

The Threat of Invasive Raccoons in Azerbaijan

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Invasive species are one of the main contributors to biodiversity loss across the globe. They are known not just for reducing native populations but also can cause extinctions (Mooney and Cleland 2001). Raccoons (*Procyon lotor*) are a medium-sized mesopredator native to Northern and Central America. However, due to numerous introductions, it can now be found in different parts of Eurasia such as Western and Central Europe, many former-Soviet countries, and Japan. The spread of raccoons has been well observed in all post-Soviet countries including Azerbaijan. However, literature on the topic has mainly been written in Russian, and there are only a few sources translated into English. In fact, many animals were brought to the former USSR intentionally for their fur, for hunting purposes, or just solely in the effort of “enrichment of local fauna.” In Azerbaijan, different furbearing mammals, such as raccoon dogs, minks, skunks, raccoons, etc. were introduced intentionally to acclimate them to the environment in the last century (Vereshchagin 1959). Out of these, only the acclimatization of the raccoon was a success. During initial releases, more than 1200 raccoons were released in 18 different regions of the Soviet Union, while most of the population was stocked in Azerbaijan. However, the impact of raccoons on local ecosystems has not been determined.

The paper highlights the history of raccoons in Azerbaijan as well as the whole Caucasus region from the middle of the last century. Raccoons, like other invasive species, can harm local ecosystems through feeding, competition, disease transmission, and hybridization. Thus, in this paper, alongside current population data, we investigate the main problem with the raccoon infestation in Azerbaijan – their negative impact on

the local fauna, as well as the economic loss they cause to farmers. In the conclusion, we suggest a potential country-scale solution for the vermin because hunting has proven to be ineffective to eliminate the dangers caused by raccoons.

The history of raccoons in Azerbaijan and other Soviet Republics

The idea of bringing raccoons to Soviet lands goes back to the early 30s. In 1936, raccoons from the Tashkent Zoo (22 in total) were released for the first time in areas that are now part of the Kyrgyz Republic (Aliyev and Sanderson 1966).

According to early literature on bringing furbearing mammals to the Soviet Republics, Lavrov mentions that raccoons should be released in places where snow cover does not stay more than 4-4,5 months (Lavrov 1958). And the best habitats for raccoons should be old and broad-leaved tree forests near non-drying rivers or swamps. He also mentions that raccoons prefer nesting in tree hollows which are at least one meter deep. So, the release sites should have at least 4-5 tree hollows within 1 square km to promote breeding (Lavrov 1958).

However, in Azerbaijan, the first release occurred in 1941 in the Ismayilli region with 21 animals (11 males and 10 females) that were brought from Europe (Aliyev and Sanderson 1966). Raccoons easily adapted to this new environment and started to increase in population shortly. In fact, raccoons in the Zagatala Valley served as the main source for releases to other parts of the country and the other Soviet Republics. In the middle of the 20th century, raccoons from Zagatala were brought to the Samur-Yalama forests bordering Russia and Azerbaijan: 18 animals in 1949, and 23 animals in 1950). And releases of raccoons within the borders of Azerbaijan continued in upcoming years. Two years later, in 1952 a total of 79 raccoons were released in the Zagatala region. In 1953, raccoons found themselves in a new suitable area with the release of 17 animals in the Altiagach forests – a protected

area today. The fur trade of released raccoons started in 1954, but by then they were only found in the northern parts of the country. It was in 1957 that raccoons found themselves in the historic refugium of Talish forests with the release of 50 raccoons in the Lenkeran district.

The raccoons from the initial release site – Ismayilli-Zagatala were released in 18 different districts or republics within the Soviet Union overall. Until 1958, a total of 1243 raccoons had been released in the Soviet Union, 504 of which were released in the Caucasus alone (Aliyev and Sanderson, 1966). As an example, the Alazan- Eyrichay Valley (located on the border of Georgia and Azerbaijan) is one of the best places for raccoon establishment. The successful accumulation of raccoons in the Caucasus was achieved by live-trapping them with so-called “shuyko” traps (in Russian) in early autumn and then releasing them in different areas. Among the over 1200 released animals in the Soviet Union, less than 75 came from outside of Azerbaijan SSR (Aliyev and Sanderson, 1966), and the Zagatala region was used as the main stocking location for Soviet raccoons.

The current range and population size of the raccoon in Azerbaijan

In one study on the distribution of raccoons in Europe, the author includes all areas of Azerbaijan except the Nakhchivan Autonomous Republic within the distribution range (Salgado 2018). Also, the population trend in Azerbaijan is noted as increasing. Raccoon populations from Azerbaijan managed to establish themselves in neighboring countries such as Russia, Georgia, and Iran (Saveljev et al. 2021; Kalandarishvili and Heltai 2019; Farashi and Naderi 2017). There was an estimated population of 40-45 thousand raccoons within the borders of the entire Soviet Union in 1964 (Aliyev and Sanderson 1966).

Currently, there is no country-wide survey to understand the population size of raccoons in Azerbaijan. Today they are

found in almost all forest areas in Azerbaijan. Raccoons prefer habitats that consist of deciduous forests close to water sources. Now raccoons have 3 isolated subpopulations in Azerbaijan: north, northwest, and south of the country (Saveljev et al. 2021). Raccoons are most abundant in the following regions: Quba-Khachmaz, Lenkeran- Astara (both mountains and lowland), Alazan -Eyrichay valley, and Samur-Devechi plains. Among the arid areas, populations have been recorded in the riverbanks in the Turyanchay State Reserve (Askerov, pers. comm.).

Regarding population size, there is a gap in the literature. This can be due to the raccoon's nocturnal lifestyle. However, there are some early data on the number of raccoons in Azerbaijan. According to Vereshchagin in Alazan-Eyrichay Valley alone, within 250 square kilometers, 180-200 raccoons can be found (Vereshchagin 1947). After successful releases in various parts of the country, Aliyev and Sanderson surveyed the population in 1954 and found that up to 25 thousand raccoons had established themselves in the Caucasus (1966). This figure shows how quickly raccoons established themselves and spread in the region just in a decade after the initial releases. Regarding the recent numbers, there is not much information available. Based on the results of camera trap surveys in the Hyrcan National Park, at least 1209 individual raccoons were recorded within 40.358 ha (Saveljev et al. 2021).

The impacts of raccoons on local ecosystems in Azerbaijan

In the early days of the release of raccoons in Azerbaijan, their diet was investigated. However, the negative impacts of raccoons' eating habits were not fully understood. Some experts do not agree with the idea that they have only a negative impact. For example, some experts considered raccoons in the Soviet Union as a "useful predator," which would keep agricultural and forest pests in control and not harm wild animals and domestic plants (Redford 1962). However, raccoons

wreak havoc on local ecosystems and affect native fauna negatively when placed outside North and Central America. In general, invasive species harm local ecosystems through feeding (predation or herbivory), competition, disease transmission, and hybridization (Parker et al. 1999).

A raccoon is a medium-sized predator (mesopredator) that feeds on both animal and plant-based foods. It has been reported that captive raccoons caught in Zagatala required 350 grams of fruit and 200 grams of meat for their daily consumption while they were transported to other areas (Aliyev and Sanderson 1966). In terms of diet, the raccoon is truly an opportunist omnivore and mainly feeds on fish, crabs, amphibians, reptiles, insects, various bird eggs, sometimes rodents, and available fruits. In early spring, when fruits are scarce, they rely on an animal-based diet. These prey and predator relation puts local flora and fauna at risk.

The main diet item of the raccoons in northwest Azerbaijan is various amphibians (56,2% of excrement), followed by insects, plants, and less commonly, reptiles, birds, mollusks, and fish. In the Hyrcan National Park raccoons preferred rare frogs – the Hyrcanian wood frog *Rana pseudodalmatina* and the Talish Toad *Bufo eichwaldi* in their diet (Saveljev et al. 2021). Another potential victim of raccoons in the Talish forests is the Caucasian smooth newt *Lissotriton lantzi*, which is considered extinct locally in Azerbaijan according to the Red Book (Ministry of Ecology and Natural Resources of Azerbaijan 2013). Other rare amphibians of the country such as the Karelin's newt *Triturus karelinii*, Caucasian parsley frog *Pelodytes caucasicus*, and Caucasian toad *Bufo verrucosissimus* (all listed in the Red Book of Azerbaijan) suffer from raccoon predation.

Raccoons are also known as serious predators of eggs and nestlings of reptiles and birds (especially waterfowl, sea birds, and passerines) both in their native and introduced ranges. There has been no research done on this matter in

Azerbaijan, but some of the rare birds and reptiles are also affected by raccoons. For example, the Talish subspecies of common pheasant *Phasianus colchicus talischensis*, which is a ground-nesting bird, creates an easy food source for raccoons and is now considered extinct in the wild in Azerbaijan (Ministry of Ecology and Natural Resources of Azerbaijan 2013). Another bird species known to be greatly affected by raccoons is the Black Woodpecker *Dryocopus martius*. Because this woodpecker species needs large openings in trees to breed, this has created an opportunity for raccoons to enter the nest holes and devour chicks or eggs. As a result, this species, which once spanned both the Great Caucasus and Talish forests, has become rarer (Askerov, personal communication).

Raccoons are also known as a big problem in various poultry farms and agricultural fields across the country. Raccoons can survive harsh winters while being inactive with the help of fat reserves they gain in autumn (Folk et al. 1968). Moreover, raccoons compete with local predators such as the Eurasian badger *Meles meles*, and Eurasian otter *Lutra lutra* on food sources and reproduction sites. One further reason for the increase in the raccoon population is the lack of competition with pine and beech martens, *Martes martes*, and *Martes foina*, in Azerbaijan (the latter is a Red Book species). As these two martens also have been hunted for their furs under the Soviet Union, raccoons took over their ecological niche rapidly soon after their introduction. However, after the dissolution of the Soviet Union, the fur industry collapsed. As a result, martens started to increase in population size, which stabilized raccoon growth in the country (Askerov, personal communication).

Another negative impact of raccoons on native fauna, and also farm animals, and even humans, is the transmission of diseases and parasites. When releasing them in the Soviet era, researchers noted that raccoons lost their native parasitic worms with the exception of *Uncinaria stenocephala* (Aliyev and Sanderson 1966). Aliyev and Sanderson hypothesized that this

loss can be due to the lack of intermediate hosts for helminth worms. Other parasite species, such as *Gongylonema pulchrum* roundworm and the human flea *Pulex irritans*, have also been recorded. Also, two ticks and one flea species that don't occur in North America have been found in raccoons in the Caucasus (Aliyev and Sanderson 1966). Furthermore, based on another study carried out between 2001 and 2007 in 4 different regions of Azerbaijan, 23 species of parasitic worms and 11 species of ectoparasites were found among 134 raccoon specimens (Azizova 2010). One of the parasites known to affect different mammals and birds is raccoon roundworm *Baylisascaris procyonis*, which was found in all 4 regions investigated in the abovementioned study. The author concluded that some of the parasites found in Azerbaijani raccoons can cause serious pathological changes in humans. For example, among the discovered helminths, 8 species are known to parasitize humans, and out of 11 species of ectoparasite, 7 can be found in humans (Azizova 2010). Animal farms (especially poultry farms) are at great risk to be a center of raccoon-born disease outbreaks, which can affect farmers' health and livelihoods dramatically.

Raccoons also are known for the transmission of dangerous viruses such as rabies and canine and feline distemper, which can be deadly for both humans and local carnivores, where in the US raccoons accounted for around 30% of wildlife-related rabies cases in humans in 2016 and 2017 (Ma et al. 2018a, 2018b).

Management strategies

Considering the negative impacts of raccoons in their non-native range, many countries are taking action to eradicate or at least control their population size. For example, European Parliament Regulation No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species requires member states to respond and eradicate invasive species.

However, the total number of raccoons in Azerbaijan is unknown. Researchers noted that in the summer of 1951, there was a drastic drought in Azerbaijan that caused the drying of some water sources. In response, the raccoon's range was restricted and even some migrated to subalpine and alpine landscapes (Aliyev and Sanderson 1966). Raccoons use riverbanks as a corridor to travel to new areas and establish new populations (Mori et al. 2015). Therefore, raccoons may continue to spread further by using available riverbanks in their proxy.

There are not many natural predators of raccoons in Azerbaijan to control their population. Only a handful of animals are known to prey on raccoons. These are the Eurasian eagle-owl *Bubo bubo*, the Persian leopard *Panthera pardus tulliana*, the Eurasian lynx *Lynx lynx*, the Eurasian wolf *Canis lupus*, domestic/feral dogs *Canis lupus familiaris*, etc. However, it is also noted that predation is not the main control mechanism in natural raccoon populations in North and Central America (Gehrt 2003).

As discussed previously, raccoons negatively impact not just local ecosystems, but also the livelihood of many people that rely on poultry and agriculture. Also, raccoons often reside in urban and suburban environments subsisting on human garbage, hence gaining their famous nickname: *trash panda*. Thus, Azerbaijani environmental authorities should take necessary measures to both stop the establishment of new populations and control existing ones. One of the measures taken so far in terms of raccoon control in Azerbaijan has been allowing raccoon hunting year-round. However, trying to control raccoons via hunting is not a reliable method for two reasons: Firstly, people don't usually consume raccoon meat, and now there is no trade in raccoon fur in Azerbaijan. Hunters don't have an incentive to hunt this animal in the first place. Second, raccoons are usually nocturnal animals, which decreases the chances of hunters encountering one. This is proven by the number of licenses issued for raccoon hunting

in recent times. For instance, The Ministry of Ecology and Natural Resources issued licenses for hunting a total of 29 raccoons within the 2021-2023 period, a very small amount considering the population of the species (Ministry of Ecology and Natural Resources, pers. comm).

There are various steps needed to stop raccoon infestation. The first one is education campaigns for pet owners. Some in Azerbaijan keep raccoons as pets. Therefore, strict regulations are mandatory to register and control the pet trade of raccoons – each raccoon owner should have a passport and also should be fined if they release the animals into the wild.

For the existing populations, I recommend a state-level eradication campaign by setting up live traps in known locations where raccoons have already established themselves. Considering the relatively long history of raccoon presence in Azerbaijan and the obvious threats mentioned, an eradication campaign is the only viable solution. Also, this is a more humane and easier way of controlling the raccoon population than hunting. One such campaign in Northern Italy almost fully eradicated raccoons by using cage traps and euthanizing them. All the operations were handled by one field operator and in total 69 raccoons were trapped in the surrounding areas of the Adda River between 2016 and 2019 (Mazzamuto et al. 2020). It is important to use camera traps from the beginning of any eradication effort to monitor the process and be able to identify sites with residual populations. Additionally, local stakeholders play an essential role in the identification of trapping sites as well as the entire success of the campaign. Informing locals about environmental, economic, and health concerns that raccoons pose increases the chances of an eradication campaign succeeding. Along with camera traps, some specifically trained dogs can also be used to detect areas and dens of raccoons. After detection, based on the location, a sustainable trapping method can be applied. For example, in the Italian case, they used both wire cage traps and EGG

(foothold) traps only in fenced areas (Mazzamuto et al. 2020). Captured animals additionally create opportunities for education campaigns because they can be used as “ambassador animals” to inform people about their ecology and behavior.

Such an eradication campaign in Azerbaijan will not just deter biodiversity loss but can potentially create new job opportunities for rural communities. Considering the distribution of the species, available data, and the degree of threat raccoons pose to rare local species in the Talish forests, those areas can be selected for an initial campaign. Establishing a raccoon fur production business in Talish forests could also provide new job opportunities for locals where raccoons are abundant and job opportunities are lower. However, we should mention that even if such fur facilities are established, they should be based on wild populations and no breeding program should be allowed because that might risk exacerbating the infestation.

Conclusion

Based on the data provided above, we can see that raccoons wreak havoc on the local biodiversity of Azerbaijan in various ways. Predation is the biggest issue that raccoons pose, especially against Red Book species such as various amphibians and birds, but they also present unneeded competition with natural predators and function as a disease vector. They impact local communities negatively as well, especially poultry. Based on all these findings, I recommend a state-level eradication campaign for the protection of local wildlife and the elimination of economic losses.

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