

The colonization of raccoon (*Procyon lotor* L. 1758) in Georgia – The beginning of the invasion?

Alexandra KALANDARISHVILI¹– Miklós HELTAI²

1: Szent István University, Institute for Wildlife Conservation. Gödöllő, Hungary Páter Károly u. 1, 2100. E-mail: Alexkalandarishvili97@gmail.com

2: Szent István University, Institute for Wildlife Conservation. Gödöllő, Hungary Páter Károly u. 1, 2100. E-mail: Heltai.Miklos@mkk.szie.hu

Abstract: Raccoons have been present in Georgia since the second half of the 20th century. Raccoons were introduced in most parts of the Soviet Union including Azerbaijan from where raccoons eventually found themselves on Georgian territory. Today rural residents are complaining about raccoon damage which is induced to their private property, crops, domestic animals and game birds.

Regardless of such active damages and frequent sightings of raccoons across Georgia, there are no scientific publications that document the presence of this species in the country. We collected pictures of raccoons that were taken primarily by camera traps set by photographers, researchers and wildlife enthusiasts in Georgia. In additions, the material was retrieved from various sources including social media like Facebook. We conclude that raccoons are not only present in Eastern Georgia but they are spreading towards the central Georgia. We conclude that there are breeding populations of raccoons close to the capital city of Tbilisi as well. According to the local residents, this species is causing tremendous damage both to their property and natural habitats. We thus recommend that in order to protect valuable habitats of Georgia, and resolve human-raccoon conflict monitoring and decreasing of raccoon populations must be set as a priority task of the wildlife conservation in Georgia. We also recommend to conduct further studies on raccoon population sizes which will give clearer picture of the damage degree done to the native species and to private property of local residents.

Keywords: Raccoon, Alien Invasive Species, distribution, Georgia

Received 17 November 2019, Revised 22 November 2019, Accepted 5 December 2019

Introduction

Invasive Alien Species (AIS) around the globe are recognized as one of the greatest threats to native biodiversity (Louppe, 2019). Non-native species may cause disruption in local ecosystems not only by out-competing native species, but also by modifying the habitat around them, either by their feeding behaviors or habitat use (Anderson et al. 2006.; Hayama et al. 2006). Alien species is a species introduced by humans outside its natural distribution areas. Only an alien species can be an invasive species (Convention on Biological Diversity, 1992). There are at least 81 different alien and invasive species that can be found in North-

Europe alone (<https://www.nobanis.org/fact-sheets/>) among which is the raccoon (*Procyon lotor* L. 1758).

This meso-carnivore species is highly abundant and native to North and Central America. However, because of their high adaptability they are now found in most parts of Europe and in almost all kinds of environments including wooded areas, open and marshlands, near lakes, along streams and urbanized areas (Sanderson, 1987). Currently in most parts of Europe the raccoon populations are expanding and are causing concern among the local residents (Salgado, 2018). Raccoons are also found

in distant parts of Asia like Japan where they have been present since the 1960s (Okabe, 2007). The species has been introduced to Europe and Asia for commercial purposes (like fur trade) and through pet trade (Louppe, 2019). However, it is frequent that after pet raccoons reach adulthood and become difficult to care after they are released into the wild. It also happens that the individuals escape by themselves from the houses or zoos, and are now forced to fend for themselves (Heltai et al. 2001).

The fact that raccoons are widely spread throughout the globe and are able to easily survive in a wide range of habitats, can be attributed to its generalist diet. Raccoons are capable of exploiting almost all available resources as a food source, including garbage and leftovers. Consequently, they are frequently found close to urban and suburban areas causing a strong conflict with local residents (Kays 2009). Raccoons are worrying for local farmers as well who claim that these species are causing damage to their crops and domestic animals (Beasley, 2008).

Its versatile diet also weakens the impact of potential competitors (Salgado, 2018). These medium sized carnivores which are very well adapted to urbanized areas increase connectivity between occupied natural habitats. Raccoons are also highly effective predators and are posing an especially great threat to insular ecosystems where they prey on native fauna species. In addition, they are known to be vectors of diseases like nematode-mediated pathogens and rabies (Arjo, 2005). These diseases are potentially transmitted to humans, domestic animals and/or other wildlife species causing serious, if not lethal consequences.

Introductions of raccoons in Europe began in the early 20th century. Raccoon introduction programs were taking place in Germany as early as in 1920s (Lutz, 1984). The raccoons were first released in Northern-

Hesse, Germany in 1927 (Lutz, 1996), after which two pairs were released in 1934 (Müller-Using, 1959). Later, in 1935 few raccoons were also released in areas close to Berlin (Lutz, 1984). During the war time in 1939 – 1945, few tens of raccoons managed to escape fur farms near Berlin and established territories in the nearby areas. Over the course of 20 years of adapting to the European climatic and landscape conditions, the raccoon expanded its distribution area in all directions (Bartoszewicz, 2011). After the expansion of the German population, the species was first detected in France in 1934, in the Netherlands in 1960, in Austria in 1974, in Switzerland in 1976, and in Luxemburg in 1979. The presence of raccoon was also proven in Denmark, Belgium, Czech Republic, Poland (Kauhala, 1996), and only recently in Spain (Garcia et al. 2012) and Italy (Mori et al. 2015). In Hungary the first presences were proved at the late 1990s (Heltai et al. 2001) and the average hunting bag is between 1-3 specimens annually (www.ova.info.hu).

In Russia and Belorussia, raccoon was introduced in 1954 and 1958 with the purpose to increase hunting and economic profits. However, unlike in the western and central Europe, raccoon populations did not thrive in Eastern Europe as successfully (Czesnokov, 1989). It is interesting to note that there are certain claims that the raccoon was successful in surviving and expanding in Northern Caucasus and along Black sea coast (Bartoszewicz, 2011), however, there have not been any raccoon sightings documented in the western Georgia by hunters, researchers or agencies.

Despite many complaints of the local residents regarding raccoon damage, no scientific papers have been published regarding the presence, occurrence and the spreading of raccoons in Georgia. Due to increasing complaints by local communities, we had a reason to believe that the raccoon was not only present in Georgia but they are ex-

panding towards the Central Georgia. Camera traps allowed us to observe the areas where raccoons would potentially be present. The main purpose of our study was to prepare the distribution map of raccoons in Georgia.

Materials and Methods

Since there are no official scientific publications regarding the presence of raccoons in Georgia, we collected data from various other sources, like social media, forums and contacting either National research agencies or National parks. The photo evidences were produced by camera traps established in specific areas by researchers and wildlife enthusiasts as well as by hunters and amateur photographers who frequently pass through the area.

Social Media like Facebook offered the fastest and most effective way to reach out and gather the data from different professionals. Social media offered a very good insight in local residents' attitude regarding the presence of raccoons in their region. The intensity of damage done by raccoons was also described in detail by the local residents on social media.

In the end, data was gathered from Lagodekhi Protected areas, LEPL National Nursery, Tsiv-Gombori Mountain range, Mamkoda, and Gldani villages near to the Tbilisi National Park, Alazani valley, Shuamta Mountains, Telavi city, Gurjaani town, and finally from Iori plateau. Most of the visual evidences came from Kakheti County, however, few photos have been taken in Lower Kartli County.

Results

Lagodekhi Protected areas (Kakheti County)

Lagodekhi protected area is a combination of two protected areas is the Kakheti County of Georgia: Lagodekhi Strict Nature Reserve and Lagodekhi Managed Nature

Reserve. The total area of the two is 24,451 hectares. The reserves are located in the north-eastern Georgia bordering Azerbaijan and Dagestan.

The presence of raccoon was documented on official Lagodekhi Protected area Facebook page. We contacted the Lagodekhi National park administration and were provided with pictures that came from camera traps. The administration also provided some additional information regarding raccoon damage and public attitude towards these species which turn to be highly negative. However, that information cannot be backed up with any official statistics.

Data from Lagodekhi National Park

The following pictures (*Figure 1.*) were retrieved from Lagodekhi protected area Facebook page, and from Lagodekhi National Park administration.

LEPL National Nursery (Lower Kartli county)

9 Camera traps (RECONYX ULTRAFIRE) were placed in the national breeding farm LEPL National Nursery in Lower Kartli county in Georgia (*Figure 2.*). The territory of LEPL National Nursery is stretched out on 105 hectares and is located on Gombori-Telavi highway. The closest populated area to the National Nursery is a small village of Sartichala with a little over 7000 residents.

LEPL National Nursery breeds flora species that are listed in the Georgian red list. These species are hop-hornbeam (*Ostrya spp.*), Mt. Atlas mastic tree (*Pistacia atlantica*), Zelkova species, English Yew (*Taxus baccata*), *Buxus sempervirens*, chestnut (*Castanea spp.*), sour Cherry (*Prunus cerasus*) as well as oak species. However, the farm is also involved in breeding small game species such as red-necked Pheasant (*Phasianus colchicus*) and rock partridge (*Alectoris graeca*). The farm has also an artificial lake which holds different fish species, among which are rainbow trout (*Oncorhynchus*

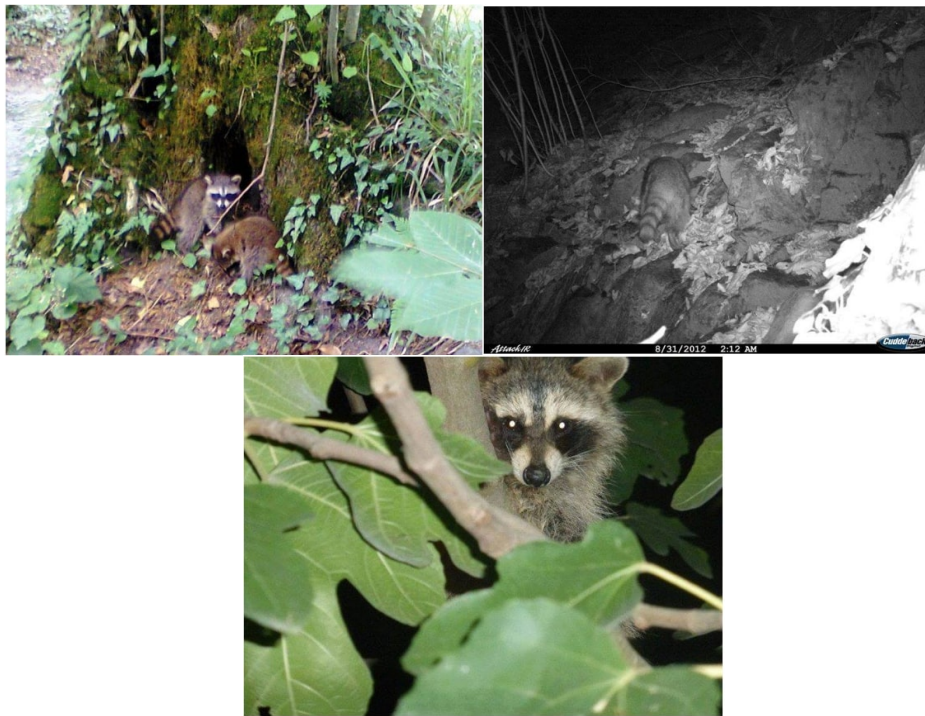


Figure 1: Picture a (Top-left) show two young raccoons which indicates that there is a breeding population of *P. lotor* in Lagodekhi Park. The picture was taken by the ranger in Lagodekhi National Park. Picture b (Top-right) was captured by one of the camera traps in Lagodekhi in August 2012. Picture c (Bottom) was taken by a local hunter close to the protected area.



Figure 2: The tracks were seen on 9 April 2019 on the territory of LEPL National Nursery. The photos from the camera traps were taken in August 2019



Figure 3. The camera trap captured this individual on 3 August 2018. The camera trap was stationed in Tsiv-gombori Mountain range in Kakheti County. According to the owner of the camera trap, this particular camera was stationed only few kilometers away from the Ikhalto monastery.

mykiss) and catfish species. These species and habitats present ideal circumstances for raccoon to feed and breed.

Tsiv-gombori Mountain (Kakheti County)

Tsiv-gombori range is connected to Caucasus Mountain System in Kakheti County. It is a watershed of the two rivers – Alazani

and 243 square kilometers (*Figure 4.*). It is a valuable habitat as it hosts many endemic and “Red List” species. Among them: the red squirrel (*Sciurus vulgaris*), field mouse (*Mus macedonicus*), the black rat (*Rattus rattus*), East European hedgehog (*Erinaceus concolor*), Caucasian mole (*Talpa cau-*



Figure 4: The raccoon was seen twice near the Tbilisi National Park; ones near Village Mamkoda and ones near Gldani village.

and Iori. The area is characterized by relatively humid climate, with subalpine meadows, grazing pastures as well as deciduous forests (*Figure 3.*).

Tbilisi National Park (Lower Kartli County)

Tbilisi National Park is located north of the Capital city of Tbilisi and holds the area of

casica), Imperial eagle (*Aquila heliaca*), spotted eagle (*Clanga clanga*).

When it comes to flora species, Tbilisi National Park is a habitat to boxwood (*Buxus colchica*), yew (*Taxus baccata*), a bare elm (*Ulmus glabra*), a small elm (*Ulmus glabra*), walnut (*Juglans regia*), Pontus oak (*Quercus pontica*) all of which are listed on



Figure 5: Raccoons in the Alazani Valley were frequently encountered close to the water body, suggesting high preference to wetland habitats.

the “Red List” (<https://apa.gov.ge/en/biom-ravalferovneba/tbilisis-erovnuli-parkis-biomravalferovneba>).

Data from Alazani Valley

The Alazani valley stretches for about 160 kilometers (*Figure 5*). It is a relatively humid area with plains covered by forests. The forests comprise of species of oak, ash,

Data from Telavi

Telavi is the main city and administrative center of Georgia's eastern County of Kakheti. Its population consists of little more than 19,000 inhabitants. The city is located on the foothills of the Tsiv-Gombori Mountain Range quite close to the forest. Rac-



Figure 6. Raccoons have been observed in the forests and close to the city of Telavi.



Figure 7. Raccoon observed in Shuamta Mountain. This female individual was seen with three kits. This suggests that there are breeding populations of raccoons in the mountainous areas.

maple and poplar. The valley is surrounded by large populated areas like Gurjaani, Lagodekhi and Telavi.



Figure 8: The photo was provided by a wildlife photographer from Gurjaani region.

coons are frequently observed very close to the city of Telavi (*Figure 6.*).

Data from Gurjaani

Gurjaani is a town in Kakheti County, a region in eastern Georgia. It is located in the Alazani River Plain, at an elevation of 415 m above sea level. It is an urbanized area with the population of little more than 8000 residents. According to the locals raccoons are a frequent sight in the town (*Figure 8.*).

Overall sightings of Raccoons in Georgia

The map below shows all of the locations where the presence of raccoons were captured by camera traps or by photographers (*Figures 10-11.*).

Discussion

In the second half of the 20th century with the purpose of enriching biodiversity, Geor-



Figure 9: The roadkill was founded close to river Iori. The location was marked with the exact coordinates recorded as 41.83990 45.13414. This individual was sighted about 50 kilometers away from the Capital City Tbilisi.

gia saw the introduction of many different mammal species. Raccoon was exceptionally successful in adapting to Zaqatala region in Azerbaijan. About 120 individuals were introduced to Azerbaijan forests in 1991, also with the purpose of enriching biodiversity of the region. (www.cabi.org/isc/datasheet/67856#D93AA386-C32B-4244-A1D8-D3DDAF773579). There were no direct releases of the raccoon individuals in Georgia, so it is likely that *P. lotor* spread in Georgia from a neighboring region. The non-native species were released in few locations within the former Soviet Union countries. It is most likely that Zaqatala region in Azerbaijan is from where the raccoon found itself in Georgia, and dispersed along Alazani valley and Iori Plateau (<http://www.eiec.gov.ge/>).

Given the fact that there was only one source population outside the eastern border of Georgia, it is most likely for the species to have spread from the eastern border towards the central part of the country. Moreover, the earliest picture taken by the camera trap is from the year 2012 from Lagodekhi Protected area indicating that the species were first present in Lagodekhi Protec-

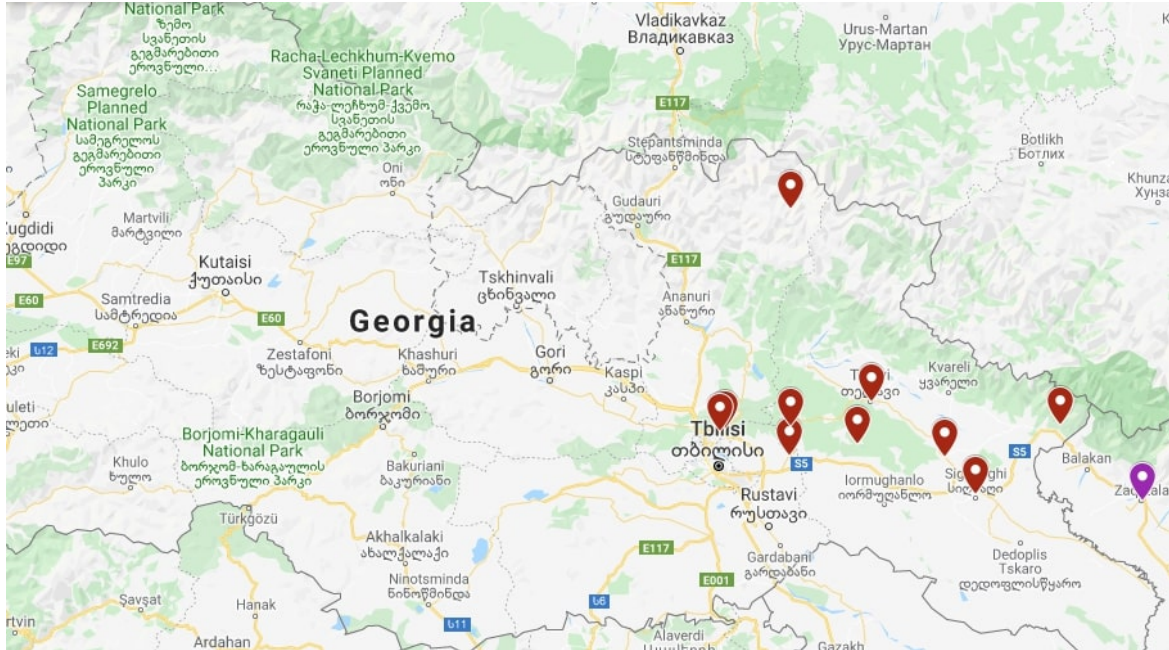


Figure 10. Raccoon sightings in Georgia are marked in red. The purple marker points out Zaqatala city of Azerbaijan – the most likely area from where raccoons dispersed in Georgia.

ted area before other sightings would take place anywhere else in the country. Although the official data is scarce, according to the frequency of sightings and intensity of locals' complaints regarding raccoon damage, it can be stated that one of the largest

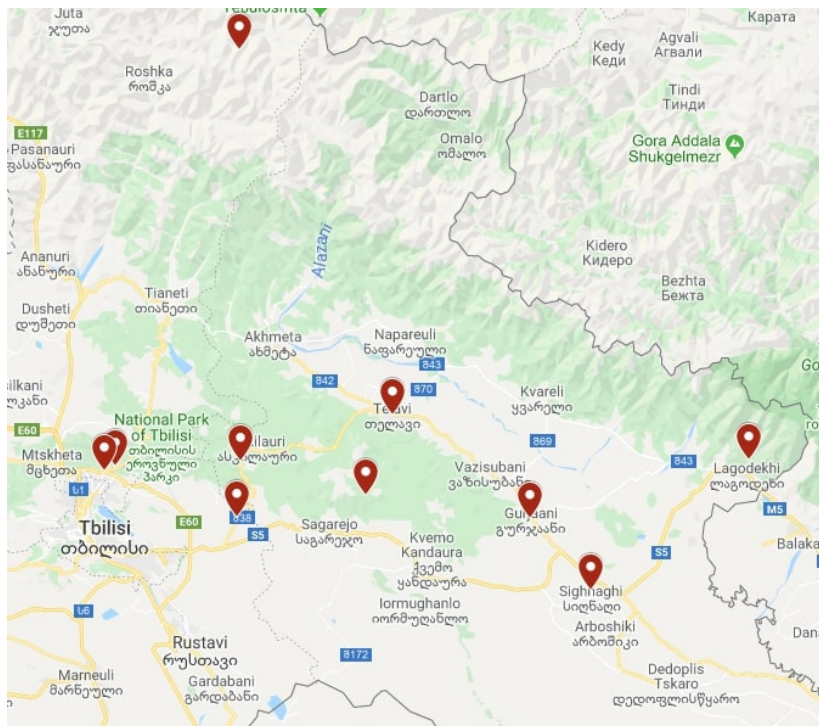


Figure 11. Locations from east to west. Lagodekhi National Park, Alazani Valley, Gurjaani, Telavi, Tsic-Gombori Mountain range, Shuamta Mountain range, Iori plateau, LEPL National Nursery, Village Mamkoda, Village Gldani.

and strongest populations are found in Lagodekhi Protected area and nearby settlements.

The climate in the eastern Georgia –where the raccoon was first seen – is quite different from the climatic regions in the central Georgia where the raccoon is currently spreading. A study done by Louppe et al. (2019) predicted that by the year 2050 favorable areas are more likely to expand in the northern regions while also maintaining current favorable spaces. Such expansion is attributed to the effects of climate change, namely the temperature rise. Raccoons residing in Lagodekhi region is a known fact to locals as well as to independent researchers and institutions, however more and more individuals are being observed in the central and northern parts of the country. This spread could be due to effects of climate change as well as due to the high adaptability of the species. Today, stable and in some areas increasing population of raccoon can be observed in Lagodekhi, Kakheti forests and even in regions close to Tbilisi National Park. According to the camera trap that captured a female raccoon with a nursery suggests that the species managed to adapt to and establish a breeding population in the high mountainous areas in Georgia such as Shuamta Mountain range.

The purpose of this study was to show that raccoons have established a strong breeding population in the eastern parts of Georgia and are spreading towards the central regions. Being an alien invasive species, raccoon has a potential to pose risk to many of the endemic species through its feeding and preying behavior (Anderson et al. 2006; Hayama et al. 2006). Georgia has a rich biodiversity and is recognized as one of the biodiversity hotspots as it is a habitat to many of the endemic species (<https://www.conservaion.org/>). Allowing alien invasive species to adapt and have breeding populations is quite risky to the native species as

they are generally easily outcompeted (Louppe et al. 2019).

According to the local residents, the raccoon is widespread in eastern Georgian areas like Alazani river valley, Iori Plateau, and on the Shiraki Plains. Like raccoon dog, raccoon managed to establish a wide range population and can cause massive damage to game bird populations such as grey partridge (*Perdix perdix*), rock partridge (*Alectoris graeca*), quail (*Coturnix coturnix*) and pheasant (*Phasianus colchicus*). However, no recorded data is available regarding the damage caused by raccoons in these areas. According to Louppe et al. (2019) raccoons are predicted to expand northward from their currently favored areas by 2050. Consequently it is likely to see more damage done by raccoons in following years unless a management or control action put in place.

Management approaches

Raccoon is an alien invasive species in Europe which is inflicting tremendous damage to native species. From the nature conservation point of view, this species is undesirable outside their natural range and management actions should focus on eliminating raccoons from the local ecosystems. The important aspect to consider is that the eradication programs of raccoon should start as early as possible, until the population density is still low and not well adapted to the new region. The goal should be to reach complete eradication as raccoon is not a native species in Europe and poses danger to native fauna species. However, raccoons are able to adapt to new environments rather fast, thus eliminating the species fast may prove quite challenging.

Eradication of raccoon in Europe is not a common practice. Raccoon was an important game species in countries like Germany where the yearly hunting bag would reach over 20 000 individuals. Although, the only successful raccoon trapping that was reported has been done around fenced areas near

nesting sites of Great Bustard inside the protected areas close to Berlin, Germany (Bartoszewicz 2011). At this state, *P. lotor* has become a well-established species in Europe and complete eradication of the species from its non-native range with legal methods becomes rather questionable. Moreover, areas that are currently raccoon free but which are suitable for the species (such as low land forests and partly forested wetlands) should be expected to be colonized first of all due to raccoons' generalist behavior and secondly due to climate change.

Trapping raccoons could be an effective control method. Hunting with dogs and trapping are methods actively used in North America as well. It has been reported that raccoon control outside the breeding season is most effective, because that is the time when raccoons are most visible. Such control strategy showed a positive effect on seabird and their habitat conservation both on regional and local levels (Harfenist et al. 2000).

The spreading and impact of the alien and invasive species is one of the biggest problems in the field of wildlife management and conservation (Louppe et al. 2019). A massive presence of the medium-sized carnivores can significantly change the species community due to its preying behavior (Anderson et al. 2006; Hayama et al. 2006).

References

- Anderson C, Griffith C, Rosemond A, Rozzi R, Dollenz O. The effects of invasive North American beavers on riparian plant communities in Cape Horn, Chile: Do exotic beavers engineer differently in sub-Antarctic ecosystems?. *Biological Conservation*, Volume 128, Issue 4. (2006). <https://doi.org/10.1016/j.biocon.2005.10.011>
- Arjo, W., Fisher, C., Armstrong, J., Johnson, D. & Boyd, F. Monitoring raccoon rabies in Alabama: the potential effects of habitat and demographics. *Wildl. Damage Manag. Confrences Proc.* 96, 14–22 (2005). <https://doi.org/10.2193/2007-450>
- Bartoszewicz, M. Invasive Alien Species Fact Sheet – *Procyon lotor* – From: Online Database of the European Network on Invasive Alien Species – NOBANIS www.nobanis.org. (2011)
- Beasley, J. C. & Rhodes, O. E. Jr. Relationship between raccoon abundance and crop damage. *Human-wildlife Conflicts* 2, 248–259 (2008).

The well known risk of IAS species are usually higher when the IAS species is a generalist predator. For the protection of valuable habitats of Georgia, monitoring and decreasing of raccoon populations must be set as a priority task of the wildlife conservation in Georgia. We also recommend to conduct further studies on raccoon population sizes either through counts or bag recordings. This in turn will show a clearer picture of the damage degree done to the native species and to private property of local residents.

Acknowledgements

We thank Giorgi Metreveli for his contribution by providing photos captured by the camera traps from LEPL National Nursery as well as Giorgi Sulamanidze for providing camera trap photos from Lagodekhi National Park. We would also like to show our gratitude to Zakro Songulashvili and Teimuraz Ziasev for sharing their data and additional relevant information with us.

The publication is supported by the EFOP-3.6.3-VEKOP-16-2017-00008 project. The project is co-financed by the European Union and the European Social Fund. The data collection in Georgia was supported by the TCP/GEO/3603 "Capacity building for sustainable wildlife management" financed by REU FAO.

- Czesnokov N. I. Dzikije životnyje meniajut adriesa. Wydawnictwo „Mysl”, Moskwa Ebenhard, T. 1988. Introduced birds and mammals and their ecological effects. Swedish Wildlife Research ‘Viltrevy’ Vol. 13:1-107. (1989)
- Garcia, J. T. et al. Recent invasion and status of the raccoon (*Procyon lotor*) in Spain. *Biol. Invasions* 14, 1305–1310 (2012). <https://doi.org/10.1007/s10530-011-0157-x>
- Harfenist A., MacDowell K. R., Golumbia T., Schultze G. Monitoring and control of raccoons on seabird colonies in Haida Gwaii (Queen Charlotte Islands). In: Darling L. M. (ed.) *Proceedings of a Conference on the biology and management of species and habitats at risk*. Makloops, B.C. 1999. (2000)
- Hayama, H., Kaneda, M., & Tabata, M. Rapid range expansion of the feral raccoon (*Procyon lotor*) in Kanagawa Prefecture, Japan, and its impact on native organisms. (2006)
- Heltai, M ; Szemethy, L ; Lanszki, J ; Csányi, S. Returning and new mammal predators in Hungary: the status and distribution of the golden jackal (*Canis aureus*), raccoon dog (*Nyctereutes procyonoides*) and raccoon (*Procyon lotor*) in 1997-2000 BEITRAGE ZUR JAGD- UND WILDFORSCHUNG 26 pp. 95-102. , 8 p. (2001)
- Kauhala, K. Introduced carnivores in Europe with special reference to central and northern Europe. *Wildlife Biol.* 2, 197–204 (1996). <https://doi.org/10.2981/wlb.1996.019>
- Kays, R. et al. Camera Traps as Sensor Networks for Monitoring Animal Communities. *The 34th IEEE Conference on Local Computer Networks.* 1, 811–818 (2009). <https://doi.org/10.1109/lcn.2009.5355046>
- Loupe V. et al. Current and future climatic regions favorable for a globally introduced wild carnivore, the raccoon *Procyon lotor*. *Scientific Reports.* 9:9174 (2019) <https://doi.org/10.1038/s41598-019-45713-y>
- Lutz W. Die Verbreeitung des Waschbären im mitteleuropäischen Raum. *Z Jagdwiss* 30:218–228. (1984).
- Mori, E. et al. The masked invader strikes again: The conquest of Italy by the Northern raccoon. *Hystrix* 26, 1–5 (2015)
- Okabe, F. & Agetsuma, N. Habitat Use by Introduced Raccoons and Native Raccoon Dogs in a Deciduous Forest of Japan. *J. Mammal.* 88, 1090–1097 (2007). <https://doi.org/10.1644/06-mamm-a-117r2.1>
- Salgado, I. Is the raccoon (*Procyon lotor*) out of control in Europe? *Biodivers. Conserv.* 27, 2243–2256 (2018). <https://doi.org/10.1007/s10531-018-1535-9>
- Sanderson G. C. Wild Furbearer management and conservation in North America. *Ontario Trapper’s Association, North Bay*, pp. 486-499. Schmidt (1987).

