

UNVEILING THE GENOMIC HISTORY OF EUROPE

Recent technical developments allow now the retrieval of hundreds, if not thousands, of ancient genomes and therefore we are now able to directly study the changes in the ancestry of European populations along time, associated to different migratory processes and archaeological horizons. It has been shown in the last four years that all modern Europeans carry three different, over imposed genetic layers: the Mesolithic hunter-gatherers, the Neolithic farmers from the Near East and the steppe nomads that arrived from Central Asia at the end of the Neolithic. The latter migration impacted the whole continent and likely triggered the spread of Indo European languages, as well as some specific genetic markers such as the lactase persistence. The arrival of steppe ancestry in the British Isles from Central Europe is associated to the Bell Beaker complex expansion and involved about 90% of replacement of the original Neolithic population. The subsequent spread of the steppe ancestry to the Western most corner of Europe, the Iberian Peninsula, involved a 40% population replacement at the genome level, but almost a complete replacement of the Y-chromosome gene pool. Subsequent population movements, such as the Phoenician and Greek expansion along the Mediterranean, as well as the Roman Empire and the posterior Barbarian movements, subsequently shaped the genetic diversity of the European continent. With enough genomic data, we will be able to connect past with present-day individuals through co-ancestry links, thus joining the past and the present in a complex genomic network.

Carles Lalueza-Fox is a Research Professor at the Institute of Evolutionary Biology (CSIC-UPF) in Barcelona, Spain. Lalueza-Fox has worked on paleogenetics for 25 years. He has published more than one hundred papers in International journals, dealing mainly with the genetic analysis of past human populations for reconstructing ancient migrations, populations affinities and adaptation. His works include the first complete mitochondrial genome from an extinct species (Nature 2001), the first functional analysis of an ancient gene (Science 2006) or the first Mesolithic human genome (Nature 2014).

Since 2004, he has focused on Neandertal genomics, mainly working with a Neandertal family group from El Sidrón site in Asturias (Spain) (PNAS 2006, 2011). He has retrieved specific nuclear genes from Neandertals, including hair pigmentation (Science 2007) and speech-associated genes (Current Biology 2007). He collaborated in the Neandertal Genome Project, directed by Professor Svante Pääbo. He was awarded for his research with the prize Ciutat de Barcelona on Scientific Research in 2007.

Beyond his research, he has published eleven popular science books, mainly on subjects of human evolution, archaeogenetics and modern human diversity. For this task, he has been awarded with the VII European Award of Popular Science (2002 Valencia), the VII Award for Scientific Communication from the Catalan Foundation of Research (2003, Barcelona), First Award of the International Prize Esteban de Terreros (Spanish Foundation for Science and Technology 2005) and XVIII Award Prisma Casa de las Ciencias (2005, La Coruña). His last book is “La forja genètica de Europa” (2018).

CURRICULUM VITAE

Name: CARLES LALUEZA FOX

D.N.I.: 37327107 Q

Passport: BA153999

Date of birth: 16/01/1965

Current professional situation

Institution: Consejo Superior de Investigaciones Científicas

Place: Institut de Biologia Evolutiva (CSIC-Universitat Pompeu Fabra)

Work address: Passeig Marítim de la Barceloneta 37-49, 08003 Barcelona (Spain)

Phone number: 933160887

Fax: 933160901

Email: carles.lalueza@upf.edu

Home address: Turull 24, 08202 Sabadell (Spain)

Professional employment and starting date: Research Professor CSIC (20-04-2017)

Academic formation

Degree	Institution	Date
Biology	Universitat de Barcelona	30/06/1988
PhD	Institution	Date
Biology	Universitat de Barcelona	06/10/1995

Past professional employments

Activity	Center/Institution	Period
Associate professor	Universitat de Barcelona	01/10/1996 - 30/11/2003
Researcher Ramon y Cajal	Universitat Pompeu Fabra	01/12/2003 - 12/04/2004
Lecturer	Universitat de Barcelona	13/04/2004 -26/05/2008
Researcher	CSIC	26/05/2008-20-04-2017

Main publications (1992-2018)

2018

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Lalueza-Fox, C., Gigli, E., de la Rasilla, M., Fortea, J., Rosas, A., Bertranpetit, J., Krause, J. (2008) Neandertal paleogenomics in the ABO blood group gene. **BMC Evolutionary Biology** 8: 342.

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Cooper, A., Lalueza-Fox, C., Anderson, S., Austin, J., Rambaut, A., and Ward, R. (2001): Complete mitochondrial genome sequences of two extinct moas clarify Ratite evolution. **Nature** 409: 704-707.

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Lalueza, C., Gonzalez, A., and Vives, S. (1996): Cranial variation in the iberian peninsula and the balearic islands: inferences about the history of the population. **American Journal of Physical Anthropology**, Vol. 99 (3): 413-428.

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Lalueza, C. (1996): Mitochondrial DNA haplogroups in four tribes from Tierra del Fuego/Patagonia: inferences about the peopling of America. **Human Biology**, Vol. 68 (6): 855-871.

Lalueza, C., Perez-Perez, A., and Turbon, D. (1996): dietary inferences through buccal microwear analysis of Middle and Upper Pleistocene human fossils. **American Journal of Physical Anthropology**, Vol. 100 (3): 367-387.

Lalueza, C., Juan, J., and Albert, R.M^a. (1996): Phytolith analysis on dental calculus, enamel surface and burial soil: information about diet and paleoenvironment. **American Journal of Physical Anthropology**, Vol. 101 (1): 101-113.

Lalueza, C. (1996): analysis of ancient mitochondrial dna from extinct aborigines from Tierra del Fuego/Patagonia. **Ancient Biomolecules**, Vol. 1: 43-55.

Ramos, M.D., Lalueza, C., Girbau, E., Perez-Perez, A., Quevedo, S., Estivill, X., and Turbon, D. (1995): Amplifying dinucleotide microsatellite loci from bone and tooth samples of up to 5,000 years of age: more inconsistency than usefulness. **Human Genetics**, Vol. 96: 205-212.

Perez-Perez, A., Lalueza, C. and Turbon, D. (1994): Intraindividual and Intragroupal variability of buccal tooth striation pattern. **American Journal of Physical Anthropology**, Vol. 94 (2): 175-188.

Lalueza, C., Juan, J., and Perez-Perez, A. (1994): Dietary information through the examination of plant phytoliths on the enamel surface of human dentition. **Journal of Archaeological Science**, Vol. 21: 29-34.

Lalueza Fox, C. and Perez-Perez, A. (1993): The diet of the Neanderthal child Gibraltar 2 (Devil's Tower) through the study of the vestibular striation pattern. **Journal of Human Evolution**, Vol. 24 (1): 29-41.

Lalueza, C., Perez-Perez, A. and Turbon, D. (1993): Microscopic study of the Banyoles' mandible (Girona, Spain): diet, cultural activity and toothpick use. **Journal of Human Evolution**, Vol. 24 (4): 281-300.

Lalueza, C. (1992): Information obtained from the microscopic examination of cultural striations. **International Journal of Osteoarchaeology**, Vol. 2: 155-169.

Lalueza Fox, C. and Berkovitz, B.K.B. (1992): Differences in the striation pattern in cases with unilateral buccal pathologies. **International Journal of Anthropology**, Vol. 7 (2): 27-39.

Research Grants

Principal Investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Economía y Competitividad

Title: The genomic prehistory of the Iberian Peninsula

Grant code: BFU2015-64699-P

Period: 2016-2018

Principal Investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Ciencia e Innovación

Title: Evolutionary inferences from targeted sequence retrieval of Neandertal genomic regions

Grant code: BFU2012-34157

Period: 2013-2015

Partner investigator

Institution: Australian Research Council (IP: Prof. Alan Cooper)

Title: A powerful new genetic view of the recent evolutionary history of humans and their diseases

Grant code: CP110105038 (380,000 Aus \$)

Period: 2011-2013

Principal Investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Ciencia e Innovación

Title: Diversidad genómica Neandertal caracterizada mediante técnicas de ultrasecuenciación

Grant code: BFU2009-06974

Period: 2009-2012

Principal Investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Educación y Ciencia

Title: Genética evolutiva de *Homo neanderthalensis*: análisis filogeográfico y rasgos adaptativos

Grant code: CGL2006-03987

Period: 2006-2009

Partner investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Educación y Ciencia

Title: Ecología, biología y comportamiento social y técnico en el Pleistoceno y Holoceno de la Sierra de Atapuerca

Grant code: BOS 2003-08938-C03-03

Period: 2004-2006

Partner investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Educación y Ciencia

Title: Aplicación de Nuevas Tecnologías al Estudio de la Diversidad Genética de las poblaciones humanas

Grant code: BOS2001-0794

Period: 2002-2004

Partner investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Educación y Ciencia

Title: Análisis de la Diversidad Genética en poblaciones humanas y otros primates.

Grant code: PB-98-1064

Period: 1999-2001

Partner investigator

Institution: SPGC - Programa Nacional de Promoción General del Conocimiento, Ministerio de Educación y Ciencia

Title: Variabilidad del DNA mitocondrial antiguo extraído a partir de material esquelético: Contrastación de modelos de dispersión de las poblaciones humanas

Grant code: PB93-0021

Period: 1994-1997

Partner Investigator

Institution: ACIN - Acciones Integradas, MEDU - Ministerio de Educación y Ciencia.

Title: Análisis de DNA en Restos Oseos Humanos del Pasado y su Aplicación al Estudio de Migraciones y Enfermedades

Grant code: HB-38-A 92/

Period: 1992 -1993

Published Books

C. Lalueza Fox. (1999). **Missatges del passat**. Edicions Bromera, Universitat de València. ISBN: 84-7660-448-3.

C. Lalueza Fox (2002). **Races, racisme i diversitat**. Edicions Bromera, Universitat de València. ISBN: 84-7660-669-9; 84-370-5384-6.

C. Lalueza Fox (2002). **Razas, racismo y diversidad**. Editorial Algar. ISBN: 84-95722-07-0.

C. Lalueza Fox (2002). **Dioses y Monstruos**. Editorial Rubes. ISBN: 84-497-0093-0.

C. Lalueza Fox (2003). **El color sota la pell**. Editorial Rubes. ISBN: 84-497-0143-0.

C. Lalueza Fox (2003). **El bestiari extingit**. Pagès Editors. ISBN: 84-9779-060-X.

C. Lalueza Fox (2005). **Genes de Neandertal**. Editorial Síntesis. Madrid. ISBN: 84-9756-338-7.

C. Lalueza-Fox (2006). **Cuando éramos caníbales**. Ed. La Voz de Galicia. ISBN: 84-9757-233-5.

C. Lalueza-Fox (2013). **Palabras en el tiempo; la lucha por el genoma neandertal**. Ed. Crítica; colección Drakontos. ISBN10: 8498924545, ISBN13: 978-8498924541.

C. Lalueza-Fox (2016). **Genes, reyes e impostores. Una historia detectivesca tras los análisis genéticos de reyes europeos**. Ed. Cálamo. ISBN: 978-84-16742-02-8.

C. Lalueza-Fox (2017). **La forja genética de Europa; una nova visió del passat de les poblacions humanes**. Ed. Universitat de Barcelona. ISBN: 978-84-475-45077-8.

C. Lalueza-Fox (2017). **Des-extinciones**. Tibidabo Ediciones. ISBN: 978-84-9117-562-9.

Research awards

1-Winner of the Premi Ciutat de Barcelona of Scientific Research 2007. 8,000 €.

Popular Science Awards

1-Winner of the VII Premio Europeo de Divulgación Científica, promoted by the Universidad de Valencia, October 2001, with the book “Races, racisme i diversitat”. Awarded: 16 November 2001. Amount: 2,000,000 pesetas (12,000 €).

2-Winner of the VII Premio de Literatura Científica, promoted by the Fundació Catalana per a la Recerca, with the book “El color sota la pell”. Awarded: 14 November 2002. Amount: 6,500 €.

3-Winner of the 1st Premio Internacional de Ensayo Esteban de Terreros (Fundación Española para la Ciencia y la Tecnología) with the book “Genes de Neandertal”. Awarded: 30 June 2005. Amount: 10.000 €.

4-Winner of the XVIII Premio Prismas Casa de las Ciencias (La Coruña) with the book “Cuando éramos caníbales”. Awarded: 15 November 2005. Amount: 6.000 €.

Research stays

1-Institution: University of Cambridge, UK (Department of Biological Anthropology)
Status: Postdoctoral researcher (founded by Comissió Interdepartamental per a la Recerca i Innovació Tecnològica, Generalitat de Catalunya).
Stay: 1997 (1 year)

2-Institution: University of Oxford, UK (Department of Biological Anthropology)
Status: Postdoctoral researcher (founded by Comissió Interdepartamental per a la Recerca i Innovació Tecnològica, Generalitat de Catalunya).
Stay: 1998 (1 year)

3-Institution: deCODE Genetics (Reyjavik, Iceland)
Status: Scientific Advisor
Stay: 2001 (1 month)

PhD Supervisor

Title: Genetic analysis of the prehistoric peopling of Western Europe: ancient DNA and the role of contamination

Student: Maria Lourdes Sampietro

University: Universitat Pompeu Fabra

Year: 2007 **Qualification :** Apto Cum Laude

Title: Homo neanderthalensis evolutionary genetics: adaptation and phylogeographic analysis

Student: Elena Gigli

University: Universitat Pompeu Fabra
Year: 2011 **Qualification :** Apto Cum Laude

Title: Addressing Neandertal evolutionary genetics at three different resolution levels: admixture with modern humans, demography and social structure

Student: Federico Sánchez-Quinto

University: Universitat Pompeu Fabra

Year: 2014 **Qualification :** Sobresaliente Cum Laude

Title: Genetic analysis of prehistoric European populations

Student: Iñigo Olalde (Beca Doctorado País Vasco)

University: Universitat Pompeu Fabra

Year: 2016 **Qualification:** Sobresaliente cum laude- premio extraordinario de Tesis Doctoral

Others

Title: Carles Lalueza-Fox (2012). Current Biology 22(19): R822, Q&A.