ENHANCING FINANCIAL SUSTAINABILITY OF THE PROTECTED AREAS SYSTEM IN GEORGIA

TECHNICAL ASSISTANCE GRANT AGREEMENT

Monitoring of Short-listed Species Indicators in Selected Protected Areas in Georgia:

Red Deer (*Cervus elaphus*)

Final Report

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Photo on the cover: *Red deer in Lagodekhi PA; Teimuraz Popiashvili, NACRES*

Contents

1 Introduction

NACRES carried out red deer population surveys in LPA and BKPA during spring 2021 as part of the Technical Assistance Grant Agreement signed between CNF and NACRES on 21 February, 2021. We used red deer faecal pellet group count method as a robust and scientifically acknowledged field method to assess red deer in forested habitats. This report describes the results of the red deer surveys and their analysis.

2 The red deer in Georgia and past assessments

The Red deer (*Cervus elaphus maral*) is represented in Georgia with several isolated populations whose ranges are practically confined to protected areas (please see appendix #1). The species is included in Georgian red list as Endangered. Lagodekhi and Borjomi-Kharagauli red deer populations are the largest in the country. A small deer population remained in Gardabani managed reserve and the species has reappeared in Tusheti's Alatovani gorge few years ago. A small population in the Adigeni municipality is connected and sourced by the Borjomi-Kharagauli population and is under great pressure of illegal hunting (NACRES, 2016).

Lagodekhi protected areas (LPA) and Borjomi-Kharagauli protected areas (BKPA) administrations are using the roar count method to monitor red deer (*Cervus elaphus maral*) populations in their respective protected areas. This method was widely used in the Soviet time and still commonly practiced in former Soviet countries. Some scientists believe that the accuracy of this method can be influenced by many factors and it cannot be considered as a reliable technique to estimate deer population size (Ciucci et al., 2009; Putman et al., 2011) while the results should not be used in species management (Douhard M. et al., 2013).

Forest is a main red deer habitat in Georgia and it is almost impossible to use methods that are based on visual observation. Faecal Pellet Count is a well-known field method to count deer in the forest (Scott et al. 2002; Mayle et al. 1999). We successfully used the Faecal Pellet-Group Count method in Borjomi-Kharagauli protected areas (NACRES report 2016), as well as outside protected areas - in Adigeni Municipality (NACRES report 2016). We used the same method in LPA in spring 2018, but due to early spring we could not obtain robust data for lower areas (strata) and only assessed red deer in the upper part of the protected areas (NACRES report, 2019).

3 Methodology

We used so-called Standing Crop Strip Transects Count (STC), a variation of Faecal Pellet-Group Count method (Mayle et al. 1999). The method was adapted to local conditions and tested in our study areas before. The method is cheap, not requiring any expensive equipment and relatively easy to use after short training. The field method is recommended for low density red deer populations (1-10 individuals per km^2).

Red deer range maps in the study areas were vital for planning the census fieldworks. We used previous range maps in LPA and in BKPA as a basis and updated them based on the park camera trap data and information provided by the park administrations.

We used stratification approach to outline strata according to habitat, elevation and possible disturbance (various human activities, tourism etc.). We placed a grid on the study areas, numbered the cells and randomly selected them for sampling. In randomly selected grid cells we conducted transects and recorded deer pellet groups in each 10 m section of the transect. A faecal pellet group was defined as a cluster of 6 or more pellets produced at the same defecation. Transects did not follow any specific geographic formation (such as ridges, rivers or slopes) and included all deer habitats.

Photo #1 Red deer transect direction using compass and rope

Transects mostly began from the corner of a selected quadrat and followed the preliminarily selected direction (such as N-W, or S-E). To keep and follow exact direction, we used a compass and 30 m rope. The rope was marked so that each 10 m section was easily seen (photo #01). We recorded deer pellet groups that were within 1 m of both sides of the rope (pellet groups that were beyond 1 m distance were ignored). Data were entered into a special field form (appendix #02).

We estimated red deer density and the total population number based on obtained data from the field and the results of pellet group decay rate experiment, carried out earlier. RE deer density was calculated as follows:

$$D = \frac{n_p}{DR \times M_{dt}}$$

Where:

D is deer density per ha,
n_p is number of pellet groups per ha
DR is defecation rate
M_{dt} is mean decay time (days) for a pellet group.

Mean decay time for Borjomi-Kharagauli was calculated in 2014 as 234 days (NACRES 2016). For Lagodekhi we initiated the faecal decay experiment in autumn 2020. The experiment continued till the summer of 2021 and the decay rate was calculated as 157 days for the upper strata and 116 for the lower strata. (Please see Chapter 3.3 for details).

4 Red deer survey in Lagodekhi protected areas

4.1 Preparatory work

As a first step, we reviewed the results of red deer counts carried out by NACRES in spring 2018 (NACRES report 2019). During that red deer census we could assess only part of the population; we obtained red deer numbers for the upper part of the protected area (1700-2400 m above sea level) but we could not collect sufficient data at lower elevations (1000-1700 m) due to rapid vegetation growth facilitated by warm weather, which affected faecal group detection probability.

We updated the red deer range map jointly with LPA administration. In 2020, the rangers had detected a red deer roar in Kabali gorge, in the north-western part of the PA and park administration suggested to include that gorge into the deer range. We updated the LPA deer range map based this new information (Appendix #3). Nevertheless, we decided not to include Kabali gorge into our study area − red deer density was extremely low in the adjacent Ninoskhevi gorge where we were only able to collect very few deer faecal samples during the 2018 surveys. Therefore, it was considered highly unlikely that we could collect sufficient samples in Kabali too because the latter is the outer gorge of the park (a large part of the gorge being actually outside the PA) that is exposed to human disturbance more than any other parts.

The previous red deer assessment also showed that the red deer density varied between the strata as well as by elevation and that there were more deer in Matsimi Khevi (bordering Azerbaijan) and fewer in Ninoskhevi i.e. deeper into the country. Also, the numbers appeared to increase with elevation (NACRES, 2019). No red deer signs were detected below 1,000 m. Hence, in the current study, we considered this altitude as the lower limit of red deer distribution in LPA.

We decided to follow the same stratification principle and divided the study area by gorges and altitude. So the four gorges: Matsimi, Lagodekhikhevi, Shromiskhevi and Ninoskhevi were divided into two: (A) the lower part, from 1000 m. to 1400 m. and (B) the upper part from 1400 m. to 2400 m. As a result, we had 8 strata: (1) Matsimi A; (2) Matsimi B; (3) Lagodekhikhevi A; (4) Lagodekhikhevi B; (5) Shromiskhevi A; (6) Shromiskhevi B; (7) Ninoskhevi A and (8) Ninoskhevi B (see Appendix #4). We decided to split the field surveys into two sets in order to address the issue of snow cover: the first fieldwork would be planned in early spring (March) to collect data at lower elevations (A strata) and the second fieldwork would be conducted in May, by which time the snow cover was expected to retreat even at higher elevations and we would be able to collect data (B strata).

We placed 1 km X 1 km grid on the study area. All cells were numbered. Six cells were randomly selected in each stratum using a random number generator (see Appendix #5). The transect length was set at 1,000 m. Of course, longer transects would give better results, but even 1,000 m transects were a challenge given Lagodekhi's extremely rugged terrain − extremely steep slopes and cliffs in the forest greatly limited observers' movement and subsequently complicated data collection. The strata were not large, each consisting of 10-12 grid cells. Hence, we assumed that 6 transects in each stratum would create a sufficient sampling effort. Transect start points mostly coincided with the corner of a selected grid cell and followed the diagonal line of the cell. The transects were walked uphill or downhill avoiding to follow any geographical formations such as ridges, riverbanks etc. We used field forms that were updated in advance based on previous experience.

4.2 Data collection in Lagodekhi PA

Initially, we were planning to begin red deer counts in mid-March. But we had to postpone the fieldwork until late March due to snow cover.

We arrived in Lagodekhi on March 27th and organised a base camp at the LPA administration's building. The next day was dedicated to training for rangers and other members of the administration. Some of the rangers were familiar with the method since, as mentioned above, we had used this method in Lagodekhi before. However, many new rangers have been recruited since last surveys. So it was important to introduce them to this relatively new filed technique. Some rangers were interested to know why we had chosen the pellet group count method over roar counts. We explained that while the roar count can be an option in certain situations, the pellet group count would be capable of producing scientifically more robust results. We also noted some of the disadvantages of the roar count method, while admitting that it is much easier to use and hearing/seeing roaring stags is probably more exciting than counting deer pallet groups.

In the afternoon, we planned to do one transect jointly with the rangers and to explain data collection details in the field. However, due to some misunderstanding between the rangers and their management, only two rangers accompanied us to the field. The others did not join us. They said they had not been warned in advance and therefore were not ready to go to the field with us.

The next day, we organized four field teams – one ranger and one NACRES field team member and began data collection. As planned, we did random transects in the lower strata (1000-1700 m.a.s.l.). We covered all the four lower strata and counted red deer pellets on 23 transects (see Appendix #6). The data were entered into the field form. We also took red deer pellet locations by GPS.

We went back to Lagodekhi in the beginning of May to collect data at higher elevations. Again, four field teams worked simultaneously. Some transects proved to be extremely difficult, or even dangerous for the field team to follow, in which case we substituted the selected cells by an adjacent one that had the next lower number. We collected data from 24 transects in the upper 4 strata (see Appendix #7).

4.3 Faecal pellet group decay experiment in Lagodekhi PA

We launched a *Faecal pellet group decay experiment* in Lagodekhi PA in September 2020. We collected fresh red deer faecal pellets and placed them on 11 locations of various altitudes (from 1,100 m. up to 2,400 m.) throughout the red deer habitat Including forest, subalpine meadows, subalpine forest and alpine meadows (see Appendix #8 for map). Each site was marked with a bright tape to help locate them during subsequent visits (Photo #2). We monitored the sites regularly and making six visits in total.

Photo #2 Red deer pallet groups, Lagodekhi PA

We first checked the decay experiment sites in November 2020 and found that most of faecal pellet groups were nt visible. Dry grass covered faecal groups in subalpine meadows and fallen leafs covered them in the forest zone. Therefore, experiment sites (#4 - 11) were considered as "decayed", because the data collectors would not be able to detect them during spring counts in 2021. We decided to continue the decay experiment and placed new fresh deer faecal groups on the same locations. Three out of 10 locations (#1, #2 and #3) were already covered by snow in November 2020. So we could check them only in May 2021. These three sites were not considered as decayed because we would potentially see them during the spring counts.

We continued monitoring the experiment locations during the winter and spring. Most of the faecal groups were decayed by May 2021, but three of them (#4, #7 and #9) remained visible until a month later i.e. the beginning of July, 2021.

We separately collected data in the lower (A) and upper (B) strata. Hence, deer excrement decay rates were calculated separately as 116 days for the lower strata (A) and 157 days for the upper strata (B). These decay rates were subsequently used to calculate red deer population in Lagodekhi protected areas.

4.4 Results

Data were collected in both lower (A) and upper (B) strata and red deer numbers were calculated using the result of the decay experiment. The total estimate for the lower (A) strata is 30 individuals (with 95% CI 5-69 individuals) and the upper (B) strata it is 20 individuals (with 95% CI 6-34 individuals). We can assume that these results are independent and they may be added to estimate the total red population in Lagodekhi PA. Thus, our estimate is ***50 individuals (95% CI 11 – 103 individuals)***. Red deer numbers are significantly higher in the Matsimi gorge stratum (this gorge borders Azerbaijan) and they appear to decrease toward the north-west (Table #1). However, this trend is not very clear due to the large confidence intervals.

Table #1 *Red deer density and number according strata in Lagodekhi protected areas.*

Strata	Deer N per stratum	N with 95 CI	Deer density per 10 km^2
Matsimi	25	2 – 56	8.9
Lagodekhiskhevi	11	5 – 18	4.9
Shromiskhevi	3	2 – 7	1.9
Ninoskhevi	11	2 – 22	4.9
Total	**50**	**11 - 103**	**Average density 5 red deer**

5 Red deer count in Borjomi-Kharagauli protected areas

5.1 Preparations

During our previous red deer assessment in Borjomi-Kharagauli protected areas that was carried out in 2015 we found that it was impossible to complete the Kharagauli stratum, due to dense, almost impenetrable evergreen under-forest (which is typical of Colchic forest) as well as due to rapid growth of the seasonal forest floor vegetation. Hence, we planned to go to that area earlier − i.e. before the seasonal vegetation would cover the forest floor − to ensure the collection of sufficient data. We also evaluated the red deer range map prepared in 2015 and found that it was at large still valid.

We divided the study area into four strata: Kharagauli, Borjomi, Atskuri and Abastumani. We took into account that Borjomi-Khragauli PA was recently expended to encompass Kurtskhana valley. Hence, we reshaped the Abastumani stratum and included this new territory into our study area. We placed 2km X 2km grid on the study area and randomly selected 6 cells in each stratum (see appendix #9). We planned 2,000 m. transects, the same length as we did during the last red deer assessment in Borjomi-Kharagauli NP.

5.2 Data collection

We began fieldwork at the end of April. We presented the methodology to the key rangers that would be potentially involved in the data collection. Some rangers raised questions about the importance of the new approach. We discussed advantages and disadvantages of the roar count method and explained that it cannot exclude various environmental and human factors that affect data and subsequently survey results. Mr. Shota Golubiani the local natural recourse specialist provided important information about red deer having expended its range during last years and that they were found in the northern part of the PA (upper reaches of the Khani and Shavi Tskali rivers). We agreed to integrate those areas into the range map (see Appendix #10 for map). However, we did not include them in our study area, because red deer density on these newly recolonized territories was expected to be extremely low and modifying the study area would not significantly influence the assessment results.

The next day we organized mixed field teams − a ranger and a NACRES observer and began data collection. Eight teams followed 2,000 m-long transects, counting red deer faecal pellet groups and entering the data into the field forms. We completed 7 transects in each stratum i.e. Borjomi, Atskuri and Abastumani (see Appendix #11). We did 6 transects in the Kharagauli stratum, a large part of which was not suitable red deer habitat – extremely dense undergrowth of cherry laurel (*Prunus laurocerasus*), Pontic rhododendron (*Rhododendron ponticum*), Colchic holly (*Ilex colchica*) bsolutely limited human movement as well as making the area not suitable for red deer (see Photo #3) a. Naturally, no red deer signs were

Photo #3 Colchic evergreen understory in the Kharagauli stratum.

detected on the random transects in such areas. Hence, we removed the territories from the red deer range and corrected the range map accordingly.

Notably, Shota Golubiani helped us very much to complete data collection in Kharagauli stratum. All the involved rangers were very active and helped us to cover huge territories in a relatively short time – 7 days. Rangers accompanied us in almost every fieldtrip and collected data with us. We tried to involve volunteers too. Due to Easter holydays and the COVID 19 lockdown restrictions, only three young persons expressed their wish to join us in the field. Finally, only Veriko Bazali, a motivated young woman was able join us in Abastumani. She accompanied our team and helped us collect data on the Abastumani transect.

5.3 Results

Because the closer examination of the Kharagauli stratum revealed that only a small sections of this stratum is suitable red deer habitat. Therefore, this stratum was eliminated and its suitable deer habitat was added to the Borjomi stratum. Hence, the field data were processed for three strata – the Borjomi, the Atskuri and the Abastumani strata. We calculated deer numbers using the mean decay rate calculated in the previous assessment (NACRES report 2016) and the total was ***456 red deer (with 95% CI 221 – 649 individuals)***. The species appears to have an uneven distribution throughout the PA – the density tends to decrease toward the west (Table #2).

Table #2 *Red deer number and density according strata in Borjomi-Kharagauli PA.*

Stratum	Deer N per stratum	Deer N with 95 CI	Deer density per 10 km2
Borjomi	330	180 – 480	21.2
Atskuri	105	40 – 137	6.7
Abastumani	21	1 – 32	1.4
Total	**456**	**221 – 649**	**Average density 9.8 deer**

We did not expect to have large CI (confidence interval) as a result of 2021 census. Compared to the previous survey we had increased the number of transects per stratum hoping that this would result in more accurate data. However, we obtained an even larger confidence interval.

6 Discussion

6.1 The status of the red deer population in Lagodekhi PA

6.1.1 Red deer population trends since 1930s

The monitoring of the red deer population in Lagodekhi PA began in 1930s with the assessment conducted by E. Markov. According to his estimates only 10-20 individuals remained in the newly established Lagodekhi reserve (Markov, 1938). Since then, the deer population grew in the predator controlled environment and by 1990 the population was over 1,400 (Gurielidze, 2004).

In early 1990s, political unrest and lack of control in protected areas – as well as elsewhere − resulted in a sharp decline of all ungulate numbers and especially the red deer (Badridze, *et al*. 2000). The official data from the PA also indicates a drastic decrease in red deer numbers (see Figure #1). NACRES conducted an independent red deer survey in Lagodekhi in 1997 and counted only 80 individuals

(Gurielidze, et al 2000). Subsequent monitoring of the red deer population in Lagodekhi showed slow recovery of the population (see Figure #1).

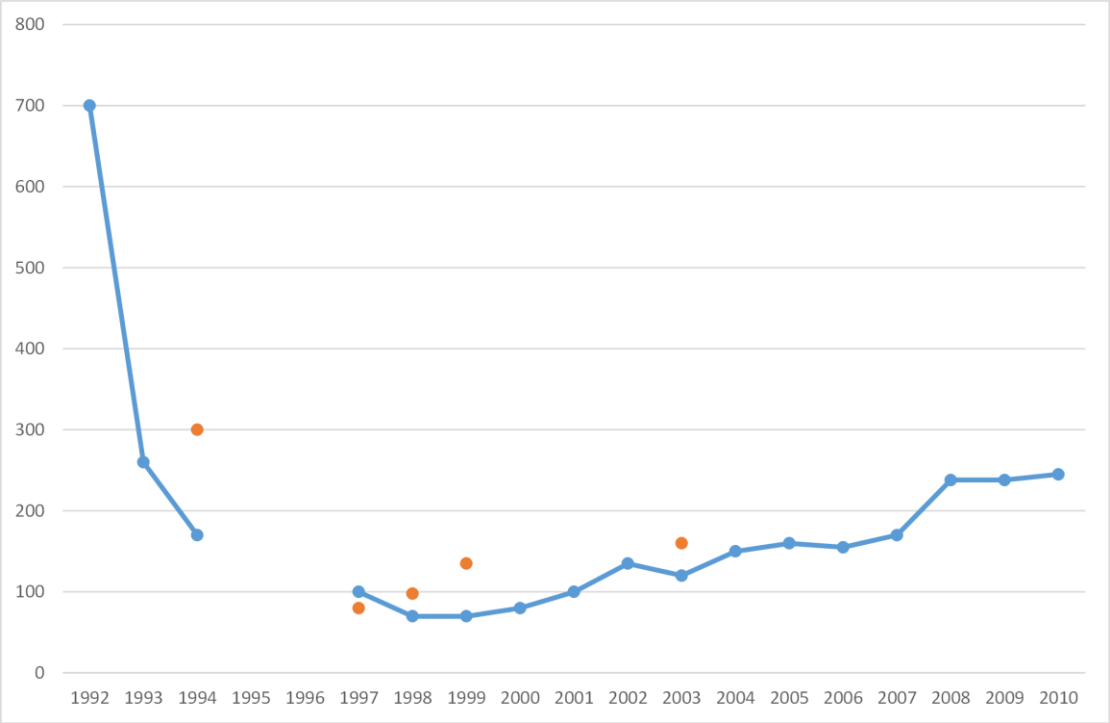

Figure #1 Red deer population trend in Lagodekhi PA

The blue line represents the red deer population trend in Lagodekhi since the break-up of the Soviet Union (according to Chronicles of Nature, summarized by G. Sulamanidze). The orange dots are independent counts carried out by NACRES.

Ilia State University assessed the Lagodekhi red deer population in 2012, 2013 and 2015 (Figure #2). The team used roar counts in 2012 and the faecal pellet group count method in 2013 and 2015. They counted 312 individuals in 2012, 537 in 2013 and 200 in 2015. The confidence interval is available for the 2015 estimate only and the 95% confidence interval was 79 – 510 individuals.

In 2018, NACRES estimated the minimum red deer population in Lagodekhi at 84 individuals (with 95% CI 43 – 129 individuals) (NACRES 2019). We used exactly the same stratification in 2019 as in the current study in which all gorges were divided into two parts − lower (A) stratum and upper (B) stratum. However, in 2018, we could only collect data from B strata. Hence the results represent only the red deer numbers in the upper strata and 2018 and 2021 results are only comparable for the upper strata. Thus, according to the current assessment, we have 19 individuals (with 95% CI 4 – 34 individuals) in B strata in spring 2021. There is a considerable decline for the Matsimi B stratum, in which we recorded 61 red deer in 2018 and only 5 in 2021. NACRES data are in line with other independent results, suggesting that the red deer population has been likely declining in Lagodekhi (Figure #2).

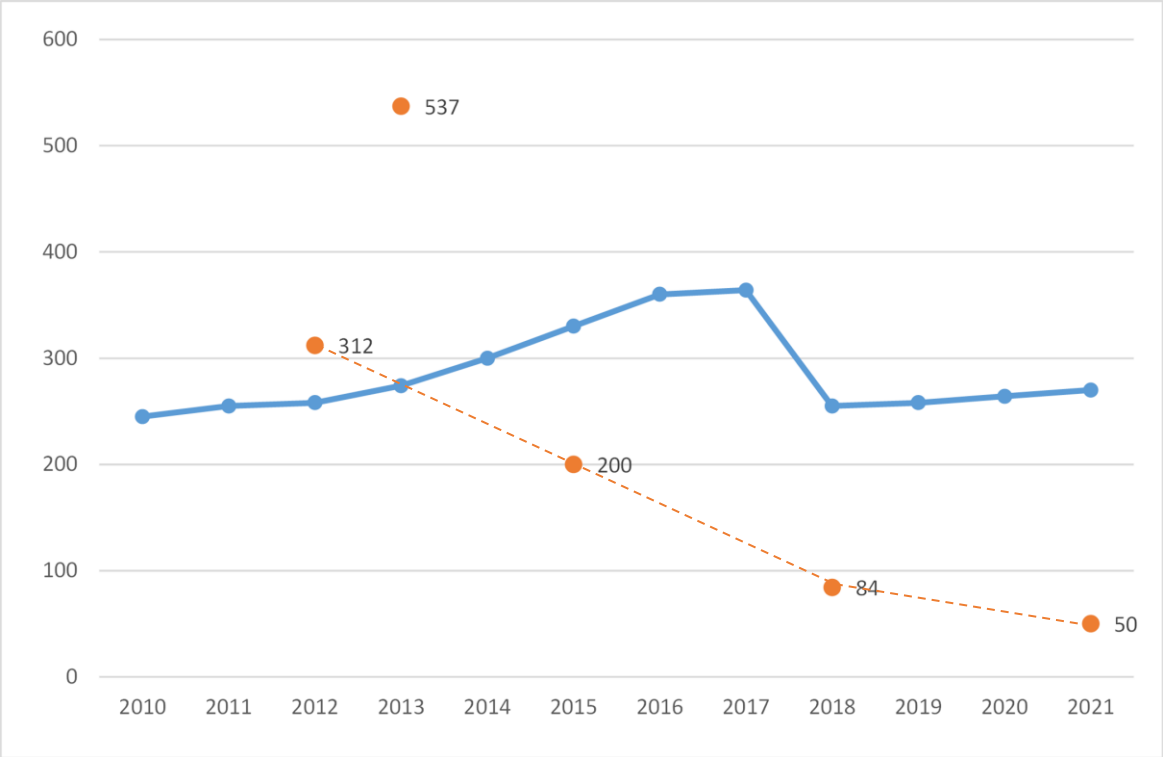

Figure #2 The dynamics of the red deer population in Lagodekhi PA during 2010-2021.

The blue line represents the trend according to APA. Orange dots are independent counts carried out by Ilia state university (in 2012, 2013 and 2015) and NACRES (in 2018 and in 2021).

According to the APA data, there was a sharp decline in red deer numbers in 2017-2018. However, according to the park director, Giorgi Sulamanidze, this was not reflective of an actual population decrease but rather was due to a change in the calculation methodology − as of 2017 they used a reduced average female number (harem size) per roaring stag[1].

[1] Until 2017, LPA administration used 4.5 as the average number of females per roaring stag ("average harem" size). In 2017 onwards, they used 3.8. This obviously reduced the calculated total population numbers, since, in this method, the total population is calculated by multiplying the recorded number of roaring stags by the average harem size (added the number of so called silent stags if available).

6.1.2 Threats to the red deer population in LPA

At this point it is difficult to associate the likely decline of the red deer population in Lagodekhi PA to any single factor. There may be one or a combination of several direct or indirect threats of which **illegal hunting** may be most important. It appears that in addition to being a more common and traditional trophy, red deer antlers in recent years have also become a valuable ingredient in some sort of home remedy − according to some sources some people actually believe that ground red deer antlers mixed with honey can cure cancer. It is rumoured among the local people that red deer antlers can be sold for 80-100 GEL per kilo at the black market. This black market might be an additional and relatively new motivation for locals to search the forest for shed antlers or even hunt large stags. We would recommend to conduct a study to establish if this illegal trade in antlers is a real additional threat to the red deer population in Georgia.

Thanks to its director's and the ranger team's remarkable anti-poaching work, LPA is distinguished as one of the best managed PAs in the country. However, their law enforcement efforts might have been insufficient to reduce illegal hunting pressure on the red deer population. The official data from APA also shows some increase in revealed violations in LPA in 2020 and 2021, which may be indicative of increased poaching levels.

Tourism may be a disturbing factor affecting the red deer population in LPA (Kobakhidze D, 2018). It can be hypothesized that with high levels of poaching the red deer may avoid humans in general, which may have implications on their habitat use and daily activity. Tourism was quite high before 2020. But then it dropped sharply in all PAs due to Covid-19 pandemic. The last two years should have been a relief for the red deer population. However, this has not shown in current population numbers, at least as yet. More research is needed to establish how important is tourism as a limiting factor for the red deer population in Lagodekhi.

Some changes in local habitats, possibly associated with **climate change and/or reduced grazing pressure**, have been noticeable in LPA. Namely, the process of reforestation of previously open subalpine zone areas is evident. Subalpine meadows have become occupied by young high mountain maple (*Acer trautvetteri*) and rowan (*Sorbus aucuparia*). In search of new high quality browsing the red deer might be forced to more rugged terrain entering into interspecific competition with tur. Tur population in LPA, on the other hand, is probably stable over the last years or even has a positive trend in LPA (NACRES report 2017). Therefore, **intraspecific competition between tur and red deer** can not be entirely excluded. On the other hand, if illegal hunting is the main cause of the red deer decline, the poachers must have been especially targeting these animals and less the tur, of which currently there is no evidence. Clearly, more in-depth study of the nature and patterns of illegal hunting, far beyond simple enumeration of revealed violations, is necessary.

Until 1990s, red deer were frequently seen on subalpine meadows. In this or previous studies no red deer were observed even in such well-known red deer grazing areas as so called Sedlavina. This might be indicative of red deer preferring to remain in the forest at least during the day which in turn may be associated with increased human disturbance (such as illegal hunting) or interspecific interaction with tur or even with a combination of these two factors.

6.2 Red deer population in Borjomi-Kharagauli PA

The BKhPA red deer population is a remnant, isolated population on the Lesser Caucasus (see Appendix #1). Its range is mostly confined to the protected areas with only small groups found in western part of Adigeni municipality, close to the administrative border with Adjara Autonomy (NACRES report 2016). There have been unconfirmed sightings of red deer on the right banks of the Mtkvari (Kura) river in town Aspindza.

By the beginning of the 20th century this population was down to only 100-200 individuals (Markov, 1934). According to EkvtimiSvili (1946), there were 78 individuals in Borjomi reserve in 1934 and the population literally doubled in 1935. Markov (1937), on the other hand, believed there were about 200-250 red deer during these same years. The "Bunebis Matiane" (Chronicles of Nature)[2] of the Borjomi nature reserve provides information about red deer numbers since 1961 at which time there were 1,150 red deer in the Borjomi reserve that was only 18 000 ha at the time. Some researchers think that this number is a significant overestimation (Kukhianidze Z, 1965). Arabuli (1977) carried out an independent assessment in 1974-1975 and counted only 371 individuals in the reserve and surrounding areas of Akhaltsikhe and Adigeni. For the same years the *Bunebis Matiane* claimed there were as many as 1,420 red deer in the Borjomi reserve alone.

By the end of 1980s the population was estimated at 500 individuals (Chikovani G., et al 1990). In 1990s, the political instability and economic crisis after the collapse of the Soviet Union severely affected the Borjomi red deer population (Badridze J., et al 2000) and the numbers dropped as low as 30 individuals by 1999 (Bejan Lortkipanidze, unpublished data). Since then, the red deer population

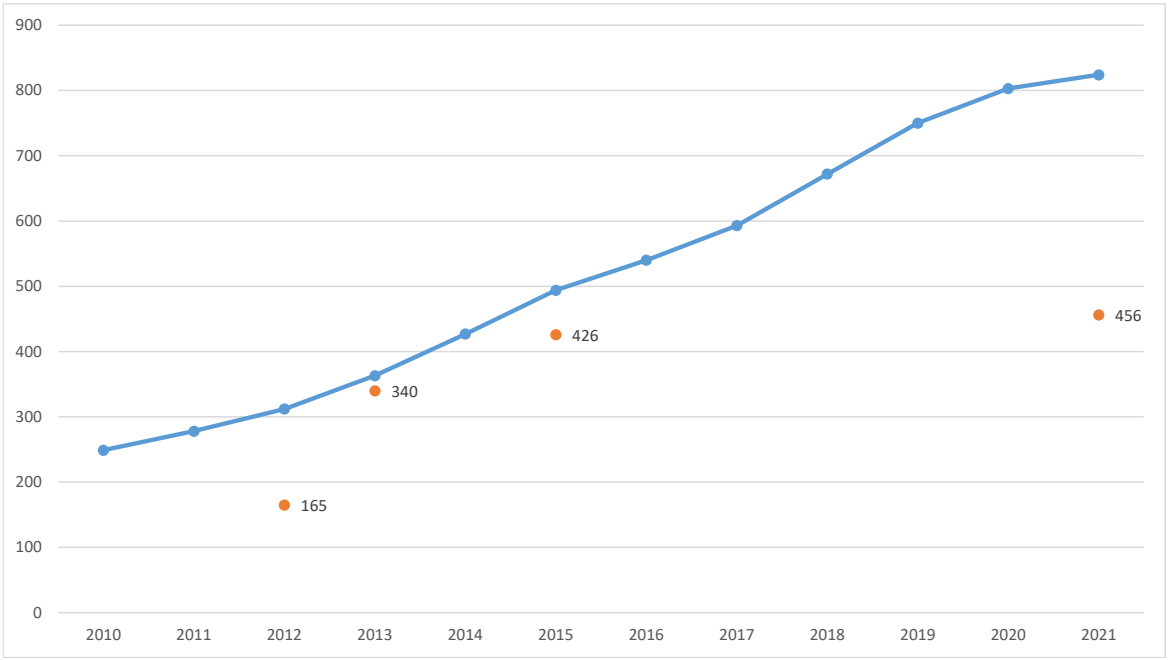

Figure #3 The dynamics of the red deer population in Borjomi-Kharagauli PA.

Blue line represents official data by Agency of Protected Areas. The orange dots are independent counts carried out by Ilia state university (2012 and 2013), and NACRES (2015 and 2021).

[2] *Bunebis Matiane* (Chronicles of Nature) was an annual publication, produced by every major nature reserve during the Soviet times.

began a slow recovery as the protected area was expanded to became one of the largest national parks in the country and biodiversity protection was significantly improved (Fig. #3).

According to APA official data the red deer population numbers are steadily growing (see Figure #3). There have been four independent assessments in last decade; Ilia State University (ISU) carried out red deer assessment in 2012 using species signs such as tracks and faecal pellets and counted 165 individuals (Ilia State University, 2012). In the same year the park counted almost twice as many red deer (312) during the rut. Ilia State University conducted another survey the following year using the pellet group count method and counted 340 individuals that was similar to the official number produced by the park – 363 red deer. NACRES carried out an assessment using the faecal pellet group count method in spring 2015 and counted 426 individuals (325-527 deer individuals with 95% CI). In the autumn of the same year, BKhPA administration conducted a roar count and estimated 494 individuals. This number is within the confidence interval of the NACRES result, so is the result obtained by Ilia state university. All of this may imply that the red deer population in BKhPA was more or less stable.

The current assessment yielded 456 red deer (with 95% CI 221 – 649 individuals). The BKhPA administration's result for 2021, which is 824 individuals, is still out of its 95% confidence interval.

NACRES estimate made in spring 2015 was 426 red deer (with 95% CI 325-527 individuals. While comparing this number to the latest NACRES result does not produce any clear trend due to large SE, a negative trend is clearer for the Abastumani area (stratum) (Table #3).

Table #3 C*omparing the results of two assessment by NACRES.*

Stratum	Red deer N in 2015	Red deer N in 2021
Borjomi	168 – 321	180 – 480
Atskuri	73 – 98	40 – 137
Abastumani	84 – 108	1 – 32
Total	**325 – 527**	**221 – 649**

Red deer decline in the Abastumani area was expected even before the data analysis because we detected much less number of faecal pellet groups on the transect as compared with the previous assessment. **This may be associated with the ongoing major road construction in that area. It may be speculated that the construction works during all winter and spring in 2021 deterred red deer from the area and the animals have taken shelter elsewhere.**

However, if we compare only independent data (2013 by Ilia state university and 2015 and 2021 NACRES) we can probably say that **the red deer population in Borjomi-Kharagauli PA has remained largely stable since 2013.**

6.3 Threats to the red deer population in BKhPA

Recent years' **large-scale infrastructure developments** have become a significant threat to the biodiversity in BKhPA. A high-power line was built in 2009 and 2010, primarily crossing through black

grouse (*Lyrurus mlokosiewiczi*) and Caspian snowcock (*Tetraogallus caucasicus*) habitats but also likely causing disturbance to other wildlife including mammals.

The ongoing construction of the Abastumani – Bagdadi road is another major infrastructure project directly affecting the park. This road connects Samtskhe-Javakheti region to western Georgia and allegedly has a military and economic importance. Some sections of this road will follow the existing minor road that is being widened but a completely new section is also being constructed. This section of the road circles Abastumani and cuts through park territory. As a compensation for this damage the park was expanded and the Kurtskhana gorge was included in the PA. While this new territory contains good red deer habitats, it remains unclear whether the expansion is sufficient compensation of the overall damage to the red deer population. Other mitigation measures such as green bridges should also be considered and targeted research and monitoring programmes should be implemented.

Poaching still remains one of the major threats to the red deer in Borjomi. Illegal hunting is probably the most important limiting factor that keeps the local population well below the carrying capacity (BKhPA's carrying capacity for red deer should be much high than current numbers).

The effort of the park administration and its rangers to combat poaching is remarkable. Local rangers actively participated in the data collection and many of them, especially those who had taken part in 2015 surveys with NACRES, showed high motivation. With additional support and training the local team has all the potential of producing even better results, especially in light of the new SMART program that is presently being put in place.

Livestock grazing may also be a limiting factor to red deer habitat use and daily activity during the summer. Livestock is also a potential source of diseases. Fortunately, no signs of diseases have been currently detected among the red deer.

7 The overall status of the red deer in Georgia

Borjomi-Kharagauli and in Lagodekhi protected areas harbour the two largest red deer populations in the country. The species range does expand beyond BKhPA to the west and north (Appendix #1) – in small numbers red deer are found in Adigeni and Baghdati Municipalities too. There are also small red deer populations in Gardabani managed reserve and Tusheti protected areas. Sporadic reports of red deer presence are available (i) from Kazbegi - a female was photographed near Stepantsminda by

***Photo #4**. Red deer near Stepantsminda; G. Darchiashvili*

***Photo #5.** Red deer in Pirikita Khevsureti. NACRES camera trap photo*

Giorgi Darchiashvili in 2017 (Photo #4) and (ii) from Phshav-Khevsureti protected areas, where a NACRES camera trap captured a young stag near Khakhabo in Pirikita Khevsureti in 2012 (Photo #5). No subsequent sighting of red deer in those areas (which area frequently visited by both researchers and birdwatchers) suggests that those animals likely were vagrant individuals from Russia.

The available latest data from all key red deer areas that are both survey results and expert assessments are as follows:

Site	**Red deer numbers**	**Source/Author**
BKhPA	456	Current assessment/2021
LPA	50	Current assessment/2021
Tusheti	50	NACRES 2020
Gardabani	31	Gurielidze et al. 2015
Adjacent areas to BKhPA	20	NACRES 2017
Total population	***607***	

Thus, as shown above, the national population can be estimated at about 600 individuals. The estimation of Gurielidze and his colleagues in 2015 was 877 individuals (Gurielidze et al. 2015).

8 Recommendations

- The monitoring of the red deer populations in LPA and BKhNP should continue and the next assessment should be conducted in 2023;
- Anti-poaching capacities need to be enhanced at both PAs. Among other things, special anti-poaching training, law enforcement strategies as well as introducing SMART programme are expected to help the rangers combat the poaching more effectively;
- The long-term impact of the existing/ongoing infrastructure projects on Borjomi-Kharagauli PA should be further assessed and closely monitored especially in respect of red deer and other large mammals and appropriate mitigation measures such as green bridges, etc. should be implemented;
- Newly introduced SMART programme will potentially generate new important data on large mammals and they should be integrated into species monitoring programmes;
- A detailed study should be conducted to assess the illegal trade in red deer antlers as well as other aspects of red deer poaching and an effective awareness campaign should be carried out among the local communities. Additionally, it would be highly desirable to conduct special studies looking into possible linkages between the red deer decline and other human and ecological factors (e.g. tourism, interspecific completion, even biting insects) as well as climate change.

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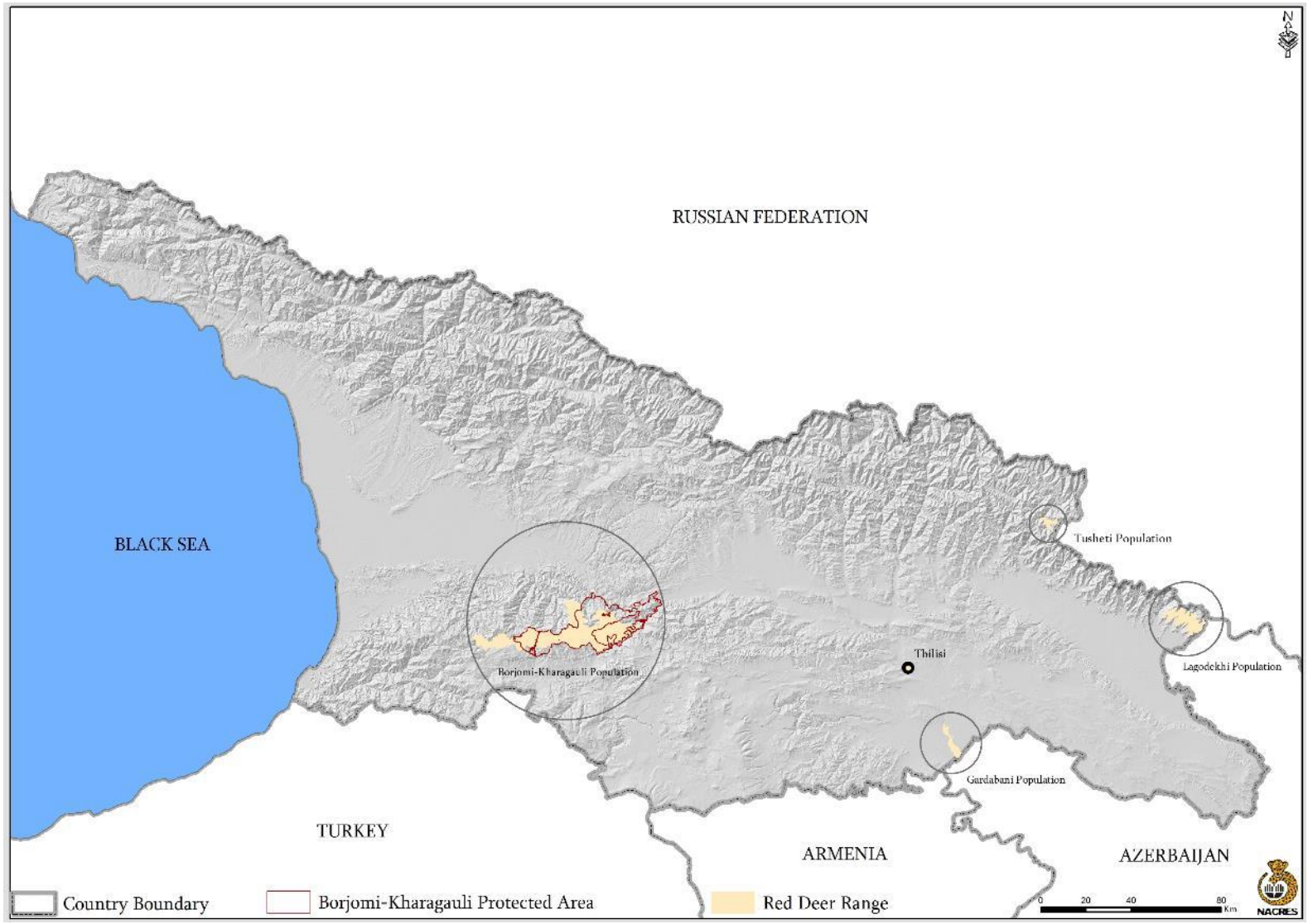
APPENDICES

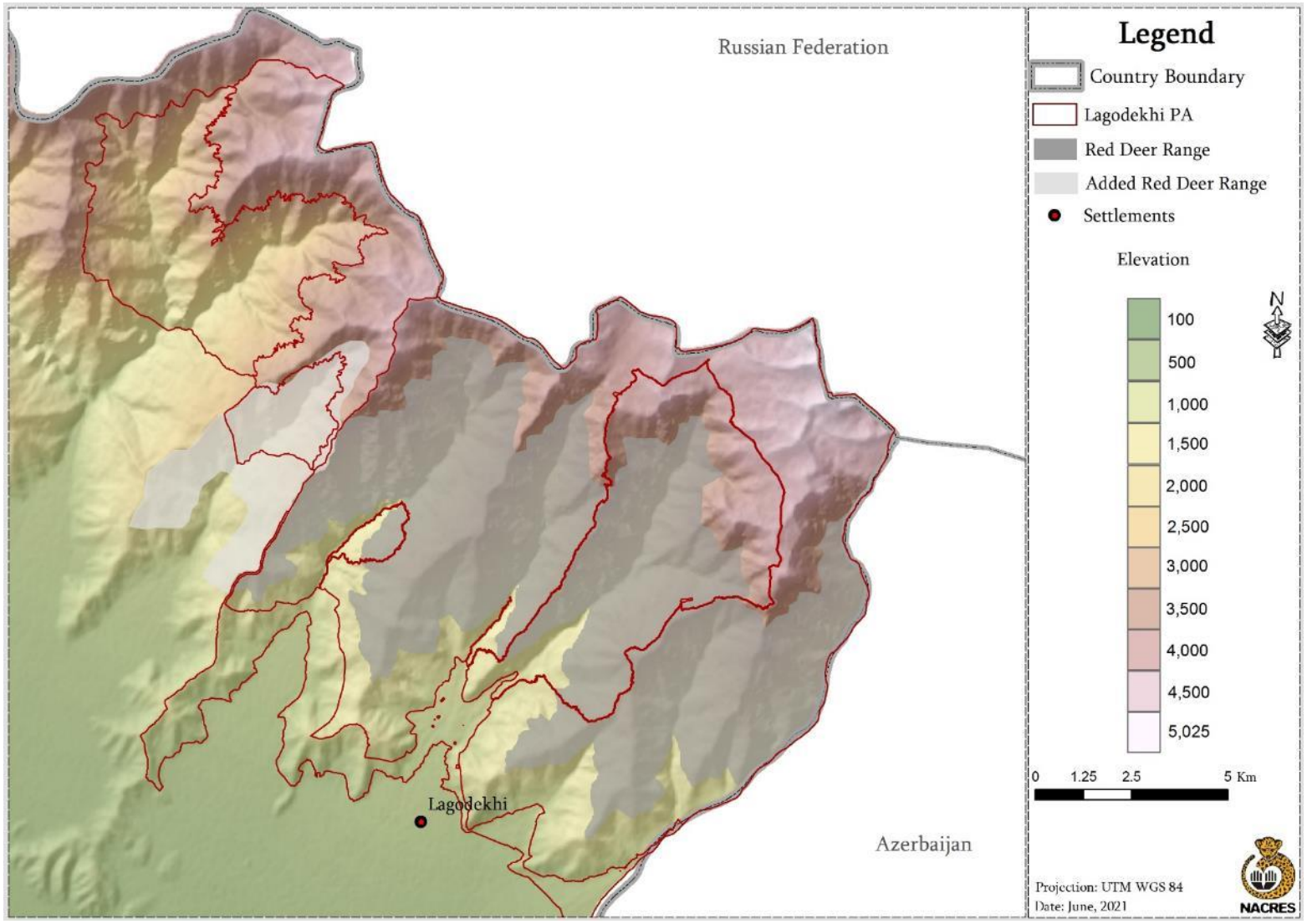
Appendix #1 The distribution of red deer in Georgia



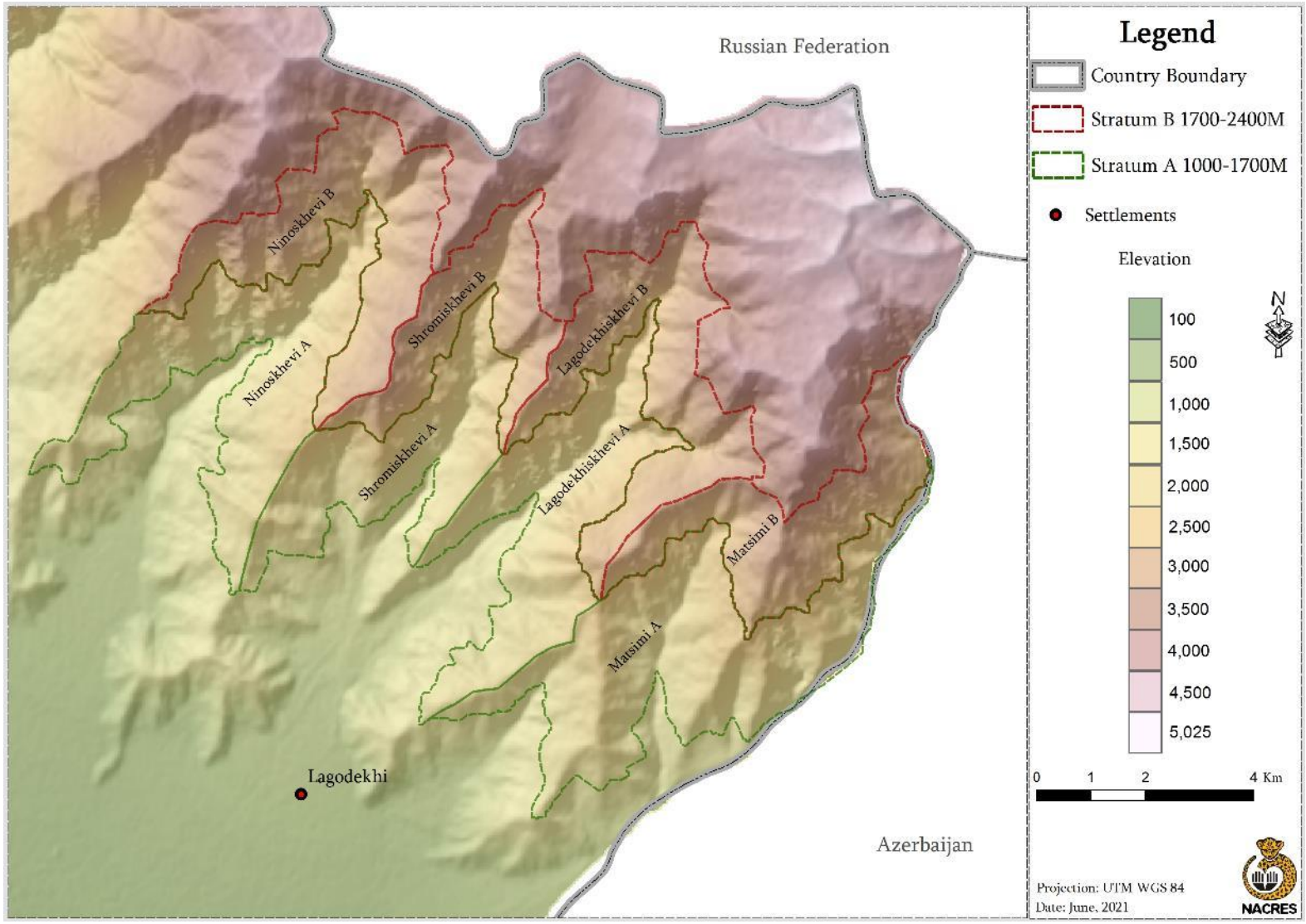
Appendix #2 Red deer count field form

Data Collectors (Name, Last name) 1. 2.						date				Stratum
						Direction				Cell #
Transect start point coordinates						Transect end point coordinates				
Start time						End time				
Transect	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**Total**
0-100											
100-200											
200-300											
300-400											
400-500											
											subtotal
500-600											
600-700											
700-800											
800-900											
900-1000											
											subtotal
										Total	
Notes											

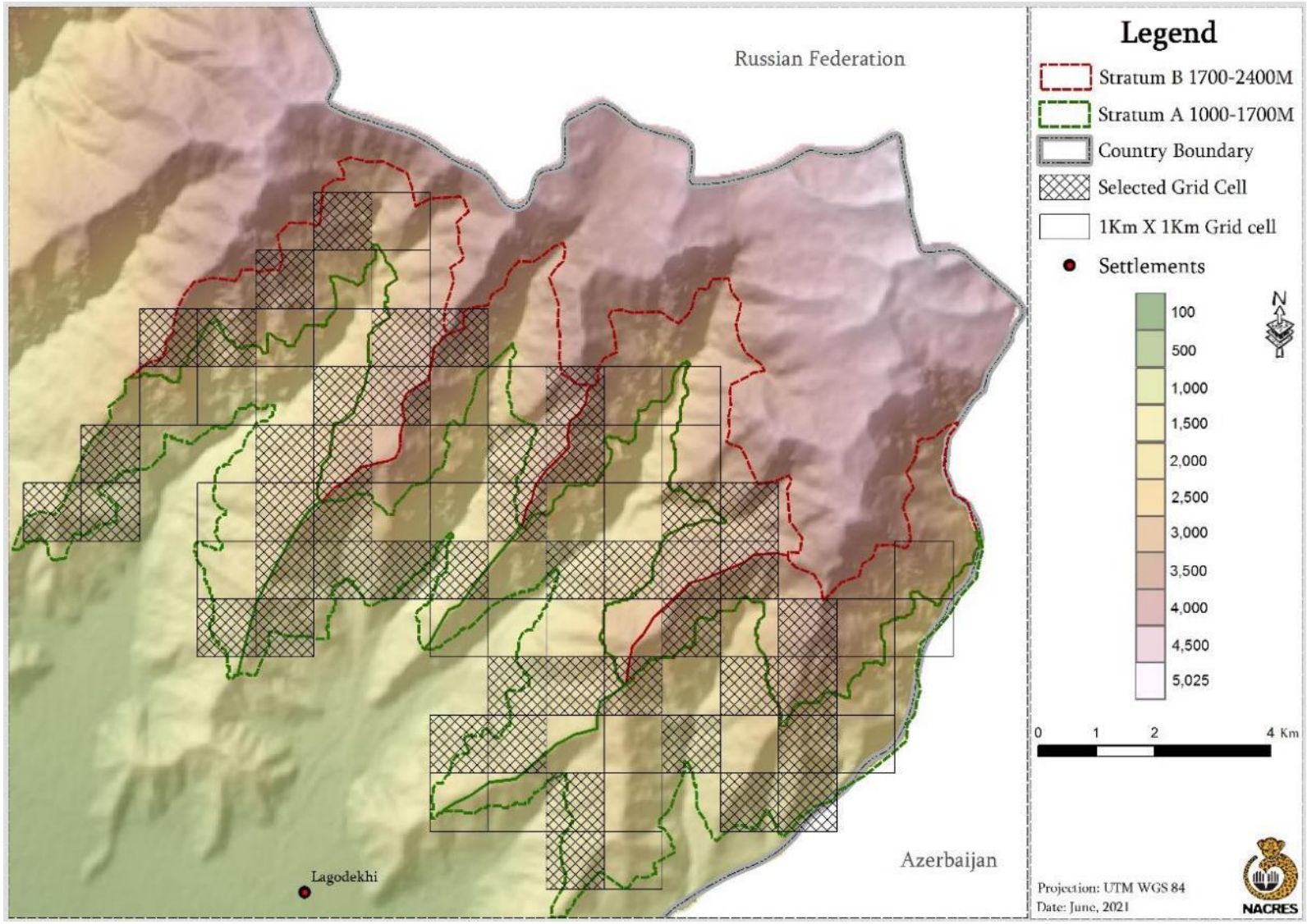
Appendix #3 Red deer range in Lagodekhi protected areas



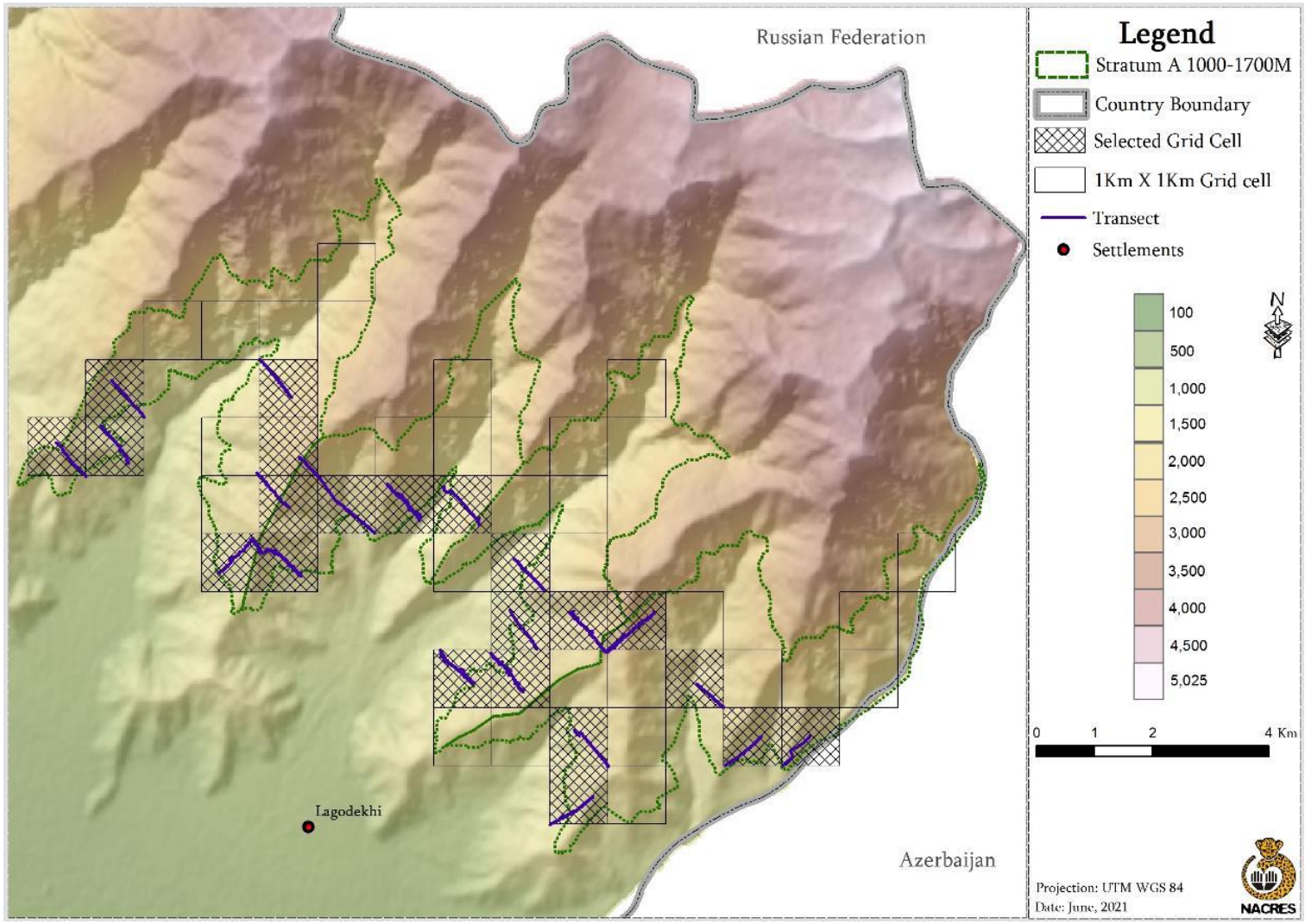
Appendix #4. Stratification of Lagodekhi study area for red deer counts



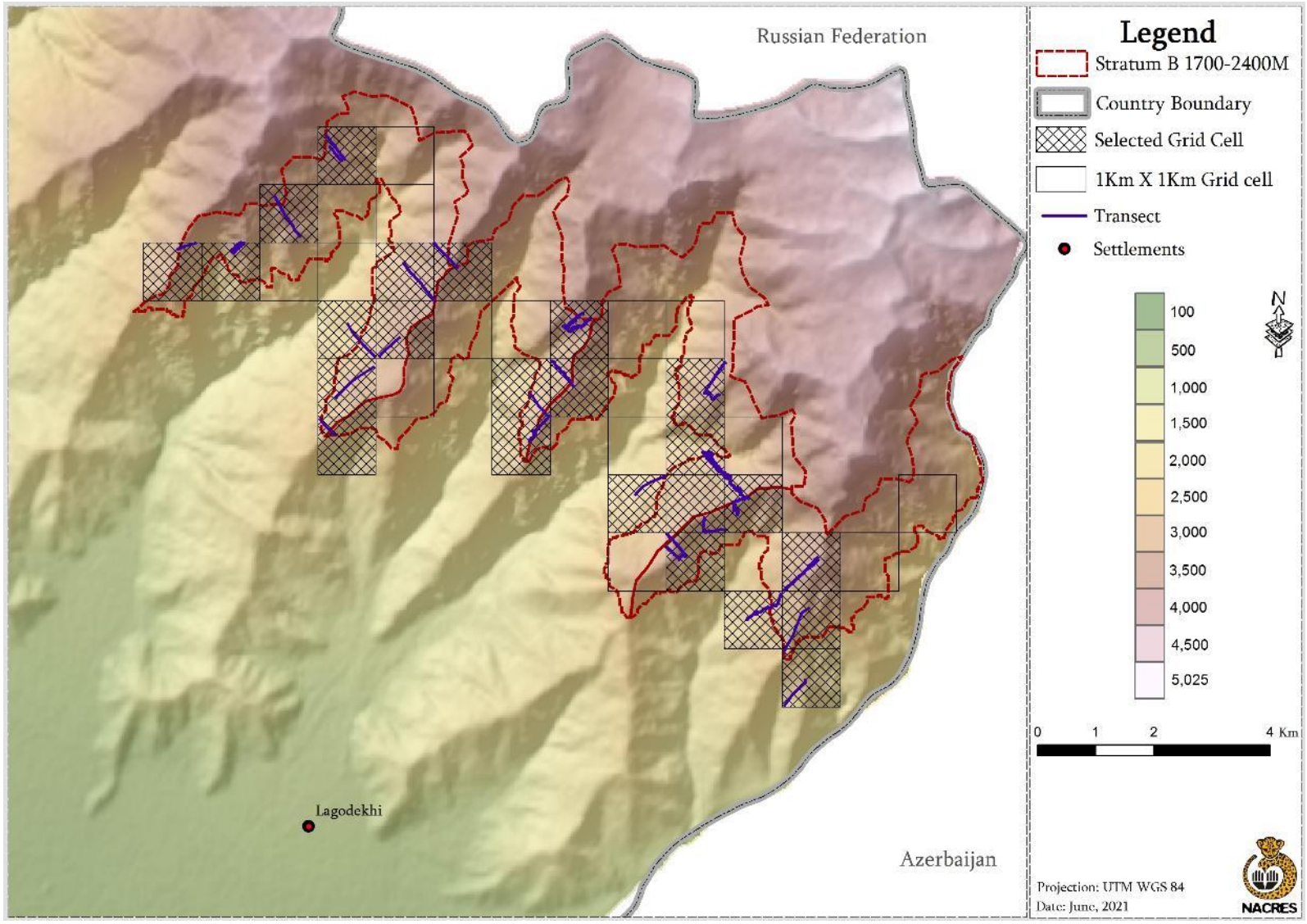
Appendix #5. 1 km X 1 km grid and random cells, Lagodekhi PA



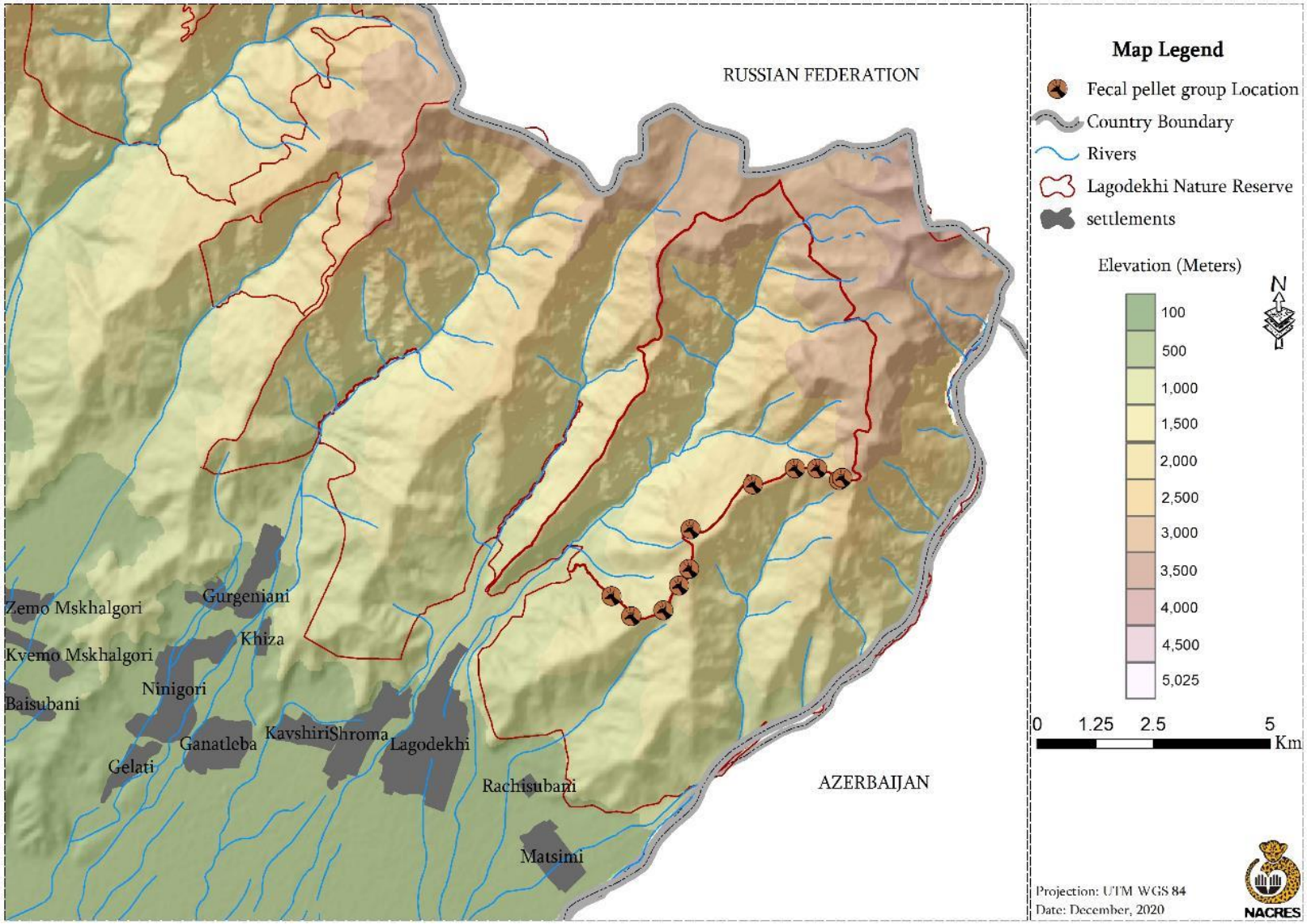
Appendix #6 Sampling transects in selected grid cells, A Strata, Lagodekhi PA



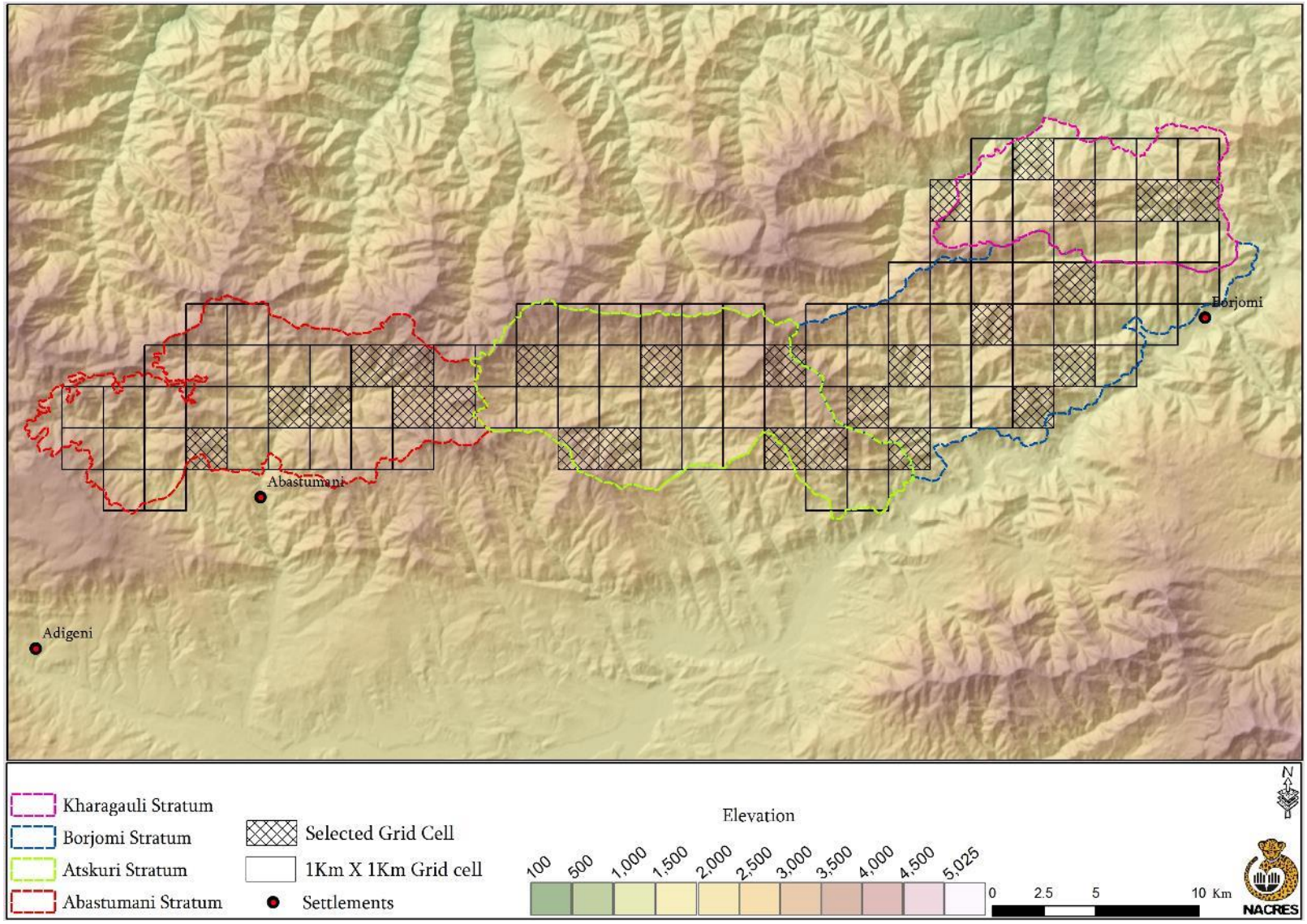
Appendix #7 Sampling transects in selected grid cells, B Strata, Lagodekhi PA



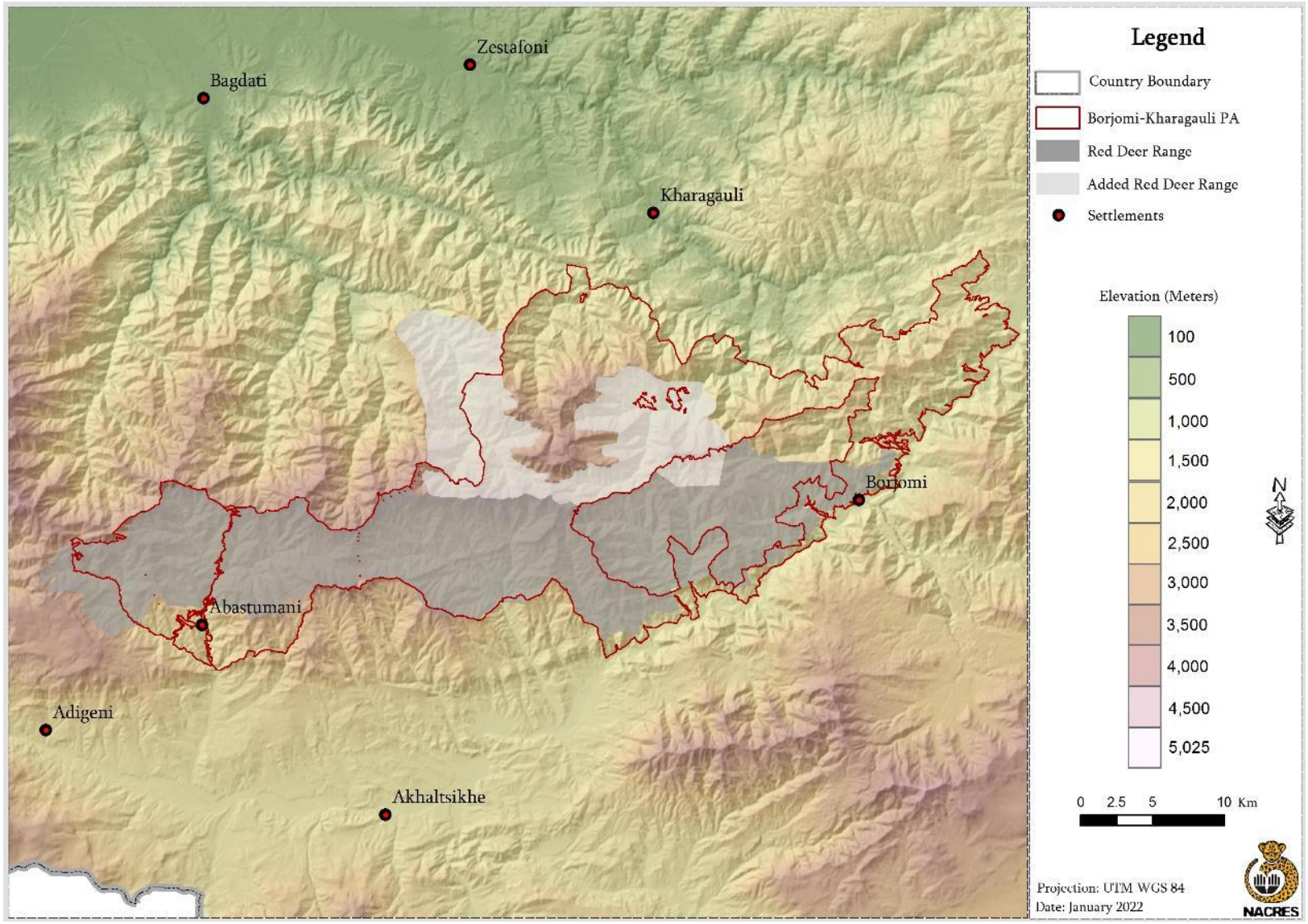
Appendix #8. The locations of red deer pellet group decay experiment, Lagodekhi PA



Appendix #9. Stratification and random grid cells in Borjomi-Kharagauli study area



Appendix #10. Red deer range in Borjomi-Kharagauli PA



Appendix #11. Transects in in Borjomi-Kharagauli PA