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POTENTIALITIES FOR USING CERTAIN MODERN TECHNOLOGIES FOR THE TRACKING AND MONITORING OF FREE-ROAMING HORSES

Maya POPOVA[1], Pavlin ZHELEV[2], Gradimir GRADEV[3]

[1]Agricultural University - Plovdiv, 12 Mendeleev Blvd, Plovdiv, Bulgaria
[2]Eco karta LTD, Pastrogor, Bulgaria
[3]Green Balkans, 9 Stara Planina Str., Stara Zagora, Bulgaria

Corresponding author email: m_popova1@abv.bg

Abstract

With reference to the implementation of the areas - `Traditional practices for seasonal grazing of animals` and `Conservation of endangered local breeds`, the interest in free grazing of various farm animals in Bulgaria has been significant in recent years. Horses are particularly suitable for this type of breeding. Pastures are often located in remote areas with limited access, which makes it difficult to visit and inspect the herds and facilities in the pastures on a daily basis. In order to find modern technological solutions to solve these problems and reduce costs and efforts of farmers, we tested several modern devices that are traditionally used in other areas, and their application in animal husbandry in Bulgaria is an innovative approach. These are GPS (Global Positioning System) for tracking animals, photo traps, as well as drones. As a result, we found that they have a successful application in monitoring horses which are raised free grazing, save costs and time, do not cause stress and side effects. These devices can be used to control access to pastures and limit theft, harassment and other encroachments on herds.

Key words*: behavior, conservation, GPS, sensors, wild horses.*

INTRODUCTION

Karakachan horses are an old autochthonous breed, preserved in relatively the same form in which it existed for centuries (Petrov, 1940; Sabeva, 2009; Popova & Etarska, 2020). In this regard, research on Karakachan horses will give us the opportunity to collect data on a breed that has preserved genes from ancient times.

Today in Bulgaria, this breed is grown predominantely, freely all year round in the typical habitats - pastures in high parts of mountains. In most cases, they inhabit remote pastures, isolated from settlements and buildings. These horses have a hard time accepting rearing in stables and other buildings. This makes it difficult to carry out direct studies on the Karakachan horses, and many of the characteristic features of this resistant breed remain unknown compared to other modern barn-raised breeds allowing detailed studies of the latter.

With the use of modern technologies, we can afford to study horses in remote locations and in their typical habitats. The collection of data on behavioral and defensive responses, social behavior of the horses, such as group dynamics (group sizes and membership), locomotion dynamics, grazing intensity, in addition to allowing for a better knowledge of breed characteristics, will be of benefit also for purely practical applications (White & Garrot, 1990; Anderson & Lindzey, 2003; Cagnacci et al., 2010).

At the same time, the development and application of modern technologies directly in the field will promote among the owners the possibilities of modern animal husbandry and its benefits, as well as the creation and application of information technologies through the creation of databases (Osechas, 2008; Hampson et al., 2010; Bachmann et al., 2014; Burla et al., 2014; Collins et al., 2014; Mann et al., 2014; Radoi et al., 2015; Burov, 2018).

The purpose of the research is to study basic ethological signs and the choice of habitat over a large area by the Karakachan horses from the national gene pool, through the use of GPS trackers and other technologies for monitoring and following horses in ecologically and biocompatible breeding.

MATERIALS AND METHODS

The study was conducted in the areas of the village of Prisadets (on the Bulgarian/Turkish

border - within Bulgaria) and the village of Levka, falling within SPA Sakar (BG0002021), which overlaps with SCI (BG0000212), part of the ecological network NATURA 2000 (MOEW, 2013). In biogeographical terms, the area falls into the Southern biogeographical region and, more specifically, according to the biotic basis, it refers to the "Dolnomarishko - Dolnotundzhansky" subregion (Gruev & Kuzmanov, 1999), as Mediterranean influence penetrates the sub-region along the Maritsa and Tundzha rivers. This defines the climate as milder and allows the horses to be kept outdoors all year round.

The object of observation were two herds of horses from the Karakachan breed, which are free-roaming horses all year round. The first herd consists of 29 mares, 1 stallion and 10 foals. The second herd consisted of 1 stallion and 12 mares.

The observations were carried out within 12 months. Twelve (12) and twenty-four (24) hour field observations were conducted.

Ethological studies were carried out - by the method of visual observation as well as tracking the choice of habitat with GPS-trackers, etc.

Five GPS trackers were purchased, 2 of which were placed on the stallions of the 2 herds and the rest were placed on mares from the same herds to attempt to track the sexual behavior of the free range horses.

The frequency of reporting Data from the GPS trackers was set to once every 15 minutes for a period of 12 months.

ArcMap ver.10.0 was used to process the data from the GPS trackers from the *.csv file sent by the transmitters and convert them into a *.shp file. Google Earth Pro ver. 7.3.6.9285. was used to visualize the positions of the horses on a satellite image of the Earth's surface. We used Microsoft Excel for the primary processing of the information.

RESULTS AND DISCUSSIONS

Animal tracking and activity monitoring using wireless sensors provides high-resolution data to retrieve their location and study their behavior. These quantitative measures are useful for better formulating ideas and informing practices in animal ecology, such as resource use, home range, animal dispersal, and population dynamics, which have so far relied on visual observation (Cagnacci et al., 2010).

Dorio stallion herd. The stallion Dorio was marked on 18.09.2021 (Figures 1 and 2).

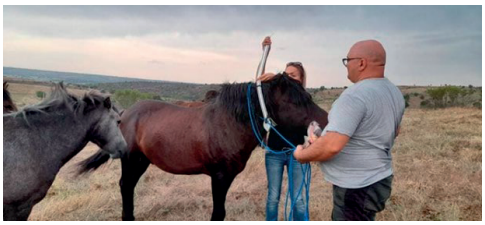

Figure 1. Placing a GPS-tracker on a Dorio stallion

Figure 2. Dorio stallion with tracker attached

Data processed until 31.08.2022 total positions collected from the trackers are from 402 to 32,224, but if we subtract the positions of the mares, from the tracker of the stallion Dorio there are a total of 13,288, of which daily positions (from 06:00 to 21:00) – 1,271, and the night positions (from 21:00 to 06:00) are 966 (Figure 3). The total area of the inhabited territory is 13,659 decares, with a perimeter of 17,590 km.

Interestingly, the Dorio stallion has few positions down in the low by the river, which is due to the episodic range capture. Signals (270 positions) from there were received mostly at dusk and at night, which is very little against the background of all 13,288, and it cannot be said with certainty that they mainly spent the night there and drank water at that time. It is also noticeable that there are not many positions between 11 a.m. and 1 p.m., which may mean that this is when the horses go down to the river to drink water.

There are no clearly specialized places to spend the night, apart from entering the village of

Prisidets, when they are most likely being chased by wolves. There is no mobile operator coverage in the area with fresh running water and rock salt applied. For this reason, it is not possible to model the behavior for the water drinking residence time and the diurnal range. More field observations should be made.

Most positions are on the crests of the ridges (when looking in Google Earth and verifying the positions on the ground) or on the northern slopes. This suggests that in low areas the device loses range.

The old border electrical signaling system serves as a fence (in the West) of the animals' territory, although 4 permanently open portals fall into this area. There is a small clustering of positions (8-10 positions) around the portals apparently on the rare occasion they have passed through them. One portal is near the village and they use it for overnight stays in the village. The other (northernmost) was used once on 17-18.10.21 when staying outside their normal area.

To the East, the newly built border fence and the Tundzha River limit the horses.

In the North, the old border electrical signaling system rests on the Tundzha river and also limits the territory to some extent, despite the open portals, and in the south the terrain is more rugged, but they still have the opportunity to move. On the maps (Figures 3 and 4) it is clearly visible how the old border electrical signaling system limited the territory and the horses went out only through the open portal of the village of Prisadets and through one at the northernmost positions. It can be seen that the remaining positions have been cut off along the border electrical signaling system.

It is noted that there are positions in the old almond plantations in the territory. This means that here, in addition to the mainly open meadows, the old almond orchards are also sporadically used (Figure 5). It can be seen on the map that there is also a reservoir here, which is visited by the herd mainly in the afternoon hours (most often between 14:00-16:30), which is also confirmed by the field observations.

Trackers were placed also on mares from the same herd to try to track sexual behavior. The GPS trackers used have a special feature that tracks more atypical temperature deviations and movements to determine if the mare has been grazed or will be foaled. The results of the observation did not show such activity on the GPS, although the mares foaled and on field observations we observed graze and jumping.

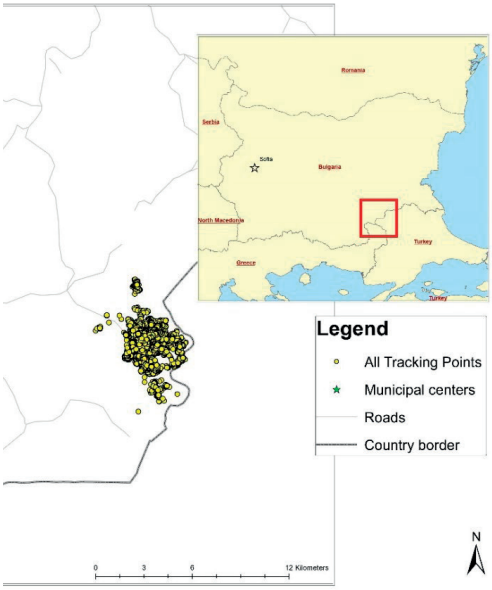

Figure 3. Map of the positions Dorio's herd

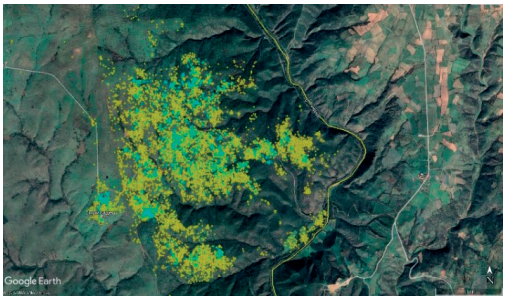

Figure 4. Map of all tracking positions of mare and stallion from the stallion Dorio's herd

Figure 5. Map of the most frequently used positions of the stallion Dorio's herd

This may be due to the loss of range in the area, as well as the fact that the GPS's used did not provide accurate temperature information. Because of the location of the temperature sensors, averaged values were sent between the horses' body temperature and that of the environment.

Data from the mares' trackers was processed from 22.03.2022 - to 27.04.2022 - entirely in the spring period, when the foals and coverings from the stallion were expected. Total positions collected by the trackers are 2,884, of which day positions (from 06:00 to 21:00) – 1474, and night positions (from 21:00 to 06:00) are 1,410 (Figure 6). Apart from 6 evenings, there are no other clearly defined day and night positions in the village.

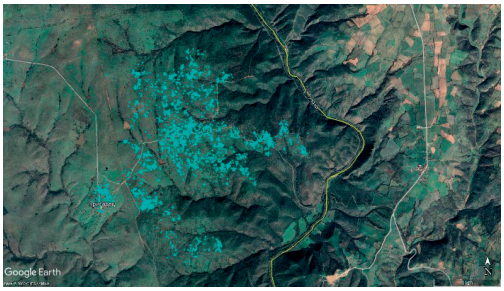

Figure 6. Map of all tracking positions of the mare from the herd of the stallion Dorio in the period from 22.03.2022. until 27.04.2022

When looking at all stallion and mares positions on one map it looks like they are moving together in the same territories, therefore the horses are moving in a herd and not separated. When analyzing the data more thoroughly, when looking at a specific day where there are positions from both GPS trackers at equal intervals, it is observed that the two animals are moving at a certain distance from each other. This distance in the herd can be interpreted as a sign that the animals are calm, not attacked by predators to cluster close together, but graze scattered over the terrain. But it can also be due to the fact that when the GPS trackers are located close to each other, they give some deviation in the coordinates.

Unfortunately, the terrain has deep ravines and there is no range for the transmitters there. Their main watering place and salt blocks are in the deepest part and we cannot ascertain exactly how long they spend there.

From the maps it can be assumed that horses prefer open areas, avoiding scrubby areas and forests. All known positions are only on the higher parts of the terrain 150-215 a.s.l. and there is not enough information on the positions in the lowlands, where there is water and salt - 60 m above sea level, because of the technology limtations.

The herd of stallion Oliver. The pastures occupied by Oliver's herd are fenced with an electric herder, and the pastures are alternated on a rotational basis.

The pastures are alternated using an electric herder, with a minimum of 70-100 acres per horse per year. The annual care (review of the state of health, prevention, individual marking, etc.) and the relocation (Figure 7) between the individual pastures is carried out with the help of volunteers.

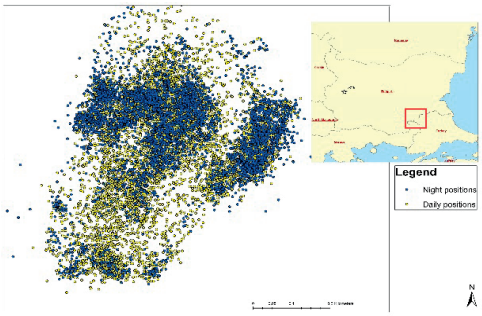

Figure 7. Map of the positions of stallion Oliver's herd until 08.12.2021

Pasture 1 (Figure 8) is used during the autumn (October and November 2021), winter (December 2021, January and February 2022) and spring (from March to May 2022) seasons, and the date of moving to this pasture is 28.10. 2021; date of moving from the pasture – 25.05.2022; collected data – 12,244 positions.

There are clearly marked overnight positions on the highest part of the hill in an open meadow.

The pasture is 331 acres with a perimeter of 2.34 km, with an approximate altitude of 222 to 267m. The pasture is a hill with a sloping top and is a mixture of oak coppice forest and forest glades. Both day and night positions are in the meadows and there are almost none in the forest area.

There is one watering place in the pasture - a probe with a pump that collects water in cisterns.

There is a certain dependence on the watering time, as the horses visit it either around 11-12 hours before lunch or around 16-17 hours in the afternoon, but only once a day.

Figure 8. Pasture 1 – Autumn, Winter and Spring – stallion Oliver's herd

Pasture 2 (Figure 9) was used for a short time as the date of moving to this pasture is 25.05.2022, and the date of moving from the pasture is 09.06.2022; data were collected from 1,775 positions. For daytime positions we take the hours from 5:40 to 21:00 and there are 1,062 in number, and evening positions -703 in number.
The pasture is 357 acres with a circumference of 5.5 km, with an approximate altitude of 147 to 225 m. The pasture is a mixture of overgrown gully and meadows with all the horse positions being in the meadows. Both the day and night positions are there and there are hardly any in the thicket.
There are no clearly defined roosting positions in this pasture. There is one place for the horses to drink water (a micro-dam), but there is no clearly defined time to visit for drinking water.

Figure 9. Pasture 2 – summer season – of stallion Oliver's herd

Pasture 3 (Figure 10) - summer season as the date of moving to this pasture is 9.06.2022, and the date of moving from the pasture is 16.07.2022; a total of 3,193 items were collected.
For daytime positions, we take the time range from 5:40 AM to 9:00 PM, with daytime positions being 2,059 in number and evening positions being 1,134 in number.
The pasture is 223 decares with a perimeter of 3.1 km, with an approximate altitude of 183 to 216 m, with a flat section of about 200 m above sea level prevailing. The pasture is a mixture of forest and woodland meadows, with all horse positions in the meadows. Both the day and night positions are in the open meadows and there are almost none in the wooded area.
In this pasture, there are no clearly defined overnight positions and there is one watering place (micro-dam), but there is also no clearly defined time for visiting a watering hole.

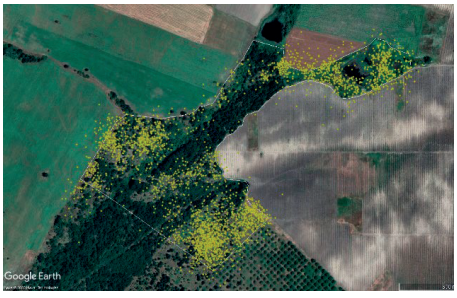

Figure 10. Pasture 3 – summer season – of stallion Oliver's herd

The entry of free-ranging horses into settlements and crops is a major problem. Thanks to the outlined virtual fences, the reason for entering the nearby settlement was established, namely an attack by wolves. As a result, night lighting was spent where the horses would gather when attacked by wolves.
As a result of the study, we can summarize the benefits of using GPS trackers, which are: possibility to outline virtual fences (Figure 11); signals are sent when leaving the fences and immediate measures can be taken; the detection of the horses becomes much faster.
As a result of the conducted research, we found that GPS-trackers facilitated the work related to the selection of suitable pastures according to the number and age of the stallion, rotation of the pastures used, limited the number of victims to predators, limited the entry of free herds into the settlements, by building specially designated

places lit up at night, for the horses to visit in order to escape from predators at night, etc. All this is a prerequisite for reducing the costs of raising herds, for their quick localization if necessary, and timely reaction to incidents. Also, these technologies can provide data on crossing virtual fences, separating certain individuals from the general group, etc.

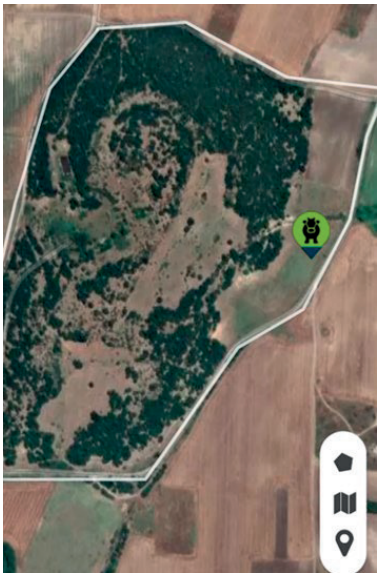

Figure 11. Oliver's virtual herd fence

CONCLUSIONS

The used GPS-tracker model is suitable for tracking the location of free-range horses, which helps to easily find them in hard-to-reach areas and large territories. With enough observations of the herd, certain behavioral responses such as places to hide from predators, water sources, diurnal and nocturnal positions can be learned and tracked. In the event of an attack, the GPS-tracker immediately signals unusual movement or leaving the virtual borders of the herd. The herd's entry into foreign territory can easily be seen and prevented.

Because of the location of the temperature sensors, averaged values were sent between the horses' body temperature and that of the environment. Reproductive indicators as well as clinical indicators (temperature, pulse, etc.) cannot be tracked.

Due to the lack of coverage near the Turkish border, there is still no established watering period and no clearly defined roosting places in the herd of stallion Doryo.

From the maps it can be assumed that horses prefer open areas, avoiding schrubby areas and forests. It follows that forest and shrub areas should not be counted as part of pasture acres.

Despite some difficulties, it is possible to carry out quality monitoring of animals using GPS-trackers. Owners will be able to calmly monitor on their mobile devices where and how much their horses move in the field, in the mountains, they will have the opportunity to identify atypical behavior.

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