

UNIVERSITY OF BUCHAREST

Faculty of Biology, Department of Genetics

HABILITATION THESIS

SUMMARY

DOMAIN BIOLOGY

**Annotations in an evolutionary context of genes and
transposons from the *Drosophila melanogaster* genome**

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Key words: *D. melanogaster*, γ COP gene, artificial transposons, natural transposons, genome, evolutionary context, immunogenetics, Genome ARTIST, Linux, *Drosophila* Laboratory.

The habilitation thesis “**Annotations in an evolutionary context of genes and transposons from the *Drosophila melanogaster* genome**” describes some of the main scientific, academic and professional achievements obtained after completing the doctoral degree in Biology in 2006, along with my prospective objectives. My PhD thesis, entitled “**Aspects of *Drosophila* developmental genetics**” was almost entirely completed in the *Drosophila* Laboratory at the Faculty of Biology, University of Bucharest.

I have developed interdisciplinary expertise encompassing **Genetic Analysis, Bioinformatics, Genomics** and **Biostatistics** with a focus on *D. melanogaster*, a standard platform for biological research. After the introductory and general aspects explained in Chapter 1 of this thesis, I detail my accomplishments in Chapter 2, where dedicated sections and subsections address the essential requirements of my university career. My main goal is to conduct basic research projects alongside prospective PhD students, so the scientific accomplishments are particularly highlighted.

In 2000, as a PhD student, I founded the first biocenter in Romania designed to support modern genetic analysis and transposon mutagenesis on *D. melanogaster*. Following the award of my doctoral degree, I managed two public research grants which were essential for the development of the *Drosophila* Laboratory. With this funding, I partially supported two PhD students, and two others were sustained by a third grant, where I worked as a key researcher. A fifth graduate student successfully worked under my technical guidance even though he did not benefit from formal financial support.

Achievements in Genetic analysis

As a drosophilist, my main research pursuit centers on the essential *gammaCop* (γ COP) gene of *D. melanogaster*, aiming to decipher its pleiotropic roles, which range from development, viability and fertility to the modulation of the innate immune response. The specific genetic analysis experiments were ignited during my PhD program and continue to revolve around the mutant alleles γ COP^{S057302}, γ COP^{11a}, γ COP^{14a} and γ COP^{16b}. I am also interested in the complex interactions between the γ COP mutant background and the expression patterns of genes in the **Imd** and **Toll** pathways, following the experimental infection of *D. melanogaster* with various pathogenic bacteria. Another topic was the functional analysis of the **CG18135** gene, for which the first mutant phenotypes were obtained in the *Drosophila* Laboratory.

Insertional mutagenesis with P-element derivatives has been one of my main experimental activities, an endeavour aimed at providing a better understanding of transposon biology in the *D. melanogaster* genomic context.

Contributions to Bioinformatics

The development and optimization of the **Genome ARTIST** software is a milestone product of the bioinformatics research performed in the *Drosophila* Laboratory. Our tool solved the issue of transposon mapping at the nucleotide level, an important aspect of the insertional mutagenesis experiments.

At the same time, my constant endeavours were centred on setting up a state-of-the-art laboratory of Bioinformatics and Biostatistics relying on the Linux operating system, a milestone meant to support both advanced teaching and research activities in these interdisciplinary scientific fields.

Advancements in Genomics

One of the main scientific results in this area of research was the sequencing, assembly and transposon annotation of Horezu_LaPeri, a Romanian strain of *D. melanogaster*. In addition, I was involved in immunogenetics studies concerning the transcriptional response of the *D. melanogaster* genome to experimental infections with opportunistic pathogenic bacteria, such as *Pseudomonas aeruginosa*.

Contributions to Biostatistics

A methodology for the statistical analysis of qRT-PCR data, a debated topic in molecular biology was developed in the *Drosophila* Laboratory and implemented in the original, open source tool qDATA.

Academic and professional accomplishments

A section of this thesis is dedicated to my academic achievements, detailing contributions to *curriculum* development in support of general genetics. I have been a faculty member in the Department of Genetics since 2001, when I became a teaching assistant, subsequently advancing to Lecturer in 2004 and to Associate Professor in 2019. The most important courses I have introduced and taught are Genomics at the undergraduate level, alongside Advanced Genetic Analysis and Bioinformatics at the graduate level.

In a distinct section, some of my professional achievements, such as managerial activities and media appearances for the purposes of science communication, are presented.

Some of my most significant papers are presented in the following table, where each scientific article is associated with its respective field of research.

Area of research	Article title	DOI/Web link
Genetic Analysis	Chifiriuc, M. C., Ratiu, A. C., Popa, M., & Ecovoiu, A. A. (2016) . Drosophotoxicology: An emerging research area for assessing nanoparticles interaction with living organisms. <i>International Journal of Molecular Sciences</i> , 17(2), 36.	https://doi.org/10.3390/ijms17020036
	Ecovoiu, A. A. , Ratiu, A. C., Micheu, M. M., & Chifiriuc, M. C. (2022). Inter-species rescue of mutant phenotype - The standard for genetic analysis of human genetic disorders in <i>Drosophila melanogaster</i> model. <i>International Journal of Molecular Sciences</i> , 23(5), 2613.	https://doi.org/10.3390/ijms23052613
	Chifiriuc, M. C., Bologa, A. M., Ratiu, A. C., Ionascu, A., & Ecovoiu, A. A. (2022) . Mutations of γ COP gene disturb <i>Drosophila melanogaster</i> innate immune response to <i>Pseudomonas aeruginosa</i> . <i>International Journal of Molecular Sciences</i> , 23(12), 6499.	https://doi.org/10.3390/ijms23126499
	Ratiu, A. C., Ionascu, A., & Ecovoiu, A. A. (2024) . A novel insertional allele of the <i>CG18135</i> gene is associated with severe mutant phenotypes in <i>Drosophila melanogaster</i> . <i>Frontiers in Genetics</i> , 15, 1355368.	https://doi.org/10.3389/fgene.2024.1355368
Bioinformatics	Ecovoiu, A. A. , Ghionoiu, I. C., Ciuca, A. M., & Ratiu, A. C. (2016). Genome ARTIST: A robust, high-accuracy aligner tool for mapping transposon insertions and self-insertions. <i>Mobile DNA</i> , 7, 3.	https://doi.org/10.1186/s13100-016-0061-0/
	Ecovoiu, A. A. , Bologa, A. M., Chifiriuc, D. I. M., Ciuca, A. M., Constantin, N. D., Ghionoiu, I. C., Ghita, I. C. & Ratiu, A. C. (2022). Genome ARTIST_v2 - An autonomous bioinformatics tool for annotation of natural transposons in sequenced genomes. <i>International Journal of Molecular Sciences</i> , 23(20), 12686.	https://doi.org/10.3390/ijms232012686
Genomics	Ratiu, A. C., Neagu, A., Mihalache, M. R., Lazar, V., & Ecovoiu, A. A. (2016) . Molecular and bioinformatics analysis of the relative expression profiles of <i>dorsal</i> , <i>Toll-1</i> , <i>Relish</i> and <i>Duox</i> genes in young versus old diutinus workers of <i>Apis mellifera</i> . <i>Romanian Biotechnological Letters</i> , 21(3).	https://rombio.unibuc.ro/wp-content/uploads/2022/05/21-3-10.pdf
	Bologa, A. M., Stoica, I., Ratiu, A. C., Constantin, N. D., & Ecovoiu, A. A. (2022) . ONT-based alternative assemblies impact on the annotations of unique versus repetitive features in the genome of a romanian strain of <i>Drosophila melanogaster</i> . <i>International Journal of Molecular Sciences</i> , 23(23), 14892.	https://doi.org/10.3390/ijms232314892
	Bologa, A. M., Stoica, I., Constantin, N. D., & Ecovoiu, A. A. (2023) . The landscape of the DNA transposons in the genome of the Horezu_LaPeri Strain of <i>Drosophila melanogaster</i> . <i>Insects</i> , 14(6), 494.	https://doi.org/10.3390/insects14060494
Biostatistics	Ionascu, A., Ecovoiu, A. A. , Chifiriuc, M. C., & Ratiu, A. C. (2024). qDATA - An R application implementing a practical framework for analyzing quantitative real-time PCR data. <i>BioTechniques</i> , 1–15.	https://doi.org/10.1080/07366205.2024.2442217

Career perspectives

In Chapter 3, I describe my career perspectives with a ground zero for the scientific ones, ranging from insights into **yCOP** and **CG18135** genes, upgrades to **Genome ARTIST** and modeling of antibiotic resistance to the transposon annotation for the genomes of *D. melanogaster* and *Apis mellifera* (the honey bee) in an evolutionary context. Particular attention will be paid to **corsair**, a spontaneous eye development mutation that I discovered in 2025 affecting a line from the collection of *Drosophila* Laboratory.

I also intend to modernize the syllabuses for the disciplines of my academic portfolio, with a particular emphasis on Advanced Genetic Analysis. Another main objective is to transfer teaching expertise to my colleagues and to involve PhD students in academic laboratory activities in parallel with our common original research endeavours.

One of the main upcoming professional topics is my contribution to the development of a national network of laboratories interested in research on the *D. melanogaster* model. A main objective is also to obtain public or private funding to support both my research areas and the prospective doctoral students.

The concise but comprehensive bibliography of this habilitation thesis not only supports the technical aspects summarized in the text, but it also may be a starting point for those interested in this extraordinary field of research.

DATE

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