



Genetic non-invasive sampling (gNIS) as a cost-effective tool for monitoring elusive small mammals

Clara Mendes Ferreira^{1,2} · Helena Sabino-Marques^{3,4} · Soraia Barbosa^{1,2,5} · Pedro Costa^{3,4} · Cláudia Encarnação^{3,4} · Russell Alpizar-Jara⁶ · Ricardo Pita^{3,4,7} · Pedro Beja^{1,7} · António Mira^{3,4} · Jeremy B. Searle^{1,2,5} · Joana Paupério¹ · Paulo Célio Alves^{1,2,8}

Received: 6 October 2017 / Revised: 15 April 2018 / Accepted: 20 April 2018 / Published online: 17 July 2018
© The Author(s) 2018

Abstract

Genetic non-invasive sampling (gNIS) may provide valuable information for population monitoring, as it allows inferences of population density and key behavioural traits such as dispersal, kinship and reproduction. Despite its enormous potential, gNIS has rarely been applied to small mammals, for which live-trapping is still the most commonly used sampling method. Here we evaluated the applicability and cost-effectiveness of gNIS compared with live-trapping, to monitor a metapopulation of an Iberian endemic and elusive rodent: the Cabrera vole (*Microtus cabreræ*). We compared the genetic diversity, kinship and dispersal movements inferred using both methods. For that, we optimised microsatellite markers for individual identification of *M. cabreræ*, using both tissue ($n = 31$) and faecal samples ($n = 323$) collected from a metapopulation in south-western Iberia. An initial set of 20 loci was optimised for tissue samples, from which 11 were selected to amplify in faecal samples. Overall, gNIS revealed a higher number of identified individuals (65) than live-trapping (31), and the estimated genetic diversity was similar using data from tissues and gNIS. Kinship analysis showed a higher number of inferred relationships and dispersal events when including gNIS, and indicated absence of sex-biased dispersal. The total cost (fieldwork and genetic analysis) of each genotype obtained through live-trapping was three times greater than for gNIS. Our data strongly supports the high potential and cost-effectiveness of gNIS for monitoring populations of elusive and/or threatened small mammals. We also illustrate how this genetic tool can be logistically feasible in conservation.

Keywords Conservation genetics · Conservation biology · Population monitoring · Cabrera vole · Genetic parentage analysis · *Microtus cabreræ*

Joana Paupério and Paulo Célio Alves contributed equally to this work.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s10344-018-1188-8>) contains supplementary material, which is available to authorized users.

✉ Clara Mendes Ferreira
claraferreira6@gmail.com

✉ Joana Paupério
joanapcastro@cibio.up.pt

¹ InBIO/CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus de Vairão, 4485-661 Vairão, Portugal

² Departamento de Biologia, Faculdade de Ciências da Universidade do Porto, Porto, Portugal

³ InBIO/CIBIO-UE – Centro de Investigação em Biodiversidade e Recursos Genéticos, Pólo de Évora, Universidade de Évora, Núcleo da Mitra, Apartado 94, 7002-554 Évora, Portugal

⁴ Unidade de Biologia da Conservação, Departamento de Biologia, Universidade de Évora, Évora, Portugal

⁵ Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY 14853, USA

⁶ CIMA, Centro de Investigação em Matemática e Aplicações, IIFA, Departamento de Matemática, Escola de Ciências e Tecnologia, Universidade de Évora, Évora, Portugal

⁷ CEABN/InBIO, Centro de Ecologia Aplicada “Professor Baeta Neves”, Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1349-017 Lisbon, Portugal

⁸ Wildlife Biology Program, University of Montana, Missoula, MT 59812, USA