ENHANCING FINANCIAL SUSTAINABILITY OF THE PROTECTED AREAS SYSTEM IN GEORGIA

TECHNICAL ASSISTANCE GRANT AGREEMENT

Final report

Monitoring of Eurasian lynx in Vashlovani PAs

Prepared by: NACRES – Centre for Biodiversity Conservation and Research
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1 Introduction

This final report is the third deliverable under the Technical assistance Grant agreement signed between CNF and NACRES on the 7th February, 2022 for conducting the Eurasian lynx monitoring activities in Vashlovani protected areas. It describes lynx population census in Vashlovani and Chachuna protected areas during winter-spring 2022, as well as problems met and solved, and lessons learned.

2 Background

As a result of the **technical support to prioritize biodiversity monitoring indicators (species and habitats) for 12 Georgian PAs to support the development of standardized PA-specific Management Effectiveness Assessment plans *(Biodiversity Monitoring Indicators)***, commissioned by CNF in May, 2020, an agreed short list of fauna indicators was elaborated through an intensive and participatory process that involved all leading relevant experts and key stakeholders. The process was carried out in close cooperation with the main beneficiaries − Agency of Protected Areas (APA) and the Ministry of Environmental Protection and Agriculture (MEPA).

The Eurasian lynx (*Lynx lynx*) was chosen as one of the priority indicators for Vashlovani PA as the TOR specifies "based on the following reasoning: Lynx is one of the most endangered carnivores, as such the importance of monitoring is widely recognised; it is also protected by the Bern Convention and included in the national Red List".

Eurasian lynx is widely distributed in Georgia, but almost everywhere it occurs at low densities. In Vashlovani (semi-arid ecosystem) lynx more or less entirely depends on smaller prey such as hare, pheasant and chuckar. These prey species are also targeted by poachers. Lynx is persecuted because it is considered a pest by local farmers and hunters. The monitoring of lynx population in Vashlovani protected areas should give a good indication of poaching levels as well as overall human disturbance.

3 Methodology and survey design

3.1 Study area

As the Eurasian lynx is a medium sized predator with relatively low natural density it would be inappropriate, if not impossible, to isolate and separately study the "Vashlovani lynx population" from the wider Semi-arid lynx population. Therefore, it was agreed to also cover the Chachuna managed reserve and its surroundings as it is the second core area of Georgia's semi-arid zone as far as lynx population is concerned.

In order to determine the concrete boundaries of the study area for this survey, we reviewed the semi-arid lynx population assessment that was conducted in 2012. Specifically we examined the camera trap database including the photos as well as camera trap locations. This exercise helped us identify possible important lynx sites/habitats in and around the two protected areas. Consequently the study area for this survey had to include not only Vashlovani and Chachuna protected areas but also certain adjutant territories (See map in Appendix #1).

The study area is a relatively open landscape with occasional trees and patches of arid light woodland. Therefore, it is not always possible to find a tree on both sides of the selected trail that would also be suitable for mounting a camera trap. Wooden poles (approximately 8 cm in diameter) were purchased to be used in such cases.

3.2 Census method

Every individual of lynx has a unique coat pattern, similar to human fingerprints. Individual animals can be identified on photos by comparing the density, shape and locations of spots on the body. Camera traps can be used to assess lynx population. The method is used worldwide to count lynx as well as other spotted/striped cats such as leopards, jaguars and tigers. This census method can provide an accurate population number and density. In addition to lynx data, camera trapping usually provides information on other large mammal species in the study area, their activity and even on aspects of habitat use by those animals.

In order to allow individual identification, it is important that each animal is photographed from both sides simultaneously. Thus, at least two camera traps per site must be installed i.e. one on each side of the trail.

For the purpose of this survey 2.5 km X 2.5 km grid was placed on the study area. This is a smaller grid cell than that used in the previous study. During the previous study we took the same grid (2.7 X 2.7 km) that mainly used in Europe (Zimmerman F., et al. 2013; Gimenez O., et all 2019). We know that the female home range in the similar semiarid habitats could be smaller than in Europe (Mengullluoglu D., et all 2020) and hence, we decide to have smaller grid to obtain more accurate data. On the map, we ignored all grid cells that did not include lynx habitat (mostly steppes) or were largely located across the border in Azerbaijan. We selected every second grid cell in which camera traps would be placed (Appendix #1).

In total, 36 camera trap sites were pinpointed on the map that had to be visited and scanned for an active trail (i.e. a trail that is evidently actively used by lynx or other wildlife) as well for the right spot along it to place two camera traps on either side of the trail. Such an exercise can be quite time consuming. There we decided to give priority to those sites that were used in the previous assessment in 2012 and showed good performance. This approach would expectedly increase the probability of lynx capturing by the cameras and reduce the effort.

Camera traps were checked prior to fieldwork at the office. They were programmed and a special field protocol was prepared for using at the installation site to minimize unwanted results such as “empty”, blur or dark pictures, fake shots etc.

Camera traps were set to take three pictures per trigger, this would increase data size but on the other hand, maximize chances of getting more clear pictures, which is crucial for the identification of lynx individuals. Camera trap pairs coded in advance as follows: Lynx 1A, Lynx 1B, Lynx 2A, Lynx 2B etc. Any extra cameras were coded on site and the code included the word ‘S camera’ and sequential number.

The issue of placing a special lure at the camera trap sites was discussed with the IUCN Cat Specialist Group members. While some experts opposed luring, arguing that it might affect the lynx movement, Dr. Tatjana Rosen recommended using lures in order to maximize the chances of obtaining good quality pictures by “persuading” the animals to stay longer in front of the cameras. Indeed, clear pictures are essential for the process of individual identification of photographed animals. Therefore, we decided to follow Dr. Rosen’s recommendation and use the recommended eau de perfume *Obsession* or valerian extract as a lynx lure. It is important to note that these lures are not strong enough to alter the normal lynx movement but they can provoke additional interest so that the animals spend more time at the camera trap sites.

Following another recommendation from Dr. Rosen we decided to place additional single camera traps on actively used animal trails outside the selected grid cells in order to obtain additional information on lynx individuals as well as their movement within the study area. For this purpose, extra 18 camera traps were prepared for installment throughout the study area.

We developed a field protocol to standardise the process of camera traps installation (Appendix #2). The protocol included equipment checklist, criteria of selecting camera trap sites, short installation guidelines for setting a camera trap in the field such as orientation, exposition and height from the ground, photo documenting the site, GPS location, placing lures, etc. The protocol was discussed among field team members and their comments were incorporated into the final version. The protocol was printed out and disseminated among the team members before the fieldwork.

Camera trap data was sorted and organized at NACRES office. Lynx pictures sorted separately and three persons identified individuals independently. Based on the identification result the data were organized into 5 days sample occasions. Dividing data into 5 days occasions is widely accepted by European studies on lynx, or studies carried out in Turkey and Europe (Zimmerman et all 2013; Mengulluoglu D., et all 2020 and Glimenez O., et all 2019). Later we organize data into the “capture history” matrix which represents lynx capture/recapture history during the sample occasions and identified individuals. We run the data file through Capture software and based on the best selected model assessed population in the study area.

We calculated MMDM (Mean Maximum Distance Moved) to calculate lynx density in the study area. The distance was calculated through our data on lynx recaptures and camera trap locations. We outlined a territory by the simple Convex Polygon Method (CPM), i.e. by connecting peripheral camera trap locations into a polygon. We added the MMDM as a buffer around the convex polygon and identified effective sample area in Vashlovani PA. Then we excluded the none lynx habitat such as steppes and large open areas.

We also analyzed data via SECR (spatially explicit capture-recapture) method and run the lynx data through R software. We organize data in two input files (1) “capture history” data file, represent capture history via matrix which represents lynx capture/recapture data according to camera traps and sample occasions (periods of the capture) and (2) detector layout file, which represents camera trap locations and actual effort of the cameras. We organized data into 24 hours as sample occasion to have more precise data (Hernandez-Blanco J., et al 2013).

4 Fieldwork

Four sets of fieldwork were completed in Vashlovani and Chachuna protected areas. The first trip took place in February and the purpose was to install camera traps in preliminary selected sites. The next two subsequent fieldworks were dedicated to collecting camera trap data and readjusting or relocating the camera, if needed as well as to checking the direction of the camera in relation to the trail. Re removed camera during the fourth fieldwork and accomplished data collection.

4.1 Installing camera traps

The first fieldwork to set camera traps in the study areas began in February 14 and continued for 13 days. All team worked together setting camera traps the first day of the fieldwork. They tested the field protocol and discussed any issues that came up during the installation process.

Next day, the field team split into two and began installing camera trap units within the selected grid cells. Two field vehicles were at their disposal which allowed their mobility and independent movement of the subgroups in the field. It was therefore possible to complete the installation process in a relatively short period of time.

Photo #1. *Installing a camera trap on a wooden post*

On a number of locations, we had to use wooden posts to support camera trap pairs on either side of the trail so that they could take animal photos simultaneously (Photo #1). After the installation, sites were photo documented and GPS locations were taken. All of this information was immediately entered into a data base on the field computer.

It was relatively difficult to find suitable locations for camera trap installation in the northern part of Vashlovani PA where the trails tend to be wide and almost everywhere there were alternative passes. This made it extremely difficult to set camera trap pairs there. In addition, the area was full of livestock, their tracks were everywhere and we struggled identifying which trails was used by wildlife.

During the fieldwork, 36 pairs of camera traps were installed in the grid cells that were selected in advance (see appendix #3), of which 22 pairs were set in Vashlovani and 14 in Chachuna managed reserve and nearby lynx habitats such as the Kotsakhura area, Dali Mountain, etc. We also set 10 extra cameras on the trails that were apparently actively used by large mammals − 9 cameras in Vashlovani PA and one in the Chachuna study area.

4.2 The second fieldwork

Next fieldwork was delayed due to bad weather. It began on 25th of March and continued 7 days. Dr. Tatiana Rosen also joined the NACRES team a little later after it began. We were able to organize three groups (two persons in each) and they worked simultaneously visiting the installed camera traps. The objectives were to:

- Change the memory card;
- Check battery level;
- Check camera orientation and if it was securely mounted on the post;
- Remove grass or leaves if needed;
- Place *Valeriana* extract on the site
- Change/replace cameras if it did not work properly or was stolen.

We discovered that two pairs of cameras (Lynx 16 and Lynx 22) had been stolen. We replaced them with new units. Four cameras (Camera 05, Camera 07, Lynx 18A and Lynx 31A) were found to have failed to collect any data and had to be changed too. We decided to relocate one pair (Lynx 11) to a better location and the site were marked as *Lynx 11 alt* on the map (Appendix 3). A new single camera trap (S Camera #02) was added at the eastern part of the Didi Chrdili range in central Vashlovani PA.

At the end of the day, all collected data were copied to an external drive and new data from GPS were downloaded. We collected a total of 103,755 images (449 GB) from 74 operational cameras out of the total of 82 installed.

4.3 The third fieldwork

The third fieldwork began on April 11 and continued for six days. The objectives were the same as in the previous fieldwork – retreat of data, camera adjustment and replace of damaged cameras. This time, all the previously installed cameras were found to be intact. However, we discovered that data (photos) had been deleted from two cameras (Lynx 23 A & B). Later, we could recover some data from the erased memory cards. We also found that *Lynx 26 B* was turned off by local shepherds and obviously did not collect any new data during that period.

4.4 The fourth fieldwork

The third fieldwork began on May 17th and continued for 6 days. This was the last fieldwork and aimed to remove all the camera traps from the study area. Two volunteers from Tbilisi helped us in the fieldwork. We went to Chachuna area first and collected cameras there. Border police let us wait for the permit for three hours without proper explanations. That of course affected on our field schedule.

We successfully visited all camera trap sites, during the fieldwork and accomplished data collection in the study area. Fortunately, none of them was stolen. The data were transferred to hard disc, for consequent analyse.

4.5 The process of data classification

As mentioned, all camera trap data (i.e. photos) were copied to the external storage unit and the images were organized in folders according to fieldwork and camera codes. *Adobe Lightroom Classic* software was used to sort the data. At first, images were imported to the program and catalogues were created for each field trip (Photo #2). Then, pictures were examined, species were identified and corresponding keywords[1] (tags) were assigned to each image. Cameras had been set on the multi-shot mode and took three pictures per trigger. Hence, all three pictures were assigned the same keyword, even if some of them did not take animal pictures. For each wild animal – wolf, lynx, wild boar etc. – separate a sub-folder was created where images with corresponding keywords were copied. Pictures with humans, livestock (sheep, cows) or other domestic animals (dogs, cats) were also assigned corresponding keywords. If an image contained both human and domestic animals, the entry would have all the relevant keywords e.g. people, dog, sheep. Such images were placed together in separate folder. So each photo was entered in a single and not in multiple subfolder.

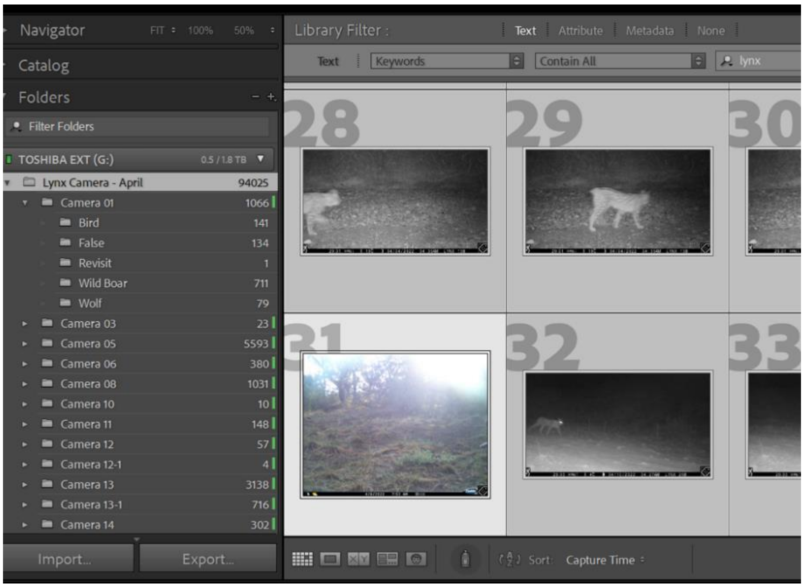


Photo 2. *Folder hierarchy of Camera Trap data in lightroom catalogue*

There were images in which species identification was impossible because of a blur moving object or in the case of nighttime photos due to over or under exposure. Such photos were put in a separate folder with the title 'Not Identified'. We titled a photo 'false' if no animal was seen in it. Such images could have been triggered by a moving tree/bush branches or by grass heated in the sun and moved by the wind. "False" pictures were put in separate folder and they had deleted after the data analysis is completed.

We used *Image Data Export* software to create *csv* file that includes the following information: filename, date, time, folder name, path, keyword(s), etc. Exported table can be used in the process of data analysis.

[1] Keywords or tags are stored with file metadata and are used for filtering or sorting files. Each keyword describes image content (e.g. species) and is very useful for data analysis.

5 Results

5.1 General data

Our camera trapping activity continued three month (95 days). 84 camera traps were active during 6,241 trap/days and collected 319,810 images in total (about 1,110 GB in size). False trigger rate was very high - 259,020 images that is about 80% of all collected data. 24 photos were damaged.

The data includes 284 lynx photos, which may be a result of approximately 100 separate triggers. There are also other mammal species: badger (1,144 photos), brown bear (298 photos), wolf (1,576 photos), red fox (1,137 photos), golden jackal (2,161photos), jungle cat (918 photos), wild cat (25 photos), martens (155 photos), raccoon (312 photos), porcupine (548 photos), hare (5,250 photos) and wild boar (2,209 photos). Small mammals, reptiles and birds were on 3,925 photos (See selected photos in Appendix #4). People and domestic animals were on 39,134 pictures. Animal identification was not possible on 1,322 photos.

5.2 Lynx population number

Lynx captured on 25 cameras traps sites out of 46 and we collected 284 lynx photos in total (see appendix #5). Only three cameras spotted lynx in Chachuna area and all the camera were located on Kotsakhura ridge. Lynx distribution was much wider in Vashlovani protected area. Lynx was spotted on 22 camera trap locations almost in all parts of the protected area. We could not shot lynx pictures on the cameras installed in Black Mountain area, in north-eastern part of Vashlovani protected area.

Some of the photos was not good enough for individual recognition. Mostly night photos were blur, or overexposures and therefore spots on lynx body was not visible (photos #3 and #4).

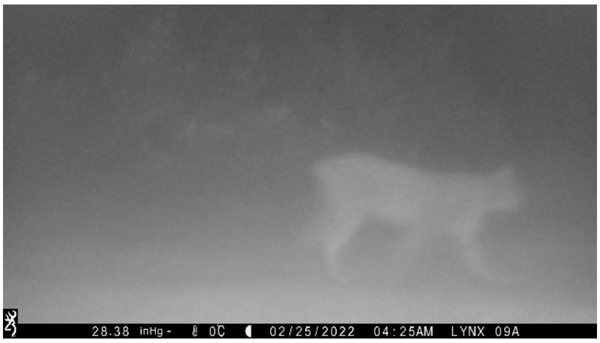
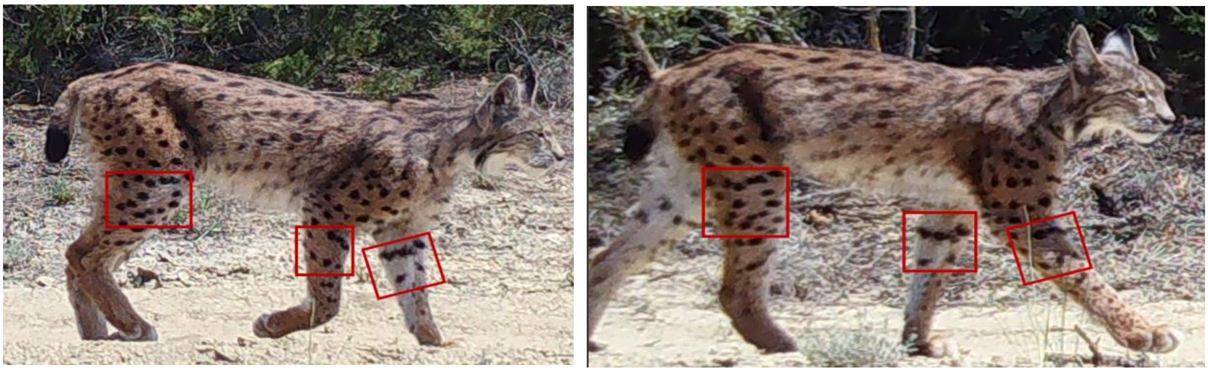


Photo #3 and #4 *Overexposed and blur images of lynx excluded from the final data*

We rejected such photos and did not include them in data analysis. Camera traps were set in multi picture mode and it took tree pictures per trigger. That give us flexibility and selected best lynx photos to identify individuals in the camera trap data.

Our study showed that Browning Spec Ops camera model traps were not good in making sharp night pictures. The failure of making sharp night pictures were compensated by longevity of the study and density of the cameras in the study area. We recommended to use visible flash cameras in the future to have much better night pictures. That will greatly help to identify lynx individuals.

Tatyana Rosen, Teimuraz Popiashvili and Bejan Lortkipanidze made independent identification of the lynx individuals. Later the results were compared to each other and agreed on the final number of individuals in the data. We found that spot locations on the hind and front limbs were the most distinct and useful for individual identification (photo #5 and #6). We could not distinguish subadult from adult individuals and therefore our data include all age categories.



Photos #5 and #6. *Example how the Individuals where identified*

Based on the camera trap data we identified 11 individuals in study area. We spotted 9 individuals in Vashlovani protected area and only two individuals in Chachuna managed reserve and surrounding areas. Individuals in Chachuna area were not recaptured in Vashlovani and vice versa. Hence, the data looked as two independent sets for each areas, with large distance between the lynx activity centers. Hence, we decide to analyze the Vashlovani national park data independently. These two individuals could make unnecessary noise in the result and our analysis could end up with large standard error.

We successfully run the data through Capture software. The program selected the best model that fit to our data. The model criteria closest to 1 was considered as the best suitable model (Table #1).

Model	M(o)	M(h)	M(b)	M(bh)	M(t)	M(th)	M(tb)	M(tbh)
Criteria	0.90	1.00	0.67	0.88	0.00	0.53	0.56	0.87

Table #1 *selecting the best model for assessing lynx population number in Vashlovani protected area*

According the result the most suitable model was M(h) Jackknife which assumes capture probabilities vary among individual animal. The model was identified as useful by other lynx researchers in Europe too (Zimmerman F., et al 2013). According to the model lynx population was estimated as ***10 individuals with 95% CI 10-16 individuals***.

We calculated MMDM (Mean Maximum Distance Moved) to calculate lynx density in the study area. According to our data mean maximum distance moved by lynx was 8 km. We added the MMDM as a buffer around the convex polygon and identified effective sample area in Vashlovani PA. Then we excluded the none lynx habitat such as steppes and large open areas. We also excluded lynx habitat on the left side of Alazani river, as we believed that during out study lynx did not crossed the river. Hence, we got **392 km^2** area of the effective sample area (see map in appendix #6). Therefore, lynx lowest density in the study area was ***2.6 individuals per 100 km^2 and highest 4 individuals per 100 km^2***.

We run data into R software and estimated lynx density. SECR method analysis showed that lynx density estimate is on ***average 1.83 per 100 km^2 (95% confidence interval 0.95–3.52 per 100 km^2)***.

We could not run the lynx data in Chachuna through analysis as the data was obviously very small. We had only two individuals with one recapture during three month of data collection. Obviously, lynx population in Chachuna is smaller comparing to Vashlovani.

6 Discussion

We analyzed the lynx data with both method and they gave close results. Conventional capture-recapture analysis showed slightly higher density and population abundance than the SECR analysis. Although we think that SECR method showed lower lynx density in Vashlovani, because multiplying the mean density to lynx habitat resulted in lower number individuals than we identified through comparing camera trap photos. According to SECR we have 7 individuals and camera traps data showed at least 9 individuals in Vashlovani.

Hence, we think that we have at least 2.25 individuals per 100 km^2 (considering that we have at least 9 individuals). Therefore, we can say that according to SECR analysis ***lynx population density varies 2.25 - 3.52 per 100 km^2***. The density looks much more accurate than conventional mark-recapture method results and can be considered as final lynx density in Vashlovani PA.

Based on the SECR density and lynx habitat calculate through MMDM buffer we can say that lynx population varies 9-14 individuals.

The lynx population assessment is very close to our previous assessment in Vashlovani in 2012 (NACRES report 2012). During the previous study we counted 10 individuals (95% CI 9-16 individuals) and density of the population was about 2.6 individuals per 100 km^2 (minimum density 1.8 individuals and maximum density 4 individuals/100 km^2). That possibly mean that population in Vashlovani is more or less stable. That also means that lynx main pray the hare (*Lepus europaeus*), as well as chuker (*Alectoris chukar*) and pheasant (*Phasianus colchicus*) populations are more or less stabile too. We think that hare availability in the study area should be much more important for lynx populations than other bird pray species. Colleagues found that Eurasian lynx was temporally and spatially synchronized with the hare in northern Anatolia and therefore predicting that the hare was the main pray species in the semiarid ecosystem (Soyumerta A., et al 2019).

Lynx population should have fluctuations during the 10 years based on the prey availability in the study area. The 10 years abundance cycles of the snowshoe hare (*Lepus americanus*) and the Canadian lynx (*Lynx Canadensis*) in the boreal forest of North America have been well known (Stenseth et al. 1997). We assume that the fluctuations happens in semiarid ecosystem too, but we can not see it based to current study. We consider that we estimated lynx population probably on the same fluctuation level as we had lynx population 10 years ago. Therefore, we recommend to do the lynx population's assessment much more frequent that 10 years period.

We tried to assess lynx population in Chachuna area, but data was very small. We identified only two individuals on Kotsakhura ridge and we can consider it as the minimum number for the area. Hence, we have at ***least 11 lynx individuals in semiarid ecosystem in Georgia***, by simply adding the Chachuna individuals to minimum lynx population number in Vashlovani PA.

Unexpectedly, we could not spot lynx on the right side of the Iori river in Chachuna area. The area was very rugged, remote and excellent habitat for lynx. Last time we shot lynx pictures only on the right side of the Iori river in 2012. Probably human pressure increased there, or main pray distribution changed in Chachuna area.

Based on the study result we consider the lynx population as stable. But threats on wildlife still exist in the study area. We encountered poaches several times during our study and think that main threat on lynx populations is poaching. Hunters do not target lynx specifically, but target on their lynx main pray species - hare (*Lepus europaeus*) and chukar (*Alectoris chukar*). Hunting pressure with conjunction of climate change in semi-arid ecosystem could be important threat to the pray populations and consequently to lynx population in semi-arid ecosystem.

Overgrazing and unregulated pasture use might also affect on the prey species populations. That especially true for Chachuna area where large flock of sheep graze almost everywhere and there is little control of the activity. Our cameras spotted sheep grazing in strict protection zones in Vashlovani too. Unregulated grazing could disturb pray species during winter and early spring, the most sensitive period of time and that should affect survival of the prey species individuals.

7 Conclusions and recommendations

- We have 9-14 individuals in Vashlovani PA with density of 2.25 - 3.52 per 100 km2. We calculated at least two individuals in Chachuna area. Total lynx population in semiarid ecosystem of Georgia can be considered as minimum 11 lynx individuals.
- The population can be considered stabile, but more frequent monitoring might show lynx abundance cycles with close relation with prey species abundance in the study area;
- We could not spot lynx in the badlands, on the right side of Iori river and only found lynx on the left side, on Kotsakhura ridge. More data is needed to find out if lynx population made the special shift in the area;
- Modern black flash cameras (model - Browning Spec Ops, 2020 edition) could not make good night pictures and lynx photos were often blur or overexposure. Common flash cameras is recommended to continue lynx population monitoring;
- We recommend strengthening control over grazing in Vashlovani and Chachuna protected areas and improve anti-poaching capacity of both protected areas.

8 References

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A P P E N D I C E S

Appendix 1. Study area and sample grid cells

Appendix 2. Camera trap installation protocol

Field protocol

Field Equipment

- Two pairs of camera traps, with proper name (For example Lynx 01a and Lynx 01b),
- GPS-navigator and spare batteries;
- Grass cutter (to clear area from grass);
- Spare camera traps (replacing if main camera did not work properly, or to set single camera on the actively used animal trail);
- Two pair of polls to set camera traps.

Setting camera traps

- Exposition – ideally camera should face north and south;
- Distance between camera and trail should be about 4-5 m.
- Cameras should be set on the 50-60 cm above the ground. If the terrain is not even the camera should be set in a position to control 50-60 cm areas above the trail.
- Camera should be set on the firm object. Young trees move in windy weather and can cause more false triggers.
- Vegetation should be cleared before the camera traps to reduce false triggering and obtain clear lynx photos.
- Extra (single) camera can be set on the trail actively used by large mammals. It does not matter if the selected area is in, or out the selected grid cell.

Checking camera trap mode

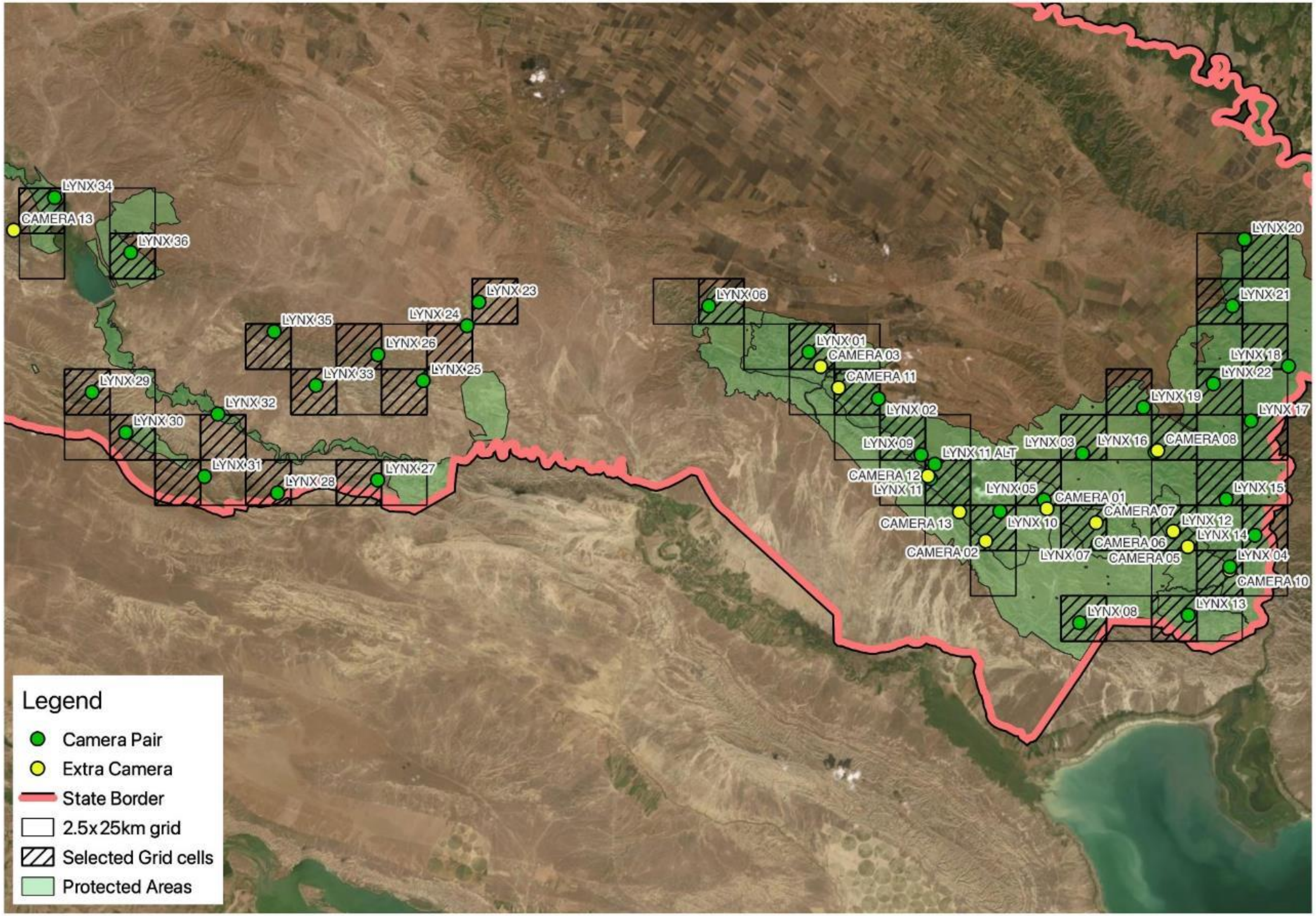
- Camera trap name
- Time and date
- Multishot mode: 3x
- Delay: 5 sec
- Sensitivity: Normal
- Trigger speed: Normal

Checklist after setting the camera trap

- GPS location (lynx 01; lynx 02 and etc.)
- Name of single camera trap GPS location: Cam 01; Cam 02 and etc.
- Photo of the camera trap location;

On the field base the GPS locations and photo of the camera trap should be transferred into field computer.

Appendix 3. Camera trap locations



Appendix 4. Selected camera trap pictures


27.86 inHg 8C 05/18/2022 05:43AM LYNX 20A

29.19 inHg 24C 05/07/2022 04:47PM LYNX 08A

28.31 inHg 16C 04/29/2022 07:00AM CAMERA13

28.13 inHg 27C 05/06/2022 11:36AM LYNX 30A

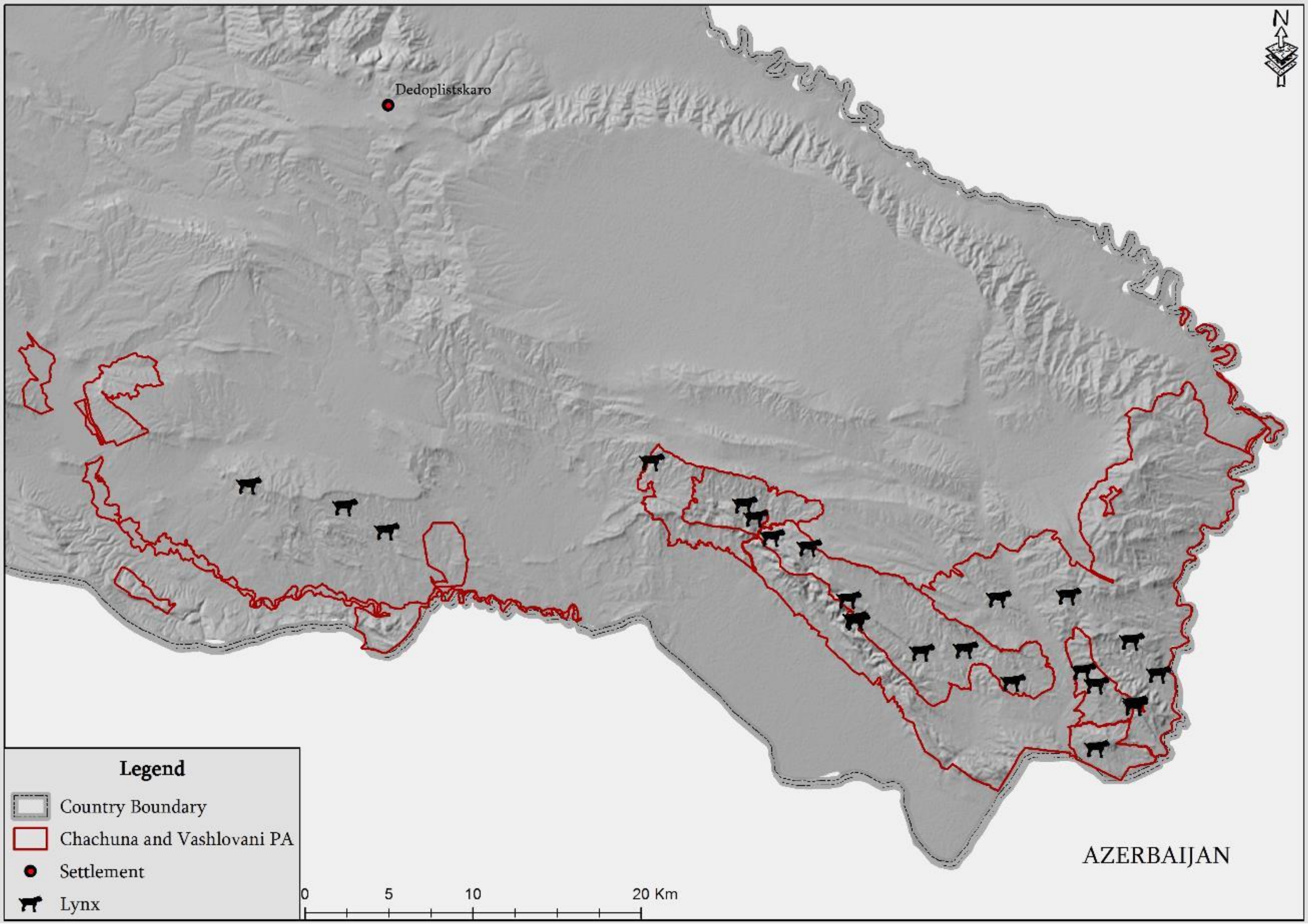
28.28 inHg 4C 05/09/2022 06:45AM LYNX 09B


28.23 inHg 28C 05/14/2022 06:26PM LYNX 09A

28.50 inHg 15C 04/10/2022 09:55AM LYNX 03A

27.55 inHg 19C 04/02/2022 09:07PM LYNX22

Appendix 5. Cameras that spotted lynx in the study area



Appendix 6. Effective study area