Dataset

3D models related to the publication: “Molar wear in house mice: insight into diet preferences at an ecological time scale?”

Sabrina Renaud[1]*, Ronan Ledevin[2], Caroline Romestaing[3], Emilie A. Hardouin[4]

[1] *Laboratoire de Biométrie et Biologie Evolutive (LBBE), UMR 5558 CNRS, Université Claude Bernard Lyon 1, Université de Lyon, Villeurbanne, France*

[2] *De la Préhistoire à l’Actuel : Culture, Environnement et Anthropologie (PACEA), UMR 5199 CNRS, Université de Bordeaux, Pessac, France*

[3] *Laboratoire d’Écologie des Hydrosystèmes Naturels et Anthropisés (LEHNA), ENTPE, Université de Lyon, Université Claude Bernard Lyon 1, UMR 5023 CNRS, Villeurbanne, France*

[4] *Department of Life and Environmental Sciences, Faculty of Sciences and Technology, Bournemouth University, Poole, UK*

*__Corresponding author__: sabrina.renaud@univ-lyon1.fr

Abstract

This contribution contains 3D models of upper molar rows of house mice (*Mus musculus domesticus*) belonging to Western European commensal and Sub-Antarctic feral populations. These two groups are characterized by different patterns of wear and alignment of the three molars along the row, related to contrasted masticatory demand in relation with their diet. These models are analyzed in the following publication: Renaud et al 2023, “Molar wear in house mice, insight into diet preferences at an ecological time scale?”, https://doi.org/10.1093/biolinnean/blad091.

Keywords: dental functional morphology, mastication, *Mus musculus domesticus*, Sub-Antarctic environment

Submitted:2023-06-06, published online:2023-07-28. https://doi.org/10.18563/journal.m3.200

INTRODUCTION

This contribution presents 3D models of molar rows for 30 specimens of house mice (*Mus musculus domesticus*, see Table 1 and Fig. 1.). From a source area in Western Europe, the house mouse has been unintentionally introduced in numerous environments worldwide. Their arrival on various Sub-Antarctic islands is related to the whaler activity. Consequently, on the Kerguelen Archipelago, they were reported as already abundant by the end of the 19th century. On these remote and inhospitable environments, the house mouse thrives as a feral species that incorporates an important component of invertebrates in its diet (Le Roux et al., 2002), thus showing a pronounced shift in the exploited resources compared to commensal populations. This has consequences on their jaw and incisor morphology, showing an optimization for incisor biting rather than mastication at the molars (Renaud et al., 2015; Renaud et al., 2019).

The models presented here include a commensal population from Brittany (Tourch, N = 10) as well as mice from the Guillou island on the Kerguelen Archipelago, corresponding to two years of trapping (1993, N = 9 and 2009, N = 11). This sampling was complemented by previously published specimens from a commensal population near Lyon, and their lab-bred relatives (Savriama et al., 2022), in order to characterize the consequence of the shift in diet on the molar crown geometry.

For each specimen, the upper molar row was segmented, including the roots. Starting from this model, the first upper molar was manually delimited by removing the contact with the second molar. On these two models, the roots were discarded to focus on the crown only by using previously described templates (Savriama et al., 2022). A truncated template of the first upper molar was further applied, with the top of the cusps cut to mimic an advanced degree of wear, in order to mitigate the effect of tooth abrasion on the morphological signal (Ledevin et al., 2016). These procedures resulted in three dense sets of sliding semi-landmarks describing (1) the erupted part of the upper molar row; (2) the crown of the first upper molar; (3) the truncated first upper molar. The molar geometry was analyzed using geometric morphometrics applied to the corresponding 3D coordinates.

The lab-bred mice served as reference showing a decreased rate of wear compared to their commensal relatives, due to reduced mastication in mice fed *ad libitum*. Sub-Antarctic mice from Guillou island displayed a decrease in the rate of molar wear, in agreement with an optimization towards incisor biting to seize preys. Lab offspring and Sub-Antarctic mice were further characterized by straight molar rows, whereas in commensal mice, the erupting third molar was deviated away from the longitudinal alignment with the other molars, due to masticatory loadings. The “wear-free” first upper molar, in contrast, only described differences related to the phylogenetic history of the populations.

Quantifying changes in molar geometry, especially by considering the whole molar row including the relative alignment of the teeth, could thus contribute to trace subtle diet variations, and provide a direct insight into the constraints during mastication.

METHODS

The skulls were scanned at a cubic voxel resolution of 12 µm. Mice from Tourch were scanned on the General Electric (GE) Nanotom microtomograph (µCT) of the AniRA-ImmOs plat-

Inv nr.	Populations	Sex	Weight(g)
G09_06	*Guillou 2009*	F	10.0
G09_10	Guillou 2009	F	16.0
G09_15	Guillou 2009	F	11.0
G09_16	Guillou 2009	M	14.0
G09_17	Guillou 2009	M	11.0
G09_21	Guillou 2009	F	21.0
G09_26	Guillou 2009	M	25.0
G09_27	Guillou 2009	F	20.0
G09_29	Guillou 2009	F	13.0
G09_65	Guillou 2009	M	14.0
G09_66	Guillou 2009	M	12.0
G93_03	Guillou 1993	F	12.6
G93_04	Guillou 1993	F	11.0
G93_10	Guillou 1993	F	15.7
G93_11	Guillou 1993	M	14.5
G93_13	Guillou 1993	F	14.0
G93_14	Guillou 1993	F	13.9
G93_15	Guillou 1993	F	10.2
G93_24	Guillou 1993	M	21.0
G93_25	Guillou 1993	M	33.5
Tourch_7819	Tourch	F	12.0
Tourch_7821	Tourch	F	11.0
Tourch_7839	Tourch	M	9.0
Tourch_7873	Tourch	M	13.0
Tourch_7877	Tourch	F	11.0
Tourch_7922	Tourch	M	15.0
Tourch_7923	Tourch	F	16.0
Tourch_7925	Tourch	M	13.0
Tourch_7927	Tourch	F	9.0
Tourch_7932	Tourch	M	9.0

Table 1. Label, population, sex and weight of the specimens. G09_26 correspond to a "senescent" specimens with highly worn teeth. Guillou specimens are stored as laboratory collection at the LBBE (Laboratoire of Biométrie et Biologie Evolutive, University Lyon 1, France). Tourch specimens are stored in the CBGP - Small Mammal Collection, https://doi.org/10.15454/WWNUPO, Centre de Biologie pour la Gestion des Population, Univ Montpellier, CIRAD, INRAE, Institut Agro, IRD, Montpellier, France).

form of the SFR Biosciences, Ecole Normale Supérieure (Lyon, France). Skulls from Guillou were scanned at the PACEA laboratory (Bordeaux, France) using a similar equipment (GE v tome x s). The scanning parameters were as follows: 100 kV, 70µA, 3000 projections at 360° with Cu filter. For each mouse, the right upper molar row was delimited using Avizo (v. 9.1—Visualization Science Group, FEI Company), except for the specimen G93-24 for which the left molar row was considered instead. In most cases, an automatic threshold was sufficient to isolate the molar row from the surrounding bone and generate a surface including the roots; in a few cases, connections with the bone had to be manually delimited. The 3D surfaces are provided in .ply format, and can therefore be opened with a wide range of freeware.

ACKNOWLEDGEMENTS

We deeply thank contributors who collected mice from the different areas: Jean-Pierre Quéré for Tourch, Benoît Pisanu and Jean-Louis Chapuis for Guillou. We acknowledge the contribution of SFR Biosciences (UMS3444/CNRS, US8/Inserm, ENS de Lyon, UCBL) AniRa-ImmOs facility and the Mateis laboratory (INSA, Lyon, France), and we particularly thank Mathilde Bouchet and Justine Papillon for her kind assistance during the scanning sessions. This work was supported by the Fédération de Recherche BioEnviS – FR3728 of University Claude Bernard Lyon 1.

BIBLIOGRAPHY

Le Roux V, Chapuis J-L, Frenot Y, Vernon P. 2002. Diet of the house mouse (*Mus musculus*) on Guillou Island, Kerguelen archipelago, Subantarctic. *Polar Biology* 25: 49-57. https://doi.org/10.1007/s003000100310

Ledevin R, Chevret P, Ganem G, Britton-Davidian J, Hardouin EA, Chapuis J-L, Pisanu B, Mathias MdL, Schlager S, Auffray J-C, Renaud S. 2016. Phylogeny and adaptation shape the teeth of insular mice. *Proceedings of the Royal Society of London, Biological Sciences (serie B)* 283: 20152820. https://doi.org/10.1098/rspb.2015.2820

Renaud S, Delépine C, Ledevin R, Pisanu B, Quéré J-P, Hardouin EA. 2019. A sharp incisor tool for predator house mice back to the wild. *Journal of Zoological Systematics and Evolutionary Research* 57: 989-999. https://doi.org/10.1111/jzs.12292

Renaud S, Gomes Rodrigues H, Ledevin R, Pisanu B, Chapuis J-L, Hardouin EA. 2015. Fast morphological response of house mice to anthropogenic disturbances on a Sub-Antarctic island. *Biological Journal of the Linnean Society* 114: 513-526. https://doi.org/10.1111/bij.12454

Renaud S, Ledevin R, Romestaing C, Hardouin E A 2023. Molar wear in house mice, insight into diet preferences at an ecological time scale. *Biological Journal of the Linnean Society.* https://doi.org/10.1093/biolinnean/blad091

Savriama Y, Romestaing C, Clair A, Averty L, Ulmann J, Ledevin R, Renaud S. 2022. Wild versus lab house mice: Effects of age, diet, and genetics on molar geometry and topography. *Journal of Anatomy* 240: 66-83. https://doi.org/10.1111/joa.13529

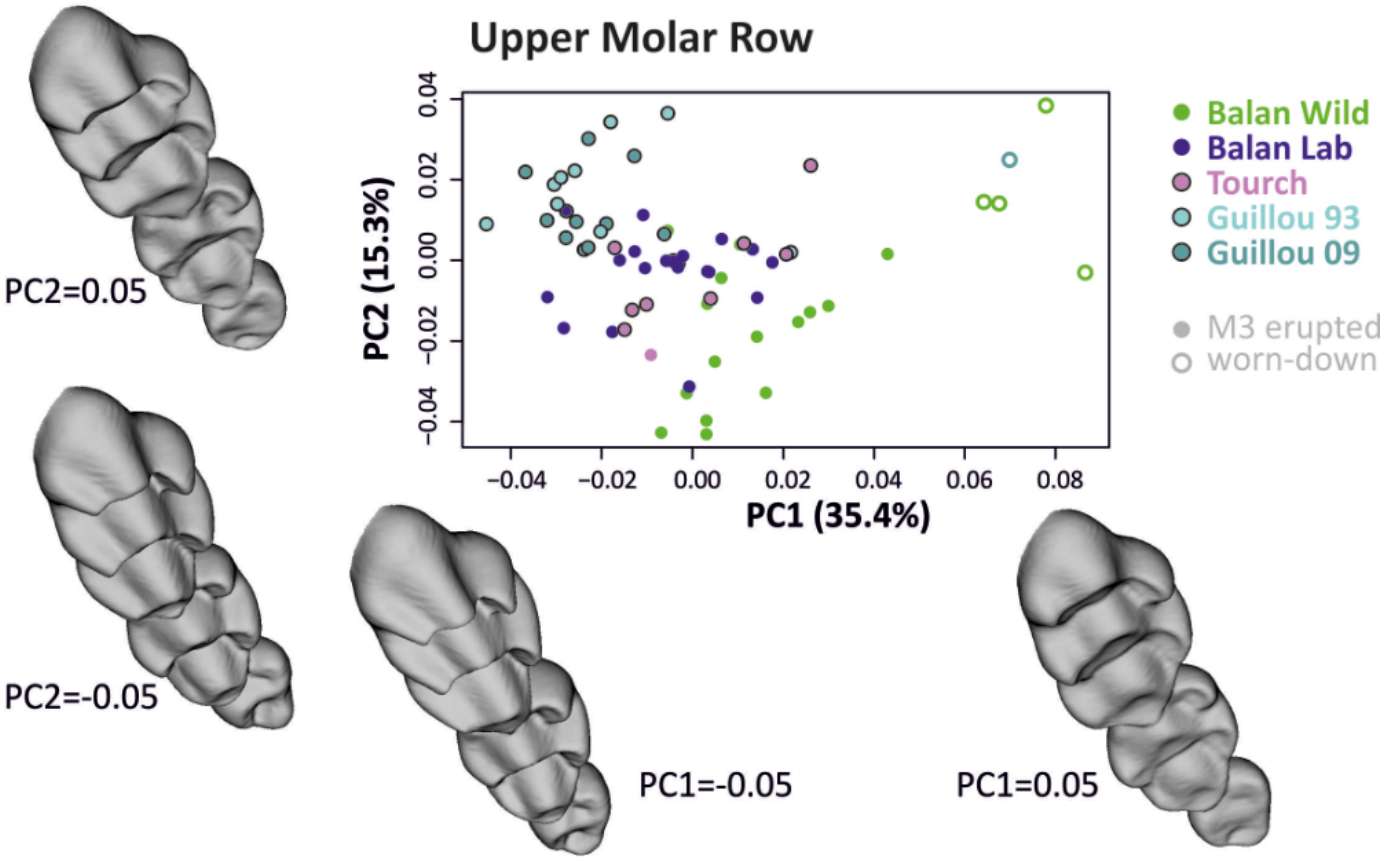

Figure 1. Morphospace depicting the shape variation of the upper molar row in a set of house mouse populations, including Western European commensal mice (Balan, Tourch) and mice from Guillou island (Kerguelen Archipelago). The first two axes of a PCA on the aligned coordinates are represented. Along each axis, visualizations of molar shape corresponding to PC scores = 0.05 and -0.05 are depicted. Circles with dark outline: models deposited in the present contribution. Open circles: highly abraded molars.

ISSN: 2274-0422