Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

A rapid glue-on GPS tagging protocol for coypu (Myocastor coypus)

Olivier Gimenez

olivier.gimenez@cefe.cnrs.fr

Centre d'Écologie Fonctionnelle et Évolutive

Camille Mottier

IMAG

Camille Giacomel

Centre d'Écologie Fonctionnelle et Évolutive

Julie Blanchet

Centre de Biologie et de Gestion des Populations

Samuel Perret

Centre d'Écologie Fonctionnelle et Évolutive

Annick Lucas

Centre d'Écologie Fonctionnelle et Évolutive

Christophe de Franceschi

Centre d'Écologie Fonctionnelle et Évolutive

Nathalie Vazzoler

Symbo

Max Lecouturier

Maison de la Nature

Romain Duda

Centre d'Écologie Fonctionnelle et Évolutive

Karine Berthier

National Research Institute for Agriculture, Food and Environment

Tanguy Le Brun

FDC34

Nicolas Lescureux

Centre d'Écologie Fonctionnelle et Évolutive

Frank Rosell

University of South-Eastern Norway

Christian Robstad

University of South-Eastern Norway

Emmanuelle Artige

Centre de Biologie et de Gestion des Populations

Sylvain Piry

National Research Institute for Agriculture, Food and Environment

Marco Cianchetti-Benedetti

TechnoSmart

Nathalie Charbonnel

Centre de Biologie et de Gestion des Populations

Method Article

Keywords: Biologging, glue-on tagging, GPS telemetry, invasive alien species, One Health, semi-aquatic rodents

Posted Date: June 4th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9630153/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Understanding the spatial ecology of invasive species is essential for effective management, particularly when ecological damage and sanitary risks are involved. GPS tracking offers valuable insights but remains challenging for semi-aquatic rodents. Here, we describe an exploratory glue-on GPS tagging protocol for coypu (*Myocastor coypus*), applied without anaesthesia and adapted from techniques used on Eurasian beavers (*Castor fiber*). The method is rapid to deploy, minimizes handling time, and limits animal disturbance. We tested this approach on 15 individuals, with contrasted outcomes, allowing us to assess both feasibility and constraints. While successful deployments yielded usable movement data, tag loss and performance issues were observed, likely related to species-specific behaviour such as burrow use and frequent immersion in water. We provide a detailed description of the protocol, field performance, and discuss limitations and recommendations for future applications. We do not draw ecological inference, but share practical methodological insights to inform future GPS studies on coypu and similar species.

Introduction

GPS telemetry has become a cornerstone of wildlife research, providing detailed information on animal movements, home range, and habitat use (Cagnacci et al. 2010; Kays et al. 2015; Nathan et al. 2022). However, applying GPS technology remains challenging in many systems due to constraints related to body size, species behaviour, and ethical considerations associated with capture and handling (Latham et al. 2015, Hofman et al. 2019, Mortensen & Rosell 2020, Holton et al. 2021). These limitations are particularly evident for semi-aquatic rodents.

The coypu (*Myocastor coypus*) is an invasive species widely distributed across Europe and causes substantial ecological damage through grazing and burrowing (Carter & Leonard 2002, Bonnet et al. 2023). They are also associated with sanitary risks, notably leptospirosis (Vein et al. 2014). Despite their importance for management, fine-scale movement data for coypu remain scarce, likely reflecting these methodological challenges (see however Haramis & White 2011; Banjade et al. 2023).

Existing telemetry approaches are often difficult to implement in this species. Collar-based devices are poorly suited due to morphology and the risk of entanglement, while surgical implantation or anaesthesia-based protocols may raise ethical or logistical constraints, particularly in wildlife management. In this respect, glue-on tagging techniques, successfully used for more than a decade on Eurasian beavers (*Castor fiber*) (e.g. Robstad et al. 2021), represent a promising alternative, although they have not yet been described for coypu.

Here, we describe a glue-on GPS tagging protocol for coypu applied without anaesthesia. We detail the method, report field performance, and discuss species-specific constraints that influence its success. Our objective is to provide practical guidance for future applications rather than to draw ecological inference.

Methods

Study context

The protocol was developed within an interdisciplinary project investigating interactions between coypu and humans in urban and peri-urban environments in southern France (Montpellier metropolitan area). The study was conducted in the Hérault department and focused on two hydrological systems: the Lez River and the Étang de l'Or pond and river system. Coypu are present throughout both systems, with regular opportunistic observations reported along the river courses and associated habitats (> 3900 occurrences over the 2006–2026 period; GBIF.org (29 April 2026) GBIF Occurrence Download https://doi.org/10.15468/dl.qtknxd).

Capture and handling

Capture operations were conducted in the municipalities of Lattes and Prades-le-Lez by certified trappers registered with their respective local authorities, as required by regulation.

Between October 2025 and March 2026, coypus were captured using double-entry cage traps (approximately 80 × 25 × 30 cm) baited with apples. Traps were set in the late afternoon, activated overnight, and checked early in the morning (typically between 6am and 8am) by the trappers. When a suitable individual was captured (≥ 1 kg, complying with the 3–5% rule; Kenward 2001), the research team was notified and arrived on site within approximately one hour.

Animals were handled while awake, without the use of anaesthesia, and released at the capture site after approximately 20–40 minutes (Fig. 1a). To minimize stress and facilitate handling, individuals were transferred from the trap into a dark burlap sack, limiting visual stimulation (Fig. 1b). One operator restrained the animal within the sack, positioning the head towards the bottom of the sack, while a second operator exposed the tail and lower back to allow tag attachment.

All personnel involved in handling and tag deployment were certified for animal manipulation. Protective equipment was systematically used to mitigate sanitary risks, particularly those associated with leptospirosis, and to prevent injuries. This included masks, boots, and thick protective gloves.

For each individual, a unique identifier was assigned and standard metadata were recorded, including GPS location, time, weather conditions, and team composition. Sex, body mass, tail length and body size were recorded, with body size measured from tip of nose to end of tail.

GPS device and tag attachment protocol

We used glue-on GPS tags (Axy-Trek 4G; TechnoSmart, Rome, Italy), measuring approximately 40 × 20 × 10 mm and weighing ~ 20 g (Fig. 1c). Tags were equipped with a GPS unit and a solar panel to extend

battery life. Locations were recorded every 30 minutes, and data were transmitted via the 4G network every 6 hours to optimize energy consumption. Data were retrieved through a dedicated online platform. All GPS units were tested under controlled conditions at the laboratory field site to ensure proper functioning, including successful acquisition of GPS signals and data transmission to the dedicated online platform.

Prior to deployment, each tag was enclosed within a protective synthetic mesh (~ 20 × 20 mm mesh size, Ø 1.3 mm) that was hand-stitched around the device. Tags were glued directly onto the fur and attached to the lower back of the animal, approximately 5–10 cm from the base of the tail, using a two-component epoxy adhesive (Araldite Methacrylate 2051) (Fig. 1d). The mesh acted as an anchoring layer, reinforcing attachment while helping to reduce contact between the adhesive and the skin (Fig. 1e). During attachment, adhesive (typically 25–50 mL per individual) was applied to the guard hairs surrounding the tag, ensuring strong fixation while avoiding contact with the skin. Particular attention was paid to maximizing adhesion while limiting movement of the device during curing. The protocol was designed to rely exclusively on guard hair attachment, thereby reducing the risk of thermal or chemical injury. After placement, the adhesive was allowed to cure (approximately 15 minutes under typical Mediterranean field conditions). Tags were designed to detach naturally after approximately 3–4 weeks. The protocol was first applied on two individuals during a preliminary trial conducted in 2024.

Besides Fig. 1, additional videos illustrating key steps of the protocol are available online (see supplementary material at https://drive.google.com/drive/folders/1SzrSx1OpQGuX_KjMfW6L2frVWRM48sVx?usp=drive_link).

Results

The protocol was deployed on a total of N = 15 individuals. Deployment was successful in nine cases, yielding substantial GPS data for five individuals and more limited data for four, with data acquisition durations ranging from 7 to 27 days, reflecting variation in tag retention and/or device performance. In other cases, early tag loss or data transmission failure occurred. Here, we focus on one representative individual for which high-quality data were obtained, while a more detailed analysis of inter-individual variability will be presented elsewhere.

For this individual, weighing 7 kg and measuring 650 mm in head–body length and 435 mm in tail length, the GPS tag remained functional for 22 days following capture in Candillargues. The resulting dataset provides a detailed account of movement trajectories over time (Fig. 2a). Recorded locations allowed reconstruction of movement paths and identification of areas of repeated use.

The corresponding utilization distribution, estimated using the package ctmm and the autocorrelated kernel density estimation method (Calabrese et al. 2016), indicates a home range of 52.2 ha (95% CI: 43.9–61.1 ha; Fig. 2b). The estimated distribution reveals a spatially structured pattern of space use, with several core areas of high intensity embedded within a broader home range.

Discussion

This study documents an exploratory application of a glue-on GPS tagging protocol to coypu, adapted from established methods developed for semi-aquatic mammals such as beavers (e.g. Pitman & Bastille-Rousseau 2023). While glue-on tags have proven effective in related species, their performance remains context-dependent. In our study, the protocol offered clear advantages in terms of rapid deployment and reduced handling, but did not perform consistently across individuals.

This variability likely reflects species-specific constraints. Similarly to beavers, coypu may experience high mechanical stress on attached devices due to their frequent use of burrows (i.e. repeated passage through narrow tunnels, leading to friction and abrasion against the burrow walls), as well as repeated immersion in water. Seasonal variation in behaviour may also play a role. In semi-aquatic mammals, increased time spent in burrows and higher grooming activity during certain periods can reduce both tag retention and fix success rates (e.g., Pitman & Bastille-Rousseau 2023). Although not explicitly tested here, such effects may have contributed to the variability observed in our deployments. In addition, as in any biologging study, technical failures of the devices themselves (e.g. loss of signal, incomplete data transmission) cannot be ruled out and may further contribute to heterogeneous outcomes. More generally, the performance of animal-borne tags depends on a combination of species traits, device characteristics, and environmental conditions, with substantial variability and non-negligible failure rates reported across studies (e.g. Hofman et al. 2019).

More broadly, our results emphasise the importance of a question-driven and pragmatic use of GPS telemetry, where feasibility and expected data yield are carefully evaluated prior to large-scale deployment (Latham et al. 2015). In this context, exploratory trials such as ours represent a necessary step in protocol development. Importantly, the aim of this contribution is not to evaluate coypu movement ecology, but to share practical methodological insights, including failures, that are rarely reported but are critical when developing new field protocols. Transparent reporting of such limitations can help avoid unrealistic expectations and guide future improvements (Holton et al. 2021).

Based on our experience, we recommend: (i) pilot testing on a limited number of individuals, possibly in captive conditions; (ii) careful optimisation of tag placement and attachment materials; (iii) explicit consideration of species-specific behaviours such as burrowing and immersion (including seasonal effects); and (iv) conservative expectations regarding deployment duration and data yield.

Glue-on GPS tagging without anaesthesia represents a promising tool for studying coypu movements. By providing a transparent account of both successes and limitations, this study aims to support future applications of telemetry in semi-aquatic invasive rodents.

Declarations

Ethical approval

All procedures adhered to national and European regulations governing the care and use of animals (Directive 2010/63/EU; French authority Decision 2007/04/06; French Penal Code, Articles 521–1 and R. 654–1). All trapping procedures complied with French regulations (Decrees of the French Ministry of Ecology and Sustainable Development of 29 January 2007, pursuant to Article L. 427–8, and of 2 September 2016, pursuant to Article R. 427–6 of the French Environmental Code). Capture and release were authorised by the Direction départementale des territoires et de la mer (DDTM34; Prefectural orders No. DDTM34-2024-10-15318 and No. DDTM34-2025-07-16063). The intervention was limited to the external attachment of GPS tags and did not involve experimental procedures as defined under French regulations on the use of animals for scientific purposes. Consequently, no formal project authorisation (Demande d'Autorisation de Projet, DAP) was required. All handling and tagging operations were conducted by trained personnel certified for animal manipulation at the appropriate level. The project was reviewed by the local Animal Welfare Structure (Structure chargée du Bien-Être Animal) of the Centre d'Écologie Fonctionnelle et Évolutive.

Author Contribution

OG, CM, NV, SP, TLB and NC conceived the idea and design of the study, OG, CM, CG, JB, SP, AL, CF, NV, ML, RD, KB, EA, SP and NC performed the experiments and collected data, OG and CM analyzed the data, SP, AL, CF, FR, CAR and MCB developed methods, OG wrote a first draft of the manuscript, all authors provided critical feedback and approved the final version, OG, RD, KB, NL and NC contributed resources.

Acknowledgement

We thank Shinichi Watanabe for discussions on his experience with GPS tracking of coypu in Japan. We thank Mariline Poupaud for her support throughout the project and for encouraging us to initiate the GPS tracking work. We also thank Virginie Delort and Angélique de Bastos (Direction départementale des territoires et de la mer; DDTM34) for promptly issuing capture and release permits, and David Gomis for initiating the Observatoire Montpelliérain en Écologie et Évolution de la Santé, which enabled the collaboration behind this work. We are deeply grateful to all those who assisted with fieldwork, especially the trappers without whom this project would not have been possible, in particular Eric Deneuve, who was the first to place his trust in us, as well as Guilhem Guiraudou and Frédéric Gasque, and Gwenaëlle Faucon for her continuous support through the Maison de la Nature at Lattes. This work was supported by the ExposUM Institute of the University of Montpellier.

Data Availability

Code and data are available at https://github.com/oliviergimenez/coypu-gps-tagging-protocol

References

1. Banjade M, Adhikari P, Hong S-H, Lee D-H (2023) Radio Tracking Reveals the Home Range and Activity Patterns of Nutria (Myocastor coypus) in the Macdo Wetland in South Korea. Animals 13:1716
2. Bonnet M, Guédon G, Bertolino S, Harmange C, Pagano A, Picard D, Pays O (2023) Improving the management of aquatic invasive alien rodents in France: appraisal and recommended actions. Manage Biol Invasions 14:625–640
3. Calabrese JM, Fleming CH, Gurarie E (2016) ctmm: an r package for analyzing animal relocation data as a continuous-time stochastic process. Methods Ecol Evol 7:1124–1132
4. Carter J, Leonard B (2002) A Review of the Literature on the Worldwide Distribution, Spread of, and Efforts to Eradicate the Coypu (Myocastor coypus). Wildl Soc Bull 30:162–175
5. Haramis GM, White TS (2011) A beaded collar for dual micro GPS/VHF transmitter attachment to nutria. 75:79–82
6. Hofman MPG, Hayward MW, Heim M, Marchand P, Rolandsen CM, Mattisson J et al (2019) Right on track? Performance of satellite telemetry in terrestrial wildlife research. PLoS ONE 14:e0216223
7. Holton MD, Wilson RP, Teilmann J, Siebert U (2021) Animal tag technology keeps coming of age: an engineering perspective. Philosophical Trans Royal Soc B: Biol Sci 376:20200229
8. Kenward RE (2001) A Manual for Wildlife Radio Tagging. Academic, San Diego, CA; London
9. Latham ADM, Latham MC, Anderson DP, Cruz J, Herries D, Hebblewhite M (2015) The GPS craze: six questions to address before deciding to deploy GPS technology on wildlife. New Z J Ecol 39:143–152
10. Mortensen RM, Rosell F (2020) Long-term capture and handling effects on body condition, reproduction and survival in a semi-aquatic mammal. Sci Rep 10:17886
11. Pays O, Mimet A, Bonnet M, Grimault-fremy A, Grillo X (2026) Assessing the consistency of control activities with priority zones for aquatic invasive rodents in Western France. Eur J Wildl Res 72:22
12. Pitman JB, Bastille-Rousseau G (2023) Retention time and fix acquisition rate of glued-on GPS transmitters in a semi-aquatic species. Anim Biotelem 11:24
13. Robstad CA, Lodberg-Holm HK, Mayer M, Rosell F (2021) The impact of bio-logging on body weight change of the Eurasian beaver. PLoS ONE 16:e0261453
14. Vein J, Leblond A, Belli P, Kodjo A, Berny PJ (2014) The role of the coypu (Myocastor coypus), an invasive aquatic rodent species, in the epidemiological cycle of leptospirosis: a study in two wetlands in the East of France. Eur J Wildl Res 60:125–133

Figures



Figure 1

Field protocol for capturing, handling, and equipping coypus (*Myocastor coypus*) with GPS tracking devices in southern France. **(a)**Release of the individual at the capture site following handling; the white unit shown was used during a preliminary trial and differs only in color from the devices used in this study, as shown in (c). **(b)** Capture and handling of an individual using a cage trap. Animals were transferred into a dark burlap sack to reduce stress and safely restrained by trained operators. **(c)**GPS units prepared prior to deployment. **(d)** Preparation of the dorsal area and application of a two-component epoxy adhesive to the guard hairs on the lower back, ensuring no contact with the skin. **(e)** Attachment of the GPS device, secured using the protective mesh and adhesive applied to the fur.

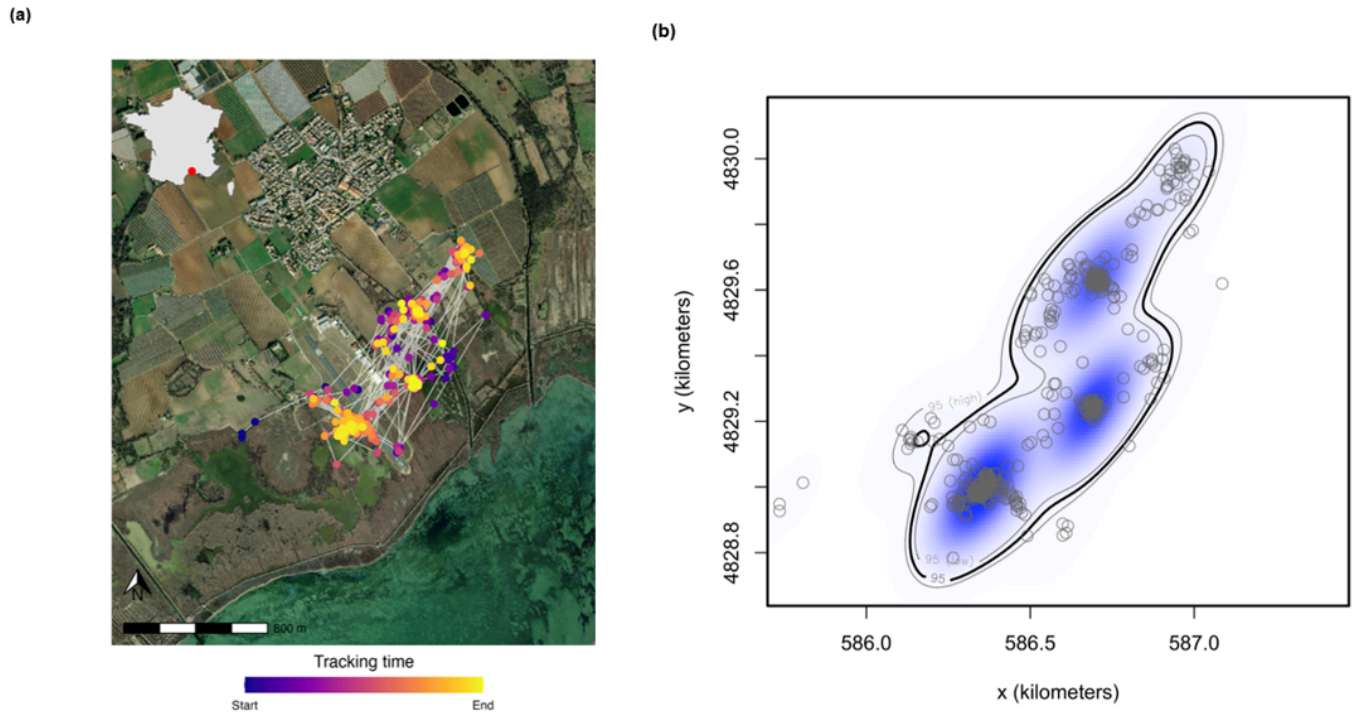


Figure 2

Spatio-temporal movement and home-range estimation of a GPS-tracked coypu (*Myocastor coypus*) in southern France.

(a) Observed locations overlaid on a high-resolution satellite basemap (Esri World Imagery). Points are coloured according to tracking time, from the beginning (dark purple) to the end (yellow) of the monitoring period (January 1 to February 22, 2026), and connected by segments to illustrate movement paths. An inset map indicates the study area location in southern France.

(b) Autocorrelated kernel density estimation (AKDE) of the utilization distribution derived from the same tracking data. The shaded surface represents space-use intensity, with darker areas indicating higher use, and contours delineate the 95% home range. Grey points show observed locations.