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PROJECT: PROMOTION OF ECO CORRIDOR IN THE SOUTHERN CAUCASUS

Consultancy service for

Mapping of Habitats of Key Species and Key Biodiversity Areas in the Western Lesser Caucasus Ecological Corridor

Final Report

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EXECUTIVE SUMMARY

NACRES experts, in collaboration with WWF Caucasus Programme Office GIS specialists and a forestry expert, conducted the assessment and mapping of habitats of the key species and priority areas in the Western Lesser Caucasus ecological corridor for the project, **Promotion of Eco Corridor in the Southern Caucasus**. The purpose of the work was to provide the basis for determining the geographic scope of the corridor, setting conservation objectives as well as conservation and intervention priorities within the corridor but outside the existing protected areas.

Habitat suitability models were conducted for the preselected three key species: the red deer, brown bear and chamois. All available geo-referenced data on the distribution of the key species in the study area and primarily those from NACRES' previous studies were put together and sorted for modelling. Variables for habitat modelling were identified and agreed upon with the rest of the habitat modelling team. The results of the habitat modelling were then used to propose priority areas. The team also elaborated recommendations for conservation activities within the corridor.

The majority of available GPS locations for the key species came from NACRES' previous studies and they had not been collected for habitat modelling purposes. This created certain constrains and limitation while using these data in habitat suitability modelling.

Maximum Entropy Modeling (MAXENT) software package was used for species suitability modeling. Two separate models - environmental and human disturbance models were elaborated for each species based on the selected variables and data. Using MAXENT software, the two models were combined and 5 habitat categories were outlined. Any areas where most important habitat categories of the key species overlapped were considered as of highest importance and were outlined as potential priority sites for the project. Two scenarios for priority sites identification were considered; The first included all three key species and the second one only included the red deer and chamois. The latter yielded with a more clustered distribution of high value areas and better enabled the delineation of priority sites. As a result 9 priority suites were proposed. Both general and species-specific recommendation were also elaborated.

Contents

1 Background

Three experts from NACRES including Irakli Shavgulidze, Bejan Lortkipanidze and Giorgi Gorgadze in collaboration with WWF Caucasus Programme Office GIS specialists, Giorgi Beruchashvili and Natia Arobelidze and with the support of Dr. Leri Chochua, forestry expert, conducted the assessment and mapping of habitats of the key species and priority areas in the Western Lesser Caucasus ecological corridor for the project, **Promotion of Eco Corridor in the Southern Caucasus**. The purpose of the work was to provide the basis for determining the geographic scope of the corridor, setting conservation objectives as well as conservation and intervention priorities within the corridor but outside the existing protected areas. The specific roles of the NACRES experts were (a) to Identify modelling variables for the key species and provide available geo-referenced data or expected ranges based on expert judgement and existing knowledge, (b) to evaluate habitat suitability modelling results and verify them before the production of habitat suitability maps, (c) to propose priority areas for conservation action based on the habitat suitability maps and develop recommendations for conservation of the key species within the study area, (d) to identify and specify applicable methods for future field research of the key species, and (e) to present the results at an expert workshop in the framework of the ECF Programme.

The Western Lesser Caucasus ecological corridor (i.e. the project's study area) stretches from Borjomi-Kharagauli Protected Areas (BKPA) to the west up to the Turkish border and encompasses the whole of Adjara Autonomous Republic, Meskheti Range and in addition to BKPA also includes another three protected areas: Kintrishi Nature Reserve; Mtirala National Park and Machakhela Protected Areas. The total study area is 502,635 ha (see Appendix #1).

Habitat suitability models were conducted for three preselected key species: the red deer, brown bear and chamois to help identify priority areas within the corridor in which conservation intervention was most appropriate. All available geo-referenced data on the distribution of the key species in the study area and primarily those from NACRES' previous studies were put together and sorted for modelling. Variables for habitat modelling were identified and agreed upon with the rest of the habitat modelling team. The results of the habitat modelling were then used to propose priority areas. The team also elaborated recommendations for conservation activities within the corridor.

2 Compiling preliminary information on key species

Our team participated in several meetings of the national team at which a draft list of variables were discussed for habitat modelling. Each of the zoology experts also compiled a brief overview of available information on the key species populations in the study area. It was emphasised that the available information mainly consisted of (i) existing literature, (ii) reports of conservation research conducted within the corridor by NACRES or other organisations, (iii) accounts and knowledge of local protected areas' staff and (iv) the expert knowledge of the team members. It was also noted

that the quality and level of knowledge differed greatly for each of the key species, the chamois being the least studied species and also perhaps one of the least studied large mammals in Georgia.

In preparation for a regional workshop, scheduled for 26-27 October 2015, we compiled all available information for certain variables. The aim of the workshop was to discuss and agree on final modelling variables. The information prepared for this purpose is presented in Appendix 2.

3 Regional workshop/training on modeling variables

The workshop took place at the WWF Caucasus programme office during 26-27 October 2015. It was attended by expert teams from Armenia and Azerbaijan too. Christian Montalvo, the project's habitat modelling consultant, presented the overall approach as to how to identify key conservation areas within the ecological corridors via GIS analysis and how the GIS specialist and species experts should work together to achieve best results.

Mr. Montalvo suggested that we prepared two GIS models for each key species: the first was a so called environmental model, showing suitable habitats based on the environmental variables, and the second model had to show human influence on species' habitats. The habitats had to be classified into three categories: unsuitable, sub-optimal and suitable habitats. Consequently, the two models had to be combined in order to identify five habitat categories: (1) **matrix** (unsuitable habitat in at least one of the two dimensional models), (2) **core areas** (optimal habitat conditions in both dimensional models), (3) **potential ecological traps** (optimal habitat conditions in the environmental model, sub-optimal habitat conditions in the human disturbance model), (4) **potential refuges** (sub-optimal habitat conditions in the environmental model, optimal habitat conditions in the human disturbance model), and (5) **potential sinks** (sub-optimal habitat conditions in both dimensional models).

As a result of the workshop, we identified variables for each key species. We based some of the variables on the ecological profiles that we prepared for the three species prior to the workshop. Some of the information in the ecological profiles was discussed in more detail with the colleagues from Armenia and Azerbaijan. Finally, workshop participants came up with a total of 15 preliminary variables that had to be used in habitat suitability modelling for the key species (see Table 1).

Table 1: *Preliminary variables for mapping habitat suitability for brown bear (BB), chamois (CH), and red deer (RD) in Georgia, including preliminary proxies for some variables*

#	Variable	SPECIES			Proxy
		BB	CH	RD	
1	Land Use/Land Cover	X	X	X	
2	Mosaic structure	X	X	X	
3	Exposition	X	X	X	
4	Human density	X	X	X	Cost distance to settlements
5	Elevation	X	X	-	
6	Grasslands/Forest ratio	X	-	X	

7	Open stands	-	X	X	
8	Livestock density (cattle and sheep)	-	X	X	Cost distance to shepherds cottages/houses
9	Road density	X	-	-	Cost distance to roads
10	Forest classes	X	-	-	
11	Slope	X	-	-	
12	Above and below timberline	-	X	-	
13	Logging concessions (presence - absence)	-	X	-	
14	NDSI - Normalized Difference Snow Index	-	-	X	
15	Undergrowth (Rhododendron)	-	-	X	

4 Follow up activities after the workshop

After the regional workshop, NACRES experts had several meetings with Mr. Giorgi Beruchashvili, the team's GIS specialist, and Dr. Leri Chochua, forestry expert, to discuss the available data and habitat sustainability model variables. These discussions showed that data for some variables, which had been previously agreed upon at the workshop, were not accurate enough for habitat modeling (such as logging concessions, livestock density). On the other hand, there were some overlaps between certain variables (for example *above and below timberline* and *mosaic structure* were already reflected in variable *forest classes*). After careful consideration we decided to eliminate certain variables such as *above and below timberline, logging concessions, livestock density* and *mosaic structure.*

In addition, we also presented earlier work that NACRES conducted with Dr. Chochua in parts of the current study area. During that study, forest habitats were classified and mapped based on its importance to the brown bear. The approach was accepted by the rest of the team and Dr. Chochua and the team's GIS specialists developed a forest class variable using a similar approach.

The GIS specialists suggested that we also used NDVI - Normalized Difference Vegetation Index as a variable showing plant biomass in the study area. This variable was considered to be potentially related to key species habitat suitability and it was therefore included in the variables list. A total of 12 variables were eventually used for developing first drafts of species habitat suitability models (see table #2).

Table 2: *Variables for initial mapping the habitat suitability of brown bear (BB), chamois (CH), and red deer (RD) in Georgia.*

#	Variables	SPECIES		
		BB	**CH**	**RD**
1	Land Use/Land Cover	X	X	X
2	Exposition	X	X	X
3	Human density	X	X	X
4	Elevation	X	X	X
5	Grasslands/Forest ratio	X	X	-

6	Open stands	X	X	X
7	Road density	X	X	X
8	Forest classes	X	-	-
9	Slope	X	X	X
10	NDSI - Normalized Difference Snow Index	-	X	X
11	NDVI - Normalized Difference Vegetation Index	X	X	X
12	Undergrowth	-	X	X

Several scenarios of habitat modelling were elaborated. The statistical model MAXENT showed that some parameters played extremely little or no role in key species habitat modelling. Mostly because the data, on which given variables were based, were too general, the model was unable to find any relation between the key species locations (GPS points) and those variables. Therefore we removed the following variables *Land Use/Land Cover*, *Grasslands/Forest ratio* and *Undergrowth* in the subsequent modelling process. We also removed *Elevation* because no location data for the key species were available from high elevation areas (see chapter #4). The final list of variables is showed in Table 3. These variables were used to create suitable habitat models of the key species, based on which we eventually identified priority areas.

Table 3: *Final variables for mapping habitat suitability for brown bear (BB), chamois (CH), and red deer (RD) in Georgia.*

#	Variable	SPECIES		
		BB	**CH**	**RD**
1	Exposition	-	X	X
2	Human density	X	X	X
3	Open stands	X	X	X
4	Road density	X	X	X
5	Forest classes	X	X	X
6	Slope	-	X	X
7	NDSI - Normalized Difference Snow Index	-	X	-
8	NDVI - Normalized Difference Vegetation Index	X	X	X

5 GPS data for the key species

It is important to note that the available GPS locations for the key species had not been collected for habitat modelling purposes. The data that we compiled for habitat modelling came from NACRES' previous studies such as population surveys, which relied on various field techniques including camera trapping and non-invasive DNA sampling. This posed certain constrains and limitations to the habitat modelling process. For example, it was impossible to distribute the data by season because most of them were collected during a specific time of the year. In addition to NACRES data we also used available information from the protected areas (e.g. some data on chamois). The Project, **Promotion of Eco Corridor in the Southern Caucasus** also collected information on the key species from local population. This information was evaluated by the NACRES experts and part of it was successfully used in the habitat modelling process.

Brown bear

More than 600 brown bear GPS locations were available for the habitat modelling. Most of them were from within Borjomi-Kharagauli national park (448 locations). The data were sorted and locations closer than 30 m. to each other were excluded. It soon became clear that the high concentration of GPS points within Borjomi-Kharagauli Protected Areas (BKPA) forced the model into the wrong direction. The model suggested that the forest in Adjara was less favoured by bears than that in the Borjomi area. According to NACRES information bear density in Adjara was not any lower than elsewhere and therefore it was assumed that the model was not working properly.

In order to address the huge imbalance in the geographical distribution of GPS points, we randomly reduced the number of points from BKPA from 448 to 55 locations and ran the model again. In the final stage of the habitat modelling we used 111 GPS locations in total (55 GPS points from BKPA, 25 from Kintrishi State Reserve, 24 locations from elsewhere in Adjara and Adigeni municipality). Most of these locations had been collected in autumn.

The modelling process was further refined by removing several variables that were evidently responsible for inaccurate results. Because the bear locations had been collected for other purposes (such as NACRES' study to estimate the bear population via non-invasive genetic method) the sampling scheme did not evenly or at all cover all habitat types e.g. higher altitude areas and steep slopes. This obviously had a significant impact on the bear habitat modelling process – the model showed higher elevation areas and steep slopes as unsuitable bear habitats. Therefore, *elevation*, *exposition* and *slope* were removed from subsequent modelling process.

Chamois

Few GPS locations were available for chamois. The species is understudied in Georgia and its relatively low density makes data collection even more difficult. In final habitat modelling process we used 36 GPS points (15 from BKPA, 14 from Mtirala National Park, 5 from Kintrishi State Reserve and 2 locations from the Adigeni area). All of those data had been collected from relatively accessible places and only few were from high elevation areas. Hence, the habitat model suggested that the chamois avoided high elevation areas in the study area. This was of course in contradiction to the known ecology of the species. Therefore we had to remove the variable of *elevation* and run the model again.

Red deer

A total of 219 GPS points were used for red deer habitat suitability modelling. Most of them had been collected in BKPA during early spring. Red deer data were not collected from higher elevation areas due to deep snow. Therefore, *elevation* was not used in the modelling process.

6 Data analysis and mapping

As mentioned above, Maximum Entropy Modeling (MAXENT) software package was used for species suitability modeling. Two separate models - environmental and human disturbance models were elaborated for each species based on the selected variables and data. Using MAXENT software, the

two models were combined and 5 habitat categories were outlined: 1. Core areas; 2. Potential ecological traps; 3. Potential refuges; 4. Potential sinks; 5. Matrix (see Chapter 3 for more details).

By definition *core areas* and *ecological traps* were the most important territories for the given species and potentially for any intervention for its conservation. Any area of overlap of most important habitat categories of the key species was considered as one of highest importance and was outlined as potential priority sites for the project.

Table #4. Ranking habitat categories

Habitat Categories	**HSI Value**
Core areas	1.00
Potential ecological traps	0.75
Potential refuges	0.50
Potential sinks	0.25
Matrix	0

In order to combine the habitat maps of the three species, produced by MAXENT, we used the Habitat Suitability Index (HSI) approach. Species habitat categories were ranked – a numerical index was assigned to each category between 0 and 1; 0 indicates unsuitable habitat, 1 represents the most suitable habitat (see Table #4). Initially habitat layers with HSI values of each of the three species were combined in GIS to reveal areas with the highest combined HSI values. Such areas are shown on the map as darker areas (see Appendix 3). On this map the territories that had the combined HSI value 3.00 have the darkest coloration and indicate the overlap of *core areas* of all three species. Then, any sites with the combined value between 1.00 and 3.00 were considered as potential priority areas. However, the priority areas, as revealed by this approach, covered much of the study area or its patches were very scattered. This allowed few opportunities for outlining any clear boundaries between different priority sites and subsequently for their prioritization, which would be a more practical approach for the project. It was clear that this was a result of inclusion of the brown bear habitat model. The brown bear, being the most habitat generalist species among the three key species, was responsible for the obtained more or less even distribution of high HSI value patches. Subsequently, the brown bear habitat model was excluded based on the assumption that any priority areas for each or both of the remaining two key species would inevitably include important bear habitat categories. Thus the red deer and chamois habitat suitability models were combined using the same approach as described above. Any area with the combined value between 0.75 and 2.00 was considered as a priority area. This exercise yielded a more clustered distribution of high value patches and eventually enabled the delineation of 9 priority sites (see Appendix 4).

7 Priority sites

Each of the 9 priority sites includes important bear habitats, which means that these territories are also important for bears. Further prioritization is still possible even within these 9 sites depending on specific project objectives. In general terms, the higher the combined HSI the greater the value of a given site for the two key species, red deer and chamois, and, presumably, also for other wildlife. Such sites may be a focus of the project conservation activities. Below is the short description of each priority site. The numbering of the sites on the map (Appendix 4) does not reflect their importance, but sites of similar ecological role and conservation values are grouped and described together.

Site #1 (see Appendix 4): The total area of Site #1 is 20,171 ha. It encompasses parts of Adigeni and Akhaltsikhe municipalities and is adjacent to the western parts of BKPA. It includes core habitats of all three key species. According to our preliminary data all key species are found in these areas, possibly at lower densities than within the protected area. This site is important (i) as a buffer zone of BKPA and (ii), in respect of the key species and other wildlife, for potential range expansion. Implementing effective conservation activities in this site would benefit the status of the key species populations within the protected area and potentially encourage their further expansion beyond the PA boundaries.

Site #2. The total area of this site is 32,465 ha. It covers parts of (i) Chokhatauri municipality of Guria region, (ii) Khulo municipality of Adjara and (iii) Adigeni municipality of Samtskhe-Javakheti. It includes *core areas* of all three species. According to locals, both bears and chamois occur in this site. It appears that occasionally red deer are also found there. Natural re-colonization of these areas by the red deer should be possible from the east. Site #2 lies on one of the most feasible potential ecological corridors toward the west for the three species and other wildlife.

Sites #3A and **#3B,** respectively covering 8,706 ha and 35,475 ha have similar ecological and conservation values. While both of them include small portions of *core areas* of all three species, they are largely dominated by sub-optimal habitat categories. It is possible that these sites still function as corridors for all three species. However they are probably especially important for red deer. The habitat modeling showed that no other territories to the west had sufficiently large suitable habitats of red deer. According to local hunters, red deer are seldom observed in Site #3B. Site #3A can be considered as a corridor to the south connecting with the Posof Protected Areas in Turkey.

Site #4. The total area of the site is 6,710 ha. It entirely situated Adjara and includes parts of Shuakhevi and Khulo municipalities. Despite small size, it includes suitable habitats for chamois and brown bear, and also small patches of *core areas* of red deer. This site can be considered as an important stepping stone between Borjomi-Kharagauli Protected Areas and the protected areas of Adjara, for bears and chamois as well as other wildlife.

Sites #5A and **#5B,** covering 5,353 ha and 23,418 ha respectively, have similar conservation importance. Site #5A to the west of Machakhela is inn Khelvachauri municipality. Site #5B encompasses parts of the following municipalities: Shuakhevi, Khelvachauri and Keda. Both sites

have important bear and chamois habitats. These are large territories where healthy trans-boundary populations may still exist. Studies are needed to assess their actual status.

Sites #6A and #6B covering 20,352 ha and 43,870 ha respectively, represent relatively large areas that surround the complex of two adjacent protected areas, Kintrishi Protected Areas and Mtirala National Park. They can be viewed as buffer zones of those protected areas. Brown bears and chamois are observed in #6A all year round. According to our habitat suitability models, site #6B has important habitat categories for the brown bear and chamois, and may have role as a corridor for the movement individuals from west to east and *vice versa*.

8 Results and recommendations

Brown bear

The brown bear habitat suitability model showed that the species can live almost everywhere in the study area. There are no major obstacles (natural or man-made) between existing protected areas to interrupt the movement of individuals. The current bear density in western parts of the study area is unknown, but based on the available sporadic information it should not be very low.

The model also revealed that suitable bear habitats may be located very close to human settlements. It is however not known how often bears actually use such territories. According to NACRES data, brown bear attacks on livestock and agricultural fields are very common in Adjara. Local hunters often kill "problem bears" and possibly other "innocent" individuals too. As far as bear conservation is concerned within the ecological corridor, the mitigation of the human-brown bear conflict is probably the highest priority. This should be achieved by studying the root causes of the problem and elaboration/implementation of mitigation measures.

Recommendations for bear conservation in selected priority sites:

- **Study of root causes and intensity of human-bear conflict**. The study should include interviewing local population; assessment of damage caused by bears; assessment of livestock husbandry practices and identification of crops and localities targeted by bears; bear telemetry study would help understand habitat use by bears in human dominated landscapes and assess their home range in light of acute human-bear conflict.
- **Identify human-bear conflict hot spots (based on the above study) and conduct human-bear conflict mitigation activities/pilot projects.** These activities/pilot projects should demonstrate and promote modern methods/tools (e.g. electric fences, livestock guarding dogs etc.) to protect livestock and crops. Successful pilot projects will potentially reduce damage caused by bears and increase acceptance of the species among the local population and, hence, decrease the hunting pressure on bears.
- **Assess bear population density**. This can be most reliably done via the non-invasive genetic method. Knowing the actual bear abundance is the key to assessing its population status, planning further conservation activities and to conduct effective communication with the

local communities. In addition this information would contribute to the national monitoring of the species. The non-invasive genetic method was tested and adapted by NACRES in BKPA in 2014.

Chamois

Chamois habitat modeling suggests that the suitable habitat of this species is more widespread throughout the study area than it was previously believed. According to the species habitat suitability map (see Appendix #5) important chamois habitats are mainly located around the protected areas, but there are also possible corridors that connect them. However, it is unknown which of the identified priority sites actually have chamois. The chamois range may be very fragmented and not all suitable habitats are currently actually occupied by the species, due to human pressure (such as poaching).

While the chamois is included in the red list of Georgia as *Endangered*, its actual status in many parts of the country including our study area is unknown. Hence it would be advisable to assess chamois distribution and density within the priority cites or even throughout the ecological corridor. In addition threats to chamois population should be studied and addressed. Illegal hunting is believed to be one of the major threats to chamois in all Georgia. However other specific types of threats may also be present in the study area. Any studies of chamois habitat use and movement (daily and/or seasonal) would help assess the connectivity (or lack of it) between the Borjomi-Kharagauli and Kintrishi populations. Such data could be used to improve the chamois habitat suitability model and to identify critical sites that need special and/or urgent attention.

Recommendations for chamois conservation in the priority sites:

- **Rapid assessment of threats and distribution** should be carried out in all priority sites. Interviewing local population, camera trapping and/or direct observation methods may be used to outline the chamois range.
- **Local chamois monitoring schemes** should be conducted within selected priority sites (using direct counts, camera traps etc.).
- **Studying chamois habitat use and movement** will be useful to better understand the functioning of the eco-corridor.
- **Elaboration and implementation of specific conservation measures** will be possible on the basis of the above assessments/studies with the purpose to mitigate identified threats and any constraints to the connectivity between the chamois groups/subpopulations**.**

Red deer

Recent red deer population assessment and census conducted by NACRES estimated that there were between 300-500 individuals in Borjomi-Kharagauli Protected Areas (BKPA). It was also noted that some individuals venture outside the protected areas to the west and north-west. Locals from Adigeni and Baghdati also reported occasional red deer sightings. The red deer habitat modeling confirmed that these territories are highly suitable for the species (see Appendix #6). It is possible

that some individuals permanently live there. In any case, there is good potential of red deer restoration in those areas.

Poaching is believed to be number one threat to the red deer in Georgia. This is reflected in the fact that red deer populations remain only in protected areas, while their habitats are found throughout the country. However there may be other types of threats or human-induced limiting factors too. Therefore all possible threats should be identified and adequately addressed via effective conservation measures.

The model suggested that red deer distribution to the west (toward and within Adjara) may be limited by certain characteristics of the Colchic forest such as a very dense evergreen undergrowth. Further research is needed to better understand red deer habitat preferences to improve the habitat model and to model red deer population expansion to the west.

Recommendations for red deer conservation in the priority sites:

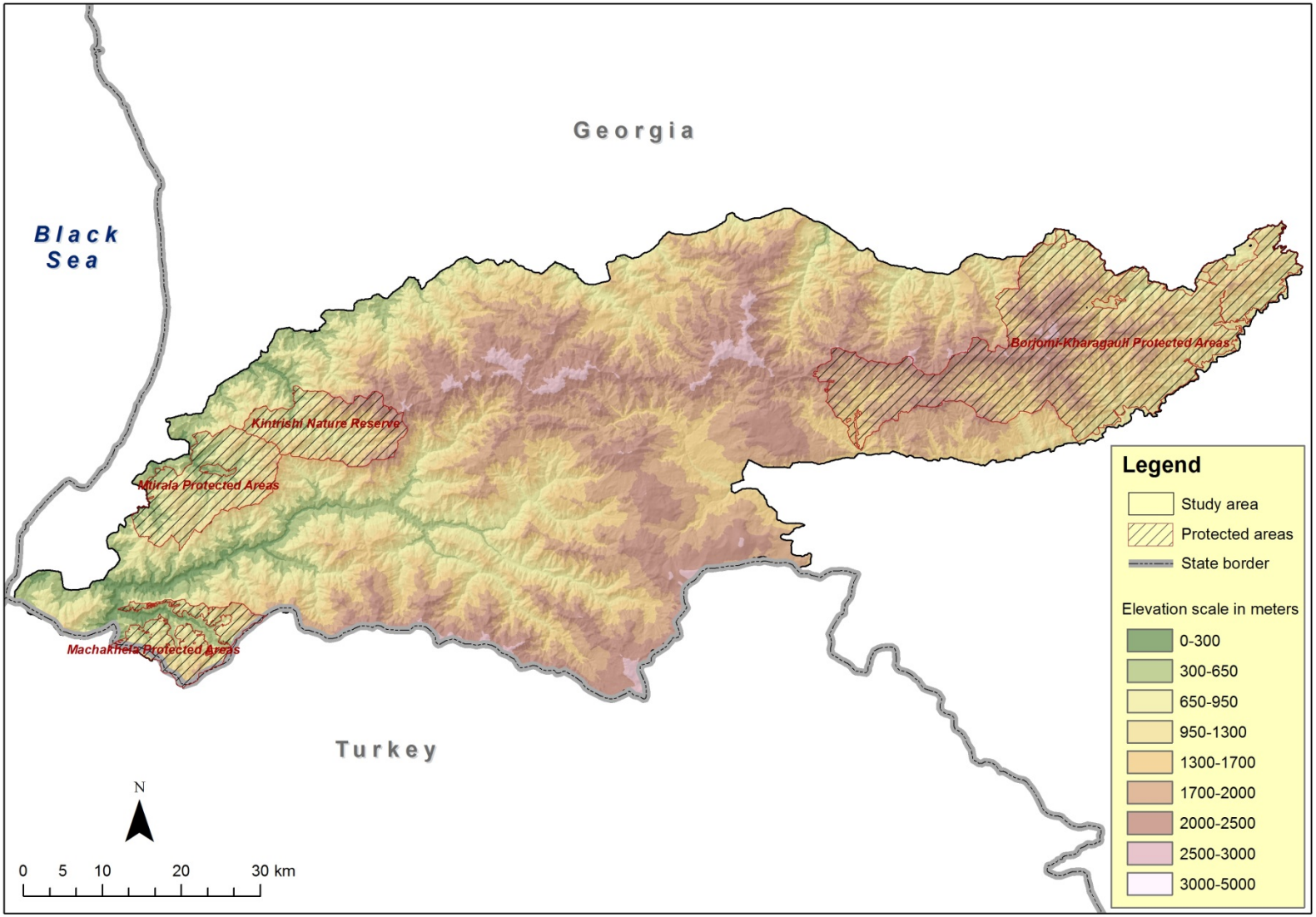
- **Study of red deer distribution.** Red deer presence/absence should be established in selected priority cites, especially in sites #1 and #2 (see Appendix #4 for map), among other methods, by using camera traps and direct observation techniques.
- **Local red deer monitoring schemes** should be conducted within selected priority sites (using roar counts, fecal group pellet count, camera traps etc.).
- **Red deer habitat selection** needs to be studied to refine existing habitat model and predict species range expansion.
- Based on updated habitat and species range expansion models **specific conservation measures** (such as restocking) in concrete sites should be planned and implemented.

General recommendations for supporting the key species conservation in the eco corridor:

- **Strengthening law enforcement and reducing hunting pressure** will inevitably benefit all three key species populations and many other wildlife. The local offices of the Inspection of Environmental Protection (IEP) may be supported and their capacity to combat poaching should be increased.
- **Involving the public in nature protection activities.** A number of different approaches may be used to encourage members of general public to cooperate with IEP.
- **Involving the youth in conservation**. Young locals may be involved in data collection or other conservation activities. Through participation in serious monitoring or research activities young people will learn more about wildlife conservation and potentially become supporters of further project activities.
- **Developing sustainable animal watching tourism**. The feasibility of bear and chamois, and other wildlife watching in Adjara should be assessed. Wildlife watching may generate income for the locals and increase their acceptance as well as their perceived values of wild animals.

- **Awareness raising and education campaign** should be conducted throughout the corridor targeting at the general public and/or specific groups such as resource users, hunters, farmers, etc.

APPENDIX 1: STUDY AREA



APPENDIX 2: SPECIES INFORMATION

Topics	Brown bear
Species name	*Ursus arctos*
Global conservation status (IUCN Red List)	Least Concern
Status of population in Georgia (Red List of Georgia)	Endangered The official 2012 national assessment estimated the total population at 1,600 individuals. In 20015 NACRES estimated brown bear density in the Borjomi-Kharagauli study area at 1.9-2.3 individuals per 100 km^2 , using the non-invasive genetic method. We can assume that the average bear density in the country is roughly within this range. Thus the total Georgian bear population is probably between 600 – 800 individuals.
Home range (in km^2), including delineating historical and/or existing population in the study area based on topographic maps and high resolution Google Earth images	Winter (excl. Hibernation period): 40-60 km^2 Summer: 60-350 km^2 (based on literature)
Relief (elevation, slope, exposition, snow cover)	Found in a great variety of terrain. No lower elevation limit; upper elevation limit is considered 3500 m.a.s.l. Steep rocky spots (60 degree and more) will be avoided
Vegetation cover preferences (i.e. habitat structure)	All types of forest (preferably with dense undergrowth for hiding), shrub and grassland. Benefits from forest openings in which their food plants are often abundant.
Food preferences and availability, including water intake/needs	Omnivore; eats a variety of vegetable foods such as nuts, fruits and berries, grass and leaves, plant roots and other underground structures, etc.; a range of carnivorous foods from insects to large ungulates; often attacks livestock, raids bee hives and crops. The importance of vegetarian *vs.* carnivorous food usually varies by season as well as from location to location.

Predators, including records of their presence within the study area (GPS points including data)	N/A
Threatening human activities and related factors (e.g. fragmentation)	Illegal hunting, disturbance (such as the extraction/collection of forest resources), tourism and infrastructure development; habitat fragmentation (through poaching, other disturbance or forest clearance).
Minimal viable population parameters (number of individuals needed to maintain a healthy population and minimal area to maintain a healthy population	-
Density (appropriate number of individual per km^2)	1.9-2.3 bears per 100 km^2 in BKPA and adjacent areas
Movement patterns (i.e. average traveling distance in a day, average migration distance and natural and artificial barriers to movement)	2-15 km
Record of species presence within the study area (GPS points, preferably with date)	GPS points available from Adjara and BKPA from 2014-2015.

Topics	**Chamois**
Species name	*Rupicapra rupicapra*
Global conservation status (IUCN Red List)	Least Concern
Status of population in Georgia (Red List of Georgia)	Endangered The official 2012 national assessment estimated the total population at 3,550 and that of the Lesser Caucasus at 770 individuals.
Home range (in km^2), including delineating historical and/or existing population in the study area based on topographic maps and high resolution Google Earth images	1,5-4 km^2 (based on literature)
Relief (elevation, slope, exposition, snow cover)	Usually found in steep, rocky areas in the mountains. In winter, prefers spots with relatively little snow cover such as south facing slopes. The lower elevation limit is about 500 m.a.s.l. and the upper limit is believed to be 3,100 m.a.s.l.

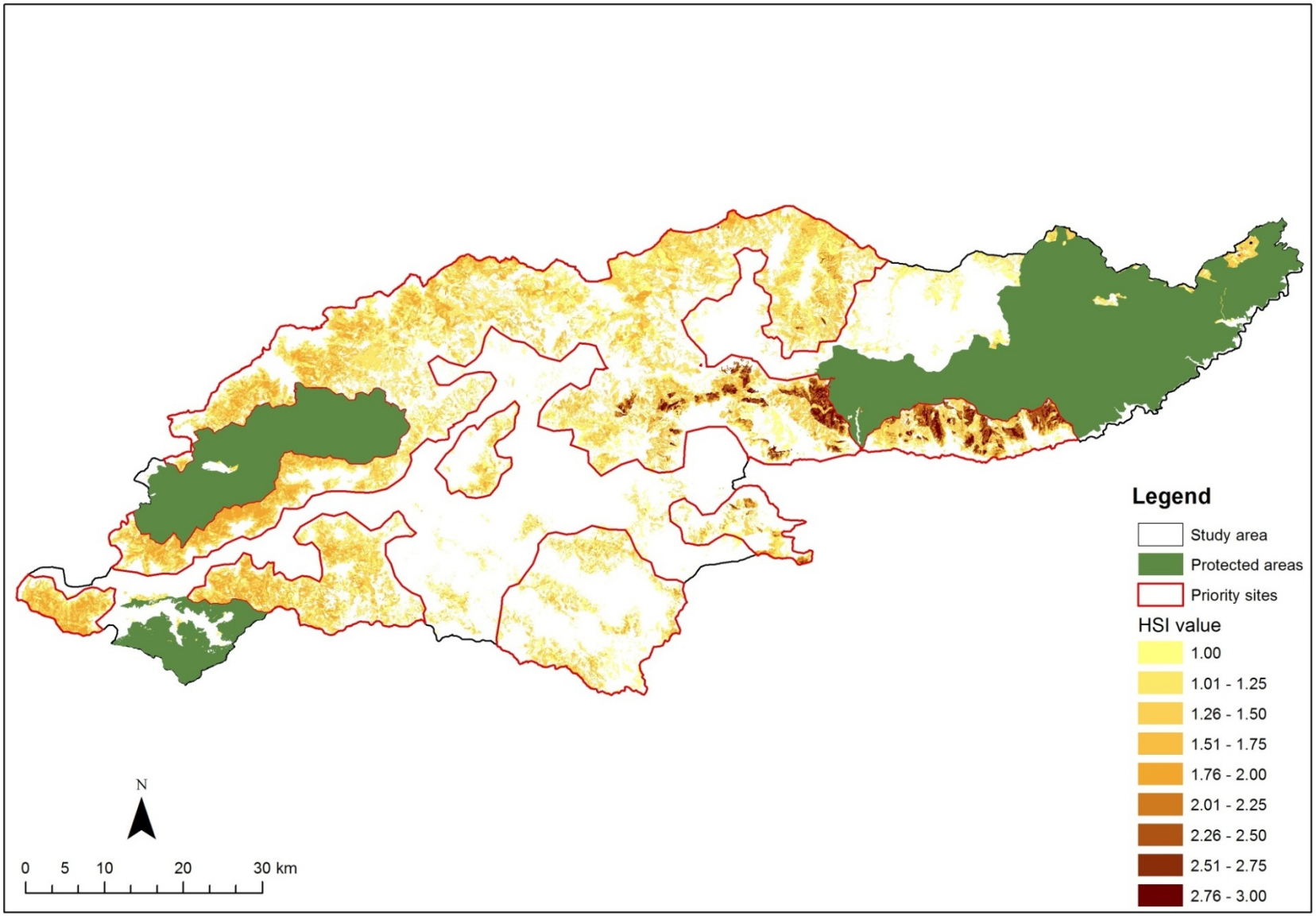
Vegetation cover preferences (i.e. habitat structure)	A variety of mountain habitats including alpine and subalpine meadows, open rocky areas, subalpine or even lower *broadleaved,* coniferous and *mixed woodlands.*
Food preferences and availability, including water intake/needs	Grasses, herbs, bushes, leaves of trees, buds, shoots, and fungi. The availability of natural salt licks and mineralized water is usually an important feature of the habitat.
Predators, including records of their presence within the study area (GPS points including data)	Wolf, lynx, brown bear, some birds of prey. In some areas, the competition with domestic livestock is a problem, and the competition with other large herbivores – in the given study area with red deer (*Cervus elaphus*), and roe deer (*Capreolus capreolus*) – is also possible.
Threatening human activities and related factors (e.g. fragmentation)	Illegal hunting, habitat fragmentation, disturbance (e.g. livestock grazing), tourism, infrastructure development (such as for mountain tourism).
Minimal viable population parameters (number of individuals needed to maintain a healthy population and minimal area to maintain a healthy population	-
Density (appropriate number of individual per km^2)	44 (as per official 2012 national assessment)
Movement patterns (i.e. average traveling distance in a day, average migration distance and natural and artificial barriers to movement)	0.5-1.5 km
Record of species presence within the study area (GPS points, preferably with date)	GPS points available from Adjara and BKPA from 2014-2015.

Topics	**Red deer**
Species name	*Cervus elaphus*
Global conservation status (IUCN Red List)	Least Concern
Status of population in Georgia (Red List of Georgia)	Critically Endangered

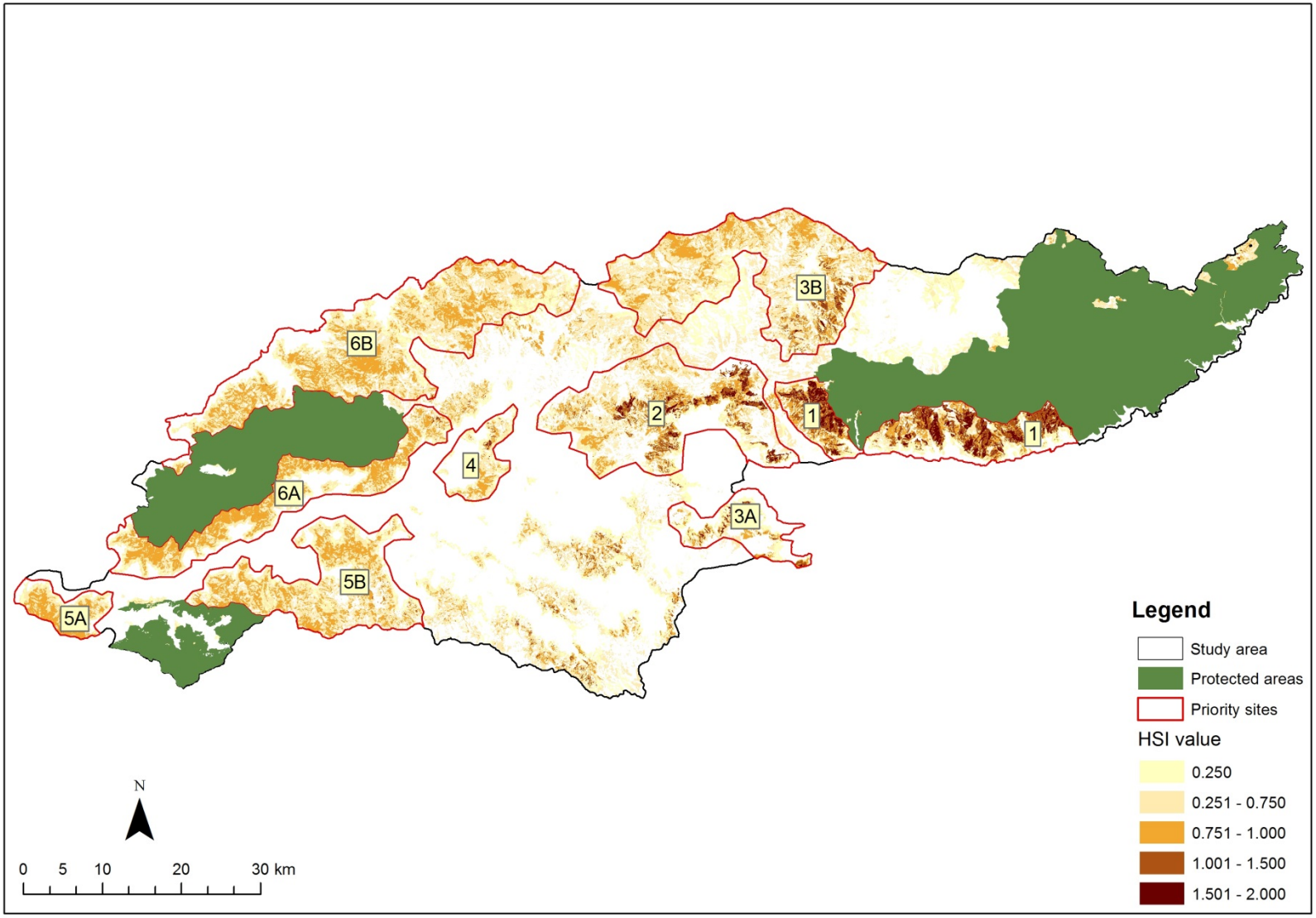
	The official 2012 national assessment estimated the total population at 500 and that of the BKPA at 160 individuals. The BKPA administration counted 460 individuals in 2014 Red deer census conducted by NACRES in BKPA in spring 2015 using the Pallet Group Counts method estimated the population at 325-527.
Home range (in km^2), including delineating historical and/or existing population in the study area based on topographic maps and high resolution Google Earth images	5-12 km^2 (based on literature)
Relief (elevation, slope, exposition, snow cover)	Within the study area found in subalpine meadows and forests. In winter, prefers areas with relatively less snow cover such as the lower altitudes. No lower elevation limit; The upper elevation limit is probably 3,100 m.a.s.l. Generally avoids steep rocky areas but may trespass such areas using wildlife/man made trails.
Vegetation cover preferences (i.e. habitat structure)	*Broadleaved,* coniferous and *mixed woodland preferably with dense (but not impenetrable) undergrowth for hiding.* Benefits from forest openings.
Food preferences and availability, including water intake/needs	A very generalist herbivore; grazing/browsing on almost all available plant foods. The availability of natural salt licks and mineralized water is usually an important feature of the habitat.
Predators, including records of their presence within the study area (GPS points including data)	Wolf, lynx, brown bear, some birds of prey.
Threatening human activities and related factors (e.g. fragmentation)	Illegal hunting, habitat fragmentation, disturbance (e.g. livestock grazing), tourism, infrastructure development.
Minimal viable population parameters (number of individuals needed to maintain a healthy population and minimal area to	-

maintain a healthy population	
Density (appropriate number of individual per km^2)	0.9-1.4 red deer per km2 in BKPA. Density greatly differed within the study area.
Movement patterns (i.e. average traveling distance in a day, average migration distance and natural and artificial barriers to movement)	1-5 km As relevant to the study area, deep snow cover is usually avoided; so are large open areas in human dominated landscapes, steep and/or rocky spots with no wildlife/man made trails.
Record of species presence within the study area (GPS points, preferably with date)	GPS points available from Adjara and BKPA from 2014-2015.

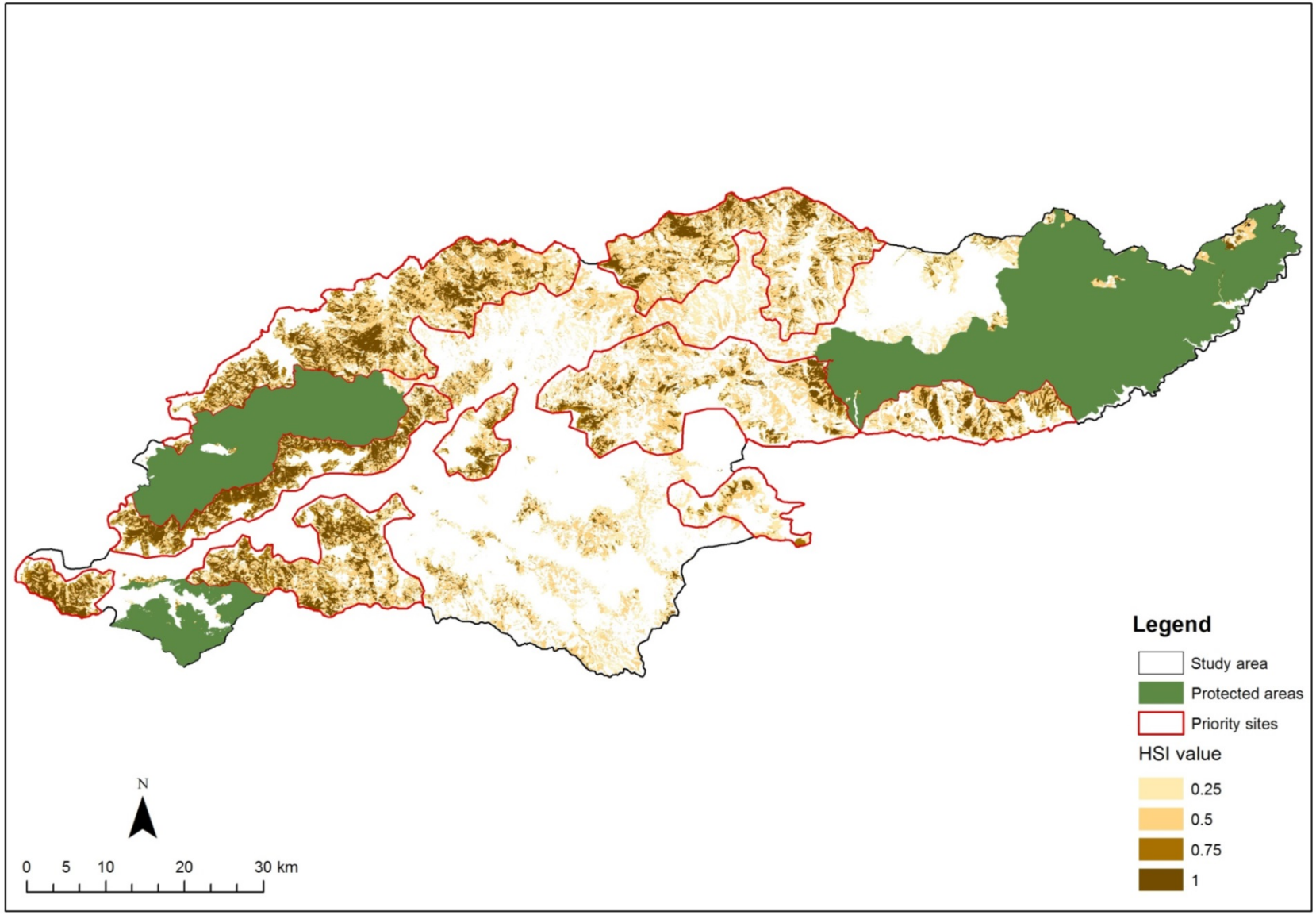
APPENDIX 3. PRIORITY SITES FOR THREE KEY SPECIES



APPENDIX 4. PRIORITY SITES FOR TWO KEY SPECIES



APPENDIX 5. PRIORITY SITES FOR CHAMOIS



APPENDIX 6. PRIORITY SITES FOR RED DEER