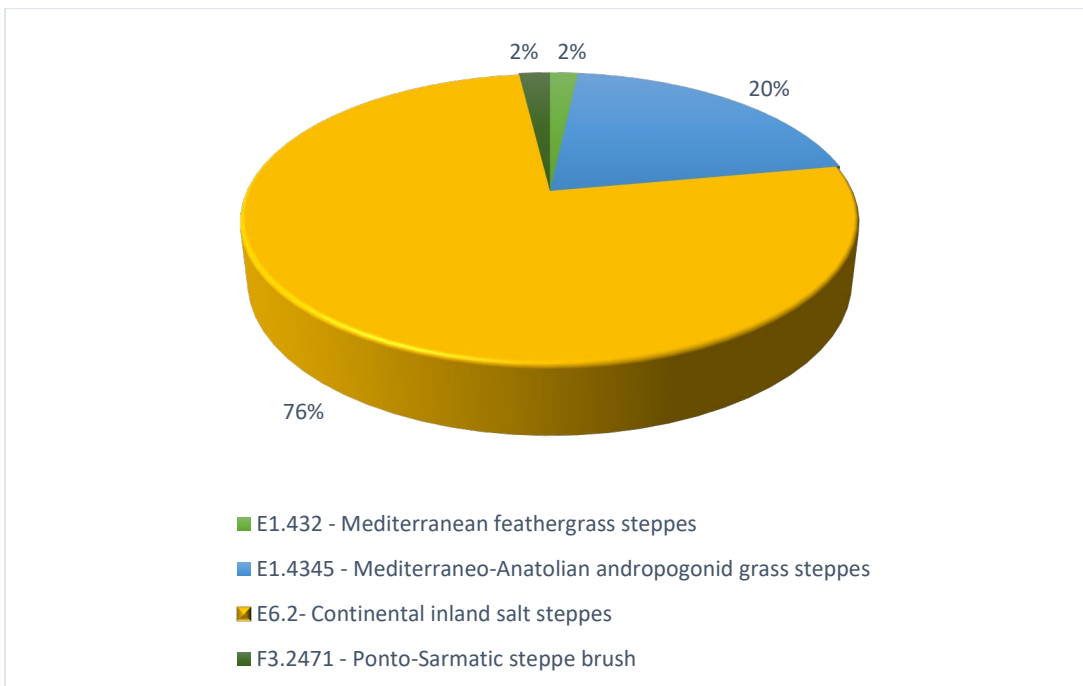
Fig. 5. Percentages of habitat types on Vashlovani grazing lands.

The grasslands both in Vashlovani NP and Samukhi plains are on the whole in moderate condition (see Figure 6 and Appendix 4 for map). The majority of Samukhi grasslands are in moderate condition, while in Vashlovani, there are areas whose overall condition have been categorised as "good" (marked in green on the maps) as well as those that are in "bad" condition (marked in red in the maps). The "red areas" are found mainly as a strap through Vashlovani and they are associated with intense sheep movement during the seasonal migration as well as temporal sheep movement during the grazing period for accessing water or good grazing areas. Green areas are scattered throughout the park in small and medium-sized patches and they are apparently associated with local physical conditions such as moisture availability, edaphic factors, etc. as well as with relatively low grazing pressure.
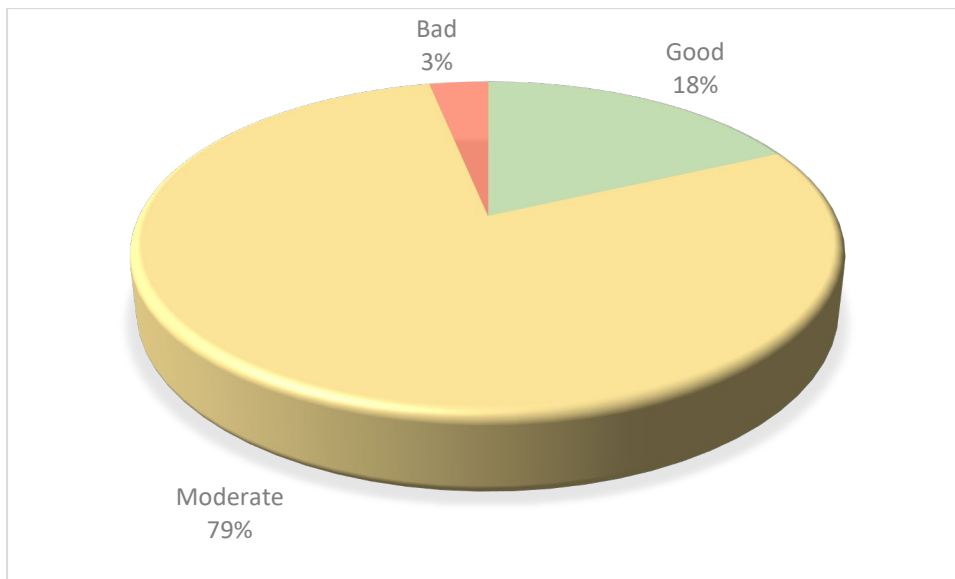
Fig. 6. Grassland condition (all grassland habitats), Vashlovani NP and Samukhi plains.
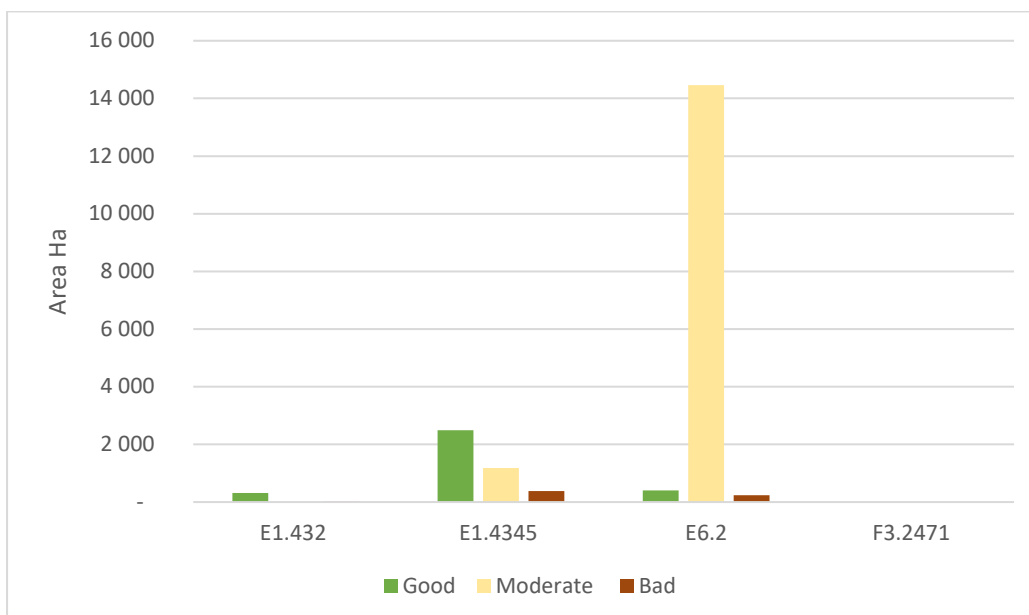
Fig. 7. Grassland condition by habitat types, Vashlovani NP.

Continental inland salt steppes (E6.2) are characterised with rich fodder and are therefore very attractive pastures for sheep grazing. Signs of extensive grazing and trampling impact are evident throughout these habitats. Still, their overall condition is mostly *Moderate* (yellow) (see Figure 7 and Appendix 4). However, it is also important to note that grazing is an important factor for maintaining these grasslands – without grazing pressure, in some areas, they may go through successional stages that would eventually lead to their becoming scrub or arid light woodland. These steppes provide habitat to numerous important plants and wildlife and they are critical for the newly reintroduced goitered gazelles (*Gazella subgutturosa*). Therefore, in Samukhi *Continental inland salt steppes* should be a subject of special monitoring and management (including livestock grazing management) as the actual gazelle habitat and in Vashlovani NP as potential areas for gazelle population expansion. In addition, this habitat as well as *Ponto-Sarmatic steppe brush* (F3.2471) are included in Resolution No. 4 (1996) of the Bern Convention.

4.3 Ktsia-Tabatskuri managed reserve

A total of 8 different habitats were identified and mapped in Ktsia-Tabatskuri MR (Table 3). The maps showing the distribution and ecological condition of the identified habitats are presented in Appendix 5. Two of these habitat types are wetland habitats (D2.1 and D5), two are subalpine scrub (F2.22 and F2.214) and four are grasslands (E1.7; E2.5; E3.52 and E4.3). The main focus of the study was on grassland habitats, but we also covered the adjacent non-grassland (wetland) habitats (classified as D – Mires, bogs and fens in EUNIS) and found that they were only occasionally used, primarily for hay making or horse grazing. Ecological conditions were assessed only for grassland habitats. The overall conditions of the two scrub habitats were still assessed visually during the ground surveys. Apparently, owning to their thick structure and often natural protection by volcanic rock formations, the impact of grazing is minimal on these habitats. It is however, important to note that both of them are protected by the Bern Convention (they are included in Resolution No. 4 as specific habitats of the wider habitat class *F2.2 Evergreen alpine and subalpine heath and scrub)*.

Table 3. Habitat types identified on Ktsia-Tabatskuri MR (habitat names and codes are as per EUNIS habitat classification):

CODE	Name of Habitat	Area (ha)
E1.7	Closed non-Mediterranean dry acid and neutral grassland	6 862
E2.5	Meadows of the steppe zone	7 906.6
E3.52	Heath rush meadows and humid mat-grass swards	1.4
E4.3	Acid alpine and subalpine grassland	2 535.8
F2.214	Pontic dwarf [*Vaccinium*] heaths	54.2
F2.22	Alpide acidocline alpenrose heaths	2 598
D2.1	Valley mires	2 255.3
D5	Sedge and reedbeds, normally without free-standing water	90

Photos 5 and 6. *Acid alpine and subalpine grassland* (left) and *Alpide acidocline alpenrose heaths* (right) in Ktsia

Among the four grassland habitat types, *Meadows of the steppe zone* (E2.5) and *Acid alpine and subalpine grassland* (E4.3) have the largest distributions (Figure 8). A single small patch of *Heath Juncus meadows and humid Nardus stricta swards* (E3.52) was found and mapped Northeast of lake Tabatskuri. This habitat may be present elsewhere but its detection is extremely difficult due to small size of its fragments. The significance of this habitat for grazing is low due to poor species composition and low quality fodder.
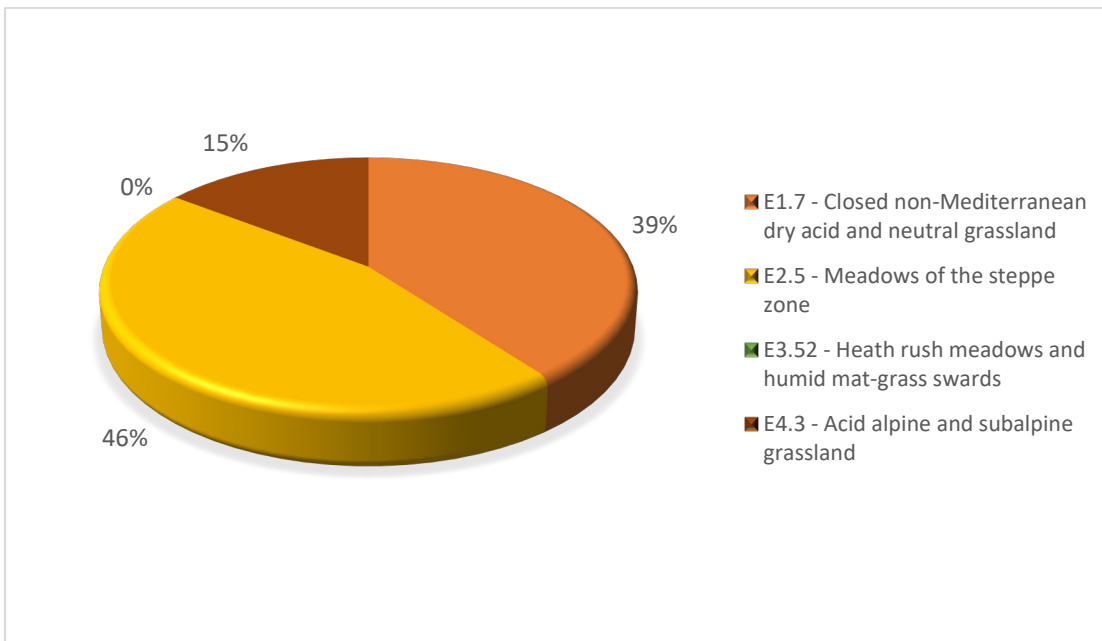
Fig. 8. Percentages of grassland habitat types in Ktsia-Tabatskuri MR.

Heath Juncus meadows and humid Nardus stricta swards (E3.52) and *Acid alpine and subalpine grassland* (E4.3) are included in Resolution No. 4[7]. *Acid alpine and subalpine grassland* is found on the high altitude ridge North of the MR. These habitats are characterised with high species diversity. At present, they are largely in good condition (Figure 10) but grazing should be closely monitored to safeguard their favourable condition in the long run.

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[7] Annex I to Resolution No. 4 (1996) of the Bern Convention on endangered natural habitat types using the EUNIS habitat classification https://www.coe.int/en/web/bern-convention/resolutions
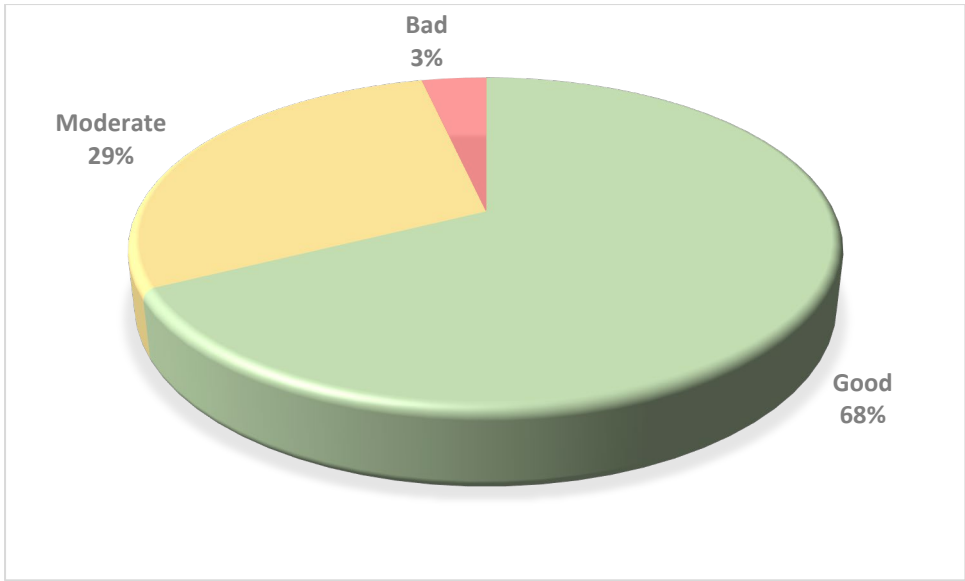
Fig. 9. Overall ecological conditions of grasslands in Ktsia-Tabatskuri (all grassland habitats)
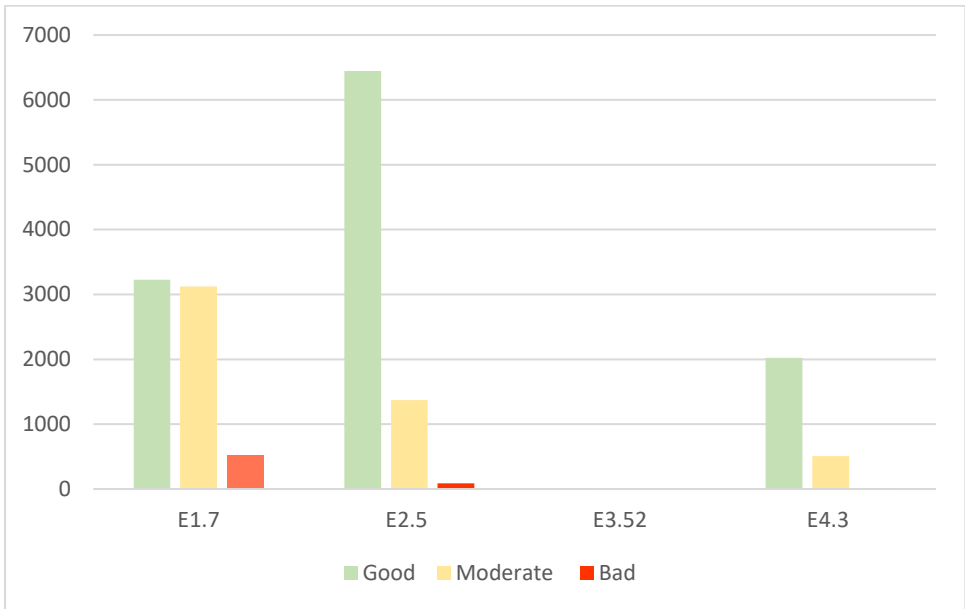
Fig. 10. Ecological condition of grassland habitats, Ktsia-Tabatskuri MR.

4.4   Javakheti protected areas

Much of the grazing/pasture lands within Javakheti protected areas is found at lake Kartsakhi. A total of seven habitat types were identified, five of which are grasslands i.e. habitats under the higher habitat class *Grasslands and lands dominated by forbs, mosses or lichens*; all habitats within this category are marked with code *E* as per EUNIS classification (Table 4). See Appendix 6 for distribution maps and ecological conditions of the identified habitats in Javakheti national park.

Hedgehog-heaths (F7.4) are a *Resolution No. 4* habitat and their monitoring and long-term conservation is an obligation to the Bern Convention. They have a very limited distribution in the study area and despite some impact such as possible limiting of growth, livestock grazing should not be a significant factor since the thorny Astragalus, forming those heaths is well protected against grazers.

Table 4. Habitat types identified in Javakheti PA study area (habitat names and codes are as per EUNIS habitat classification).

CODE	Name of Habitat	Area (ha)
E1.1	Inland sand and rock with open vegetation	1 560
E1.7	Closed non-Mediterranean dry acid and neutral grassland	5 718
E2.3	Mountain hay meadows	2 101
E2.5	Moist or wet oligotrophic grassland	266
E4.3	Acid alpine and subalpine grassland	2 529
F2.3	Subalpine deciduous scrub	486
F7.4	Hedgehog-heaths	17
D5	Sedge and reedbeds, normally without free-standing water	2

Photo 7. *Mountain hay meadow* in Javakheti PA.

Closed non-Mediterranean dry acid and neutral grassland (E1.7) is the most common grassland habitat in the study area, comprising 47% of all grasslands. *Mountain hay meadows* (E2.3) and *Acid alpine and subalpine grassland* (E4.3) are also important grassland habitats (Figure 11). Overall, the ecological condition of the Javakheti PA grasslands is "good" – 68% was assessed as "green" and 26% as "yellow" (Figure 12). Relatively mild terrain, low hills and hard volcanic bedrock probably make these lands less prone to erosion and livestock induced degradation.
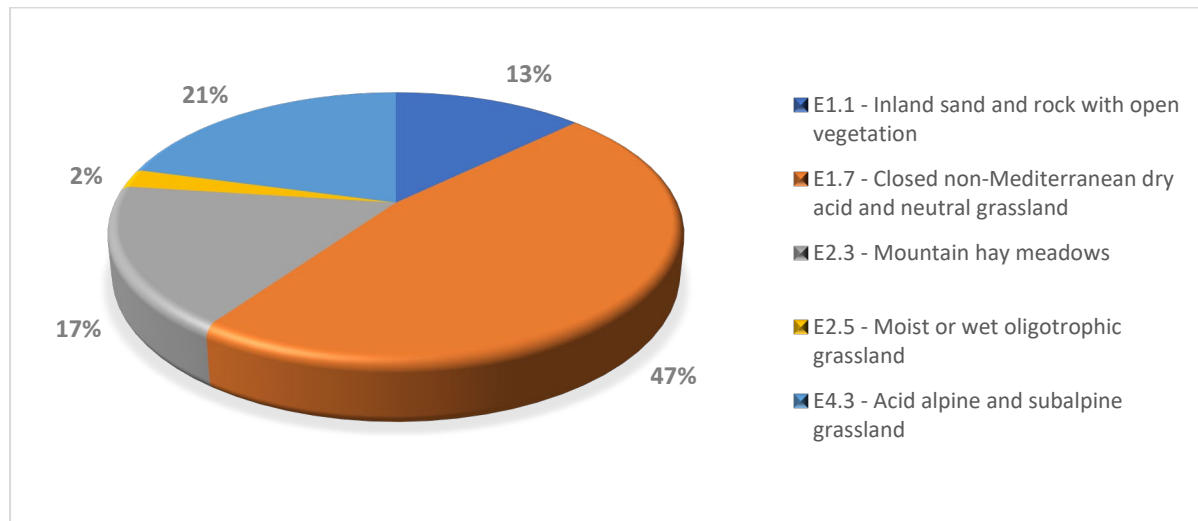
Fig. 11. Percentages of grassland habitat types in Javakheti PA.
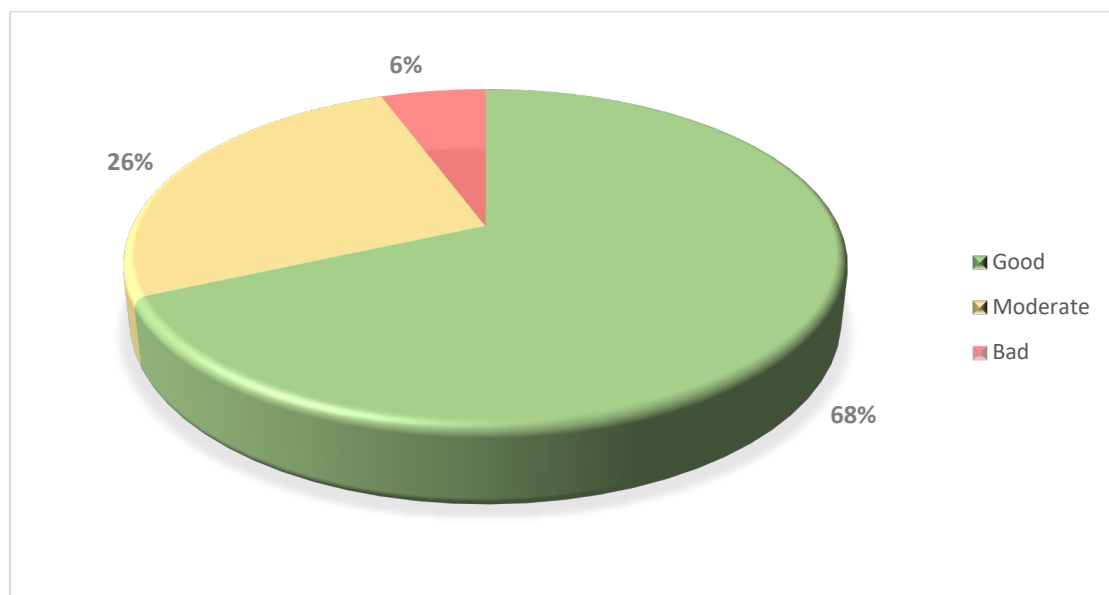
Fig. 12. Overall ecological conditions of grasslands in Javakheti PA (all grassland habitats)

Mountain hay meadows (E2.3) and *Acid alpine and subalpine grassland* (E4.3) are included in the *Resolution No. 4.* In Javakheti, mountain hay meadows are used both for grazing and hay collection – according to local herdsmen, they are first mown and later used for cattle grazing. Overall, the condition of this grassland habitat is moderate to good (Figure 13). However, a small fragment near lake Kartsakhi is in bad condition (see map in Appendix 6) and it should be closely monitored. In

general, Javakheti PAs represent a significant asset for the conservation of mountain hay meadows as a protected area as well as an Emerald site.

Acid alpine and subalpine grasslands (E4.3) have the highest plant species richness of all grasslands in Javakheti PA. The condition of these habitat is partly "moderate" and mostly "good" (Figure 13). However, close monitoring should continue to ensure that any deterioration of this habitat and its plant diversity is timely detected. *Inland sand and rock with open vegetation* (E1.1) has the largest proportion of area assessed as "red". As shown on the map (Appendix 6) it is situated in the eastern part of Javakheti NP. However, this area represents a steep-sloped gorge with strong visible erosion and the poor condition is due to the natural factors rather than livestock grazing.
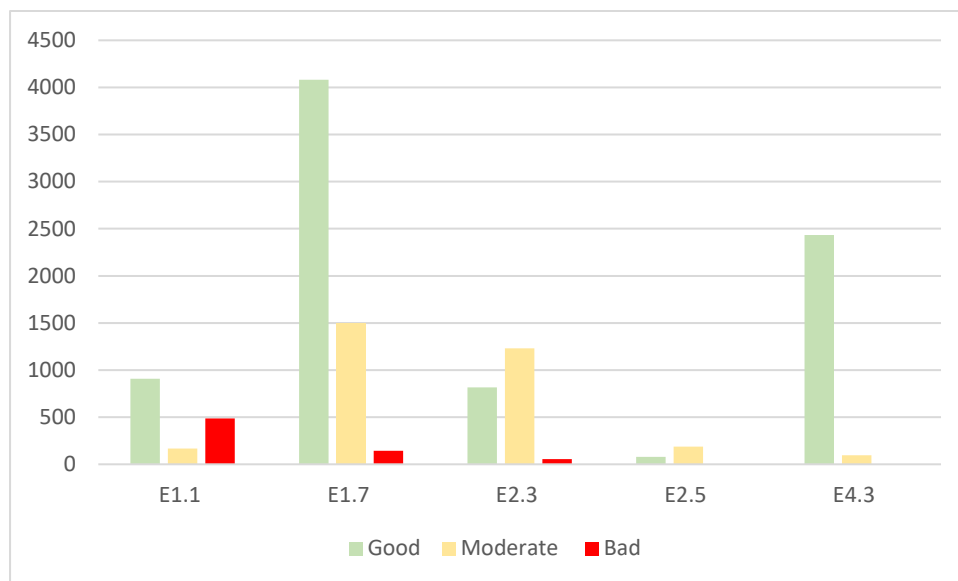
Fig. 13. Ecological condition of grassland habitats, Javakheti PA

5   Next steps and recommendations for improved management

The next round of grassland surveys on the above PAs should be carried out in 5 years. The indicative factor for the change in the state of grasslands that are used as pastures can be interpreted in multiple ways: the deterioration or improvement of the natural condition of habitats is indicated by the change in PDI and SPI indexes along with the decrease or increase in the above-ground biomass production. The number of species on the quadrats is an additional factor to be considered in terms of the natural state of the habitat.

With biodiversity conservation being the ultimate goal, all directly or indirectly related activities and management measures should facilitate the maintenance of natural or near-natural condition and the carbon-storage capacities of the grasslands used as pastures inside the protected areas and they should help increase as much as possible the ability of these natural ecosystems adapt to modern challenges such as climate change.

In the subsequent monitoring process, a special focus should be on the priority habitats of national importance according to **National Biodiversity Strategy and Action Plan of Georgia (NBSAP)** and other national documents as well as on those habitats that are under the international obligation of Georgia as a party to the Bern Convention and a signatory of the EU-Georgia Association Agreement (i.e. habitats protected by **the Resolution No. 4 of the Standing Committee to the Bern Convention** as well as by the **EU Birds and Habitats Directives**).

More specific recommendations are presented below for each protected area.

5.1   Algeti National Park

Algeti NP has a complex spatial set-up. As a result of recent reorganisation and expunction it includes grassland areas that were traditionally utilised by neighbouring villages. Most of them are located deep inside the park. Some of them are under private ownership or long-term lease and are excluded from the PA. Such somewhat fragmented spatial structure creates serious management challenges. Some pastures that are within the PA directly border private graze lands and the boundaries are often not easily identifiable.

The current study also highlighted the issue of afforestation processes that are evident on many grassland areas and meadows – the open areas are being invaded by woody plants apparently due to reduced grazing pressure.

Therefore, the long-term conservation and even maintenance of the natural grasslands and meadows in Algeti NP requires careful management planning and targeted actions such as:

- ✓ Assessment of possibilities of spatial reorganisation (including expansion) so that the national park includes some of the adjacent grasslands to increase the overall effectiveness of the protected area (as a territory representing a diverse wildlife habitat including for prospective red deer restoration) as well as to facilitate effective pasture management.
- ✓ Preparation of a comprehensive pasture management plan.
- ✓ Explore possibilities of partnerships with private owners and/or relevant state authorities for shared management or coordinated activities on the adjacent pastures.
- ✓ The monitoring and specific management measures, as necessary, for two priority habitats *Acid alpine and subalpine grasslands* (E4.3) and *Permanent mesotrophic pastures and aftermath-grazed meadows* (E2.1) should be integrated into the existing PA management plan.

5.2   Vashlovani National Park and Samukhi lowlands

Vashlovani NP is one of the advanced PAs in Georgia in respect of grassland habitat study and mapping as well as pasture management planning. Vashlovani NP pasture management plan was elaborated in 2016 and the process involved comprehensive socio-economic and ecological surveys, pasture mapping, listing of current pasture users and identifying livestock numbers; so-called pasture

passports – an individual file detailing pasture description, acceptable livestock numbers as well as grazing calendar and including a detailed map of pasture was created for each pasture. The Pasture Management Plan includes pasture monitoring activities. While this plan may need updating, it is important to continue its implementation as an integral part of the overall PA management plan.

In 2020, the European Diploma for Protected Areas to Vashlovani National Park was renewed[8] and the decision was attached with several specific recommendations of which the following two are particularly relevant to pasture management and grassland habitat monitoring and conservation:

– "continue to fully implement the pasture management plan as part of the general management plan; carefully monitor the pasture activities and the respect of lease contracts by farmers; secure the corresponding budgets from state and other sources;"
– "collect all the available scientific data and integrate them into the database under construction. Present a systematic list of habitats with a short description and respective coverage in the Vashlovani Protected Areas; establish a comprehensive list of endemic, rare and threatened species, with differentiation between the Caucasus, Georgian and local species;"

In addition, the monitoring and specific management measures, as necessary, for three priority habitats – *Mediterranean feathergrass steppes* (E1.432), *Continental inland salt steppes* (E6.2) and *Ponto-Sarmatic steppe brush* (F3.2471) – should be integrated into the existing PA management plan.

The entire of Samukhi lowlands are traditionally utilized as winter pastures for sheep mainly from Tusheti. It is also the reintroduction site for goitered gazelles (*Gazella subgutturosa*) that became extinct in Georgia decades ago and are now being restored as a result of the first successful reintroduction programme. Samukhi is adjacent to the national park and is an important and integral part of the wider Vashlovani landscape and its management must be carried out in full coordination with the national park, elements of which are already in place in the form of gazelle protection and monitoring. However, it is very important that Samukhi also receives legal protection both at the national level and as a proposed Emerald site, the processes of which have already been initiated. In the meantime, works should begin for the development of Samukhi pasture management plan (which can later become a major strategic document for the site as it obtains official designation as a PA) that would cover specific issues of not only sustainable pasture use and monitoring but also of sheep farming practices such as sheep dogs, etc., in order to support safeguarding the future of the gazelles in Samukhi.

5.3 Ktsia-Tabatskuri Managed Reserve

The territory of Ktsia-Tabatskuri MR has been used as pasturelands for a long period of time. During the Soviet times drainage canals were built, which combined with apparently heavy grazing and mowing, has now resulted in severe modification of local habitats.

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[8] Resolution CM/ResDip(2020)8 on the renewal of the European Diploma for Protected Areas awarded to the Vashlovani Protected Areas (Georgia).
https://search.coe.int/cm/Pages/result_details.aspx?ObjectId=09000016809fa907

A comprehensive pasture management plan needs to be developed for the Ktsia section of the managed reserve that would take full account of socio-economic aspects and sustainable pasture use as well as conservation interests of migratory and nesting birds.
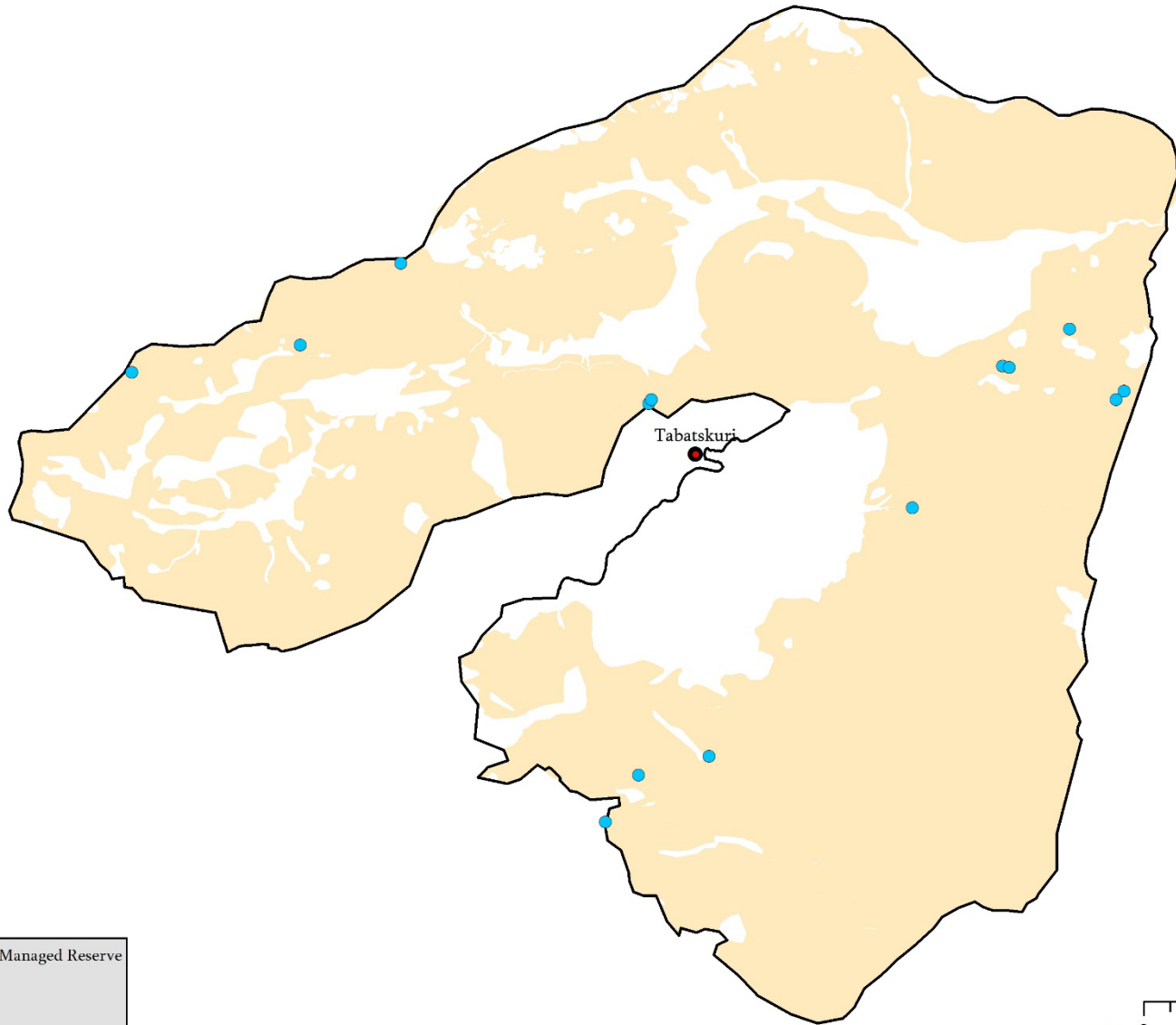
Further monitoring should focus on the following priority habitats:

E3.52 Heath *Juncus* meadows and humid *Nardus stricta* swards
E4.3 Acid alpine and subalpine grassland
F2.214 Pontic dwarf *Vaccinium* heaths
F2.22 Alpide acidocline *Rhododendron* heaths

It is also highly desirable to conduct a botanical study to establish the level of habitat modification and deviation from its natural state, based on which it will be possible to define conservation and management objectives. Ideally, modified/improved grasslands should be mapped and then cost-benefit analysis should be conducted to elaborate suitable management and grasslands and wetland restoration options, considering conservation and carbon accumulation as well as other ecosystem services.

5.4   Javakheti Protected Areas

The updating of the Javakheti PA Management plan is currently underway. Grazing is recognised as one of the most important human factors affecting biodiversity. Previous studies set the fixed pasture carrying capacity as 3 sheep per ha. This was a practical option in early stages of pasture management. However, it would be good to reassess pastures and create individual files (so called pasture passports) for each pasture with individual grazing calendar and grazing pressure recommendations. This should be done by the time the current pasture lease contracts expire i.e. before their renewal, so that any necessary changes can be introduced in contract terms and conditions.

Further monitoring should focus on the following priority habitats:

E2.3 Mountain hay meadows
E4.3 Acid alpine and subalpine grassland
E1.1 Inland sand and rock with open vegetation

Similar to Ktsia, Javakheti grasslands have are largely severely modified. Therefore, it would be very useful to conduct a botanical study to establish the level of habitat modification and deviation from its natural state, based on which it will be possible to define conservation and management objectives.

Sulda Managed Reserve

Kartsakhi Managed Reserve

Khanchali lake

Khanchali Managed Reserve

Javakheti National Park

Kartsakhi Lake

Protected Areas

Pasture

Field Data

0   2.5   5   10 Km

N

NACRES

Bugdasheni Managed Reserve

Madatapa Managed Reserve

Madatapa Lake

Legend

Protected Areas

Pasture

Field Data

0   1.25   2.5   5 Km

NACRES

NACRES

Paravani Lake

Faravani Lake Managed Reserve

Abuli Lake Managed Reserve

Saghamo Lake

Sagamo Lake Managed Reserve

Protected Areas

Pasture

0   2.5   5   10 Km
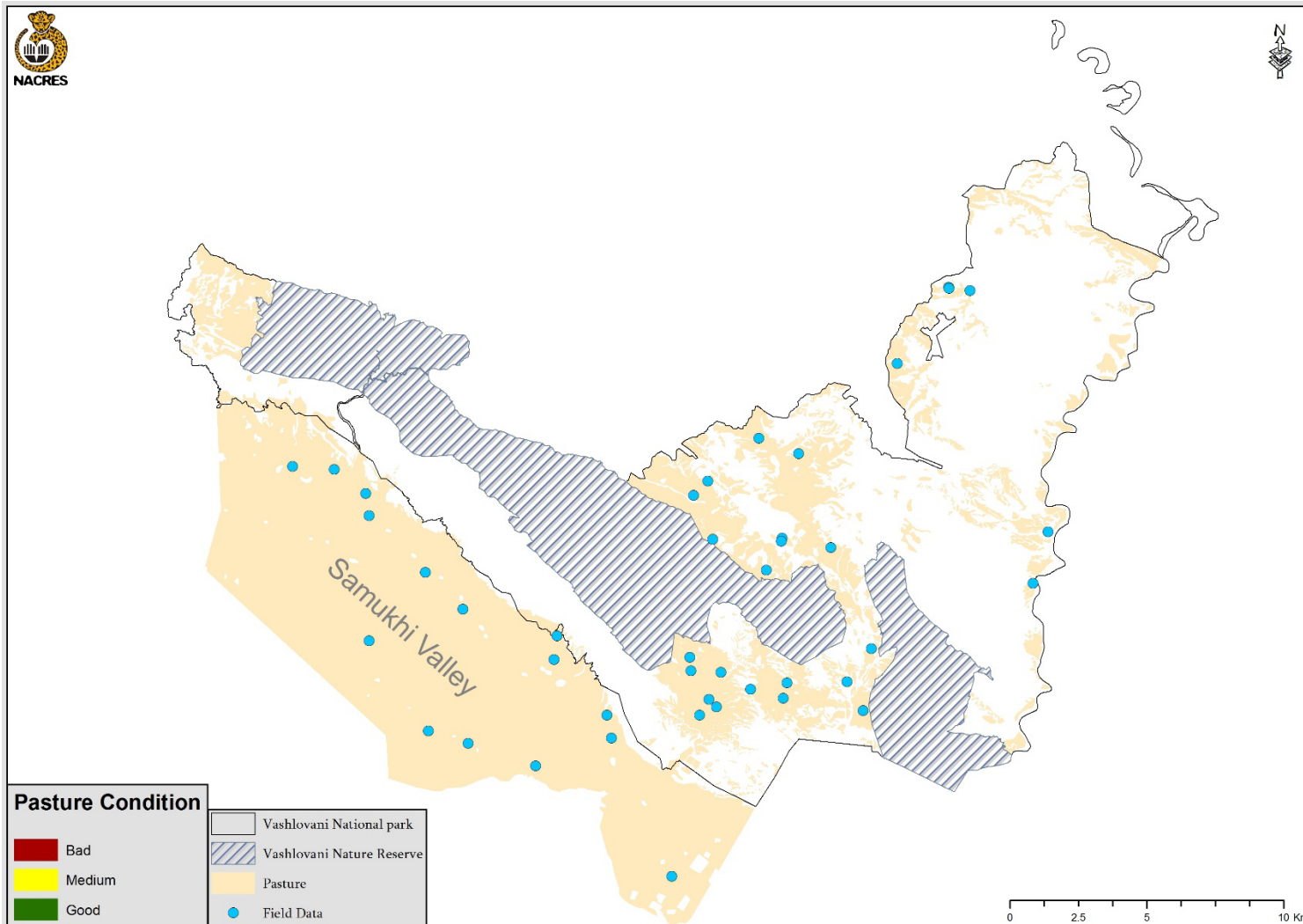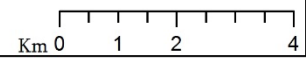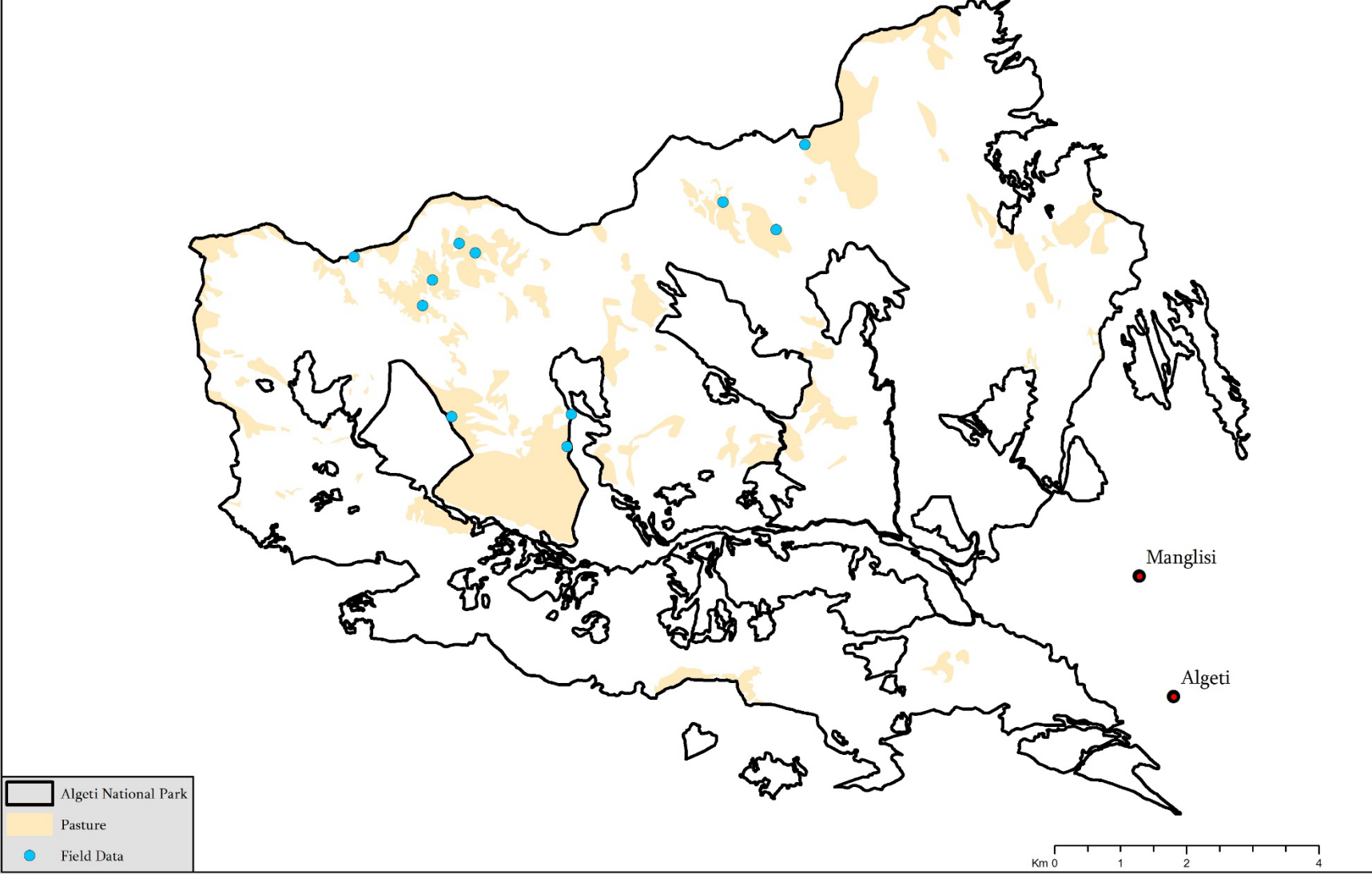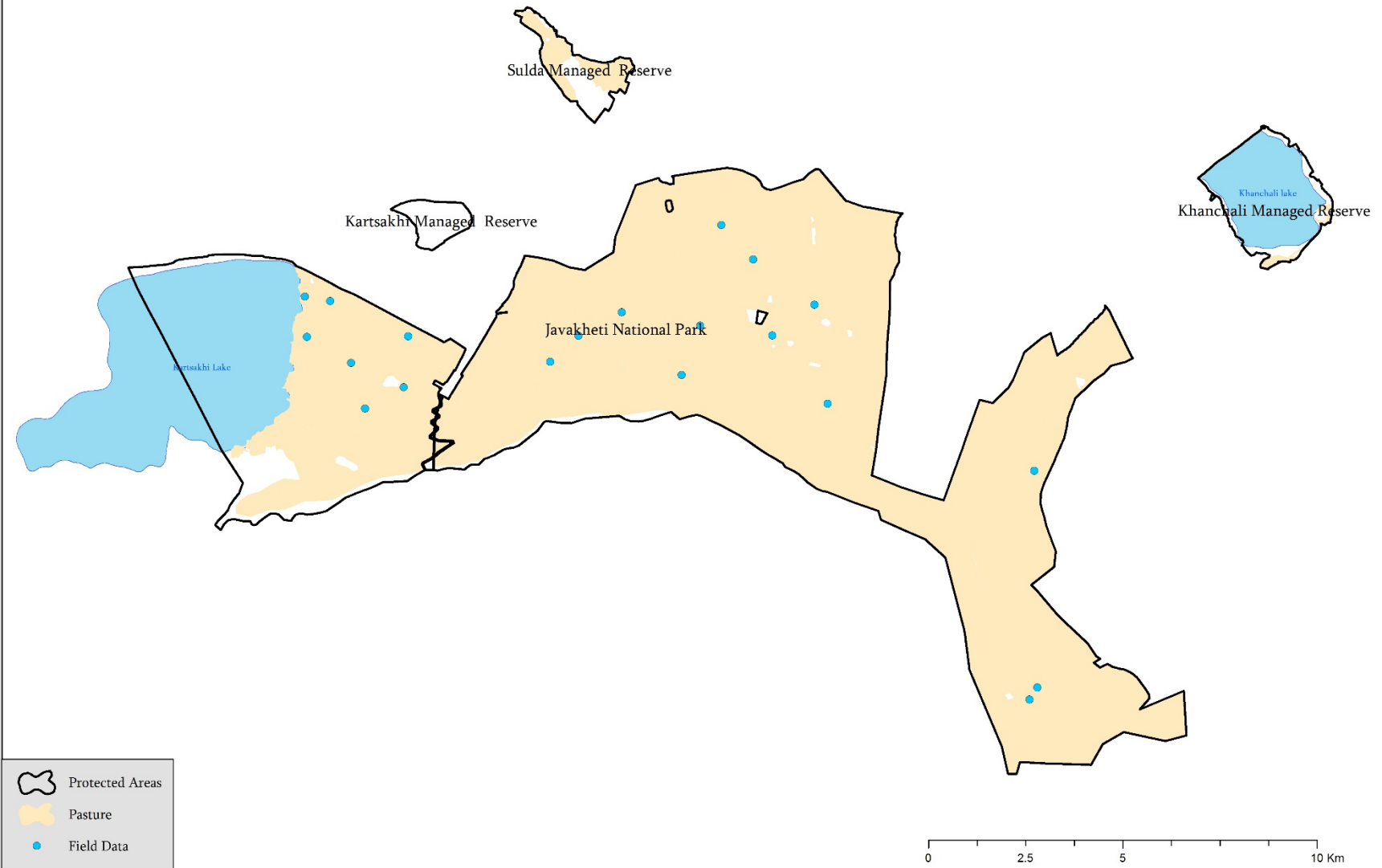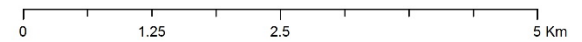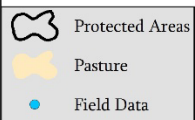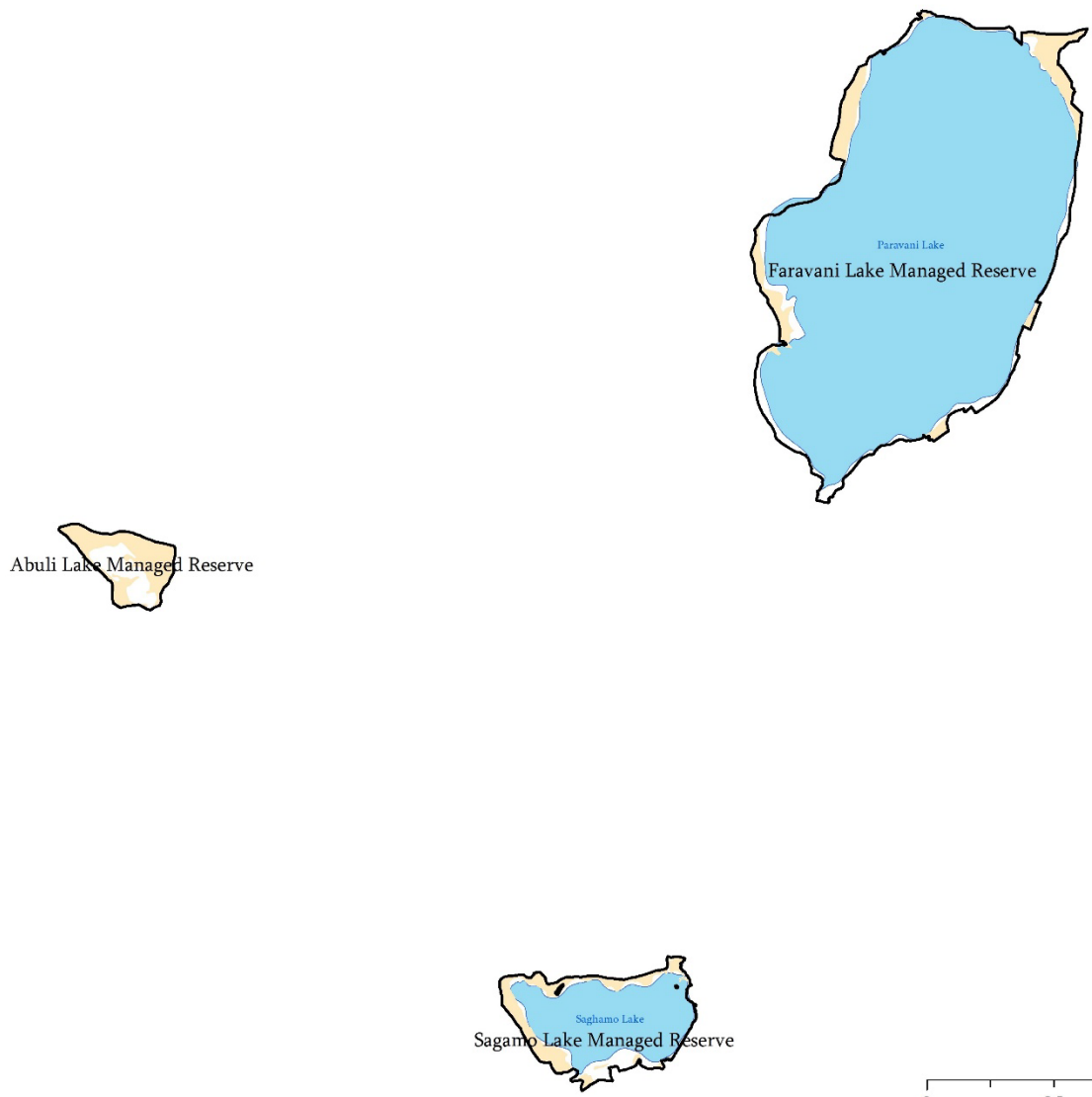
Appendix 2. Sample data sheet from the 2021 pasture survey data base

Assistant	Place	Plot_ID	Date	X	Y	Alt	Inclination	Exposition
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	1	08.09.2021	398115	4561544	2120	3	100
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	2	08.09.2021	396511	4561809	2181	15	125
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	3	08.09.2021	396366	4559013	2121	3	84
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	4	09.09.2021	353859	4565504	1811	12	242
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	5	09.09.2021	353908	4564472	1837	8	250
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	6	09.09.2021	354506	4565387	1873	2	104
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	7	09.09.2021	355045	4563803	1904	3	27
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	8	09.09.2021	355399	4562633	1937	9	327
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	9	09.09.2021	356390	4563180	1957	1	11
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	10	09.09.2021	356509	4564487	1885	3	82
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	11	10.09.2021	360159	4563833	2412	6	310
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	12	10.09.2021	360888	4564502	2312	10	343
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	13	10.09.2021	361996	4565102	2399	7	292
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	14	10.09.2021	363536	4563492	2606	3	330
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	15	10.09.2021	364013	4564760	2464	10	31
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	16	10.09.2021	365862	4564504	2448	5	305
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	17	10.09.2021	367288	4562749	2702	0	0
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	18	10.09.2021	366952	4565298	2428	7	330
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	19	10.09.2021	365372	4566463	2253	5	352
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	20	10.09.2021	364557	4567347	2176	4	335
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	21	11.09.2021	372475	4555151	2782	5	330
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	22	11.09.2021	372676	4555457	2776	7	95
Temur Popiashvili, Sandro Kolbaia, Sophie Gogibedashvili	Javakheti	23	11.09.2021	372594	4561031	2834	4	349
Temur Popiashvili, Sandro Kolbaia	Tabatskuri	1	08.07.2021	379580	4617072	2771	15	2

Topography	Slope Configuration	Moisture	Bedrock	Bare_Soil	Small_Stones	Large_Stones	Livestock_Track	Erosion
Middle Slope	Straight	Dry	Other (Medium)	6-10%	Invisible	1%	Invisible	Invisible
Upper Slope	Convex	Dry	Other (Medium)	11-25%	1%	2-5%	6-10%	6-10%
Middle Slope	Convex/Straight	Dry	Other (Medium)	11-25%	Invisible	Invisible	1%	1%
Middle Slope	Straight	Dry	Other (Medium)	More than 50%	2-5%	1%	6-10%	More than 50%
Middle Slope	Straight	Dry	Other (Medium)	26-50%	2-5%	Invisible	2-5%	2-5%
Plain	Straight	Dry	Other (Medium)	26-50%	11-25%	1%	1%	2-5%
Plain	Straight	Dry	Other (Medium)	2-5%	1%	Invisible	Invisible	Invisible
Lower Slope	Straight	Dry	Other (Medium)	2-5%	1%	1%	Invisible	Invisible
Plain	Straight	Dry	Other (Medium)	2-5%	Invisible	Invisible	Invisible	Invisible
Plain	Straight	Dry	Other (Medium)	2-5%	2-5%	Invisible	Invisible	6-10%
Lower Slope	Concave/Straight	Dry	Other (Medium)	Invisible	Invisible	Invisible	Invisible	Invisible
Middle Slope	Concave/Straight	Dry	Other (Medium)	2-5%	1%	1%	Invisible	6-10%
Middle Slope	Straight	Dry	Other (Medium)	6-10%	Invisible	1%	Invisible	Invisible
Upper Slope	Straight	Dry	Other (Medium)	1%	Invisible	Invisible	Invisible	Invisible
Lower Slope	Concave/Straight	Dry	Other (Medium)	1%	1%	1%	2-5%	6-10%
Range Top	Convex/Straight	Dry	Other (Medium)	1%	Invisible	6-10%	Invisible	Invisible
Range Top	Straight	Dry	Other (Medium)	1%	Invisible	Invisible	Invisible	Invisible
Middle Slope	Straight	Dry	Other (Medium)	6-10%	Invisible	Invisible	Invisible	Invisible
Middle Slope	Straight	Dry	Other (Medium)	1%	Invisible	Invisible	11-25%	11-25%
Middle Slope	Concave/Straight	Dry	Other (Medium)	11-25%	1%	Invisible	Invisible	Invisible
Valley Bottom	Straight	Dry	Other (Medium)	2-5%	1%	Invisible	Invisible	2-5%
Middle Slope	Straight	Dry	Other (Medium)	2-5%	1%	Invisible	Invisible	Invisible
Range Top	Straight	Dry	Other (Medium)	2-5%	Invisible	Invisible	Invisible	Invisible
Upper Slope	Convex	Moist	Other (Hard)	2-5%	2-5%	Invisible	Invisible	Invisible

Veg_Type_A	Veg_Type_B	Max_Height	Aver_Height	Biomass	Water_Access	Grazing	Thistles	Thorn	Juniper	Other
Tussock		35	2	Few	Medium	51-80% Grazed	2-5%	Invisible	6-10%	2-5%
Medow-like		35	2	Few	Badly	21-50% Grazed	1%	Invisible	2-5%	6-10%
Tussock	Medow-like	60	4	Few	Medium	21-50% Grazed	1%	Invisible	6-10%	11-25%
Tussock		40	2	Few	Badly	21-50% Grazed	Invisible	Invisible	1%	1%
Tussock		55	3	Few	Badly	51-80% Grazed	Invisible	Invisible	2-5%	1%
Tussock		25	2	Few	Badly	21-50% Grazed	Invisible	Invisible	1%	1%
Tussock	Medow-like	35	25	Medium	Medium	1-5% Grazed	1%	Invisible	2-5%	2-5%
Medow-like		70	8	Medium	Medium	Invisible	1%	Invisible	1%	6-10%
Tussock		55	2	Few	Medium	51-80% Grazed	1%	Invisible	1%	1%
Tussock		45	2	Few	Medium	6-20% Grazed	1%	Invisible	1%	2-5%
Tussock		75	40	A lot	Medium	6-20% Grazed	1%	Invisible	1%	6-10%
Tussock		45	2	Few	Medium	More than 80% Grazed	2-5%	Invisible	6-10%	6-10%
Tussock		80	3	Few	Medium	51-80% Grazed	1%	Invisible	1%	2-5%
Tussock		85	10	A lot	Well	1-5% Grazed	Invisible	Invisible	1%	2-5%
Tussock		80	30	Medium	Well	6-20% Grazed	Invisible	Invisible	2-5%	6-10%
Tussock	Medow-like	55	2	Few	Badly	More than 80% Grazed	1%	Invisible	1%	26-50%
Medow-like	Tussock	45	2	Few	Badly	More than 80% Grazed	Invisible	Invisible	2-5%	More than 50%
Tussock	Medow-like	65	2	Few	Medium	More than 80% Grazed	1%	Invisible	2-5%	11-25%
Tussock	Medow-like	50	3	Few	Medium	21-50% Grazed	1%	Invisible	2-5%	11-25%
Tussock		50	2	Few	Medium	51-80% Grazed	1%	Invisible	2-5%	2-5%
Tussock	Medow-like	30	2	Few	Well	51-80% Grazed	Invisible	Invisible	6-10%	11-25%
Tussock	Medow-like	45	15	Medium	Medium	1-5% Grazed	Invisible	Invisible	2-5%	6-10%
Tussock		30	2	Few	Medium	6-20% Grazed	Invisible	Invisible	2-5%	11-25%
Tussock		20	6	Medium	Medium	21-50% Grazed	Invisible	Invisible	1%	11-25%

Poisonous	Indicator	Flowering	Species	State	Remark	Veg_Cover (%)	Pic	SEI	PDI	SEI-Traffic	PDI-Traffic	SPI
Invisible	6-10%	Few	14	Bad		90	IMG_20140102_16.jpg"	75,0	63,1	5	2,5	7,5
Invisible	6-10%	Few	20	Bad		75	IMG_20210908.jpg"	57,8	52,5	2,5	2,5	5
Invisible	11-25%	Few	25	Medium		75	IMG_20210908_1.jpg"	74,4	63,8	5	2,5	7,5
Invisible	2-5%	Few	12	Bad		45	IMG_20210909.jpg"	61,1	41,9	2,5	2,5	5
Invisible	2-5%	Few	19	Bad		55	IMG_20210909_1.jpg"	71,1	53,8	5	2,5	7,5
Invisible	1%	Few	17	Bad		50	IMG_20210909_2.jpg"	70,0	54,4	5	2,5	7,5
Invisible	2-5%	Few	20	Medium		95	IMG_20210909_3.jpg"	73,9	77,5	5	5	10
Invisible	6-10%	Few	20	Bad		98	IMG_20210909_4.jpg"	78,3	74,4	5	5	10
Invisible	2-5%	Few	18	Bad		95	IMG_20210909_5.jpg"	74,4	68,8	5	5	10
Invisible	2-5%	Few	16	Bad		90	IMG_20210909_6.jpg"	70,6	68,8	5	5	10
Invisible	6-10%	Few	9	Good		98	IMG_20210910.jpg"	76,7	73,8	5	5	10
Invisible	6-10%	Few	13	Bad		95	IMG_20210910_1.jpg"	75,6	56,9	5	2,5	7,5
Invisible	2-5%	Few	10	Medium		90	IMG_20210910_2.jpg"	71,1	63,1	5	2,5	7,5
Invisible	2-5%	Few	10	Good		99	MG_20210910_3.jpg"	68,3	77,5	5	5	10
Invisible	6-10%	Few	9	Good		97	IMG_20210910_4.jpg"	80,0	63,1	5	2,5	7,5
Invisible	26-50%	Few	12	Bad		90	IMG_20210910_5.jpg"	65,0	57,5	2,5	2,5	5
Invisible	More than 50%	Few	11	Bad		99	IMG_20210910_6.jpg"	67,8	55,0	5	2,5	7,5
Invisible	11-25%	Few	13	Bad		90	IMG_20210910_7.jpg"	73,3	58,8	5	2,5	7,5
Invisible	11-25%	Few	13	Bad		97	IMG_20210910_8.jpg"	75,6	53,8	5	2,5	7,5
Invisible	2-5%	Few	14	Bad		85	IMG_20210910_9.jpg"	78,9	62,5	5	2,5	7,5
Invisible	11-25%	Few	11	Medium		95	IMG_20210911.jpg"	73,9	57,5	5	2,5	7,5
Invisible	6-10%	Few	10	Medium		95	IMG_20210911_1.jpg"	66,7	72,5	5	5	10
Invisible	11-25%	Few	11	Bad		95	IMG_20210911_2.jpg"	63,9	68,8	2,5	5	7,5
Invisible	11-25%	Few	19	Medium	Manure cover 1%	95	IMG_20210708.jpg"	65,6	65,0	2,5	2,5	5

Appendix 3: Distribution maps and ecological condition of grassland habitats in Algeti national park

Legend:
- Algeti National Park
- E1.7 Closed non-Mediterranean dry acid and neutral grassland
- E2.1 Permanent mesotrophic pastures and aftermath-grazed meadows
- E4.3 Acid alpine and subalpine grassland
- E7.2 Sub-continental parkland
- D2.2 Poor fens and soft-water spring mires

Manglisi

Algeti

NACRES

Km 0   1.25   2.5   5

Pasture Condition

- Bad
- Medium
- Good

Algeti National Park

Manglisi

Algeti

Km 0   1   2   4

34
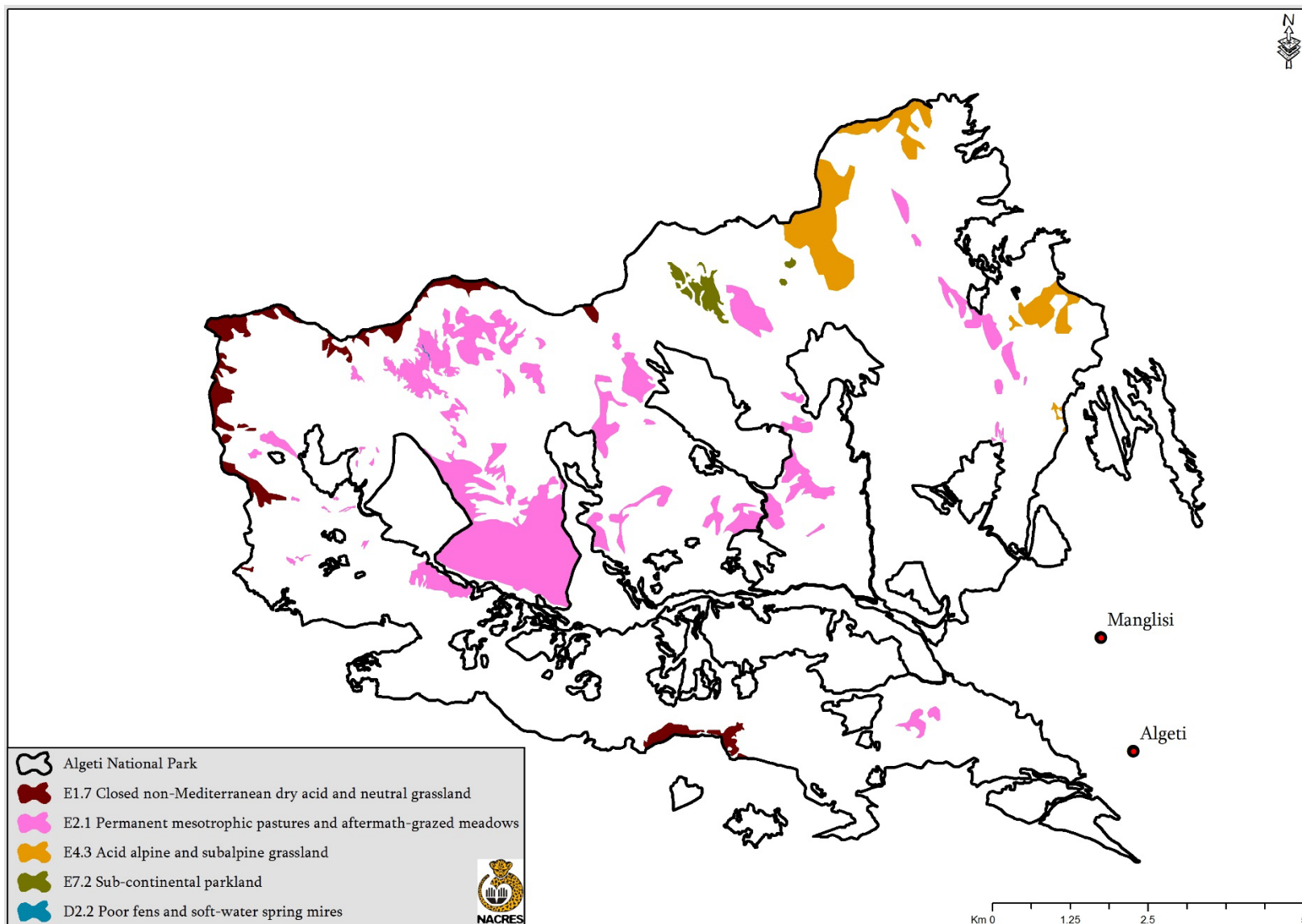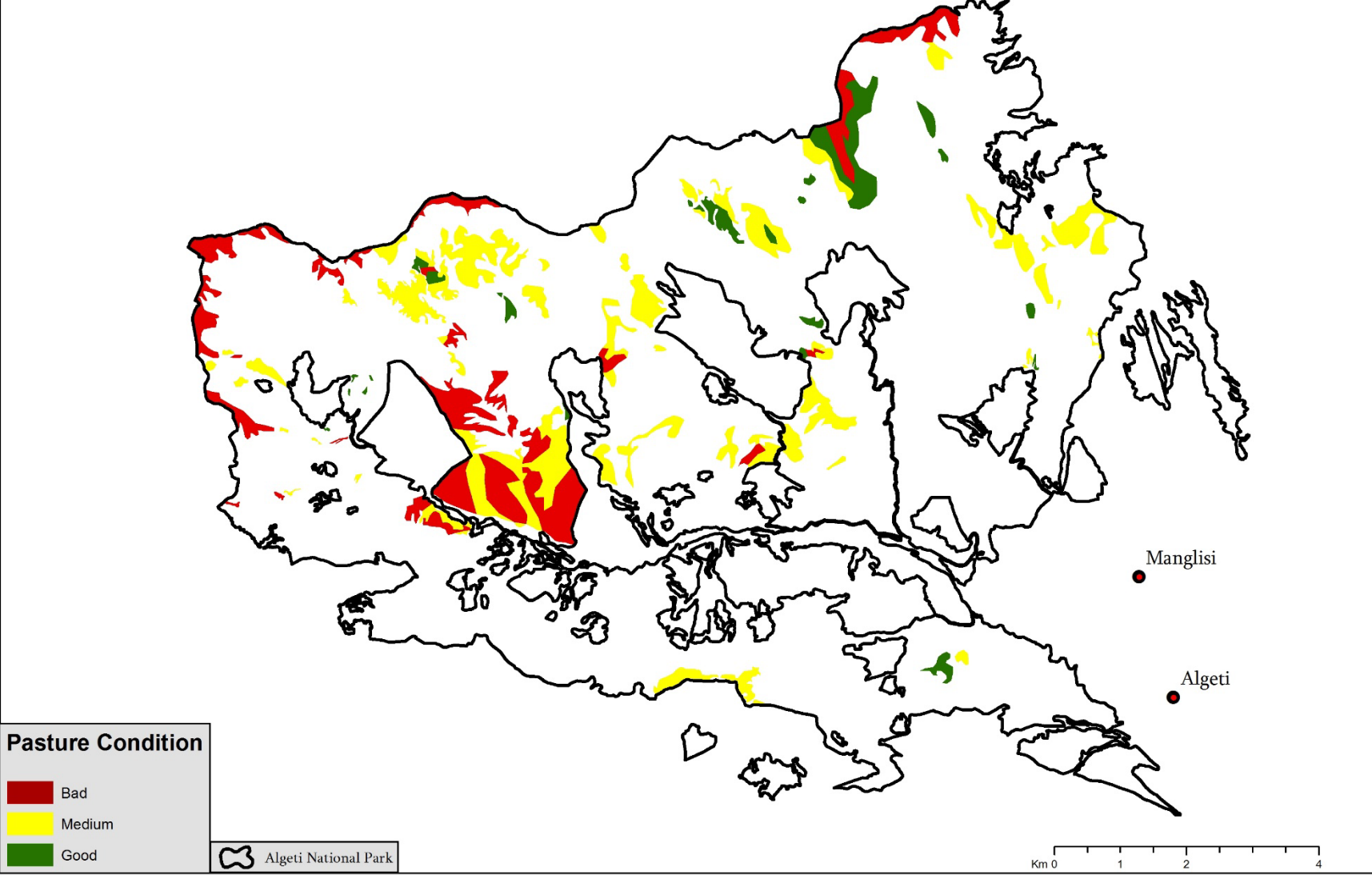
E1.7 Closed non-Mediterranean dry acid and neutral grassland

Pasture Condition
- Good
- Medium
- Bad

Algeti National Park

Manglisi

Algeti

Km 0   1.25   2.5   5

E2.1 Permanent mesotrophic pastures and aftermath grazzed meadows
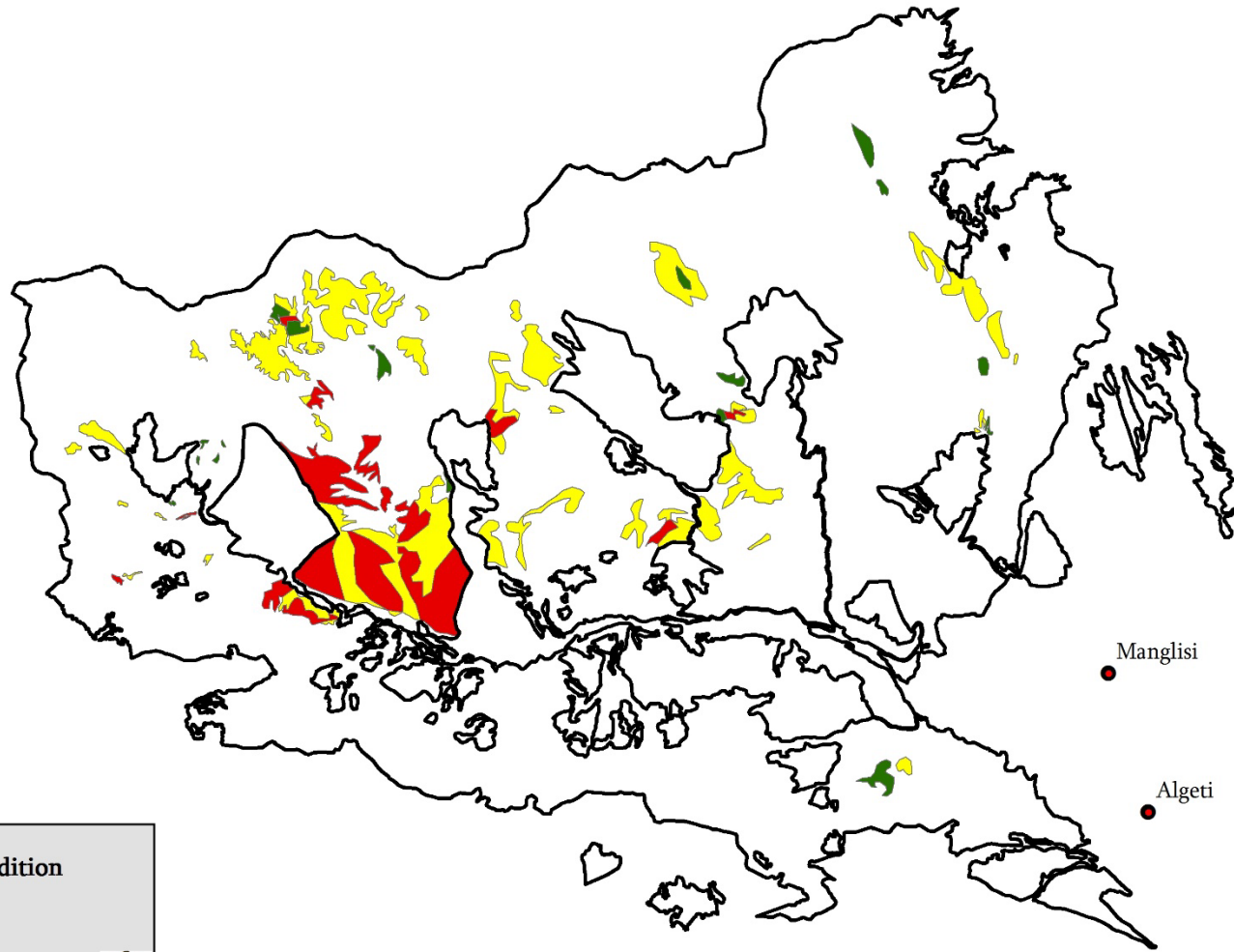
Pasture Condition
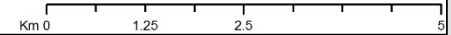
Good

Medium

Bad

NACRES

Algeti National Park

Manglisi

Algeti

Km 0   1.25   2.5   5

E4.3 Acid alpine and subalpine grassland

Manglisi

Algeti

Pasture Condition

Good

Medium

Bad

NACRES

Algeti National Park

Km 0   1.25   2.5   5
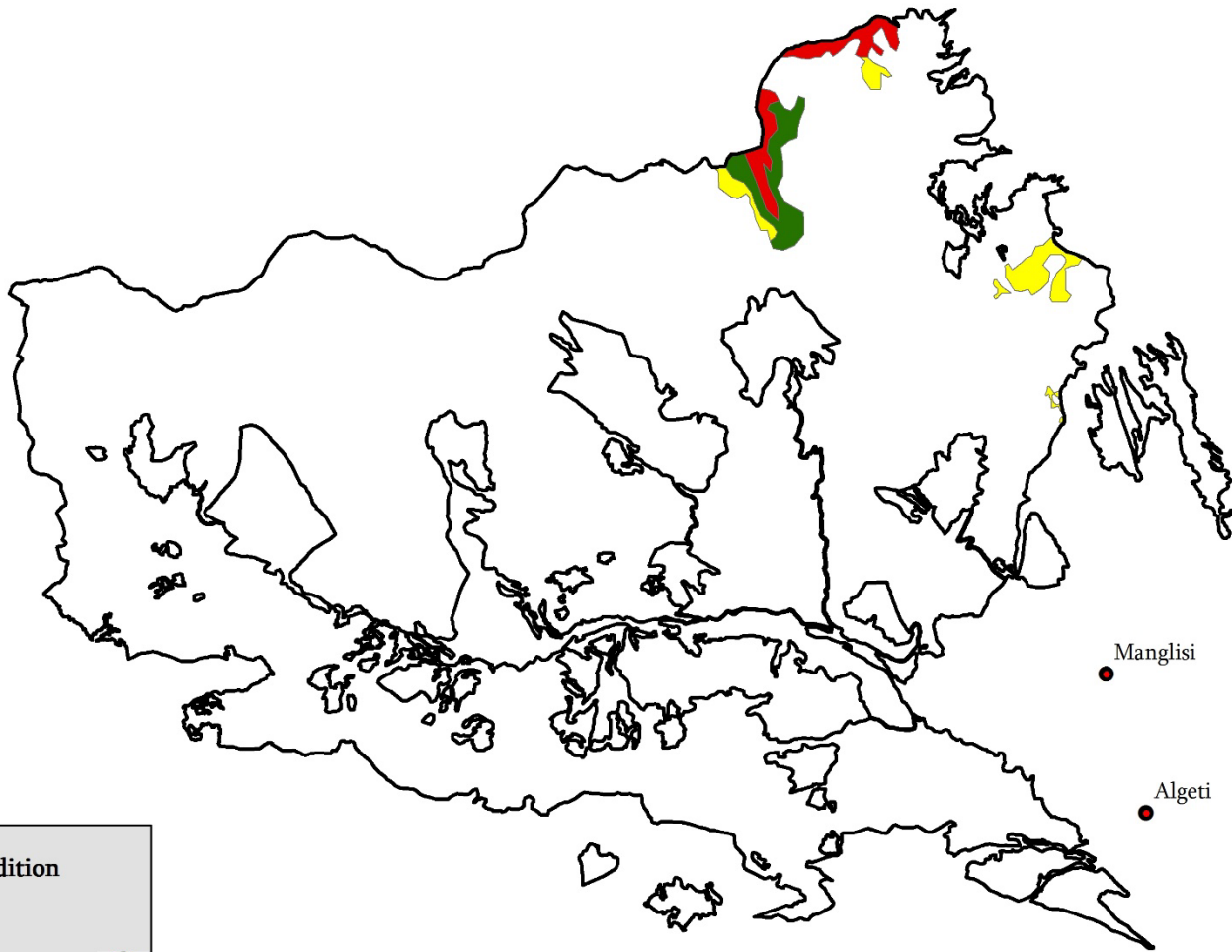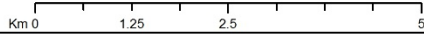
E7.2 Sub-continental Parkland

Pasture Condition

Good
Medium
Bad

Algeti National Park

Manglisi

Algeti

Km 0   1.25   2.5   5
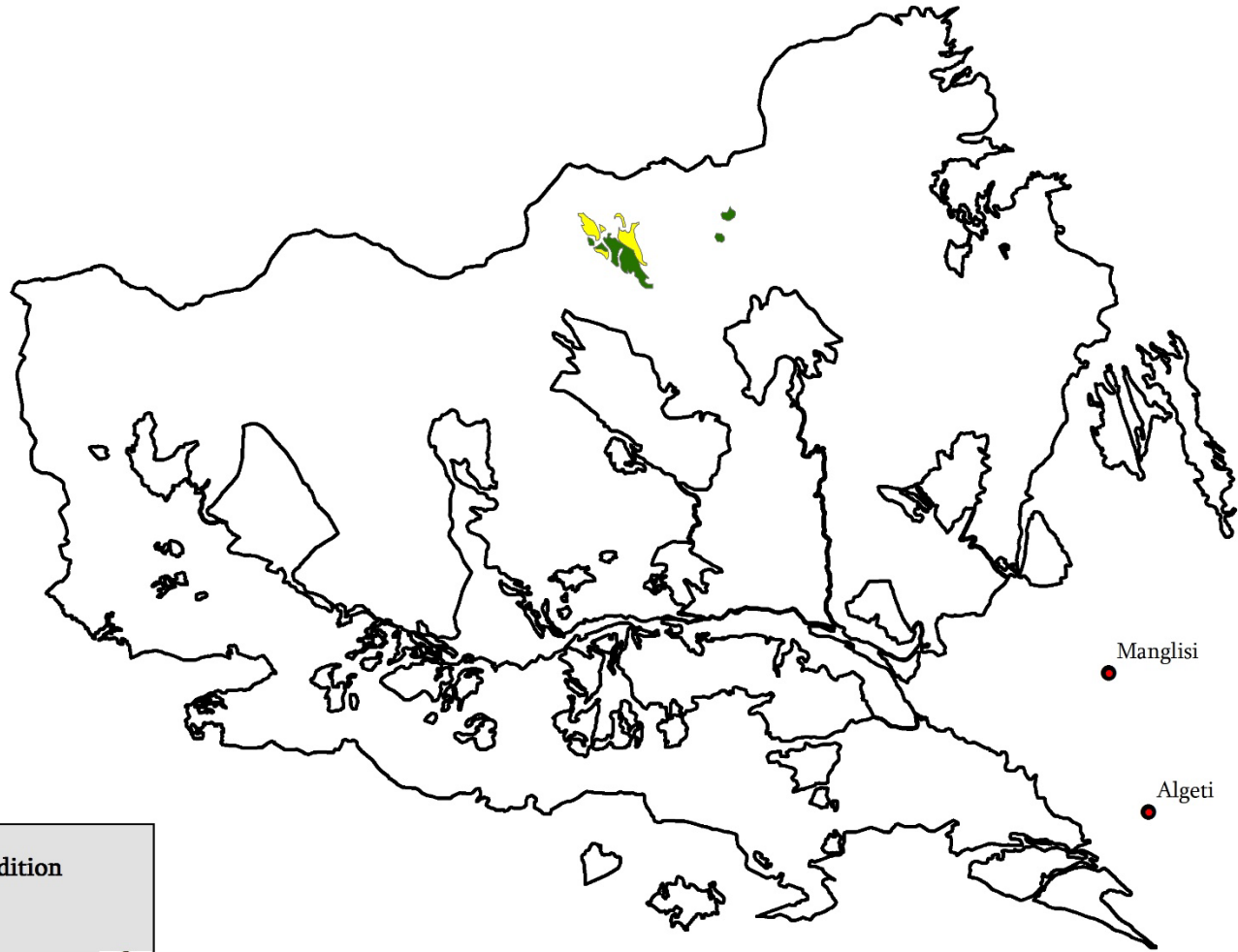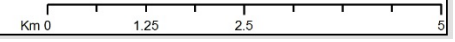
Appendix 4. Vashlovani NP and Samukhi plains

Legend
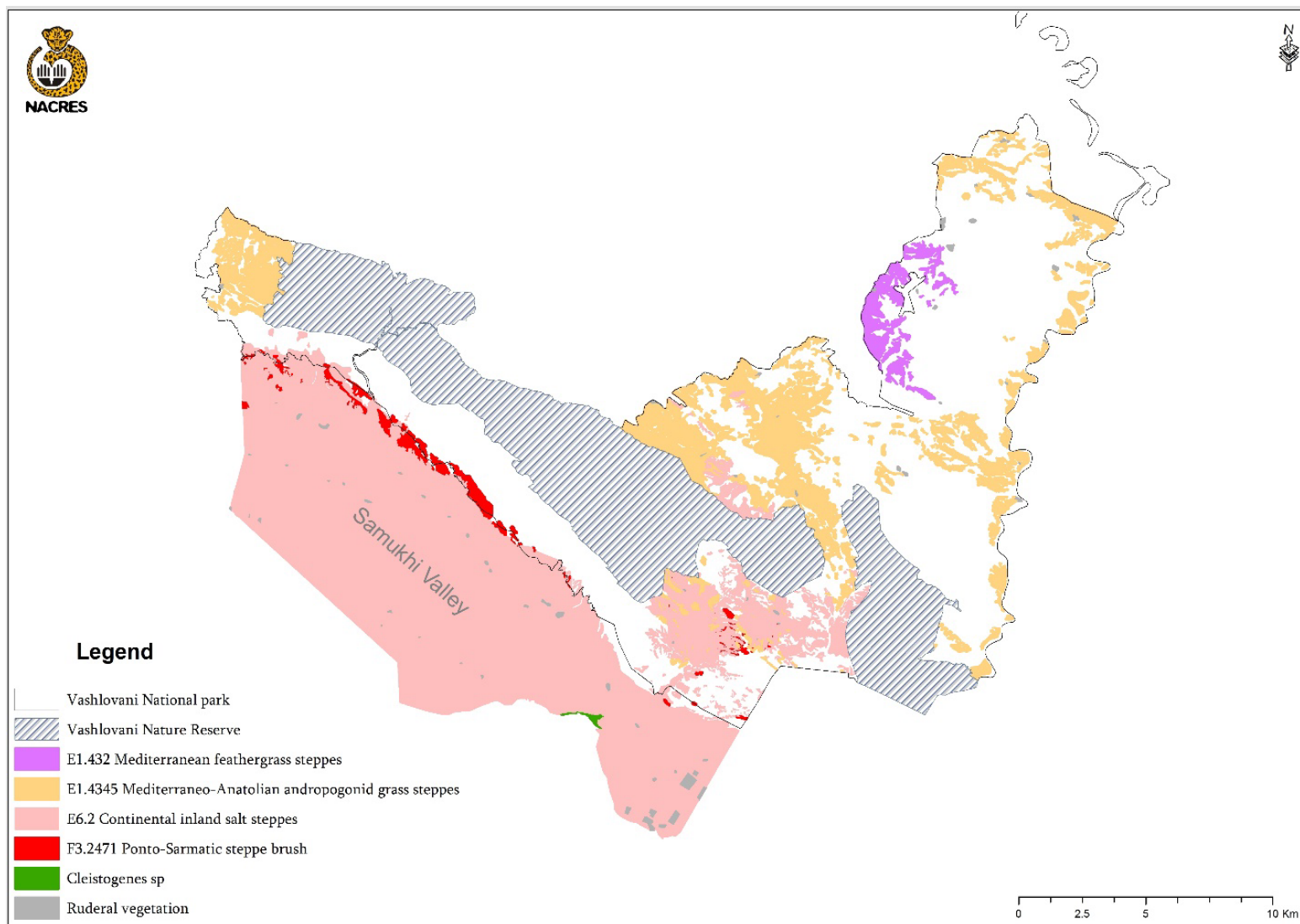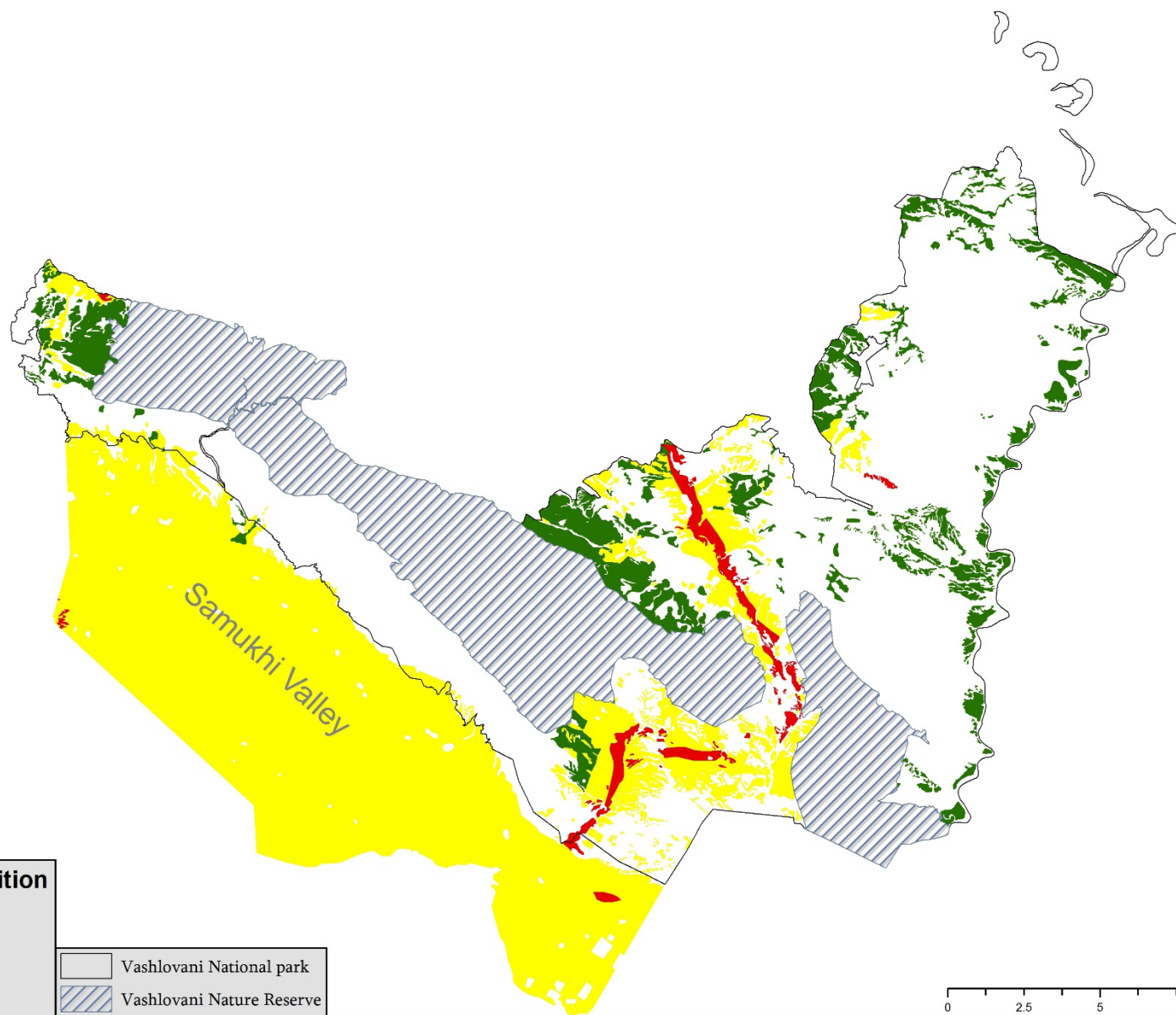
- Vashlovani National park
- Vashlovani Nature Reserve
- E1.432 Mediterranean feathergrass steppes
- E1.4345 Mediterraneo-Anatolian andropogonid grass steppes
- E6.2 Continental inland salt steppes
- F3.2471 Ponto-Sarmatic steppe brush
- Cleistogenes sp
- Ruderal vegetation
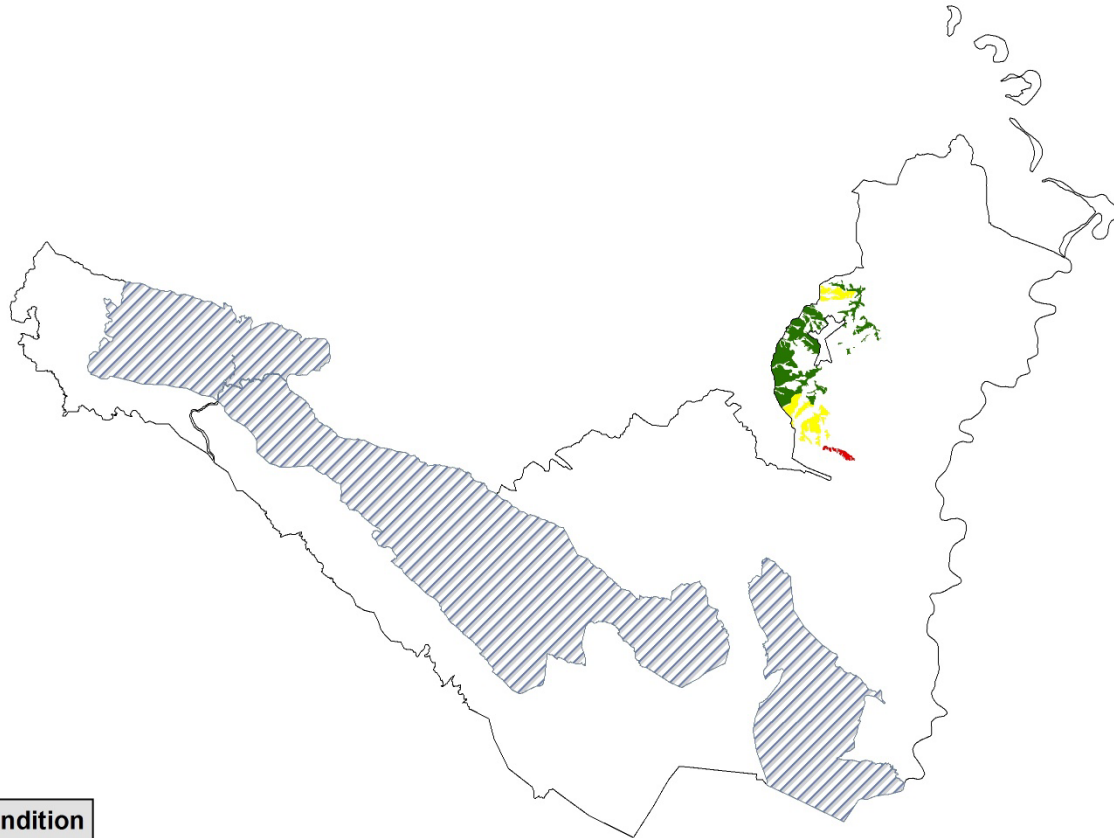
Samukhi Valley

NACRES

Pasture Condition

- Bad
- Medium
- Good

Vashlovani National park

Vashlovani Nature Reserve

Samukhi Valley

0 2.5 5 10 Km

E1.432 Mediterranean feathergrass steppes

Pasture Condition

- Bad
- Medium
- Good

Vashlovani National park

Vashlovani Nature Reserve

0   2.5   5   10 Km
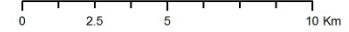
E1.4345 Mediterraneo-Anatolian andropogonid grass steppes

Pasture Condition

Bad
Medium
Good

Vashlovani National park
Vashlovani Nature Reserve

0   2.5   5   10 Km

E6.2 Continental inland salt steppes

Samukhi Valley

Pasture Condition

�	Bad
�yellow	Medium
▬green	Good

NACRES
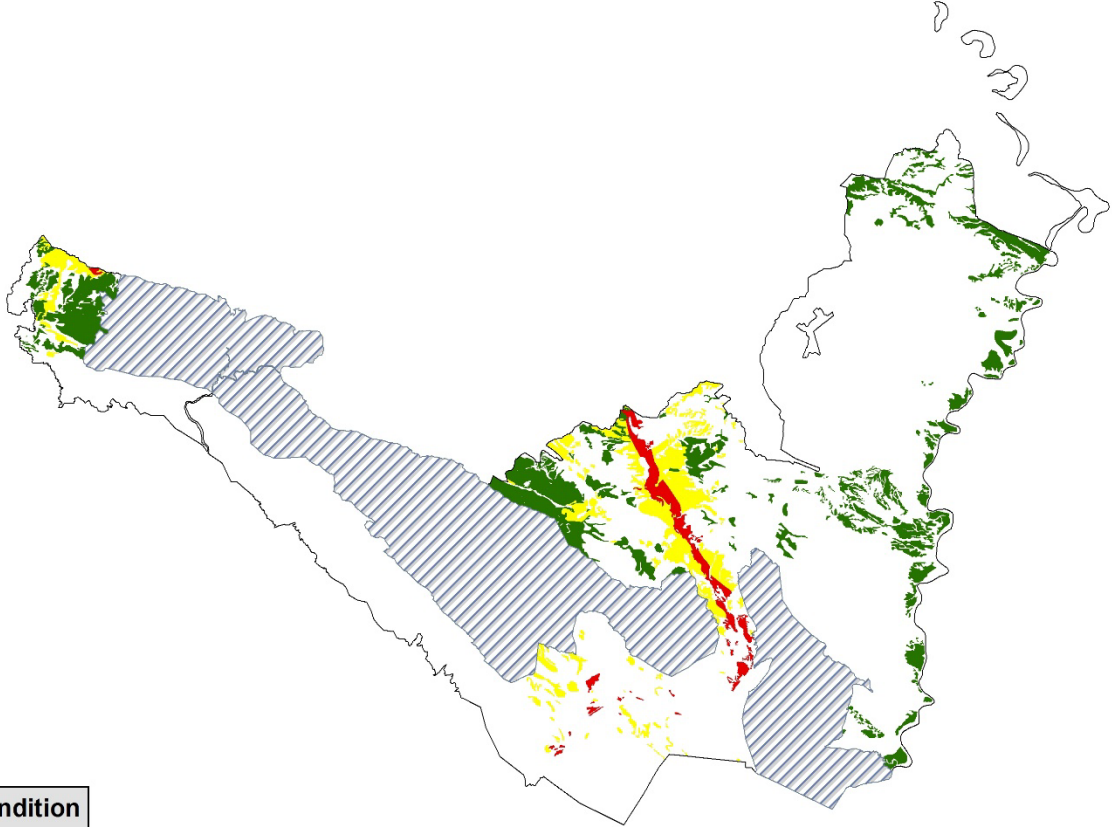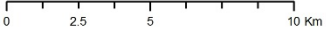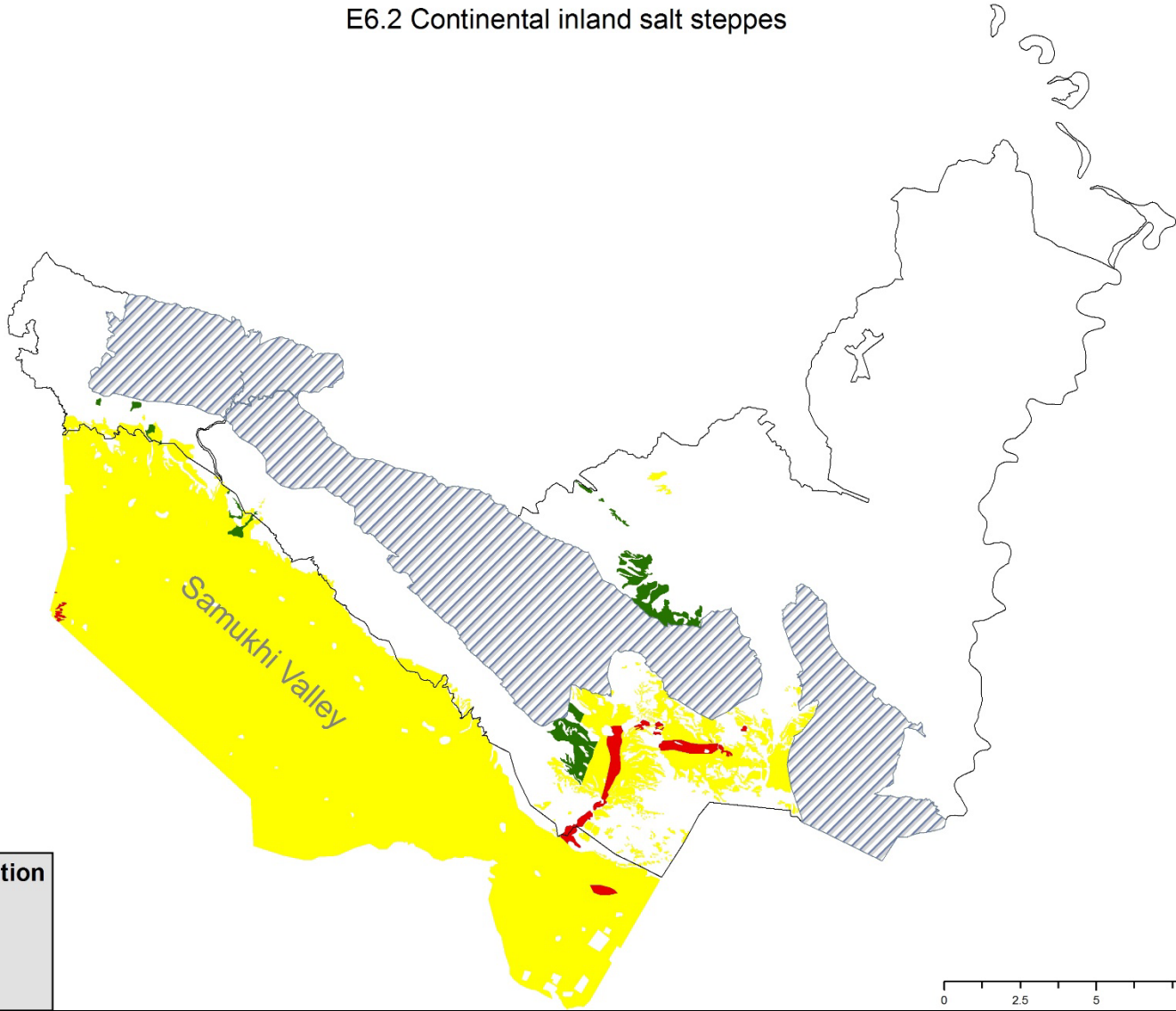
Appendix 5. Ktsia-Tabatskuri Managed Reserve

Legend
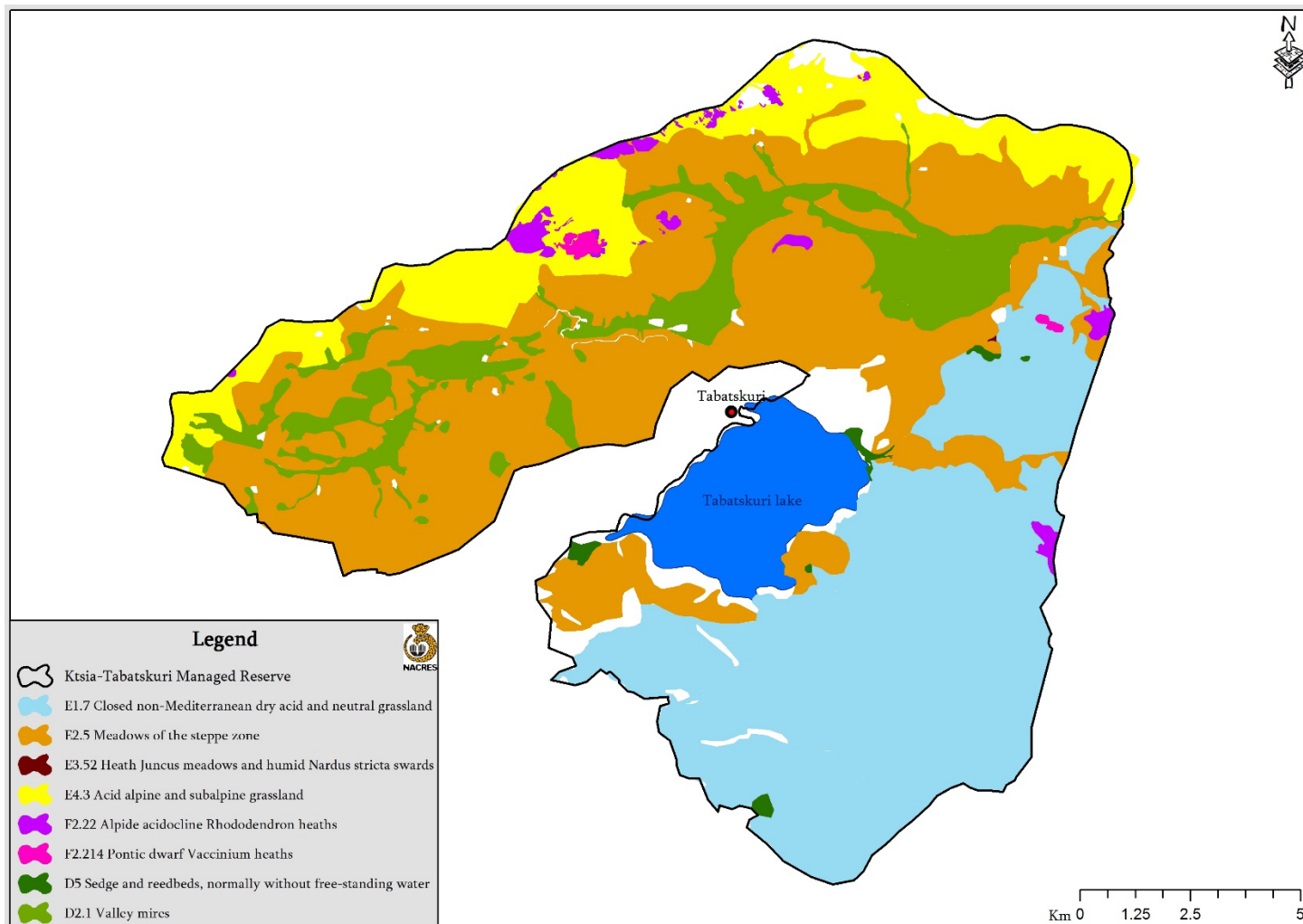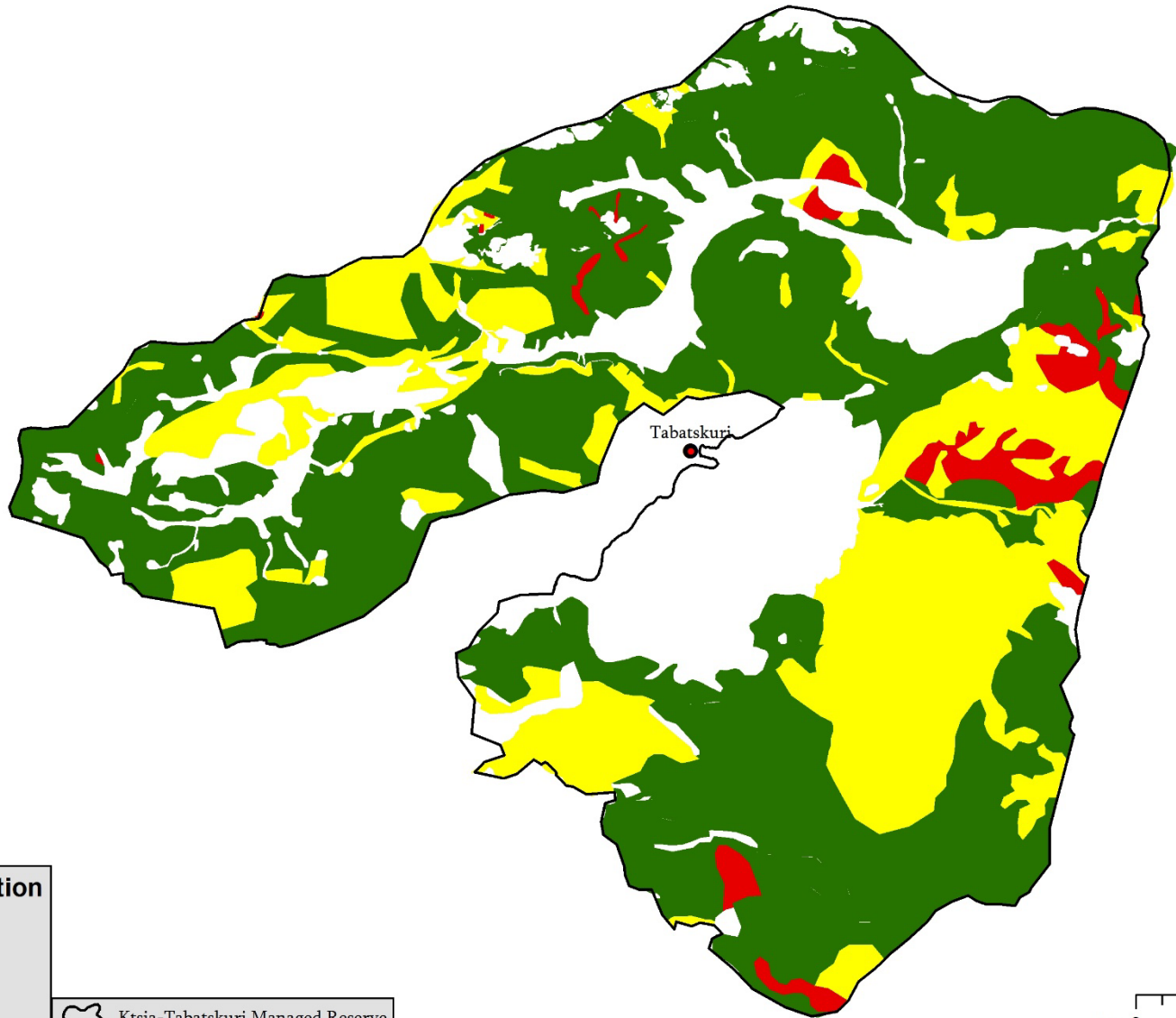
- Ktsia-Tabatskuri Managed Reserve
- E1.7 Closed non-Mediterranean dry acid and neutral grassland
- F2.5 Meadows of the steppe zone
- E3.52 Heath Juncus meadows and humid Nardus stricta swards
- E4.3 Acid alpine and subalpine grassland
- F2.22 Alpide acidocline Rhododendron heaths
- F2.214 Pontic dwarf Vaccinium heaths
- D5 Sedge and reedbeds, normally without free-standing water
- D2.1 Valley mires
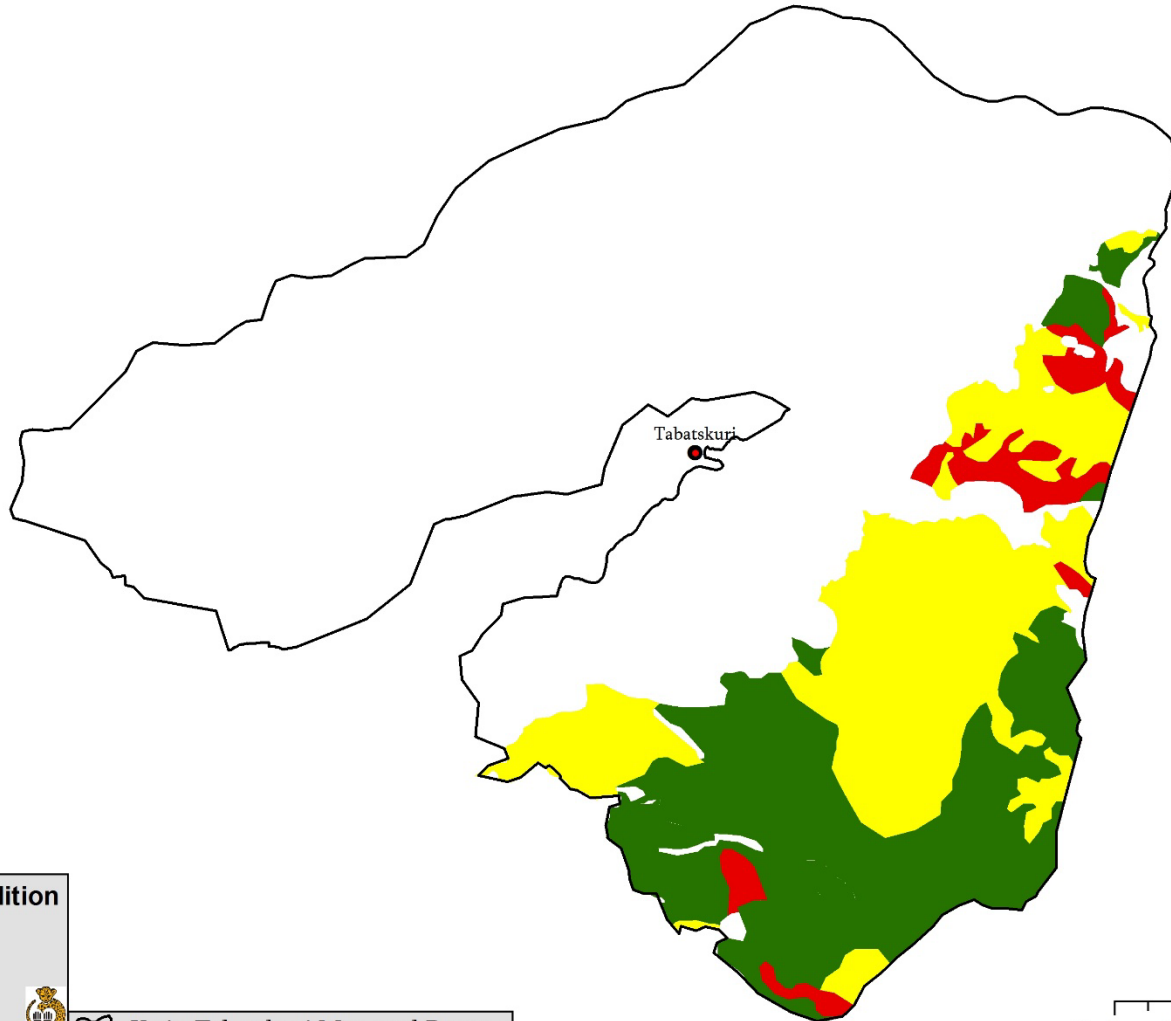
Tabatskuri

Tabatskuri lake

Km 0   1.25   2.5   5

Pasture Condition

- Bad
- Medium
- Good

Ktsia-Tabatskuri Managed Reserve

Tabatskuri

Km 0 1 2 4

NACRES

N

45

E1.7 Closed non-Mediterranean dry acid and neutral gras

Tabatskuri

Pasture Condition

Bad

Medium

Good

Ktsia-Tabatskuri Managed Reserve

Km 0   1.25   2.5   5

E2.5 Meadows of the steppe zone

Tabatskuri

Pasture Condition

- ■ Bad
- ■ Medium
- ■ Good

Ktsia-Tabatskuri Managed Reserve

Km 0   1.25   2.5   5

E3.52 Heath Juncus meadows and humid Nardus stricta swar

N

Tabatskuri

Pasture Condition

Bad

Medium

Good

Ktsia-Tabatskuri Managed Reserve

Km 0   1.25   2.5   5

E4.3 Acid alpine and subalpine grassland

Tabatskuri

Pasture Condition

- Bad
- Medium
- Good

Ktsia-Tabatskuri Managed Reserve

Km 0   1.25   2.5   5
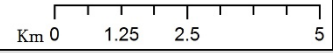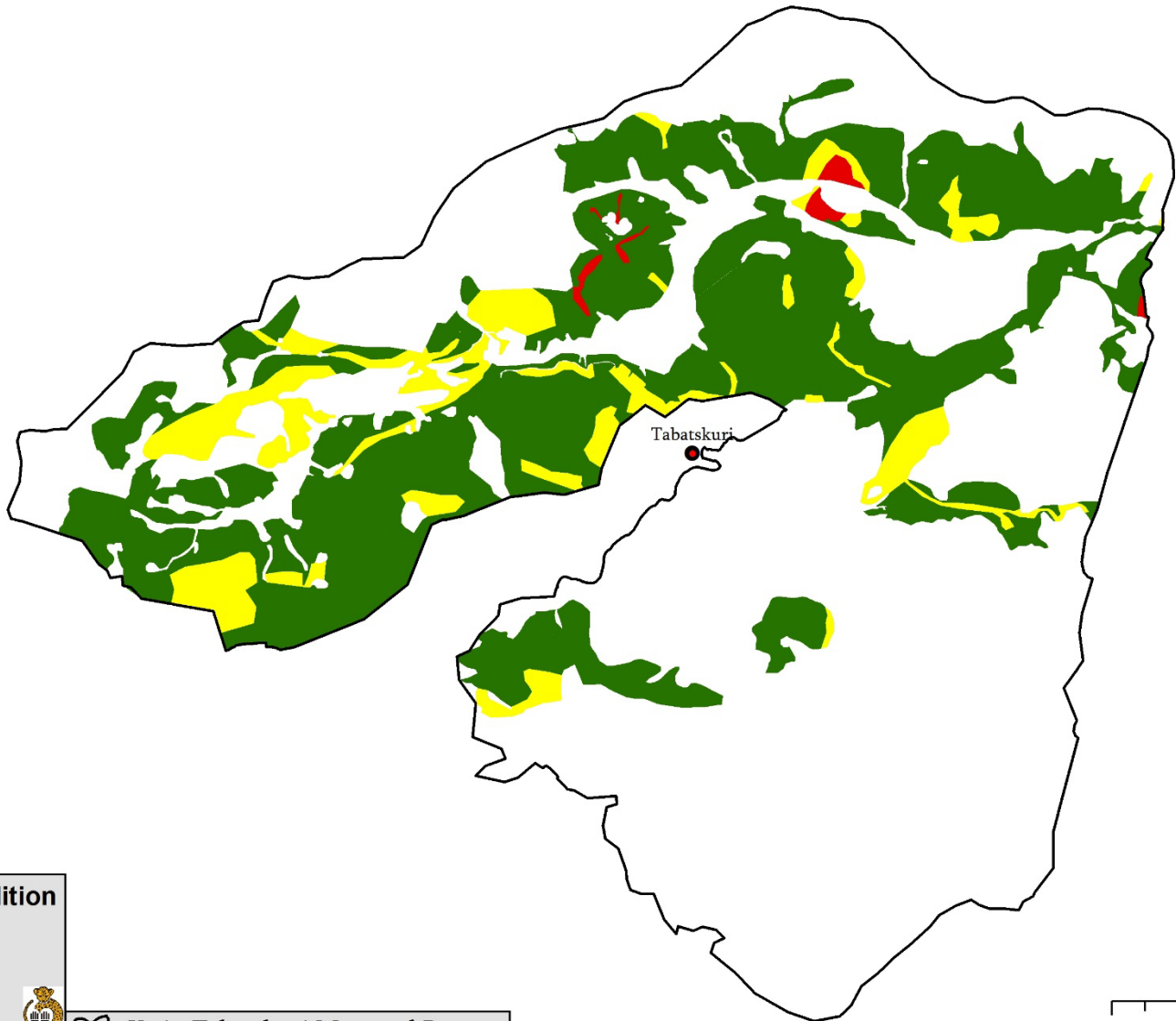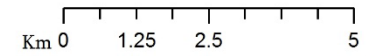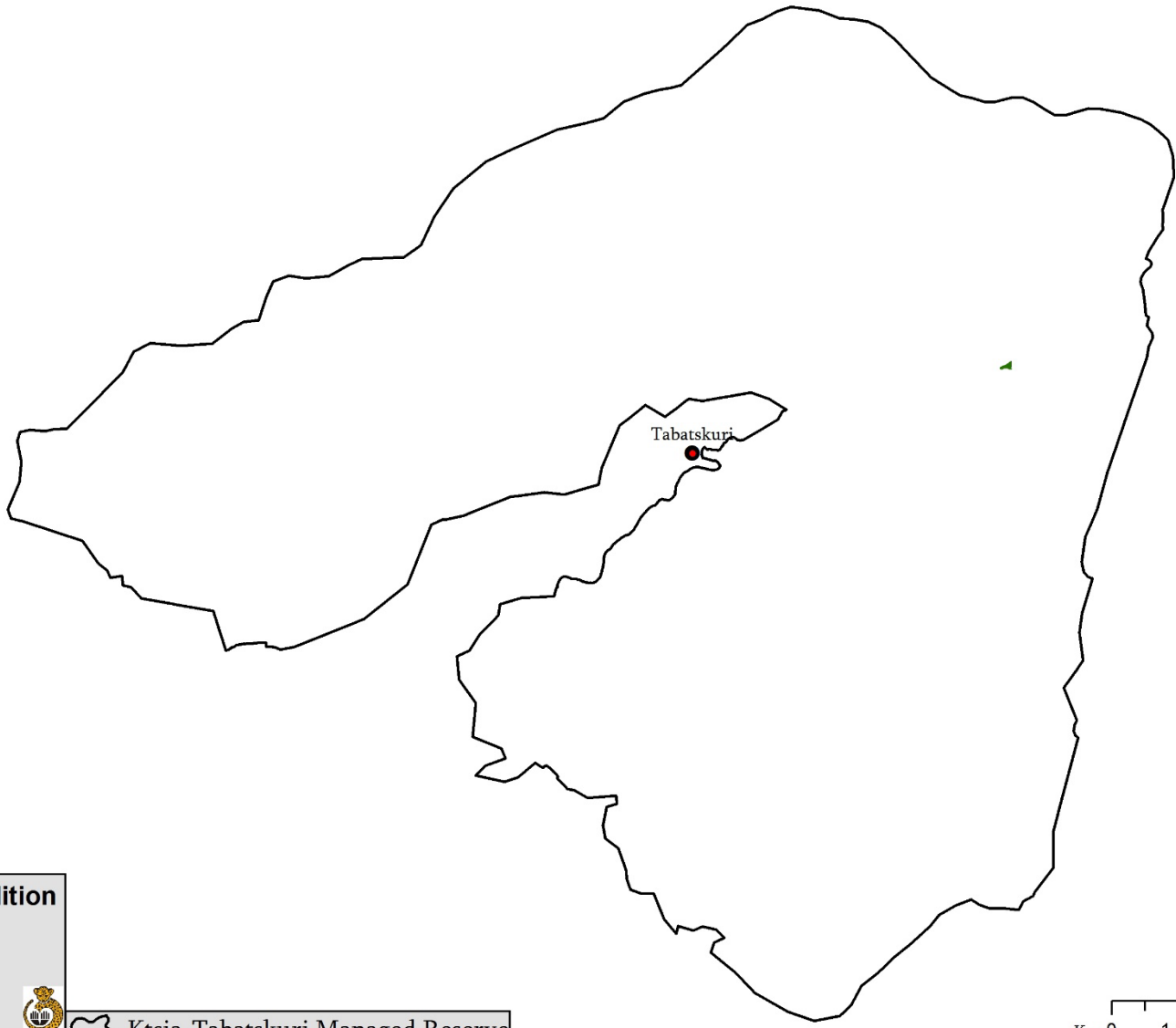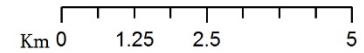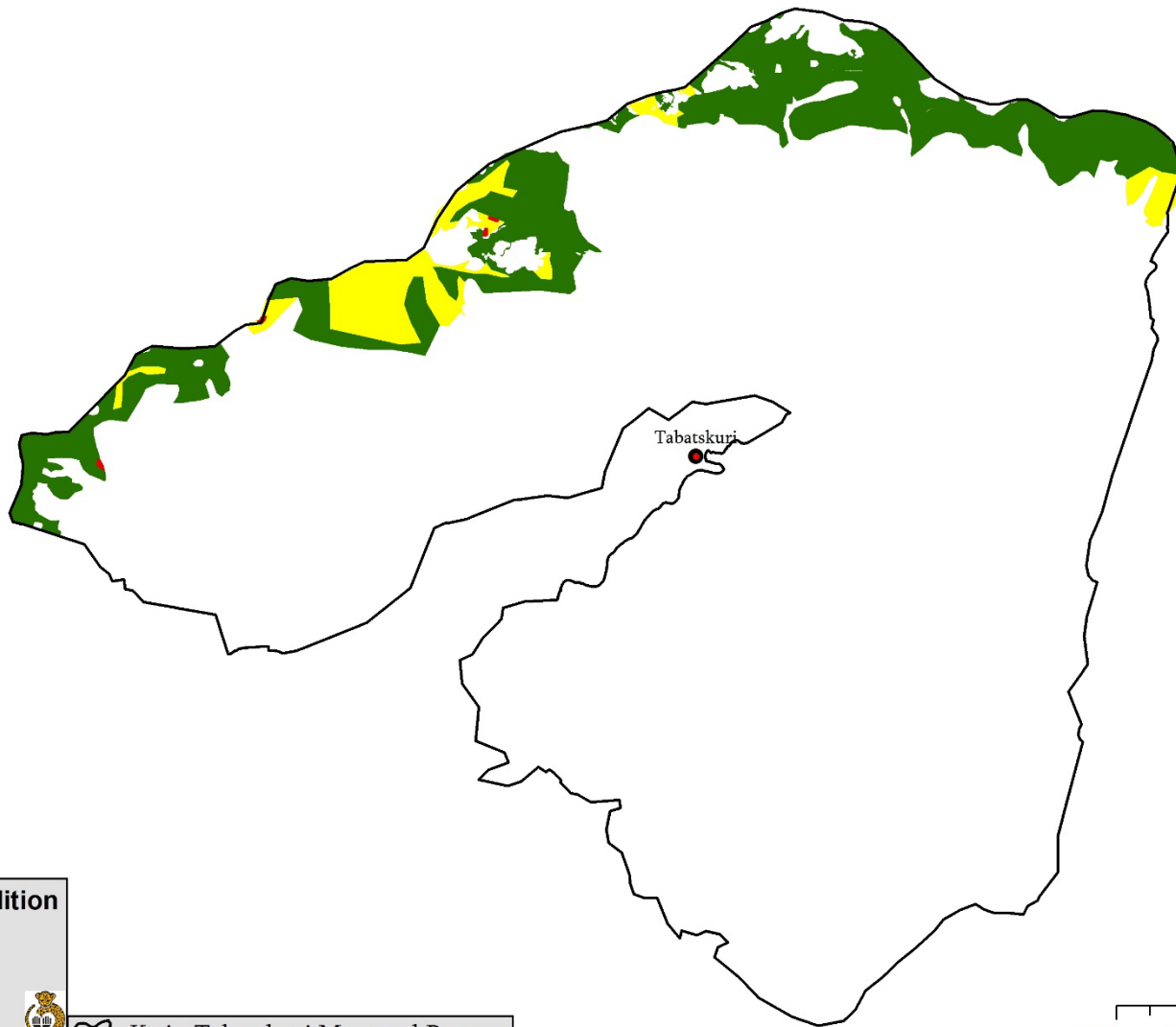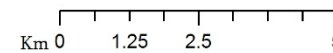
Appendix 6. Javakheti PA

Legend
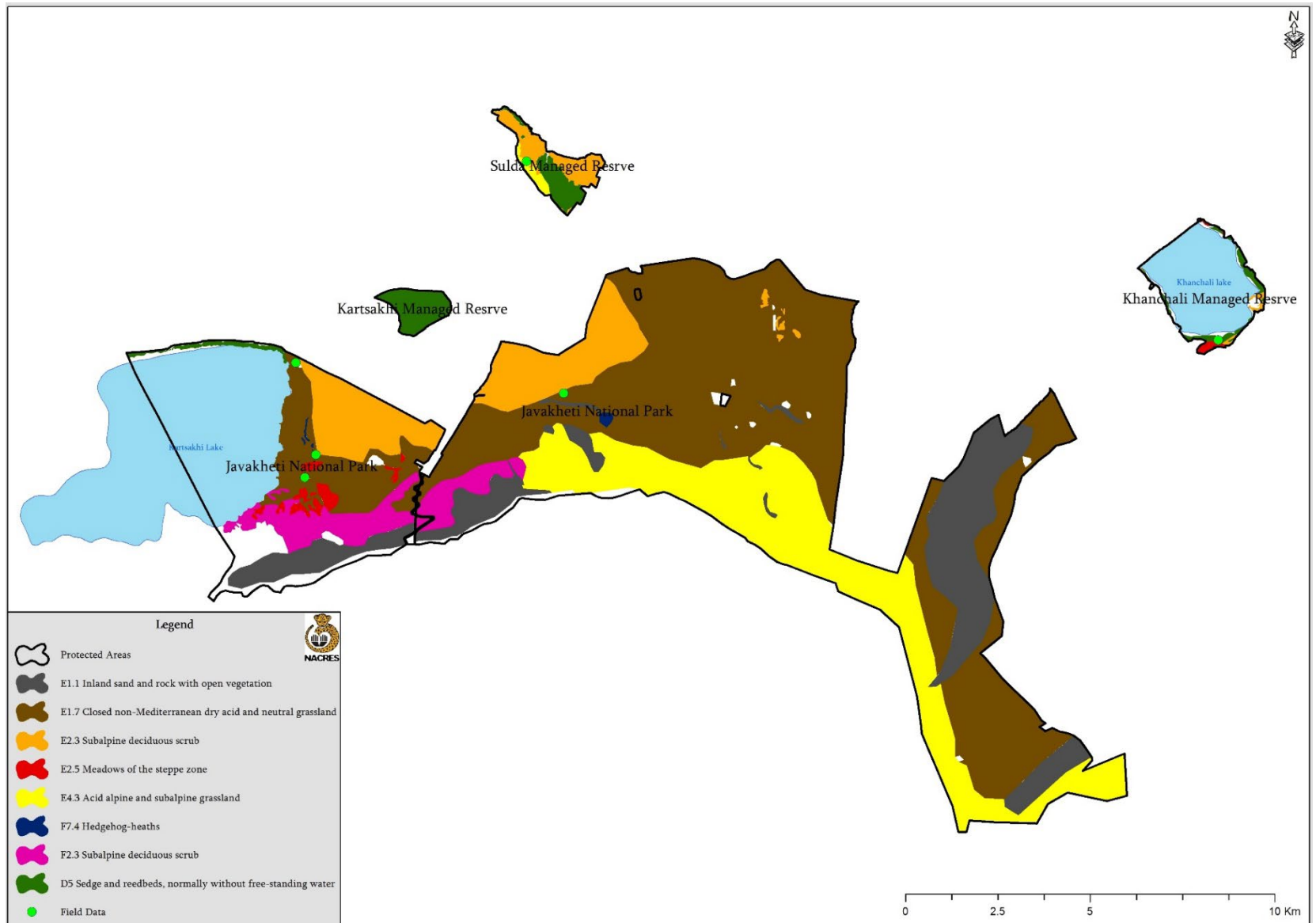
- Protected Areas
- E1.1 Inland sand and rock with open vegetation
- E1.7 Closed non-Mediterranean dry acid and neutral grassland
- E2.3 Subalpine deciduous scrub
- E2.5 Meadows of the steppe zone
- E4.3 Acid alpine and subalpine grassland
- F7.4 Hedgehog-heaths
- F2.3 Subalpine deciduous scrub
- D5 Sedge and reedbeds, normally without free-standing water
- Field Data

Sulda Managed Resrve

Kartsakhi Managed Resrve

Javakheti National Park

Javakheti National Park

Kartsakhi Lake

Khanchali lake

Khanchali Managed Resrve

NACRES

0   2.5   5   10 Km

E1.1 Inland sand and rock with open vegetation

Sulda Managed Resrve

Khanchali Managed Resrve

Kartsakhi Managed Resrve

Javakheti National Park

Pasture Condition

- ■ Bad
- ■ Medium
- ■ Good

0   2.5   5   10 Km

E1.7 Closed non-Mediterranean dry acid and neutral grassland

Sulda Managed Resrve

Kartsakhi Managed Resrve

Khanchali Managed Resrve

Javakheti National Park

Pasture Condition

- Bad
- Medium
- Good

0   2.5   5   10 Km

E2.3 Mountain Hay meadows

Bugdasheni Managed Resrve

Madatapa Managed Resrve

Pasture Condition

- Bad
- Medium
- Good

0   1   2   4 Km

E2.3 Mountain hay meadows

Faravani Lake Managed Reserve

Abuli Lake Managed Reserve

Sagamo Lake Managed Reserve

Pasture Condition

- Bad
- Medium
- Good

0   2.5   5   10 Km

E2.3 Mountain hay meadows

Sulda Managed Resrve

Khanchali Managed Resrve

Kartsakhi Managed Resrve

Javakheti National Park

Pasture Condition

- Bad
- Medium
- Good

NACRES

0   2.5   5   10 Km

E2.5 Meadows of the steppe zone

N

Madatapa Managed Resrve

Pasture Condition

Bad
Medium
Good

NACRES

0   1   2   4 Km

E2.5 Meadows of the steppe zone

Faravani Lake Managed Reserve

Abuli Lake Managed Reserve

Sagamo Lake Managed Reserve

Pasture Condition

Bad
Medium
Good

| 0 | 2.5 | 5 | 10 Km |

E2.5 Meadows of the steppe zone

Sulda Managed Resrve

Kartsakhi Managed Resrve

Khanchali Managed Resrve

Javakheti National Park

Pasture Condition

Bad
Medium
Good

0   2.5   5   10 Km

E4.3 Acid alpine and subalpine grassland

Abuli Lale Managed Reserve
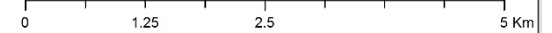
Sagamo Lake Managed Reserve

Pasture Condition

- Bad
- Medium
- Good

0   1.25   2.5   5 Km

E4.3 Acid alpine and subalpine grassland

Suldis Managed Resrve

Khanchali Managed Resrve

Kartsakhi Managed Resrve

Javakheti National Park

Pasture Condition

Bad
Medium
Good

0   2.5   5   10 Km

Paravani Lake

Faravani Lake Managed Reserve

Abuli Lake Managed Reserve

Saghamo Lake

Sagamo Lake Managed Reserve

Legend

NACRES
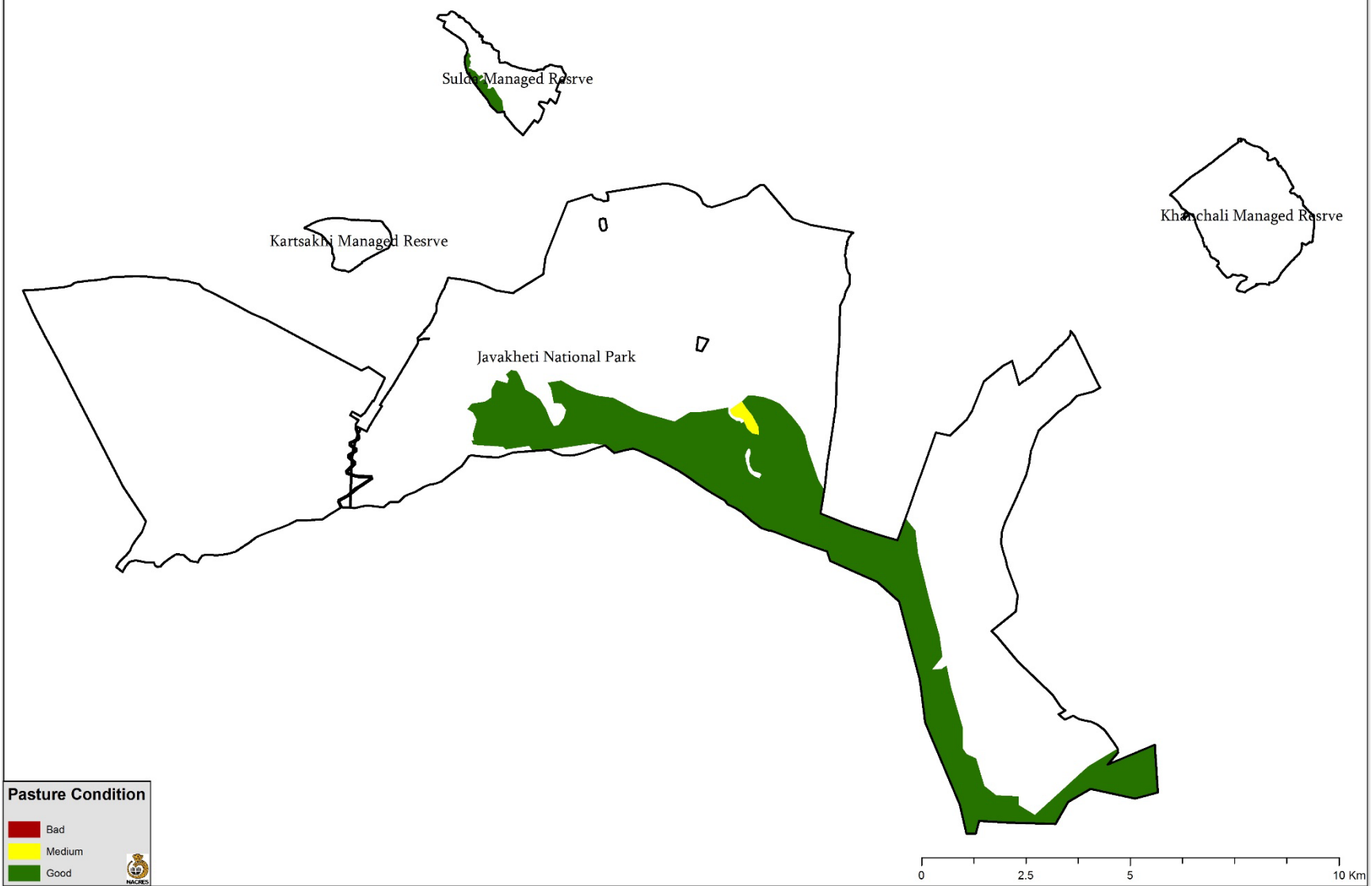
- Protected Areas
- E1.1 Inland sand and rock with open vegetation
- E2.3 Subalpine deciduous scrub
- E2.5 Meadows of the steppe zone
- E4.3 Acid alpine and subalpine grassland
- D5 Sedge and reedbeds, normally without free-standing water
- Field Data
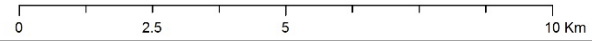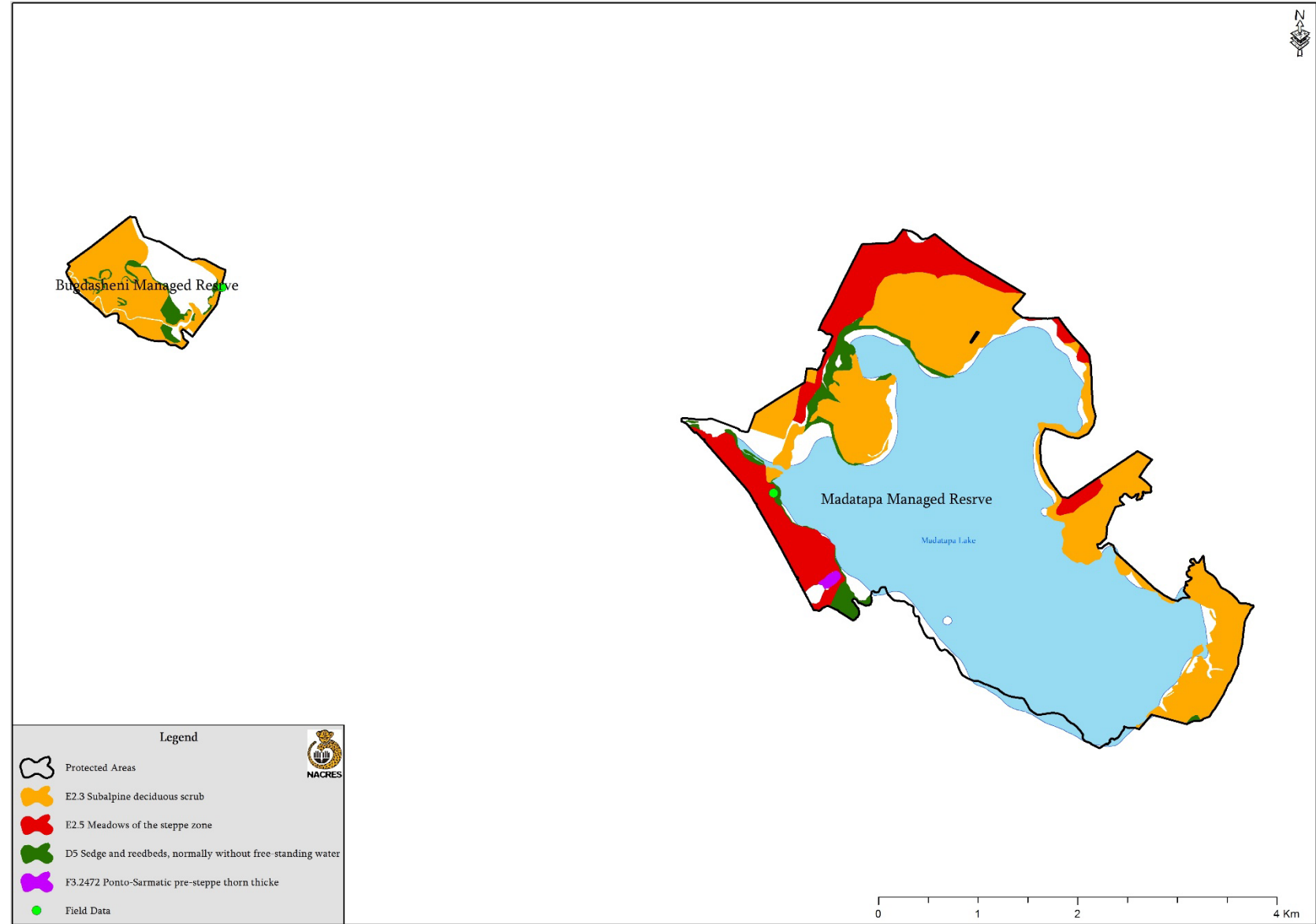
| 0 | 2.5 | 5 | 10 Km |

Legend

Protected Areas

E2.3 Subalpine deciduous scrub

E2.5 Meadows of the steppe zone

D5 Sedge and reedbeds, normally without free-standing water

F3.2472 Ponto-Sarmatic pre-steppe thorn thicke

Field Data

Bugdasheni Managed Resrve

Madatapa Managed Resrve

Madatapa Lake

NACRES

0   1   2   4 Km