NOBANIS – Invasive Alien Species Fact Sheet

Procyon lotor

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Species description

Scientific name: *Procyon lotor (Linnaeus 1758)* Procyonidae
Synonyms: None
Common names: Raccoon (GB), Waschbär (DE), Vaskebjørn (DK), Pesukaru (EE), Pesukarhu (FI), Þvottabjörn (IS), Paprastasis meškėnas (LT), Jenot (LV), Vanlig vaskebjørn (NO), Szop pracz (PL) Jenot poloskun, Енот-полоскун (RU), Tvättbjörn (SE).

Fig.1. *Procyon lotor,* photo by M. Bartoszewicz.

Species identification

Procyon lotor looks very much like the raccoon dog (*Nyctereutes procyonoides*): The masked face, greyish fur and size are similar in both species. *P. lotor*'s head is wide with big eyes and pointed muzzle. One of the most distinguishing features of the raccoon is its black or almost black mask that fully surrounds the eye region, reaching from the cheeks across the eyes and muzzle, and extending down the muzzle and up to the forehead. The mask is surrounded by

whitish hair, which makes the face look more contrasting. The colour of the coat is usually grey but some individuals are reddish or almost black. The fur turns lighter or greyish white on the flanks and legs. *P. lotor*'s striking, bushy tail has 5-7 rings with considerably lighter bands. *P. lotor* stores fat in its tail and during cold winters and dormancy it draws upon the fat reserves. During the summer its tail is thin and not so remarkable. Front footprints resemble that of human hands: fore and hind paws have five soft skinned fingers with no webbing between the digits, which is unusual among carnivores (Lotze and Anderson 1979, Zeveloff 2002).

Native range

P. lotor is native to North and Central America. In the beginning of the 20th century, its natural range was limited to deciduous forests between the east coast of North America and the Rocky Mountains on the west coast (Kaufmann 1983). At present it occurs in the entire territory of the United States, southern Canada and Central America, and it occurs in almost every kind of environment, including open and marshy grounds, wooded areas along streams and lakes and urbanised areas (Sanderson 1987).

Alien distribution

History of introduction and geographical spread

A few raccoon specimens originating from the zoological garden in Hamburg were first released in Germany in Northern Hesse (Edersee) in 1927 (Lutz 1996), then two pairs in 1934 in the same region (Müller-Using 1959), and in 1935 some raccoons near Berlin (Lutz 1984). The first urban raccoon litter was recorded in 1951, 20 km from the original site of release in Hesse (Hohmann *et al.* 2001). During the Second World War several tens of raccoons escaped from fur farms near Berlin. These animals founded a small, but stable wild population, whose range was originally limited to the grounds in the close vicinity of the place of introduction. Over the last 20 years, after a period of adaptation to European conditions, expansion of these populations in all directions became evident.

In 1936, racoons were also introduced in Russia and in 1954 and 1958 in Belorussia. Most of the introductions of raccoon in Eastern Europe did not succeed, unlike in the western and middle part of the continent (Czesnokov 1989). Nevertheless, in the northern Caucasus and on the Black Sea Coast raccoons did not only survive in the places of release but also considerably expanded their range. In the aftermath of the expansion of the German population, *P. lotor* was also recorded in France (1934), Netherlands (1960), Austria (1974), Switzerland (1975), Luxembourg (1979), Czech Republic, and Slovakia. The current European range of *P. lotor* also includes Belgium, Hungary, Poland, Denmark, Belorussia and former Yugoslavia (Bogdanowicz and Ruprecht 1987, Stubbe 1993, Kauhala 1996, Léger 1999, Mitchell-Jones *et al.* 1999, Červeny *et al.* 2001, Cirovic and Milenkovic 2003, Heltai 2005).

Pathways of introduction

The first introduced raccoons in Europe were deliberately released by man in Germany (Müller-Using 1959), where they started a wild population. Later there were large-scale deliberate introductions of *P. lotor* in Russia with the aim of "improvement and reconstruction of nature" as well as for economic reasons due to the increase of profits from hunting (Czesnokov 1989).

Some populations were established by raccoons escaping from fur farms, zoological gardens and human settlements, where they are kept as pets (Kauhala 1996, Heltai 2005).

Alien status in region

The strongest population lives in Germany, especially in the middle part of the country and in Brandenburg, near the border with Poland (Lutz 1996, Hohmann 2000). The hunting bag in Germany can be an indicator of the dynamic increase in *P. lotor* numbers. In 1970-1990, the hunting bag oscillated between 1200 and 3000 raccoons per year in the entire country (Lutz 1995). In 1992/1993, within Brandenburg, only 50 individuals were shot, whereas ten years later, in the hunting season 2003/2004, as many as 3470 raccoons were harvested in the same area, exceeding the maximum hunting bag for the whole Germany in the past three decades (Schulz 2003).

The appearance of *P. lotor* in new countries indicates high population growth and the beginning of an expansion process (see table 1). The species is constantly expanding its range in Europe and currently, apart from Germany occurs in France, Netherlands, Luxembourg, Belgium, Denmark, Switzerland, Austria, Hungary, Czech Republic, Slovakia, Poland, Belorus and Yugoslavia. In Denmark the species is observed only when animals escape from captivity, a population as such is not established (Sandor H. Markus, pers. comm.). Raccoons are occasionally found in Central Sweden and in southern Norway, but it is assumed that these are individuals that have escaped from pet owners or animal parks. All documented observations of this species in Norway have been backtracked to illegal keeping of *P. lotor* as pets. There is no evidence that there is a reproducing raccoon population in the wild (Ebenhard 1988). In Russia small wild populations of raccoons inhabit foothill of Caucasus (Павлов и др. 1973).

Country	Not found	Not established	Rare	Local	Common	Very common	Not known
Austria			X				
Denmark		X					
Estonia	X						
European part of Russia			X				
Finland	X						
Faroe Islands	X						
Germany					X		
Greenland	X						
Iceland	X						
Latvia	X						
Lithuania				X			
Norway		X					
Poland				X			
Sweden		X					

Table 1. The frequency and establishment of *Procyon lotor*, please refer also to the information provided for this species at www.nobanis.org/search.asp. Legend for this table: **Not found** –The species is not found in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** – No information was available.

Ecology

Habitat description

P. lotor has achieved such a great invasion success because of its flexibility and capability of adjusting to different environmental conditions. Although it settles in almost every kind of habitat, including partly open and marshy grounds and urbanised areas, it prefers old deciduous stands, adjacent to water (Sanderson 1987, Zeveloff 2002). A *P. lotor* population examined in Germany inhabits mainly two habitats: housing estates and mixed forests with a large proportion of hard-wood trees, such as beeches and oaks. Raccoons prefer such habitats because of food and shelter abundance – these trees provide beech nuts and acorns as well as hollows (Hoffman and Gottschang 1977, Hohmann 1998, 2000, Hohmann *et al.* 2001). In Luxembourg, one radiotracked female preferred conifer plantations and she used mainly Norway spruce trees as diurnal sleeping sites (Frantz *et al.* 2005). In western Poland, raccoons prefer wetlands with old willow trees, willow shrubs and reedbeds. Their density in such habitats is higher than in deciduous and pine forests (Bartoszewicz *et al.* 2008).

Reproduction and life cycle

Raccoons are polygynous (a male often mates with at least two females) or promiscuous (males and females mate with various partners during breeding season – Gehrt and Fritzell 1999, Zeveloff 2002). They mate from January through March, with a peak of activity in February. The pregnancy lasts for about 65 days and most of litters are born in April. The litter size ranges from 1 to 8 young (usually 2-5). Juveniles often stay with their mother throughout their first winter (about 10 months), until the next mating season. Females tend to be philopatric – they remain in their natal area (Zeveloff 2002). Males leave the natal area and disperse sometimes even over long distances (maximum distance reported was 264 km). Based on data from captures, maximum lifespan of this species in the wild is 10-12 years. The same parameter determined on the basis of dental annuli is 13-16 years. However, the majority of raccoons in the wild live less than 5 years (Lotze and Anderson 1979).

Dispersal and spread

During the first 60 years of presence in the European teriofauna the range of *P. lotor* was restricted to Germany and France and its numbers, estimated on the basis on the German hunting bag, have been stable. Since about 1980s, the German population has been increasing and the species started its expansion, extending its range. Raccoons still colonize new countries, and successive population increase is very likely. Throughout the last several years the number of raccoons has increased dramatically in urbanised areas in Germany and northern France and the population density there has reached 100 individuals/100 ha (Hohmann *et al.* 2002, Michler *et al.*2004).

Impact

Affected habitats and indigenous organisms

In its native range, *P. lotor* inhabits many types of habitats, including woodlands and wetlands. For this reason, it can be a threat to species occuring in these kinds of environments (Sanderson 1987). This is an opportunistic species, able to successfully colonize urban, recreational areas or orchards. *P. lotor* is an unspecialised predator which can hunt on the ground, in water and in trees (Ewer 1998, Hohmann 1998, Zeveloff 2002). *P. lotor* is currently the only representative of its family in Europe; therefore it occupies an entirely new ecological niche. Thanks to its well developed ability to climb trees, *P. lotor* is more versatile

than most European predators. In Germany, research into interspecific competition for resting sites between *P. lotor* and wild cat *Felis sylvestris* yielded no evidence for any severe impact from raccoon in this respect (Hohmann and Hupe 1999).
The diet of raccoons is very diverse, with seasonal changes depending on the food availability. Raccoons are omnivorous: they eat nuts, fruits (berries, fruits from orchards), grass, seeds, insects, molluscs, crustaceans, worms, eggs, fish, amphibians, birds, small mammals, carrion and garbage (Lutz 1980, Zeveloff 2002, Bartoszewicz *et al.* 2008).
In Germany, raccoons were suspected of threatening native grouse populations but there is little evidence to support this (Lutz 1996). However, it can be expected that in richer forest ecosystems, as well as on marshy grounds, raccoons will find far more suitable conditions, and the species density will be much higher, resulting in more severe impact. This possibility is confirmed by data from North America. In areas where raccoon was introduced (British Columbia, Canada) and in areas with increasing raccoon numbers, the species affects ground-nesting birds (ancient murrelets *Synthliboramphus antiquus* and Canada geese *Branta canadensis*, Hartman *et al.* 1997, Zoellick *et al.* 2004). In Illinois (USA), the after-effect of the increasing raccoon population was the declining number of birds nesting close to the ground, reaching 10 % within 10 years (Schmidt 2003).
Raccoons were also introduced to and spread in Japan where they have become a serious problem affecting agriculture and ecosystems and within its alien range in Japan, raccoons are believed to contribute to declining number of endangered hynobiid salamander.

Within its native range, the only disease that can seriously impact raccoon numbers is canine distemper (Zeveloff 2002) but during the German research no raccoons suffering from canine distemper virus was reported (Frölich *et al.* 2000). *P. lotor* is also a carrier of the roundworm *Baylisascaris procyonis* which can be dangerous other species of mammals and birds (Teer 2006).

Genetic effects
There should be no risk of hybridization with native carnivore species, because raccoons do not have close relatives in Europe.

Human health effects
In North America, raccoons are one of the most important vectors of rabies. In Germany, cases of rabies in raccoons have also been documented but seldom compared to fox or marten (Lutz 1996). Within its native range they also carry more than a dozen pathogens (*e.g.* leptospirosis, tularemia, tuberculosis, listeriosis, encephalitis) that can cause illness in other species, including humans, (Zeveloff 2002).
Because raccoons can carry the roundworm *Baylisascaris procyonis*, it is necessary to be careful with raccoon's faeces which can be filled with its eggs. The parasite could pose serious health threat to persons who accidentally ingest animal faeces, e.g eating unwashed berries (Teer 2006, Zeveloff 2002). In Germany 70-80% of the examined raccoon population proved to be positive for this parasite which is a potential zoonosis problem (Gey 1998, Hohmann *et al.* 2002).
In western Poland about 3 % of all raccoons are also infected with this parasite. Coproscopic examination revealed also the presence of 6 nematode taxa: *Ancylostoma* spp., *Baylisascaris procyonis, Strongyloides procyonis, Placoconus lotoris*, Capillariidae, *Spirocerca lupi* and a single trematode, *Echinostoma* sp. (Popiołek *et al.* in press)

Economic and social effects (positive/negative)
German studies so far have not reported serious damage caused by raccoons, even in urban areas, except for sporadic eating of crops from orchards (Lutz 1996, Hohmann 2001, Hohmann *et al.* 2001). However, as a vector of rabies and parasites, raccoon can sometimes be a problematic species. In Japan raccoons are blamed for causing a wide variety of damage: eating corn and watermelons, predating on carp kept in ponds and bothering people.

Management approaches

Prevention methods
From the point of view of nature conservation, *P. lotor* is an undesirable alien species and thus within the confines of the law should be eradicated.
In Poland within the confines of the "National Biodiversity Strategy" drawn up by Ministry of the Environment in 2003, it is recommended to study the impact of alien species on native species and ecosystems and also its social and economical effects. The result of such research should be limiting of the number and expansion and controlling of alien species especially those which are most dangerous for native biodiversity. However, there is no specific recommendation with regard to prevention or eradication methods for this species.

Eradication, control and monitoring efforts
In Europe, there is little experience with raccoon population control. For many years this has been a game species in Germany where its yearly hunting bag reaches over 20,000 individuals. However, hunting has no influence on the expansion of this invasive species to other countries.
In Poland, it has been allowed to hunt *P. lotor* all year round using livetraps since 2009. As in Germany, there seems to be little effect of the hunting on slowing down the species expansion in Poland.
The EU LIFE project (2011-2014) for the waterbirds protection in five Polish national parks includes removal of minks and raccoons from protected important bird areas.
Using trapping methods could possibly be more effective. The only effective trapping of raccoons has been done around fenced nesting sites of great bustrads Otis tarda inside of protected areas around Berlin in Germany (pers. comm. Astrid Sutor and Sabine Schwarz).
On the Queen Charlotte Islands (British Columbia, Canada), where seabird colonies have been put at risk due to the introduction of *P. lotor*, a management plan has been developed consisting of four main components: monitoring, control, research and communication. The goal of control must be complete eradication of *P. lotor* from colonies and should be carried out in early stages of colonization, when *P. lotor* densities are low. The main method used to control *P. lotor* on rocky islands is hunting using a shotgun at night with a spotlight from a small boat. Elsewhere in America hunting with dogs and trapping have been used. Control efforts on colonies are most effective if conducted outside the breeding season, when raccoons are visible. This plan has been applied having a significant positive effect on the conservation of seabirds and their habitats at local and regional scales (Harfenist *et al.* 2000).
Despite local successes, eradication of this species from large areas in Europe seems impossible with legal methods, and further colonization of formerly raccoon free areas that provide suitable habitat (low land forests and partly forested wetlands) has to be expected. *P. lotor* will inevitably become an established species in most parts of Europe and management plans should focus on conflict diminishing and communication programs.

Information and awareness
Information about raccoon distribution, ecology and impact on native fauna in Europe is very scarce, thus such data are needed. Some information is available on the Internet (see links).

Knowledge and research
Functioning of the introduced population in Europe and adaptations of this species to new environment, its reproduction rate and mortality were studied in Germany only. These studies concentrated mainly on the population structure, morphometrics in the aspect of similarities with the American population and raccoon's food composition. The spatial behaviour of one individual has been studied in Luxembourg. The use of space, diet composition and parasite infections were investigated in Poland (Bartoszewicz 2005, Bartoszewicz *et al.* 2008). Currently a detailed research founded by Ministry of Science and Higher Education of the ecology of dispersion and genetic structure of raccoon's population is being carried out in Poland (M. Bartoszewicz per. comm.).

Recommendations or comments from experts and local communities
P. lotor continues its expansion in Europe and is extending its range. There is thus a need for wide ecological research of its influence on native fauna. This will help to answer the question whether raccoon should be the object of an active control policy and if any specific prevention programmes should be developed.

References and other resources

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Links

Information about species – Animal diversity Web
Reports from German raccoon research - list of German raccoon publications

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