



1<sup>st</sup> EUROPEAN RACCOON COLLOQUIUM

# BOOK OF ABSTRACTS

2023 MARCH 16th and 17th  
LYON, FRANCE



Université Claude Bernard Lyon 1



Université Claude Bernard UFR Lyon 1



## **1<sup>st</sup> European Raccoon (*Procyon lotor*) colloquium**

The 1<sup>st</sup> European Raccoon Colloquium is held on March 16 and 17, 2023 in Lyon (France). Co-organized by the UMR CNRS 5558 Biometry and Evolutionary Biology Lab of the University Claude Bernard Lyon1 (LBBE), the French Agency for Food, Environmental and Occupational Health & Safety (ANSES), the French Biodiversity Agency (OFB) and the National Natural History Museum of Luxembourg, the colloquium aims to establish a synthesis of current knowledge on the ecology of this invasive species that is expanding rapidly in Europe. Structured in different thematic sessions (General Ecology, Population Genetics and Genomics, Epidemiology and Parasitology, Management), it allows European researchers and managers to exchange on fundamental and practical questions about the raccoon. Secondly, this colloquium is the launching meeting of a European group of fundamental and applied research on the management of raccoon populations in Europe. The idea of a group named "Euroraccoon" is presented, a group whose vocation is collective work on a European scale by sharing information, data and samples to answer on a large scale the fundamental and applied questions raised by the raccoon in Europe.

The colloquium is in a hybrid format. Forty-two people are present in person while the full attendance will be about 85 people coming from 15 countries. Thanks to all for this amazing success!

## General Information

Talks will be given in the amphitheater Emilie du Chatelet at Marie Cury Library.

Coffee breaks and poster session will be held in room 202-203 (2<sup>nd</sup> floor).

Full information for the venue are given on the colloquium website (<https://1raccoon-colloq.sciencesconf.org/resource/page/id/6>) but are remembered below:

Bibliothèque Marie Curie de l'INSA, campus de La Doua; Université Claude Bernard Lyon 1; 31 avenue Jean Capelle; 69100 Villeurbanne

GPS coordinates: N 45°46'56.7", E 4°52'37.3" ou N 45.782417, E 4.877031

Basically, you have to go for the Tramway T1, stop "INSA - Einstein", and then look for this building :



Lunches will be taken at the restaurant at INSA. Follow the guide!

The colloquium dinner will be taken at the restaurant "Chez Grand-Mère" at 8 PM on March Thursday 16<sup>th</sup>. The restaurant is in the old town of Lyon, 11 rue du Boeuf 69005 Lyon.

On Thursday evening after the poster session, we propose a walk towards the old Lyon district and the restaurant (if weather permitting). We will cross the university campus and then the Parc de la Tête d'Or (one of the most beautiful parks in Lyon). We will then walk up the quays of the Rhône, cross the river and then the Place des Terreaux (emblematic of Lyon), and then cross the Saône to walk through the old town of Lyon to the restaurant. Before dinner, there will be time for a break in one of the many bistros of old Lyon. Count 1h15 to 1h30 of walking. You can also join us directly at the restaurant for 8pm.

On Wednesday evening, for those arriving in Lyon in the afternoon or early evening, we propose a meeting in a Lyon bar near the campus, probably the [Toï Toï](#), to share a drink and possibly have dinner in the evening. The meeting will take place at 6pm but you can arrive whenever you want. The location will be confirmed at the beginning of the conference week.

## **Scientific and Organizing Committees**

### **Scientific Committee**

Pascale Chevret (LBBE)  
Sébastien Devillard (LBBE)  
Christine Fournier-Chambrillon (GREGE)  
Alain Frantz (National Natural History Museum of Luxembourg)  
Jean-François Maillard (OFB)  
Benoit Pisanu (OFB)  
Céline Richomme (ANSES)  
Gérald Umhang (ANSES)

### **Organizing Committee**

Pascale Chevret (LBBE)  
Sébastien Devillard (LBBE)  
Christine Fournier-Chambrillon (GREGE)  
Alain Frantz (National Natural History Museum of Luxembourg)  
Manon Gautrelet (GREGE/URCA)  
Jean-François Maillard (OFB)  
Benoit Pisanu (OFB)  
Elodie Portanier (LBBE)  
Céline Richomme (ANSES)  
Gérald Umhang (ANSES)

## Program DAY 1

Day 1: March 16th	Chairman	Session	Speaker	Title	At distance/ in person
8h-9h		Welcome		<i>Registration</i>	
9h-9h10	Sébastien Devillard & Pascale Chevret	Welcome and opening remarks			
9h10-9h40		General Ecology	<b>Keynote speaker: Berit Michler</b>	<b><i>Causality or correlation – why only long-term studies on raccoons yield meaningful data on the ecological impact</i></b>	at distance
9h40-10h00		General Ecology	Ulf Hohmann	<i>The social sex. About male bonding behavior in raccoons</i>	in person
10h00-10h20		General Ecology	Kristiàn Katona	<i>Raccoon (Procyon lotor) in Hungary: signs of a slowly emerging population</i>	at distance
10h20-10h50		Coffee break			
10h50-11h10	Benoit Pisanu & Jean-François Maillard	Management - Field methods	Nadia Cappai	<i>A multidisciplinary approach for raccoon (Procyon lotor) management in Casentino Valley, Tuscany, Italy</i>	in person
11h10-11h30		Management - Field methods	Francesco Bisi	<i>The raccoon in Northern Italy: research and management to achieve eradication</i>	in person
11h30-11h50		Management - Field methods	Benoit Pisanu	<i>Estimating Raccoon (Procyon lotor) population densities with capture-mark-recapture, catch-effort removal and camera-trap methods: first lessons</i>	in person
11h50-13h30		Lunch Break			
13h30-13h50	Gérald Umhang & Céline Richomme	General Ecology - Management strategy	Emiliano Mori	<i>Distribution of invasive Northern raccoons in Italy and threats to the conservation of native crayfish in central regions</i>	in person
13h50-14h10		General Ecology - Management strategy	Etienne Branquart	<i>Living with raccoons: lessons from North America</i>	at distance
14h10-14h30		Parasitology and infectious disease	Céline Richomme	<i>Parasitological and microbiological investigations in raccoons from northeast and southwest France</i>	in person
14h30-14h35		Parasitology and infectious disease (Flash-talk)	Juan Barcena	<i>Molecular and serological detection of viral diseases in raccoon populations</i>	in person
14h35-14h40		Parasitology and infectious disease (Flash-talk)	Miriam Maas	<i>Raccoons in the Netherlands: an invasive alien species with public health significance</i>	at distance
14h40-15h00		Parasitology and infectious disease	Questions and answers about the Flash-talks		
15h-15h30		Coffee break			
15h30-17h30		Poster session - networking			
20h		Colloquium dinner	Chez Grand-Mère		

## Program DAY 2

Day 2: March 17th	Chairman	Session	Speaker	Title	at distance/in person
9h-9h30	Alain Frantz & Sébastien Devillard	Genetics and genomics	<b>Keynote speaker: Alain Frantz</b>	<b><i>Using genetic tools to infer the colonisation histories of the raccoon and its Baylisascaris procyonis roundworm parasite in Western and Central Europe</i></b>	in person
9h30- 9h50		Genetics and genomics	Jérémy Larroque	<i>Microsatellites and mitochondrial evidence of multiple introductions of the invasive raccoon Procyon lotor in France</i>	in person
9h50- 10h10		Genetics and genomics	Alexandra Biedrzycka	<i>Genetic studies of European raccoon population – demography and adaptation in invasive range</i>	in person
10h10- 10h30		Genetics and genomics	Joanna Kotodziejczyk	<i>Genomic diversity of invasive raccoon populations and its pathogen diversity – importance for the invasion success</i>	in person
10h30- 11h		Coffee break			
11h- 11h20	Alain Frantz & Christine Fournier- Chambrillon	General Ecology - Space use	Vinciane Schockert	<i>Some facts on Procyon lotor ecology in southern Belgium: what do raccoons eat, how do they move and at which population density do they live?</i>	at distance
11h20- 11h40		General Ecology - Space use	Manon Gautrelet	<i>GPS tracking and multiscale study of space use and habitat selection by three populations of raccoons (Procyon lotor) across contrasted landscapes</i>	in person
11h40- 12h		General Ecology - Space use	Maren Kettwig	<i>Space utilization by GPS collared raccoons in two protected areas in Germany</i>	in person
12h- 13h30		Lunch break			
13h30- 13h50	Benoit Pisanu & Jean-François Maillard	Management - Impacts	Maurice La Haye	<i>The raccoon in Limburg (NL) in 2019-2022</i>	at distance
13h50- 14h10		Management - Impacts	Etienne Branquart	<i>Nest box usurpation by tree-nesting mammals: a threat to tawny owl?</i>	at distance
14h10- 14h30		Management - Strategy	Johannes Lang	<i>Hunting vs. pest control as measures to control invasive alien species: lessons from a German perspective</i>	in person
14h30- 14h50		Management - Strategy	Friederike Gethöffer	<i>Trapping of IAS coypu (Myocastor coypus) and raccoon (Procyon lotor) in live traps – conclusions on animal welfare</i>	at distance
14h50- 15h20		Coffee break			
15h20- 16h30		Brain Storming	All together	<i>On the opportunity of an European research group about Raccoon: Euroraccoon</i>	in person
16h30		End of the colloquium			

# DAY 1

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## KEYNOTE:

# Causality or correlation – why only long-term studies on raccoons yield meaningful data on the ecological impact

Berit Michler<sup>1\*</sup> and Frank-Uwe Michler<sup>2</sup>

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**Keywords:** raccoon, invasive species, population biology, long-term field research, ecological impact

### Abstract

The North American raccoon is an introduced carnivore species in Germany and one of the most omnivorous mammals worldwide. Due to a vast increase of raccoon numbers over the last years, a controversial discussion arose regarding the influence of the new inhabitants on indigenous and especially protected species, as well as the potential transmission of diseases and parasites. Despite being a component of the Union list of invasive alien species, extensive evidence-based knowledge about the actual consequences of raccoon settlement, primarily in natural landscapes, and the possible occupation of an ecological niche is still lacking. Aiming to elucidate the wildlife biology of this introduced species, a long-term and integrated research project was conducted from 2006 to 2017 in the northeastern area of distribution (Müritz National Park, Mecklenburg-Western Pomerania; [www.projekt-waschbaer.de](http://www.projekt-waschbaer.de)). The Müritz National Park has been colonized by raccoons since the late 1970s and is an ideal habitat for raccoons due to its abundance of water and old deciduous trees. The overarching goal of this wildlife biology study was to collect valid population biology data in order to provide a basic ecological characterization of the raccoon from a conservation and species protection perspective (Michler 2018). Based on superordinate topics (including among others spatial and social behaviour, reproduction, population structure and dynamics, epidemiology, feeding ecology & parasitology) and 16 subprojects, unique insights into the population biology of raccoons in Europe could be obtained. In depth investigations regarding the nutrition ecology and parasitology were conducted with scat analysis as the most informative approach. This is so far the only study where raccoon prey categories were linked to available resources in the study area, which is a prerequisite for assessing local impact (Michler 2020). The talk highlights the ecological background of raccoons in Germany and shows the correlation between predation and potential influence.

### References

- Michler, F.-U. (2018) Säugetierkundliche Freilandforschung zur Populationsbiologie des Waschbären *Procyon lotor* (Linnaeus, 1758) in einem naturnahen Tieflandbuchenwald im Müritz-Nationalpark (Mecklenburg-Vorpommern). *Wildtierforschung in Mecklenburg-Vorpommern*, Band 4: 302
- Michler, B.A. (2020) Koproskopische Untersuchungen zum Nahrungsspektrum des Waschbären *Procyon lotor* (Linné, 1758) im Müritz-Nationalpark (Mecklenburg-Vorpommern) unter spezieller Berücksichtigung des Artenschutzes und des Endoparasitenbefalls. *Wildforschung in Mecklenburg-Vorpommern*, Band 5: 147 S

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# The social sex. About male bonding behavior in raccoons

U. Hohmann<sup>1\*</sup>, F.U. Michler<sup>2</sup>, B. Michler<sup>3</sup>

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**Keywords:** Male coalition, female distribution, reproductive success

## Abstract

Some decades ago, raccoons (*Procyon lotor*) were regarded as unsocial mammals; especially males were thought to live solitary and only females with its young form groups. With the help of telemetry, this picture changed in the late 1990s completely. The social behavior of adult males is one of the most fascinating aspects of raccoon biology, ranging from solitary behavior to a unique form of companionship with other mostly unrelated males (Gehrt and Fritzell 1998; Hohmann 1998; Michler 2018). As male reproductive success in raccoons depends mainly on access to females, female distribution pattern seem to influence male spacial and social behavior (Gehrt and Fritzell 1998). In study areas with lower female densities (< 1 ind. per 100 ha) males tend to be solitary. In regions with possibly higher densities (4 to 12 ind. per 100 ha) more females concentrate along favorable habitats. Here males form dyads or even small groups of 3 to 4 members. Those groups can last one to three years. Within that time companion males stay close together during nocturnal movements and even share den sites regularly, leading to a pronounced home range overlap and high attraction indices within the male group (**Fig. 1**). Males showing this remarkable social behavior by forming coalitions seem to benefit from a better access to more females than non-cooperating males (Michler 2018), resulting in a higher reproductive success (Hohmann 1998; Michler 2018).

## References

Gehrt S.D., Fritzell E.K. (1998) Resource distribution, female home range dispersion and male spatialinteractions: group structure in a solitary carnivore. *Anim. Behav.* 55(5): 1211–1227

Hohmann U. (1998) Untersuchungen zur Raumnutzung des Waschbären im Solling, Südniedersachsen, unter besonderer Berücksichtigung des Sozialverhaltens. Hainholzverlag Band 5 (english summary),

Michler F.U. (2018) Säugetierkundliche Freilandforschung zur Populationsbiologie des Waschbären *Procyon lotor* (Linnaeus, 1758) in einem naturnahen Tieflandbuchenwald im Müritznationalpark. *Wildtierforschung in Mecklenburg-Vorpommern*. Band 4, 302 pp.

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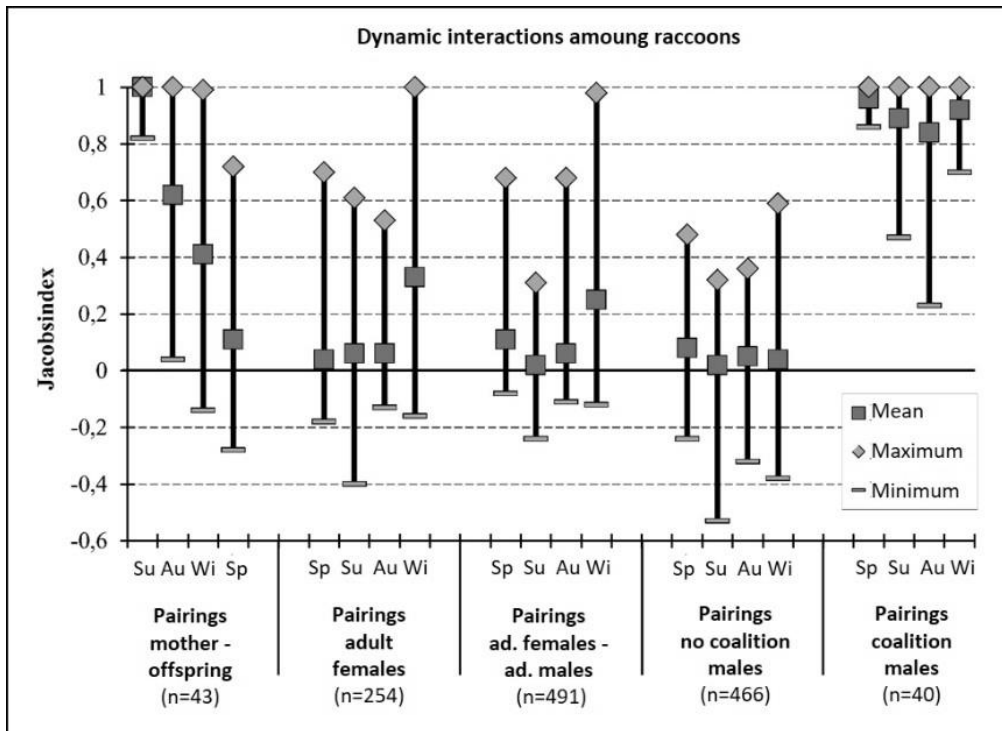


Fig.1: Dynamic interaction analysis of raccoon pairings (two individuals with > 10 % home range overlap) in Germany (Mueritz-National Park, northeastern Germany, 2006 to 2009, n = 69 radiotracked individuals; after Michler 2018). Interactions were calculated as seasonal Jacobs Indices (Jacob's Index 1 = pairing shows maximal attraction; Jacob's Index 0 = neutrality; Jacob's Index -1 = maximal rejection). For males, interactions are given for both, pairings of males forming a coalition or not forming a coalition.

Abbreviations: ad. = adult, Sp – Spring, Su – Summer, Au – Autumn, Wi – Winter; n = number of possible pairings.

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# Raccoon (*Procyon lotor*) in Hungary: signs of a slowly emerging population

Krisztián Katona<sup>1,2\*</sup>, Miklós Heltai<sup>1, 2</sup>, Zsolt Biró<sup>1, 2</sup>, László Galambos<sup>3</sup>, Zsolt Horváth<sup>1</sup>, Mihály Márton<sup>1, 2</sup>, Gergely Schally<sup>1, 2</sup>, and Sándor Csányi<sup>1, 2</sup>

<sup>1</sup>Hungarian University of Agriculture and Life Sciences, Institute for Wildlife Management and Nature Conservation, Department of Wildlife Biology and Management, Páter Károly street 1., Gödöllő, Hungary – Hungary

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<sup>3</sup>Ócsa Nature Conservation Hunting Association - Hungary

**Keywords:** invasive species; urbanisation; nest predation

## Abstract

Nowadays the raccoon (*Procyon lotor*) is distributed across mainland Europe as a result of escaped pets and introductions. The spread of this invasive species can threaten the native ecosystems. In this presentation, we summarise the most important knowledge about the occurrence of the species in Hungary, providing the basis for future research and management implications. Based on the yearly reports from game managers available in the Hungarian Game Management Database (Csányi et al. 2022) the raccoon appeared in the bag in 1998 with 9 specimens and since then it was continuously present with a bag less than 10 specimens. The latest hunting bag of raccoon was 19 individuals in the 2021/2022 period. The occurrence of the species is sporadic, but most of the individuals were shot in the central part of Hungary, near to Budapest in Pest county. We have received many photos on the hunted animals and obtained several carcasses from the hunters from different regions of the country for further examinations. From a hunting unit in Pest county we have detailed information on hunting events of raccoon (**Photo 1**). There, 42 individuals have been culled between 2015 and 2022. The sex ratio of males and females was 1:1 for adults, but 5:1 in case of juveniles. 55% of the raccoons were hunted between May and July, including 62% of all juveniles. In the last two decades we have evidence about urban appearance of the species in Budapest. Within the framework of our ongoing project on invasive species funded by the National Research, Development and Innovation Office in Hungary (RRF-2.3.1-21-2022-00006) we plan to collect data on the urbanisation, nest predation and genetic origin and relatedness of the species in Hungary.

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## References

Csányi S., Márton M., Bóti Sz., Schally G. (2022) Vadgazdálkodási Adattár - 2021/2022. Vadászati év. Országos Vadgazdálkodási Adattár, Gödöllő, 70 pp.



Photo 1: Three raccoons are feeding at the baiting site in a hunting area near to Budapest, Hungary (photo taken by camera trapping).

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# A multidisciplinary approach for raccoon (*Procyon lotor*) management in Casentino Valley, Tuscany, Italy

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**Keywords:** raccoon; protected area; *Baylisascaris procyonis*; eradication plan

## Abstract

Since 2013, the presence of a reproductive population of raccoons has been assessed in the Casentino valley, Tuscany, including part of the territories of a protected area, Foreste Casentinesi National Park. In accordance with European Regulation 1143/2014, a series of actions have been implemented to manage this invasive alien species. Since the identification of the first raccoon, environmental police officers of Reparto Carabinieri "Foreste Casentinesi" National Park undertook investigations to verify the origin of the population. Samples collected from raccoons hosted in a zoological structure present in the area and samples from individuals recovered in the Casentino Valley were compared with molecular methods by the Forensic Genetics Laboratory of "Istituto Zooprofilattico del Lazio e della Toscana". Kinship analyses found a genetic link between the two groups of samples. At the same time, the two administrations responsible for the territory, National Park, since 2016, and the Tuscan Region, since 2020, drafted and applied an eradication plan based on monitoring with camera trapping and capture and removal of raccoons. To extend the success, the PNFC has entrusted the operations to a specialized company, guaranteeing a monitoring and sampling effort applied with a scientific method according to the National Plan guidelines. Eradication program, that is still ongoing, led to the capture of N= 66 individuals. Sex ratio, age classes, monitoring and capture effort were counted. All subjects were subjected to health investigations, resulting in N=26/62 positive samples (41.9%) on *Baylisascaris procyonis*, raising public health concerns (Lombardo et al. 2022). An important awareness campaign was also implemented. The management of an invasive alien species, in order to limit damage to biodiversity and prevent health problems for the human population but also for other species, inevitably requires a multidisciplinary approach. This determines for the administrations in charge of managing an important work and economic effort.

## References

Lombardo A., Brocherel G., Donnini C. et al. (2022) First report of the zoonotic nematode *Baylisascaris procyonis* in non-native raccoons (*Procyon lotor*) from Italy. Paras Vect 15: 24

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# The raccoon in Northern Italy: research and management to achieve eradication

Francesco Bisi<sup>1\*</sup>, Maria Vittoria Mazzamuto<sup>2</sup>, Mattia Panzeri<sup>1</sup>, Damiano Giovanni Preatoni<sup>1</sup>, Lucas Armand Wauters<sup>1</sup>, and Adriano Martinoli<sup>1</sup>

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## Abstract

The Northern raccoon is an opportunistic mesocarnivore native to North and Central America. In Europe it is an invasive alien species listed as a species of Union Concern in the EU Regulation 1143/2014 because of its invasiveness and the threat it represents to native species, human activities and health. In 2016, the Lombardy Region started an eradication campaign integrating scientific information with control to achieve management goals, indeed science is pivotal to efficient wildlife management. We used an integrated approach of camera traps and live traps developed in 4 steps. The first one consisted of visual surveys and interviews with local stakeholders to identify the area for trapping campaign (30 km<sup>2</sup>). During the second step, we performed a camera trap survey (120 km<sup>2</sup>) to better address the trapping effort. The results revealed that the detectability of raccoons increased in proximity to the river and their occupancy was higher in urban areas. This knowledge helped increasing trapping success. The third step saw a second trapping season in 95 sites to remove the remaining individuals. During the final step, we doubled the number of cameras to cope with the reduced density of the population. Finally, we activated traps opportunistically to remove the last individuals. During the captures, systematic collection of catch and effort data allowed the estimation of population size and thus to have a continuous update on how far the campaign was from the complete eradication of the species, allowing to adjust the trapping effort accordingly. We captured a total of 73 raccoons during 7799 cage trap nights between 2016 and 2019; the animals were euthanized by CO<sub>2</sub> inhalation following the EC and AVMA guidelines. Camera trap data allowed us to make a Rapid Eradication Assessment that estimated an eradication probability of 99% after 6 months without detections.

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# Estimating Raccoon (*Procyon lotor*) population densities with capture-mark-recapture, catch-effort removal and camera-trap methods: first lessons

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<sup>4</sup> Groupe de Recherche et d'Etude pour la Gestion de l'Environnement (GREGE), Villandraut, France

<sup>5</sup> Direction de la Recherche et de l'Appui Scientifique – Office Français de la Biodiversité, Nantes, France,

**Keywords:** Population density; spatially explicit capture-recapture; catch-effort removal; Distance sampling camera-traps; Invasive raccoon

## Abstract

When a large population of an invasive species is established and spread, management actions must primarily target reducing their impacts. As such, reliable density estimates are needed both to set management decisions and evaluate its effectiveness. The overarching aim of this study was to assess the suitability and quality of population density estimates from three methods requiring different field design for two populations of the Raccoon *Procyon lotor* introduced in France. Spatially explicit capture-recapture modelling for open population (OpenCR) is a recent method to characterize population dynamics, spatial movement patterns, and apparent survival. More traditional catch-effort methods, based on animal removal from a closed population (CER), can characterize relative parameters of population biology and dynamics. Both of these methods require trapping individuals at relatively small spatial scales (e.g., several hundreds of hectares for raccoons). If the only parameter to be targeted is the temporal variation in population density, a promising set of novel methods based on camera trapping (such as point distance sampling CT-DS) for unmarked population could be used independently of trapping. Two of these methods (OpenCR and CER) were used to estimate raccoon densities from four consecutive sessions of live-trapping coupling CMR and removal sessions in two localities in Northern France, and two others (CE and CT-DS) from four consecutive sessions of live-trapping on one locality in Southern France. In Northern France, raccoon densities estimated from OpenCR methods (3-6/km<sup>2</sup>) were larger than those estimated from CER (1-3 raccoons/km<sup>2</sup>). In Southern France, densities estimated from CER methods were close to those estimated from CT-DS (range 0.5–1.5 raccoons/km<sup>2</sup>). Collectively, our results indicate that our trapping design needs to be improved, that CER method yield in underestimated estimates of population density, and that CT-DS methods are promising tools to monitor raccoon population management at larger scales.

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# Distribution of invasive Northern raccoons in Italy and threats to the conservation of native crayfish in central regions

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## Abstract

The Northern raccoon *Procyon lotor* is a mammalian carnivore of North American origin that has been introduced to many Eurasian countries, where several invasive populations currently occur. Regarding Italy, the species is present in Southern Lombardy, where the population is currently managed and in the area surroundings Foreste Casentinesi National Park (Tuscany and Emilia-Romagna, Central Italy). In the second area, raccoons are present since 2013, but little has been done to limit their range expansion. Particularly, no action has been carried out outside the National Park. Accordingly, their distribution currently covers most of the Arezzo Province, but without a population estimate, and some individuals have also been observed in the Forlì-Cesena, Florence, and Siena provinces. Reproduction by this species in Central Italy is confirmed for the Arezzo and Forlì-Cesena provinces. In this area, the populations of the native white-clawed crayfish *Austropotamobius pallipes* complex are decreasing due to several factors, mainly including illegal poaching and drought. Furthermore, crustaceans, where available, represent the main food items detected in Northern raccoon scats throughout the world (up to 60% of the total diet, in the frequency of occurrence). In September 2019, we detected a total of 37 dead adult freshwater white-clawed crayfish in Central Italy, with evident signs of predation by the Northern raccoon. In 2020, crayfish were sampled by hand or by traps in 14 sites; sampled individuals were sexed and measured. Signs of raccoon presence (e.g., footprints and predated crayfish) were also recorded. Our study confirms the impact of raccoons on native crayfish. Where the raccoon is present (six sites), crayfish disappeared, or their populations have been dramatically reduced in number, with a size distribution skewed towards juveniles. In two sites, close to urban settlements, fresh footprints of *P. lotor* and predated individuals of crayfish have been recorded. Therefore, urgent actions (e.g., control of raccoons, monitoring and when feasible, restocking of crayfish populations) should be taken into account to guarantee the survival of this protected invertebrate species.

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# Living with raccoons: lessons from North America

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**Keywords:** long-term management, prevention, population control

## Abstract

During the 20th century, northern raccoon greatly expanded its distribution range in North America and became increasingly abundant, especially in urbanised and in agricultural areas. It exhibited a strong demographic response due to the increased availability of food, and to a lesser extent climate warming and reduced predator control. Several nuisances have resulted from this artificial increase of raccoon densities, including the decline in waterfowl and other prey populations, the increased competition for tree cavities occupancy, the outbreak of zoonoses including rabies as well as agricultural and household damages. Integrated risk management strategies were therefore designed to reduce population densities and mitigate detrimental impacts, which provide learning experiences for the management of invasive raccoon populations widely established in Western Europe.

Large-scale population control efforts through hunting and trapping rarely succeeded in reducing raccoon populations overseas on the long term due to high mobility and compensatory reproduction of raccoons. Local predator control and novel approaches offering non-lethal ways to manage raccoon and other mammalian predators seemed more promising. In any case, lessons learnt from North America indicates that sustained results can only be achieved in combining population control with resource limitation, including the banning of any type of artificial feeding. Communication campaigns were also shown to be necessary to raise awareness about risks and enlist cooperation from the public.

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# Parasitological and microbiological investigations in raccoons from northeast and southwest France

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**Keywords:** *Procyon lotor*; *Baylisascaris procyonis*; *Leptospira*; parvovirus; ticks

## Abstract

In France, three raccoon populations are established and in expansion, in southwest, central and northeastern France. The latter is now merged with those from Belgium, Luxembourg and western Germany. Within the framework of a scientific consortium, we implemented first large sanitary investigations in 2017-2021 on mainly trapped raccoons from northeastern and southwest areas. The research focused on the zoonotic parasite *Baylisascaris procyonis* and additionally deals with a panel of internal and external parasites, viruses and bacteria of public or animal health concerns. The molecular analyses revealed 5% of positive for *Leptospira* (n=141) (mainly *L. interrogans*), some carriers of Influenza A virus (3.1%, n=92) and canine adenovirus CAV-1 (3.3%, n=92), and carnivore parvovirus CPPV-1 in 59% of the sampled raccoons (n=92) with spatial and annual differences. We found low tick burden of *Ixodes ricinus*, *I. hexagonus* and *Dermacentor reticulatus*, suggesting that raccoons poorly contribute to the life-cycle of these tick species. This role is maybe more important for *Haemaphysalis concinna* given the infestation level of immatures that we observed. We found no evidence of important role of raccoon in tick-borne pathogens life cycles, maybe except for *Apicomplexa* (13%, n=177) but further characterization of *Babesia spp* samples is needed. Finally, we found no *Baylisascaris procyonis* in the raccoons trapped in the two areas (n= 92 in southwest, n=183 in northeast). Simultaneously, in northeast France, three worms were found in a road-killed raccoon located 5 km away from the trapping area and 10 km away from the Luxembourg border. This infested raccoon was genetically assigned to the local population; however, the worms were genetically distinct from the three reference populations in northwestern Europe. To understand how the parasites were introduced, further studies will be implement in the infected raccoon area, German border area and Central France.

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# Molecular and serological detection of viral diseases in raccoon populations

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**Keywords:** Feral raccoons, epidemiology, diagnostic tools, RHDV and HEV

## Abstract

The raccoon (*Procyon lotor*) is an invasive species, native to North America, that has established in Europe showing a clear expansion in its geographic range. Raccoons may be carriers or act as reservoirs of a number of infectious agents transmissible to humans and wild animals, such as rabies and feline distemper, posing a threat to the autochthonous fauna of European countries. In Spain, feral raccoons have had a rapid expansion in Madrid and Guadalajara regions, as a sympatric species of the European rabbit (*Oryctolagus cuniculus*), which plays a key ecological role in Mediterranean ecosystems.

We are interested in studying the epidemiological role of feral raccoons in sustaining or spreading relevant viral pathogens: rabbit hemorrhagic disease virus (RHDV), a calicivirus causing severe disease in the European rabbit and in several hare species (*Lepus spp.*), and hepatitis E virus (HEV), an emerging zoonotic pathogen that infects humans as well as domestic and wild animals, being a major cause of acute hepatitis worldwide. To this aim, we have generated diagnostic tools for molecular and serological detection of RHDV and HEV in raccoon populations. We have developed ELISA assays based on the use of virus-like particles (VLPs) derived from RHDV and HEV as antigens for serological studies, and RT-PCR assays for viral genome detection.

We conducted a preliminary cross-sectional study of raccoons sampled in the Madrid region between 2017-2022 to detect RHDV circulation. Serum samples (n=111) were tested by ELISA and 97 were positive for the presence of anti-RHDV antibodies, indicating the development of an immune response. Additionally, liver, lung and faecal samples (n=57) were tested by RT-PCR and 33 were positive for the presence of viral RNA. However, sequencing was not successful for the positive samples, likely associated with low viral loads. Work is in progress to further optimize the diagnostic tools, including metaviromics.

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# Raccoons in the Netherlands: an invasive alien species with public health significance

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**Keywords:** *Procyon lotor*, *Baylisascaris procyonis*, zoonosis, epidemiology, control measures

## Abstract

The geographic range of the zoonotic raccoon roundworm (*Baylisascaris procyonis*) is expanding together with the range of its host, the raccoon (*Procyon lotor*). This creates a new public health risk in parts of Europe where this parasite was previously absent. In the Netherlands, a raccoon population is becoming established and incidental findings of *B. procyonis* have been reported. To assess the risk to public health, the prevalence of *B. procyonis* was determined in the province of Limburg. Furthermore, genetic methods were employed to assess invasion pathways of both the raccoon and *B. procyonis* to aid in the development of control measures. Macroscopic analysis of intestinal content and testing of faecal samples were performed to detect *B. procyonis* adults and eggs. The population genetics of both *B. procyonis* and its raccoon host were analysed using samples from central and northwestern Europe. *B. procyonis* was found in 14/23 (61%, 95% CI: 41%–78%) raccoons from Limburg. Genetic analyses showed that the majority of the Dutch raccoons and their roundworms were introduced through ex-captive individuals. As long as free-living raccoon populations originate from captivity, population control methods may be pursued. However, natural dispersal from the border regions will complicate prolonged population control. To reduce the public health risk posed by *B. procyonis*, public education to increase awareness and adapt behaviour towards raccoons is key.

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# **POSTER SESSION**

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# Raccoon *Procyon lotor* predation cases in Western Poland

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## Abstract

The first record of a raccoon *Procyon lotor* in Poland dates back to 1970. Its spread is very dynamic and the species is found throughout the country, except in the highest parts of the mountains in the south. In western Poland, the raccoon is now a common species, found in forests, agriculture, rural areas and cities. It also occurs in ecologically valuable areas, e.g. national parks and nature reserves. The raccoon takes advantage of available environmental resources, as evidenced by subsequent observations that expand knowledge of the species. Raccoons have been observed feeding on bats in one of the largest bat hibernacula in the Nietoperek Nature Reserve. In the Lubuskie Lake District, raccoons feed intensively on bivalves during winter.

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# Unusual shelter of the raccoon *Procyon lotor* in the forests of western Poland

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**Keywords:** keyword 1; keyword 2; keyword 3; keyword 4 (minimum 3 and maximum 5, Calibri 11 pts)

## Abstract

The raccoon *Procyon lotor* is one of three invasive carnivorous mammal species found in Central Europe. The other two are the raccoon dog *Nyctereutes procyonoides* and the American mink *Neovison vison*. Raccoons use a variety of roosts for shelter, usually hollow trees. In the pine forests characteristic of western Poland, the supply of natural shelters is low. During observations with trap cameras carried out since spring 2022, raccoon activity was observed in inhabited badger main setts.

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# The emergence of raccoon in Flanders (Belgium)

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## Abstract

In the Region of Flanders (northern Belgium), raccoon is subject to a double ban on captive holding, both on the basis of animal welfare, as on the basis of invasive species policy. Still, these bans have not prevented raccoon from being increasingly sighted. New observations arise from new introductions, and from dispersal from adjacent regions (the Walloon Region and The Netherlands). Natural dispersal has become increasingly important over time, and is now considered the dominant pathway of entry.

Anecdotally, in 2021, a raccoon was intercepted as a stowaway on a ship sailing from Baltimore to Belgium. Similarly, a raccoon was found dead in a container ship entering from Houston in 2014. These findings illustrate that there still is a risk of primary introductions, too.

Specific surveillance for raccoon is lacking. However, the increase in opportunistic observations, particularly over the past decade, is believed to reflect a real increase. Worryingly, among the Union list species established in Flanders, raccoon now ranks 5th (out of 29) in terms of overlap among sighting locations and areas designated under the Habitats Directive: about one in two sightings since 2015 occurred in such areas.

Raccoon is included in a government-led management scheme that aims to rapidly remove any sighted specimen through trapping. From June 2021 to October '22, nineteen animals were caught (F. Thoelen, pers. comm.). There are no reports of animals shot by hunters (a reporting form exists, but is not mandatory).

Although Flanders generally hosts less suitable habitat for establishment as compared to e.g. Wallonia, there are plenty of opportunities for raccoon to expand its range and establish firmly. The rapid response actions may slow, but will not prevent, the species' spread. Concerns thus exist about future trends in population extent, ecological impacts, pathogen loads, human-raccoon conflicts, and prospects for effective management.



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# Reproductive characteristics and age determination in invasive raccoon populations (*Procyon lotor*) from northeast and southwest France

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**Keywords:** Cementum aging, France, placental scar, *Procyon lotor*, reproduction

## Abstract

Determining a population's age structure and estimating its reproductive potential are important prerequisites to assessing population dynamics. For invasive alien species, such data may help to define appropriate management strategies. In France, scientific studies on raccoon populations are recent, and concern ecology, population abundance and sanitary investigations. In this context and within the framework of a French scientific consortium, 463 necropsies were performed, mainly on raccoons culled by trappers, from two populations in the south-west and north-east of France between 2019 and 2022. This series of specimens gave the opportunity to collect biometric data and external signs of reproduction, as well as the mandibles for age determination by teeth, and the genital tract of females for estimating litter size.

Sex-ratio was close to 1:1 in standardized trapped raccoons. Age determination by biometric criteria, visual analysis of teeth, and cementum aging when necessary, was performed on 175 raccoons in the southwest population, mainly from 3 municipalities constituting the core distribution, and on 135 raccoons in the northeast population, spread over a larger territory. Most individuals were no more than 3 years old, but some of them were over 10 years old, especially females. The age pyramids by sex are presented and discussed by study areas.

Estimating litter size was performed by counting fetuses or placental scars. Uterus analysis revealed gestation from the end of January until at least mid-July, with an average of 3,6 embryos (n=23, 2-6). The presence of placental scars was detected from mid-January to the end of November, with an average of 4,1 scars (n=106, 1-9). No difference between populations was observed. Age related pregnancy rate and mean litter size are studied and discussed.

These results constitute the first French data on this species, and are compared with other studies on free-ranging raccoon populations.

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# Mitochondrial and nuclear analysis of raccoons from Italian and European zoos as a tool to trace the origin of new invasion waves

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## Abstract

The North-American raccoon (*Procyon lotor*) was introduced in Central Europe during the twentieth century. In Italy, it is present since 2004 in the northern region of Lombardia, where an eradication program was needed to control this invasive population. Since 2013 a reproductive population has also been recorded in Central Italy, in the Foreste Casentinesi National Park and surroundings. It was possible to trace back the origin of this population to a single event of escape from a private zoo park, through investigation by public authorities and genetic evidences from samples collected inside and outside the zoo. To create a genetic database for molecular analyses, we collected and analysed raccoons from other Italian and European zoos. Seventy-five individuals from 8 Italian sites and 6 European centres were sequenced for a 550 bp region of the D-loop mitochondrial DNA and genotyped at 11 microsatellite nuclear loci. Seven mitochondrial haplotypes were found, two of which were new. A median joining network was built based on our sequences and sequences from the literature, highlighting the structuring in three already known lineages and an additional one. Genetic variability of highly polymorphic microsatellite markers was described by a Discriminant Analysis of Principal Components. Two PCs best summarized most of the allele diversity, and clearly defined three clusters of genetically close individuals. The first cluster included all Central Italian individuals, the second encompassed raccoons of the wild Lombardian population and captive animals kept in a rescue centre in northern Italy, where some wild individuals from this population were probably hosted. All other Italian and European raccoons clustered into a separate group of genotypes, where no internal structure was apparent. In this case, as in many others, genetic analyses have proved to be of great value in tracing the origin of individuals from alien species that colonize new areas.

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# Injuries of raccoons (*Procyon lotor*) trapped with the Duke DP trap™: animal welfare concerns.

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## Abstract

Sometimes necessary, the eradication and management of some invasive alien animal species must use tools and methods that meet ethical standards. The Agreement on International Humane Trapping Standards promotes standards for vertebrates including raccoons with the aim to limit pain, distress, fear or other forms of suffering to the animals. Trap selectivity and efficiency are parameters also include in this agreement. In this international context, we examine the injuries inflicted on raccoons by a new live trap used in France since 2021 and its selectivity: the Duke DP trap™ already marketed in the USA and Canada. Injuries were assessed at necropsies by veterinarians and graded into 5 progressive levels. Experimental design compounded with different baits was monitored by camera-traps.

Moderate to serious injuries (including broken bones) were observed in 38 of the 64 raccoonstrapped. Only 9 individuals were unharmed. Juveniles are the category most affected by the spring of the trap. The Duke DP coon trap features a fully enclosed proof design. The trap design is selective to raccoon with its dexterous paws. Baited with marshmallow ensures maximum selectivity.

Due to serious injuries, authors recommend to reconsider the Duke DP homologation in France. International standards are challenged and need to be revisited to implement state-of-the-art animal welfare.

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# Raccoon-naissance: overview of interventions on the Italian populations of the invasive raccoon *Procyon lotor*

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**Keywords:** captivity escape; Lombardy; Tuscany; eradication; *Baylisascaris procyonis*

## Abstract

In Italy, the raccoon was first reported in 2004 in Lombardy, Northern Italy, along the river Adda; later, in 2013, it was also reported in Tuscany, Central Italy, within the Casentino valley (upper basin of river Arno), and it rapidly colonized the Foreste Casentinesi National Park. The origin of both populations can be traced back to individuals who escaped or were intentionally freed from captivity, as genetically confirmed in Tuscany. Scattered records of unintentional releases and escapes have also occurred in a further 8 of the 20 Italian regions (NUTS2 territorial units), but they have been mostly related to single individuals which were captured or disappeared. Due to the invasive nature of raccoons and the environmental and health issues linked to their presence, the Italian authorities set up a national management plan in accordance with European Regulation 1143/2014. The population in Lombardy (n=73) was eradicated in 5 years (2016-2019) within the project LIFE14 IPE/IT/000018 by using a science-based management approach that saw the integrated use of cage traps, camera traps and stakeholders (mostly farmers and residents) support. In Tuscany, the population within the National Park has been controlled since 2016, while interventions outside of it began in 2020. To date, 66 raccoons have been caught in the area, and the control plan is ongoing. In both regions, culled individuals were examined to assess potential sanitary risks. While the population in Lombardy was free of zoonotic *Baylisascaris procyonis*, the alien parasite has been detected in Tuscany, raising public health concerns. The application of scientific approaches, supported by the availability of funds and dedicated personnel, the persistence of interventions over time, and the communication and sharing of the principles behind the intervention with the animal welfare community have been critical elements for the effectiveness of the interventions.

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# The role of raccoon latrines in the transmission of the *Baylisascaris procyonis* parasitosis to native vertebrate species – a preliminary study

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**Keywords:** raccoon; latrines; transmission; parasites; native species

## Abstract

The raccoon roundworm *Baylisascaris procyonis* is one of the most important and dangerous parasites spread by the invasive raccoon to the newly colonized territory. This nematode, while having raccoon as a definitive host, is also associated with larva migrans in a number of mammal and bird species, causing rapidly progressing clinical conditions, most often neurological in nature. Invasive eggs of *B. procyonis* are dropped with faeces deposited in latrines, which may be important hotspots in the transmission of this parasite to syntopic species of native smaller vertebrate fauna. It was assumed that granivorous mammals (e.g. rodents) would be at increased risk of *B. procyonis* infection while feeding from the ground or in the litter, as their migration routes routinely include areas where raccoons locate the latrines. Similarly, grain-eating birds can be attracted to these by the presence of undigested seeds in the faeces. Surveys of the presence of *B. procyonis* eggs in raccoon faeces have been conducted since March 2022 in the vicinity of Kostrzyn nad Odrą (western Poland). Raccoon densities in this area are estimated at 7 to 25 individuals per 10 km<sup>2</sup>. So far, 113 faecal samples have been collected and examined. In addition, 11 selected latrines have been continuously monitored by fototraps since November 2022. Eggs of

*B. procyonis* were found in 13 samples (11.5%) with an average of 1.1 (range: 1-52) per sample. The analysis of photos and videos obtained using fototraps showed a high level of foraging in latrines, carried out by both small mammals (mainly rodents) and birds. The presence or frequent visits to these sites by species of native fauna may result in infection with *B. procyonis*. These infections may have a long-term impact on the populations of native mammals and birds and promote the spread of this parasitosis.

# DAY 2

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## KEYNOTE:

# Using genetic tools to infer the colonisation histories of the raccoon and its *Baylisascaris procyonis* roundworm parasite in Western and Central Europe

Alain Frantz<sup>1\*</sup> and Mike Heddergott<sup>1</sup>

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### Abstract

The raccoon (*Procyon lotor*) and its gastrointestinal parasite the raccoon roundworm (*Baylisascaris procyonis*) both have expanded their global distribution through exports of raccoons from their native North American range. The eggs of the parasitic nematode are excreted via raccoon droppings and, if ingested, can cause severe disease in a range of vertebrates, including humans. In Western and Central Europe, raccoons are especially common in Germany. While the raccoon roundworm was known to occur in some German populations, its precise European distribution was unknown. However, both the raccoons and the roundworm are currently increasing their geographic distribution. We will present work performed over the last decade that investigated the precise distribution of the roundworm in Western and Central Europe as well as used genetic tools to infer colonisation histories and invasion pathways of both the raccoons and the roundworm. We show that raccoons were introduced multiple times, but that not all founder populations were infested with *B. procyonis*. At present, several raccoon population are still roundworm-free. We show that new populations of *B. procyonis* can result either from separate introduction events or from dispersal of infested raccoons. A continuous monitoring of *B. procyonis*, along with public health awareness efforts, ought to be considered in previously roundworm-free areas.

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# Microsatellites and mitochondrial evidence of multiple introductions of the invasive raccoon *Procyon lotor* in France

Jeremy Larroque<sup>1\*</sup>, Pascale Chevret<sup>2</sup>, Juliette Berger<sup>2</sup>, Sandrine Ruetten<sup>3</sup>, Tim Adriaens<sup>4</sup>, Koen Van Den Berge<sup>4</sup>, Vinciane Schockert<sup>5</sup>, François Léger<sup>3</sup>, Géraldine Veron<sup>6</sup>, Cécile Kaerle<sup>7</sup>, Corinne Régis<sup>8</sup>, Manon Gautrelet<sup>9</sup>, Jean-François Maillard<sup>10</sup>, and Sébastien Devillard<sup>2</sup>

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## Abstract

Raccoons (*Procyon lotor*) are worldwide invaders, due to deliberate or accidental releases, and their impacts exceed hundred of billions of Euros in Europe only. In France, raccoons have currently established three separate, expanding populations. Identifying the current spatial genetic structure, dispersal events and phylogeography of these populations is needed to infer the invasion history and identify management units. We used wild and captive individuals sampled in France and Belgium to characterize the genetic diversity and current population genetic structure of French raccoon populations and identify potential genetic connectivity with the Belgium population using both mitochondrial DNA and microsatellite loci. Results confirm that French populations are the result of at least three independent introductions. While the three populations display low genetic diversity and sign of recent bottleneck, they are still expanding, suggesting that in addition to their ecological plasticity, the remaining genetic diversity is sufficient to successfully adapt to their new environment and allow a quick colonization. Particular attention must be given to the North-Eastern population, which shows genetic admixture with the Belgium population, as admixed individuals may exhibit hybrid vigor facilitating their expansion. The comparison of captive and wild individuals did not allow to identify a potential captive origin of the wild populations. The current regulation in France allowing captivity in zoos without enforcement to tighten the biosecurity of detention facilities might dampen any management measure, as few introduced founders might be enough to create new populations.

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# Genetic studies of European raccoon population – demography and adaptation in invasive range

Aleksandra Biedrzycka<sup>1\*</sup>, Maciej Konopiński<sup>1</sup>, Joanna Kołodziejczyk<sup>1</sup>, Anna Fijarczyk<sup>2</sup>,  
and Eric Hoffman<sup>3</sup>

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## Abstract

Understanding evolutionary mechanisms behind invasion success enable predicting which alien species and populations are the most predisposed to become invasive. In our study we want to answer questions on the role of genetic diversity and adaptive potential in the successful spread of invasive raccoons. We used genetic tools to reveal invasion routes and demographic history of invasive raccoon populations from Poland, Germany and Czech Republic. Having this knowledge, we studied the diversity of various immune genes and attempted to quantify the role of demographic and selective processes in shaping the levels of functional genetic diversity in invasive populations. We also analysed the role of parasites as selective agents that shape immune genetic diversity. We found that the level of genetic diversity of studied populations is dependent of their demographic history, both for neutral and immune genetic markers. It seems that relatively low level of parasite infection is an effect of reasonable e-level of MHC diversity but may also confirm enemy release hypothesis.

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# Genomic diversity of invasive raccoon populations and its pathogen diversity – importance for the invasion success

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**Keywords:** genetic diversity, immune genes, parasite pressure, adaptive potential

## Abstract

Invasive alien species are in interest of researchers, as there is an increase in introductions and spreading of alien species, which decline native biodiversity. Understanding mechanisms of successful invasion is crucial to mitigate existing and prevent future invasions (1). Despite the global scale of invasion, mechanisms underlying the successful invasion are still unknown. Introduced species face bottleneck effect – decrease of genetic variability, whereas low genetic diversity decrease ability to adapt to new environment (2). However, in case of some alien species, they present higher genetic diversity in invasive populations than in native (3). Learning the level of genetic diversity and pointing genes linked to successful adaptation and invasion is necessary to predict spread of invasive populations. Apart from the role of adaptation in process of successful invasion, there are important environmental factors such as pathogens pressure. According to enemy release hypothesis, alien species after introduction to new environment lose pathogens what decrease their fitness in invasive range. Thanks to that, they may increase their fitness in new invasive range, especially in comparison to native species. Our studied organism is invasive in Europe common raccoon. First introductions took place in Germany from where they have spread to several European countries (4). The aim of our project is to assess genetic mechanisms responsible for local adaptations which determine the success of invasive species, what will be achieved by comparing the SNP diversity of populations in native and invasive range in both coding and non-coding regions. Second aim is to verificate the enemy release hypothesis. To do so, pathogens composition will be compared between native and invasive populations of raccoon using metabarcoding analyses. Learning mechanisms underlying adaptation and successful invasion of alien species is crucial in biodiversity conservation and decreasing negative consequences of invasion.

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# Some facts on *Procyon lotor* ecology in southern Belgium: what do raccoons eat, how do they move and at which population density do they live?

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**Keywords** : raccoon, diet, predation, population density, habitat use

## Abstract

In Wallonia, during the last decade, different studies have been achieved to better understand the raccoon (*Procyon lotor*) ecology and its potential impacts on native biodiversity. First, its diet was investigated through stomach content analyses at the University of Liège. Around 150 stomachs from dead raccoons were treated and macroscopic rests were identified: absolute and relative frequencies of occurrence were calculated for every food category confirming the opportunistic nature of the raccoon. The main food items composing its diet were cereals (especially maize), (dried and fleshy) fruits, beetles, amphibians, fish and worms. Other categories like rodents, food waste, gastropods, reptiles, birds and crayfish were also detected but at low frequencies ( $\leq 3\%$  each).

Secondly, raccoon population densities were estimated in two forested areas through cameratrap surveys by applying the Random Encounter Model (REM). First density results vary from 2.3 to 4.2 individuals/100 ha in Lorraine forest and 2.1 to 3.4 in Ardenne forest, although different biases may have partially underestimated effective population levels. Finally, a radiotracking study was conducted in the same forested area of Ardenne on 4 individuals (2 males ; 2 females) during 4 months (March to June 2021). The mean home range size reached 592 ha with female home ranges smaller than those of males. This study also pointed out the fact that raccoons are constantly on the move, travelling at a mean speed of 1.68 km per hour.

The cumulative results of these complementary studies show that if the predation risk caused by raccoons does not seem extremely high at first sight, their population density as well as the way they constantly move at night tend to indicate that they have various occasions to prey on sensitive species of native fauna. Mitigation measures and raccoon control are therefore essential to protect biodiversity.

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# GPS tracking and multiscale study of space use and habitat selection by three populations of raccoons (*Procyon lotor*) across contrasted landscapes

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## Abstract

Introduction of Invasive Alien Species is one of the main threats to biodiversity. The Raccoon, recently introduced and rapidly expanding in France, is likely to be a vector of zoonosis, a predator for the local fauna and a spatial and food competitor for native wild carnivores. At this date, there is no study on the ecology of the Raccoon in France, yet the acquisition of knowledge of the species in its new environment is an essential step for a better evaluation of the impacts and a better management of the species. We studied the space use and the habitat selection by raccoons in three different humid environments. Between 2017 and 2022, 39 raccoons were tracked by GPS collar around the Canal des Ardennes in the Aisne valley, a mostly open landscape with few hedges and small woods, the Parc Naturel Régional de la Montagne de Reims, a forest plateau surrounded by vineyards and crops, and the Eau Blanche valley, a protected wetland in an estuarine suburban area. The tracking of most individuals was interrupted prematurely because of technical or mechanical defects in the collars or injuries noted after recapture. The average home range size of individuals in wetlands is  $92,2 \text{ Ha} \pm 67,8$  ( $n = 9$ ) against  $165,9 \text{ Ha} \pm 75,1$  in forest massif ( $n = 11$ ) and  $429,7 \text{ Ha} \pm 236,1$  in bocage ( $n = 3$ ). Forest habitats (woodlands and swamps) are always the most represented in home ranges and core areas ( $60,6 \pm 24,8 \%$  and  $61,0 \pm 27,5\%$  respectively). In contrast, habitat selection varies both at the population and individual scales. These first analyses will contribute to build an essential knowledge base to implement an adapted population management.

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# Space utilization by GPS collared raccoons in two protected areas in Germany

Maren Kettwig<sup>1\*</sup>, Johannes Lang<sup>1</sup>, and Michael Lierz<sup>1</sup>

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## Abstract

Management of invasive raccoons needs scientific guidance to support decision-making by authorities. Although the raccoon has been established in Germany for decades, its impact on populations of its prey has been insufficiently studied. Therefore, it is still unclear to what extent the predation behavior of the raccoon poses a significant threat to rare, but spatially and temporally concentrated bird and amphibian species. Raccoons were captured near two protected areas and fitted with GPS collar transmitters, which is still a new method for obtaining space utilization data from raccoons in Europe. The transmitters were programmed for small-scale analysis of habitat use during the breeding and spawning seasons in the vicinity of the protected areas. During the main activity periods of the raccoons and inside the protected areas, a five minutes interval for GPS locations was set, while during the day and outside the protected areas, the frequency was reduced to up to seven hours. Performance of collars was different between individuals. For one individual, more than 30.000 GPS locations could be collected during eleven weeks. Preliminary results show that, for a third of the raccoons, the focus of their activity was within the protected areas. The remaining time was spent in adjacent agricultural or urban areas. Targeted hunting outside protected areas could reduce raccoon predation pressure on threatened bird and amphibian species within protected areas.

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# The raccoon in Limburg (NL) in 2019-2022

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**Keywords:** trapping; DNA analysis, raccoon roundworm; online portal

## Abstract

The project aimed to gain knowledge about raccoon trapping, set up an online notification portal ([www.wasberenmeldpunt.nl](http://www.wasberenmeldpunt.nl)) and evaluate the effectiveness of trapping. It appeared that raccoons (now) live throughout the province of Limburg. The population is an 'isolated' population and is genetically not related to the established raccoon population in central Germany. A total of 95 raccoons were trapped, but this did not result into the complete disappearance of the population in Limburg. Totally 52% of the trapped raccoons were found to be infected with this roundworm. If raccoon trapping in Limburg is not continued, it is inevitable that raccoon numbers will increase sharply in the coming years. It is expected that this increase will result in increasing damage and predation of vulnerable wildlife (including rare breeding birds, amphibians, small mammals and hibernating bats).

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# Nest box usurpation by tree-nesting mammals: a threat to tawny owl?

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**Keywords** : tawny owl, raccoon, marten, nest competition, predation

## Abstract

Bird banding data show that the reproduction success of the nest box population of tawny owls (*Strix aluco*) in South Wallonia decreased in recent years. Meanwhile, the density and the geographical distribution of raccoons (*Procyon lotor*) and native predators increased in the same area, while several litters of raccoons were found in nest boxes previously occupied by tawny owls. These data suggest that owl nest boxes are attractive to different mammals for shelter, breeding, or feeding.

Nest box attractiveness was quantified from February to June 2022 through a standardised approach to adequately assess nest usurpation and predation risk for breeding tawny owls. Attractiveness was studied in 118 forest sites where climbing behaviour of mammals was measured along tree trunks supporting a nest box and control trees without nest box. 80 nest boxes were secured to prevent predation. Climbing behaviour of mammals was quantified using both camera and fur traps.

The reproduction rate of tawny owls was very low in 2022. Nest box trees were much more often visited by mammals than control trees, whether they were occupied by birds or not. 44 nest box trees out of 118 were visited by predators, 31 by raccoons, 28 by martens and 5 by wildcats. Observations of climbing mammals peaked during their whelping season in May, suggesting that nest boxes were actively searched by females to give birth. 5 unsecured nest boxes were occupied by mammals, two of them by raccoons. Our results argue for the systematic securing and camouflaging of owl nest boxes to reduce the risk of nest usurpation and egg or nestling predation by mammals.

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# Hunting vs. pest control as measures to control invasive alien species: lessons from a German perspective

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## Abstract

Invasive alien species (IAS) are a significant and growing problem worldwide. In Europe, some aspects of IAS have been addressed through existing legal instruments. IAS that are already established in certain Member States like raccoons are the aim of concerted management actions to prevent them from spreading any further and to minimize the harm they can cause. The legal background for this management differs between the Member States and can be part of different legal spheres like hunting or pest control. In Germany and other EU countries, the raccoon and numerous other IAS are game animals and subject to hunting laws. As a result, certain hunting regulations must be applied to the management of IAS. Hunting is generally understood as the sustainable consumptive use of renewable resources, and numerous hunting regulations and traditions in Europe aim to maintain usable game populations in the long term. This goal is served, among other things, by closed seasons and regulations on permitted hunting methods. In practice, this makes the necessary and desired regulation of invasive game species more difficult. An alternative would be to remove IAS from hunting law so that the killing is no longer considered as hunting, but is subject to pest control regulations. Trained hunters should however be involved in the management of IAS, since they play a fundamental role in terms of early detection, rapid response systems and ongoing eradication efforts, which are especially important when IAS impact native threatened species. As a result, methods prohibited in normal hunting may be used to kill IAS while the principles of animal welfare still comply. In this way, numerous legal and ethical conflicts could be avoided and effective management made possible.

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# Trapping of IAS coypu (*Myocastor coypus*) and raccoon (*Procyon lotor*) in live traps – conclusions on animal welfare

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**Keywords:** live trapping, raccoon, animal welfare

## Abstract

In Germany, although being invasive alien species (IAS), raccoons are listed as game species subjected to hunting law. Live trapping of game species was approached with minimum standards in the European Union with the conclusion of the Agreements on International Humane Trapping Standards (AIHTS). In Germany, these agreements have not (yet) been implemented into applicable law. On an international level, the AIHTS standards are controversially discussed and considered insufficient by experts (SHARP & SAUNDERS 2011, PROULX et al. 2020). Our research questions the animal welfare justice of live capture of coypu and raccoon in three commonly used live capture systems and is guided by the principles of AIHTS regarding the minimum number of target animals as well as AIHTS and ISO 10990 for the performance of pathological-anatomical examinations. Extensive video recordings lead to veritable behavioural analyses during capture. The occurrence of injuries and behavioural abnormalities as well as abnormal hormonal parameters will be examined. Behavioural assessments are also assumed in AIHTS, but to the authors' knowledge have not been systematically done in known publications and studies to date. The study design includes three different types of live traps, which are mainly used in Lower Saxony.

Looking at the trap types in terms of suitability for the two species, clear differences are evident: when raccoon traps were evaluated, two traps turned out to be the ones in which the animals sustained fewer injuries. For the coypu, some traps performed better in terms of injuries.

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## **On the opportunity of an European research group about Raccoon: Euroraccoon**

The Scientific Committee

A presentation of the objectives and functioning of the research and collaboration groups within the [Euromammals](#) group philosophy will be given. The added value of these groups will be shown through the recent examples of the Eurowildcat group. A discussion on the opportunity to build such a group according to the participation of all and on the technical tools to build such a group will be made. There will also be a discussion on the perpetuation of the Raccoon conference in the years to come and in particular for a next edition next year. The discussion is open!