González•Lab
Evolutionary and Functional Genomics

Collaborative science to understand how organisms adapt to the environment

Josefa González, CSIC, Barcelona

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institut botànic de Barcelona

Centre mixt CSIC museu de ciències naturals de Barcelona

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2002	PhD in Biology	UAB Universitat Autònoma de Barcelona; University of Cambridge
2002-2005	Assistant Professor/Postdoc	UAB Universitat Autònoma de Barcelona
2005-2011	Fulbright Postdoc/Res Associate	Stanford University
2011-2017	*Ramón y Cajal* Researcher	CSIC
2017- 2023	Tenured Scientist	CSIC
2023	Research Scientist	CSIC
2025	Fulbright visiting scholar	Cornell University

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Marta Coronado-Zamora
Postdoc

Francesca Destefanis
Postdoc

Gonzalo Sabarís
MSCA Postdoc

Lauretta Van Helden
Lab tech

Lucia Muñoz
Postgraduate
JAE-Intro

Joel Font
Undergraduate

Adrian Tarazona
Visiting PhD,
IBV-CSIC

RESEARCH NETWORKS

European population genomics consortium
http://droseu.net

Adaptation Genomics
http://adaptnet.es

Life Hub CSIC: Origin, (co) Evolution, diversity and synthesis of life

Functional genomics
https://conexion-genoma.csic.es/

SCIENTIFIC SOCIETIES COUNCIL MEMBER

Smbe
Society for Molecular Biology & Evolution

- Satellite, regional and interdisciplinary meetings
- Inclusion, diversity, equity, access
- SMBE2023 Ferrara, Italy

eseb
European Society for Evolutionary Biology

Vice President

- Outreach

ESEB2025
BARCELONA 17-22 AUGUST 2025
CONGRESS OF THE EUROPEAN SOCIETY FOR
EVOLUTIONARY BIOLOGY

González•Lab
Evolutionary and Functional Genomics

UNDERSTANDING ADAPTATION

to diverse environmental conditions

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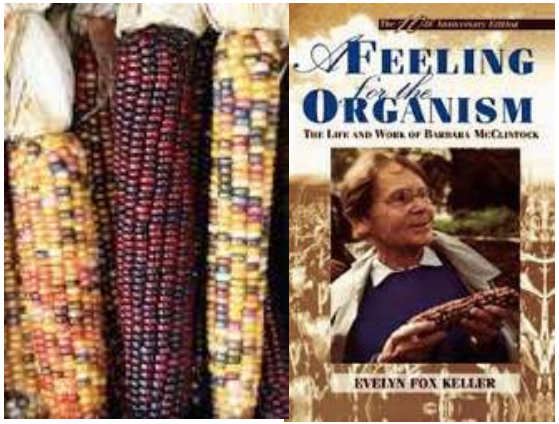
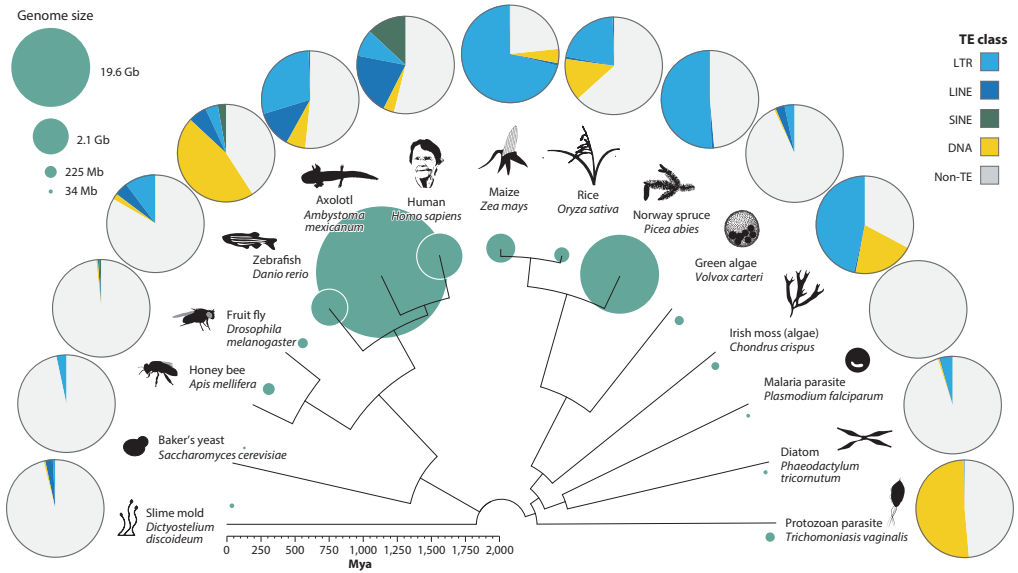
TRANSPOSABLE ELEMENTS

present across the tree of life, represent a sizable portion of the genome



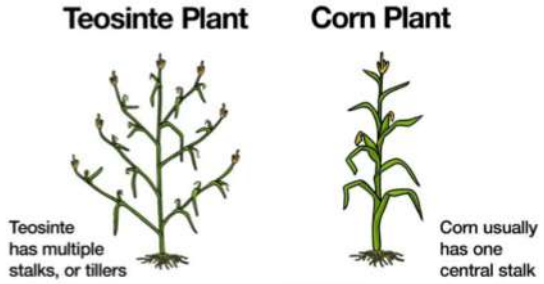
Barbara McClintock 1940's
controllers of gene expression
Nobel prize 1983

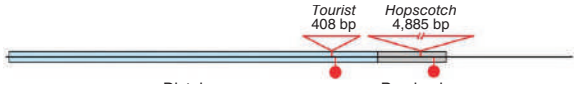


Wells and Feschotte 2020, Annu Rev Genet

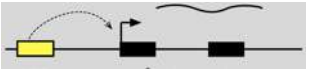
TRANSPOSABLE ELEMENTS CAN HAVE PHENOTYPIC EFFECTS

Van’t Hof et al 2016, Nature





Studer et al 2011, Nat Genet

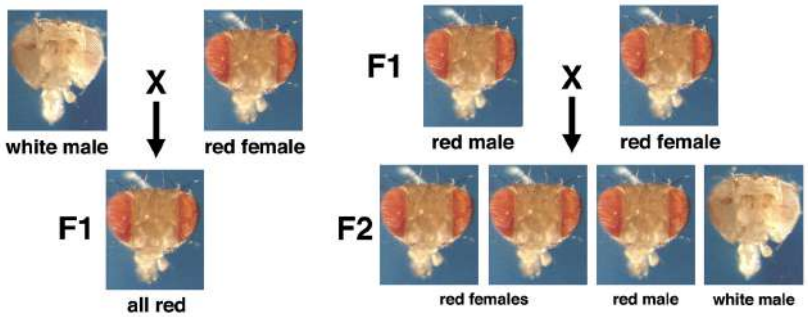


Lynch et al 2015, Cell Rep

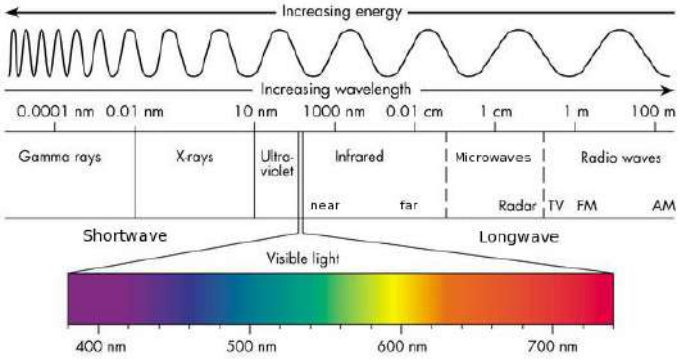
DROSOPHILA AS A MODEL ORGANISM

Drosophila melanogaster

El paper dels cromosomes en l'herència.
Thomas H. Morgan. Premi Nobel **1933**

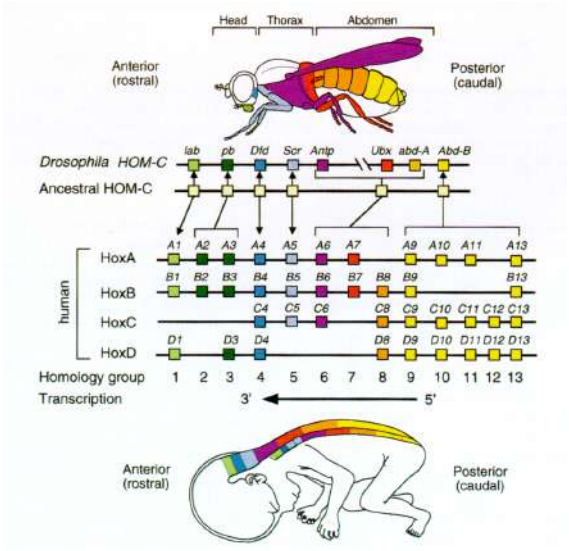


Les radiacions causen mutacions.
Hermann J. Mueller. Premi Nobel **1946**

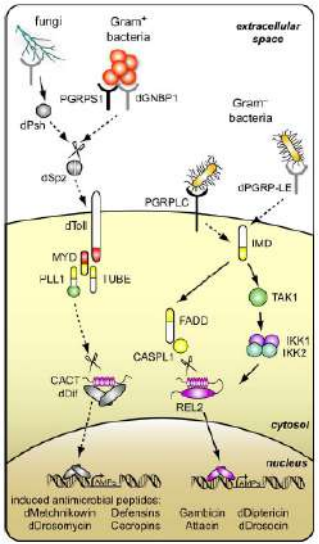


Drosophila melanogaster

Identificació dels gens que controlen el desenvolupament.
Edward B. Lewis, Christiane Nusslein-Volhard, Eric F. Wieschaus. Premi Nobel **1995**.

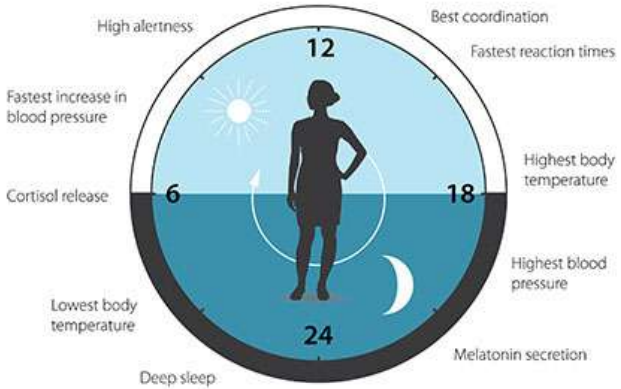


Immunitat innata i adaptativa.
Jules Hoffman, Bruce Beutler and Ralph Steinmann.
Premi Nobel **2011**.

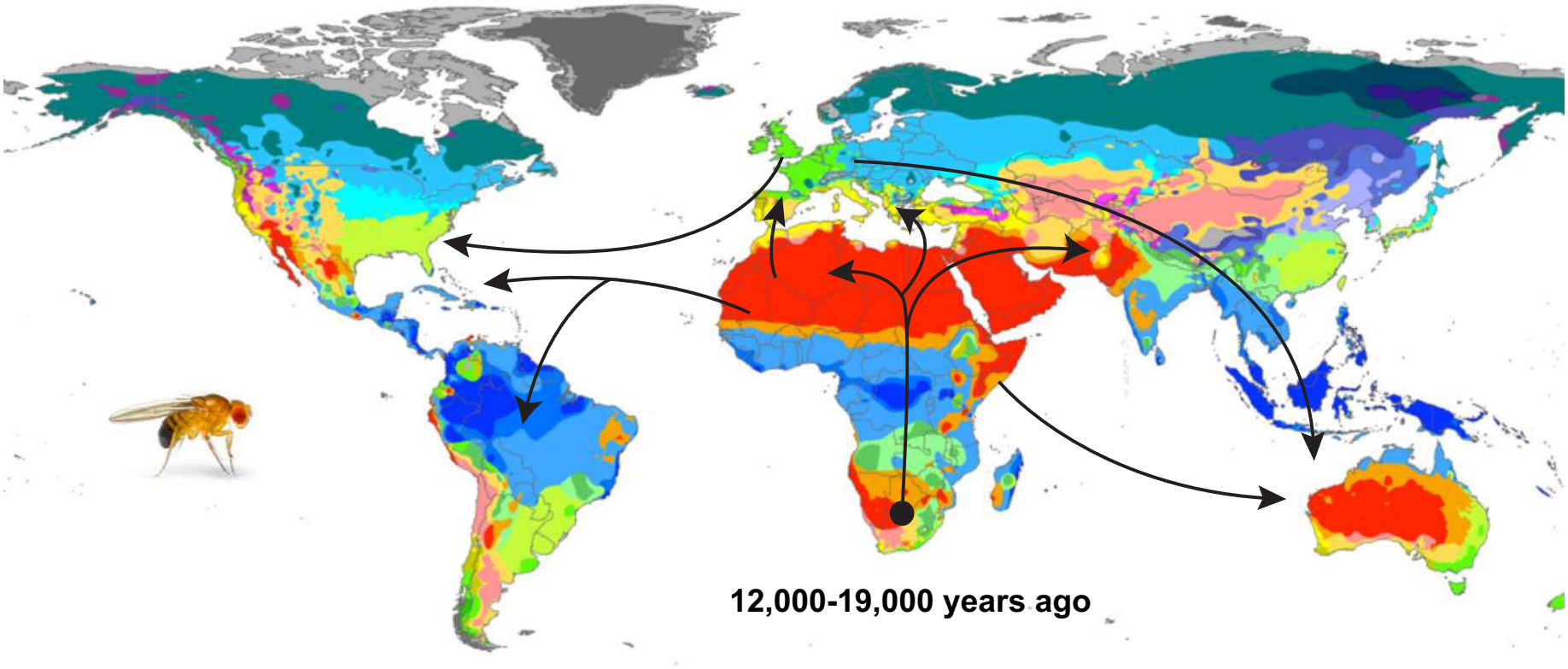


Drosophila melanogaster

Ritmes circadians.
Jeffrey C. Hall, Michael Rosbash and Michael W. Young
Premi Nobel **2017**.



Drosophila melanogaster natural populations



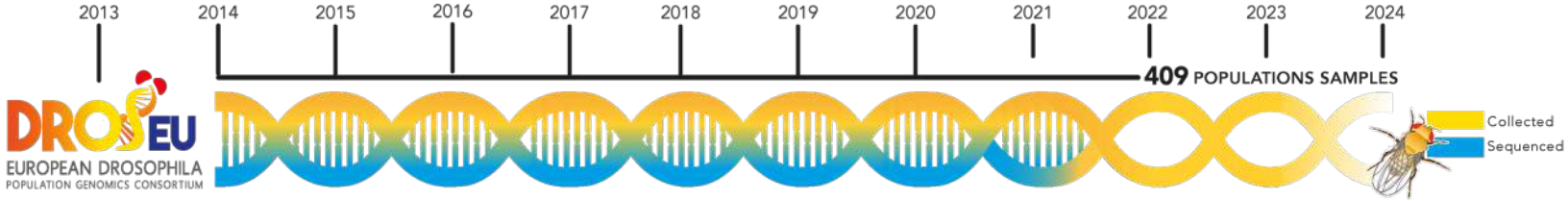
Sprengelmeyer et al 2020; Arguello et al 2019

Thomas Flatt
Uni Fribourg

Martin Kapun
NHM, Wien

Josefa González
CSIC

73 laboratories / 28 countries



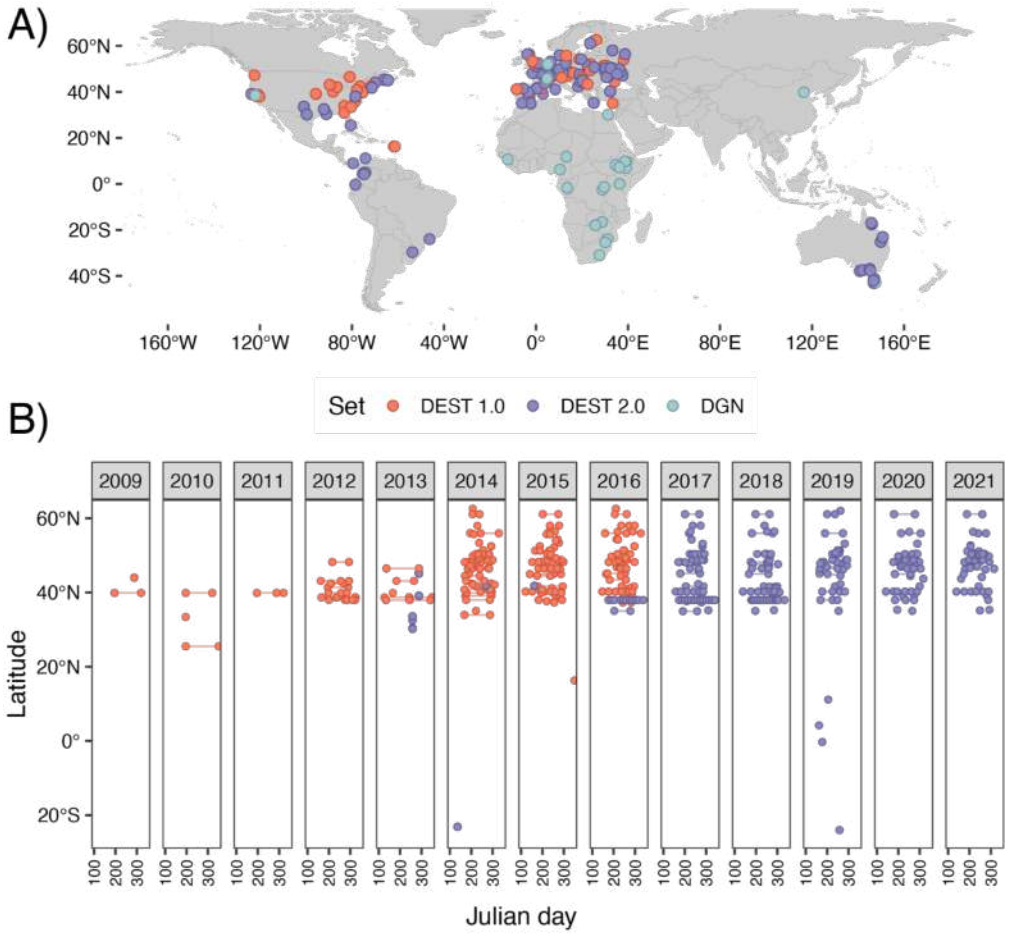
CITIZEN SCIENCE
MELANOGASTER
Catch The Fly!

Roberto Torres
LCATM

>20 schools / 5 countries

Molecular Biology and Evolution

Kapun et al 2020; Kapun et al 2021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B)
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Volume 39 • Number 2 • February 2022

Molecular Biology and Evolution

academic.oup.com/mbe

Society for Molecular Biology and Evolution

Online ISSN 1537-1719

GENOMIC ANALYSIS OF EUROPEAN *DROSOPHILA MELANOGASTER* POPULATIONS REVEALS LONGITUDINAL STRUCTURE, CONTINENT-WIDE SELECTION, AND PREVIOUSLY UNKNOWN DNA VIRUSES

FIRST CONTINENT-WIDE GENOMIC ANALYSIS

For the first time, quantitatively investigate **genomic** patterns of **genetic variation** in European ***Drosophila melanogaster.***

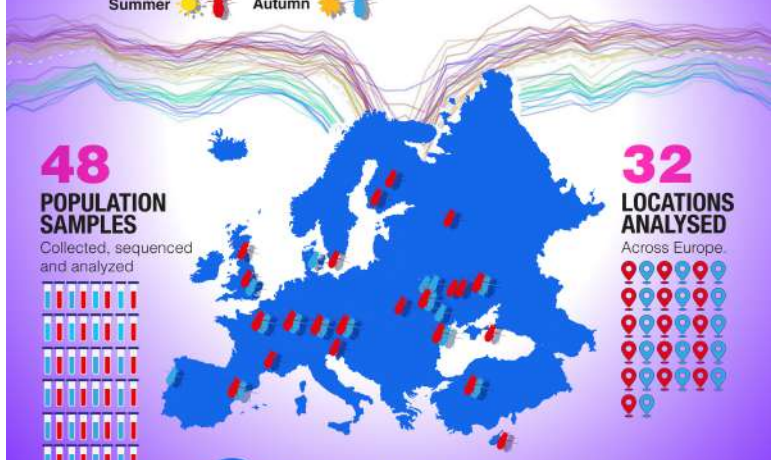
UNKNOWN EAST-WEST POPULATION STRUCTURE

Our analyses, investigate not only **SNP variation**, but also variation in transposable elements, inversions, mitochondria and host-specific **microbiota** reveal a previously unknown east-west **population structure** and identified numerous loci potentially affected by **spatially varying selection.**

SIGNALS OF SELECTIVE SWEEPS IN EUROPEAN POPULATIONS

Flies found in:

Summer Autumn



48
POPULATION SAMPLES
Collected, sequenced and analyzed

32
LOCATIONS ANALYSED
Across Europe.

ACKNOWLEDGEMENTS

This effort only became possible thanks to numerous European **collaborators who participated in sampling.**

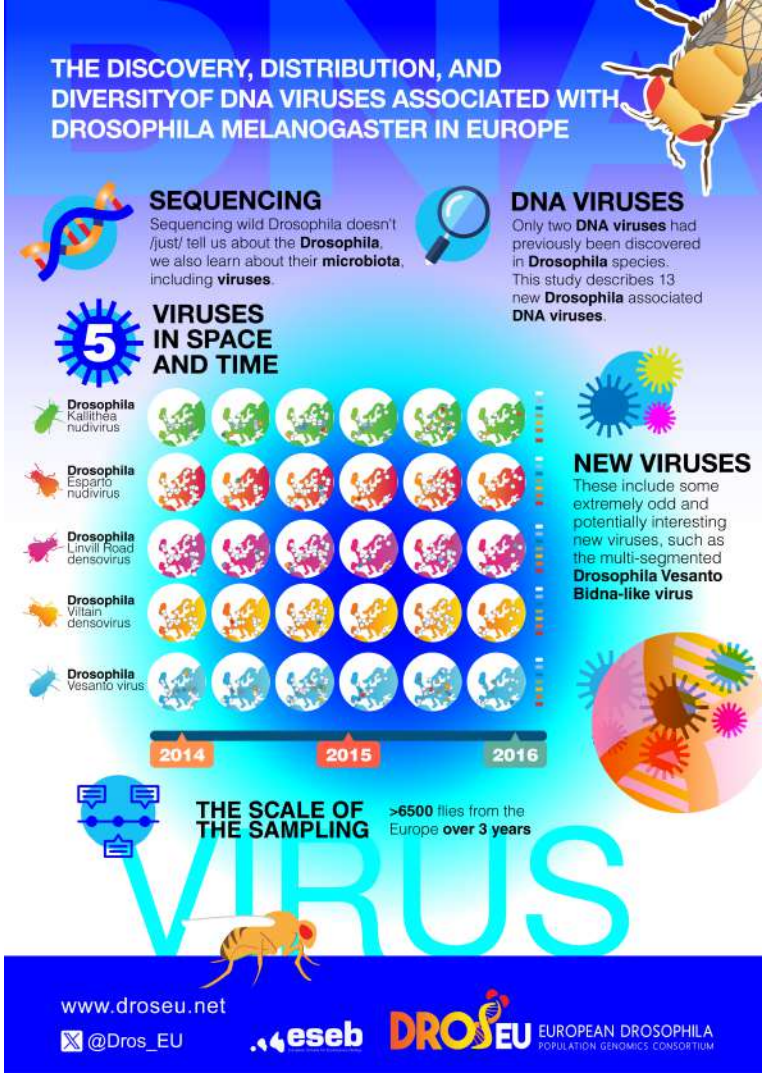
www.droseu.net

@Dros_EU

eseb

DROSEU EUROPEAN DROSOPHILA POPULATION GENOMICS CONSORTIUM

- Secuenciación de las muestras de 2014-2016: 271 muestras.
- Describimos un “pipeline” para poder analizar de forma automática múltiples secuencias genómicas
- Identificamos variantes genéticas que permiten identificar la procedencia geográfica de un genoma

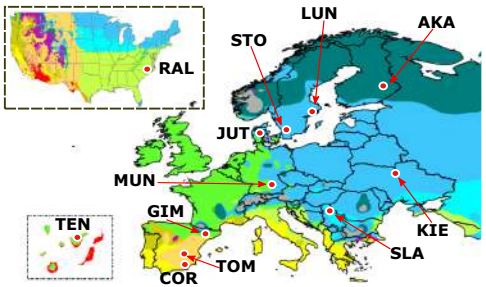


- En Drosophila solo se conocían dos virus de DNA antes del análisis de las poblaciones naturales recolectadas por los científicos y los ciudadanos, ahora se conocen 13 virus de DNA

- Cuantos mas nuevos virus se descubren mas podemos entender su biologia

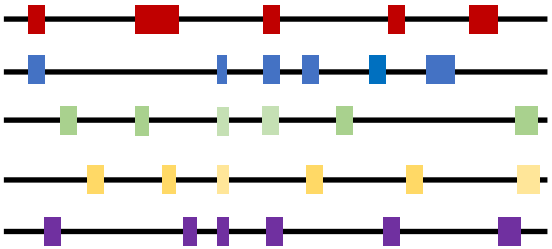
TEs shape stress response, development, behavior and pigmentation

32 new reference genomes



De novo TE annotations + MANUAL CURATION

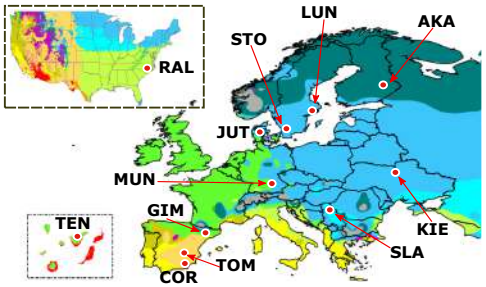
1,615 TEs → 28,365 TE insertions



Rech et al 2022, Nat Communications

TEs shape stress response, development, behavior and pigmentation

32 new reference genomes PACBIO NANOPORE



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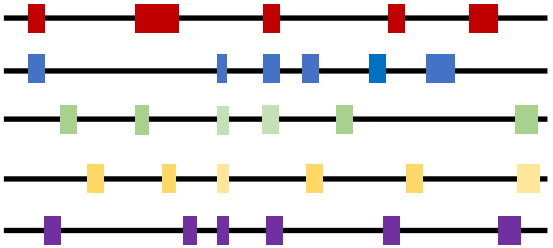
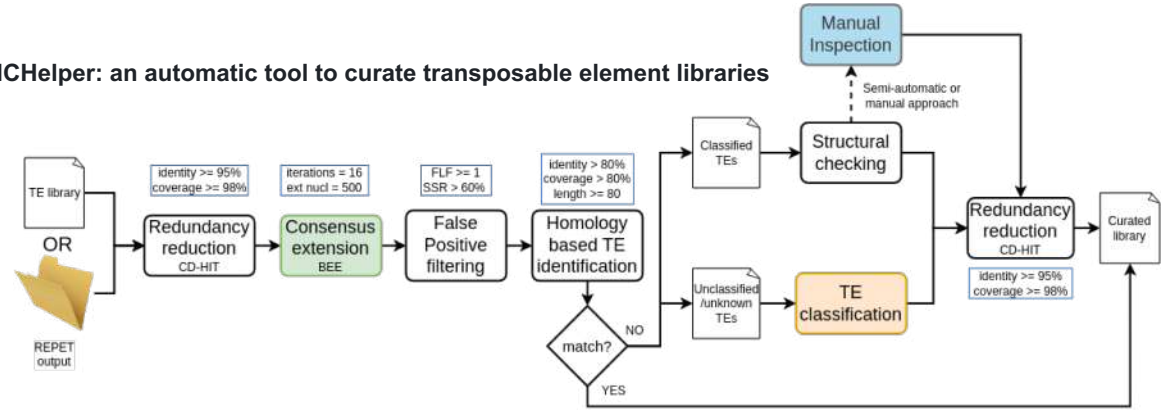


MCHelper: an automatic tool to curate transposable element libraries



Rech et al 2022, Nat Communications

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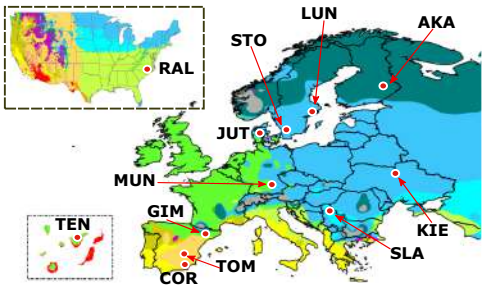

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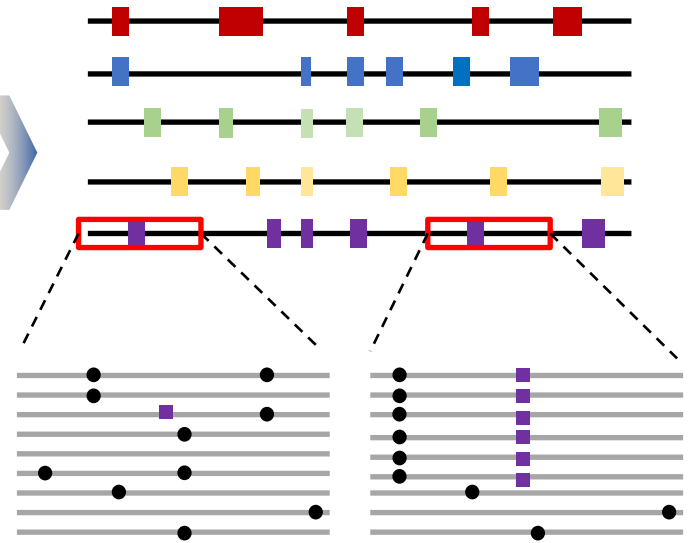
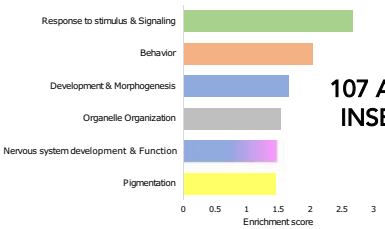




107 ADAPTIVE INSERTIONS

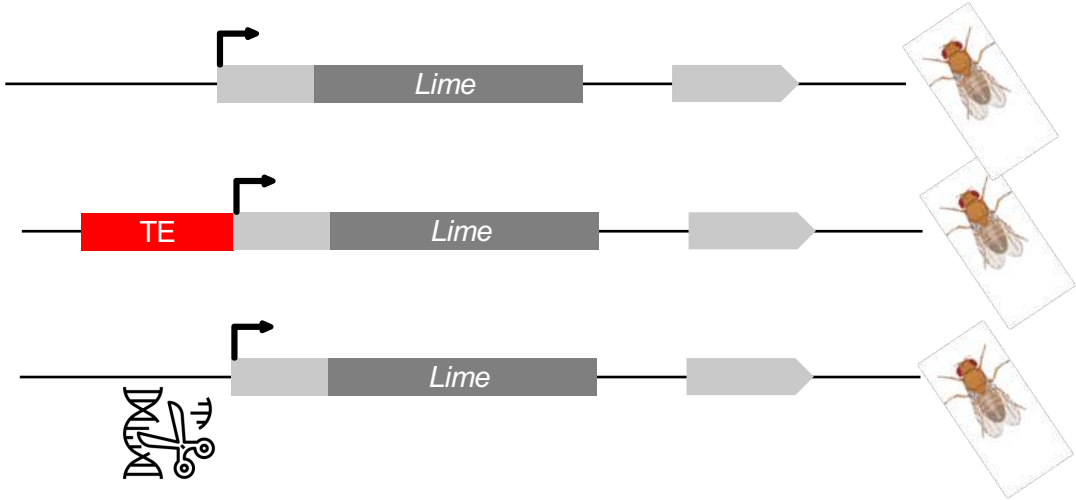
Evidence of selection in TE flanking regions (902 TEs)

hard and soft sweeps & pop differentiation

Rech et al 2022, Nat Communications

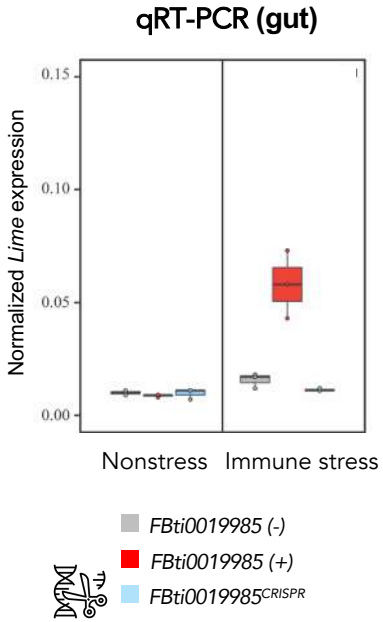
FBti0019985 increases fly survival to infection

Miriam Merenciano



Lime: gen implicado en la respuesta inmune

FBti0019985 increases fly survival to infection



Merenciano et al 2023, Mol Biol Evol

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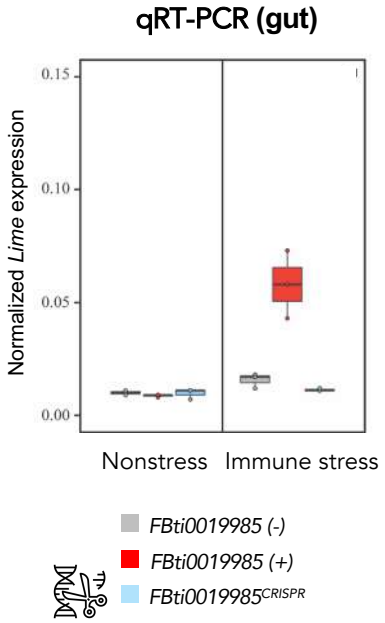

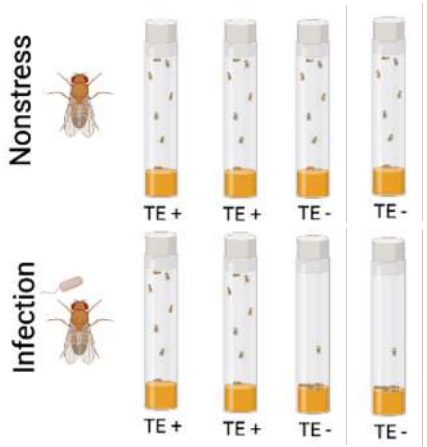

Merenciano et al 2023, Mol Biol Evol

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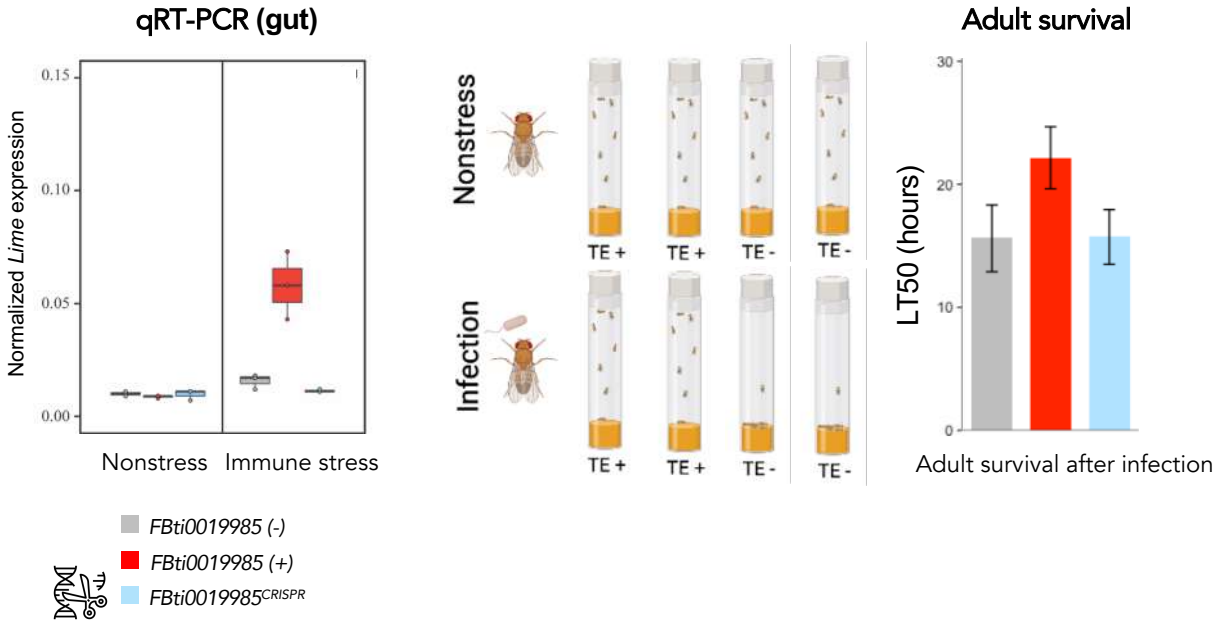
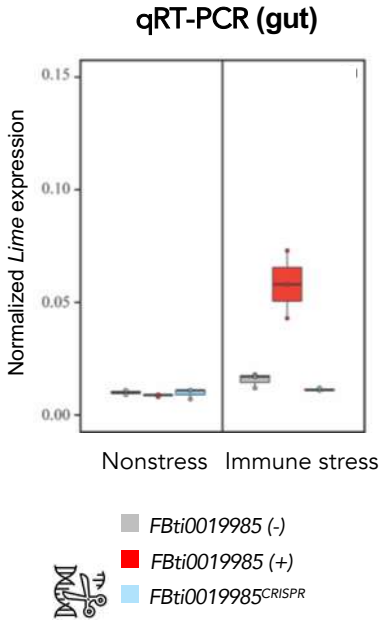
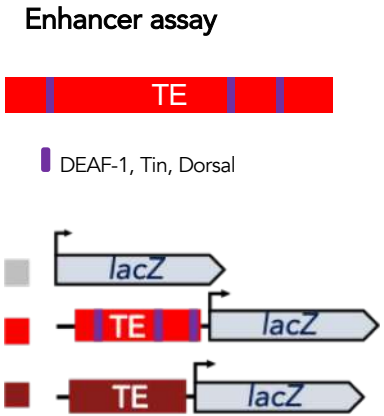


Merenciano et al 2023, Mol Biol Evol

FBti0019985 increases survival by adding immune TFBS





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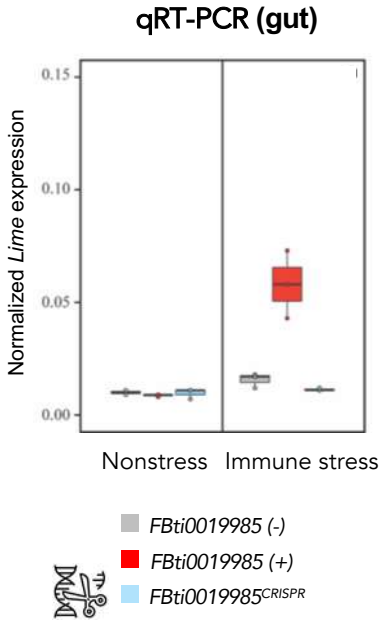

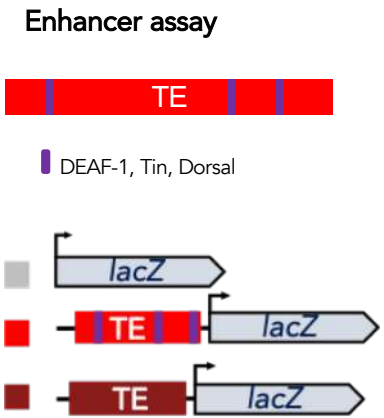

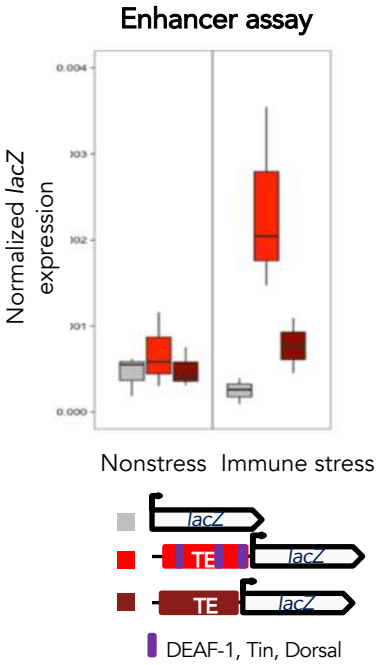

Merenciano et al 2023, Mol Biol Evol

TAKE HOME MESSAGES

- **El trabajo conjunto de científicos y ciudadanos nos permite tener acceso a una colección de datos mucho mayor y mucho mas informativa que la que pueden conseguir solo los cientificos**
- **Hemos podido identificar por primera vez genes que son beneficiosos para las poblaciones de Drosophila de los diferentes ambientes**
- **Hemos descrito nuevos virus de ADN de Drosophila que nos permiten investigar más sobre su biología**
- **Hemos identificado varios elementos móviles que permiten a las moscas sobrevivir en condiciones de estrés**

@GonzalezLab_BCN www.gonzalezlab.eu josefa.gonzalez@csic.es github.com/GonzalezLab

ACKNOWLEDGMENTS

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Francesca Destefanis
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Lauretta Van Helden
Lab tech

Lucia Muñoz
Postgraduate
JAE-Intro

Joel Font
Undergraduate

Gonzalo Sabarís
MSCA Postdoc

Adrian Tarazona
Visiting PhD,
IBV-CSIC

COLLABORATORS

Roberto Torres
LCATM

Thomas Flatt
Uni Fribourg

Past lab members: *Miriam Merenciano, Laura Aguilera, María Bogaerts-Márquez, Llew Green, Gabriel Rech, Anna Ullastres, Vivien Horvath, Simon Orozco*

FlyBase

CITIZEN SCIENCE MELANOGASTER Catch The Fly

DROSEU EUROPEAN DROSOPHILA POPULATION GENOMICS CONSORTIUM

FECYT INNOVACIÓN

eseb

FUNDING

erc
European Research Council
Established by the European Commission

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

Unión Europea
Fondo Europeo de Desarrollo Regional

Marie Skłodowska-Curie Actions

EMBO

Erasmus+

Generalitat de Catalunya
Departament de Recerca i Universitats

LIFEHUB CSIC

AdaptNet GENOMICS OF ADAPTATION NETWORK

MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

CSIC