INVESTIGACIÓN
GRUPOS DE INVESTIGACIÓN

BIOINFORMÁTICA Y ECOTOXICOLOGÍA MOLECULAR DE INVERTEBRADOS

CÓDIGO 196

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PRESENTACIÓN

English

Invertebrates are a very diverse group of animals distributed throughout the planet. They are found in all ecosystems and are vitally important for ecosystems' good health. However, their physiology is still relatively unknown because they present many adaptations specific to certain environments, increasing the complexity of their study.

They are organisms dependent on the environment since they cannot regulate their temperature, and their metabolism depends on environmental conditions. This makes them susceptible to climate change, leaving it unknown how they will respond. Likewise, the increase in human activities generates many pollutants discharged into the environment. The combination of both factors, climate change, and environmental pollution, means that invertebrates are subjected to multi-stress conditions that put their survival at risk.

In aquatic environments, invertebrates are essential. At the same time, continental and marine waters are sinks to which pollutants reach, affecting the organisms that live in them. The answers are diverse and involve different levels of complexity. At the molecular level, there is little knowledge of the effects of climate change and environmental pollution on aquatic invertebrates. The objectives that the group has set are:

- Increase the molecular biomarkers available in ecotoxicological studies.
- Analyze their evolutionary relationship and identify biomarkers that are not protein in nature.
- Study how the combined multi-stress of climate change and environmental pollution affects aquatic invertebrates, the basis of the food chain of freshwater and marine ecosystems.
- Standardize the methodology for analyzing molecular biomarkers to apply it to non-model organisms.

Achieving these objectives will allow us to understand aquatic invertebrates better, which is necessary to develop new ways of assessing the impact of human activity on the environment. It will also help update ecotoxicological evaluation methods since, today, they have not yet incorporated the technological developments of the last twenty years.

The group comprises two UNED researchers collaborating with several national and foreign researchers.

Español

Los invertebrados son un conjunto de animales muy diverso que se han distribuido a lo largo y ancho del planeta. Se encuentran en todos los ecosistemas y son de vital importancia para la buena salud de los ecosistemas. Sin embargo, su fisiología es aún bastante desconocido debido a que presentan muchas adaptaciones que son específicas de ciertos ambientes, aumentando la complejidad de su estudio.

Son organismos dependientes del medio ya que al no poder regular su temperatura, su metabolismo depende de las condiciones ambientales. Esto hace que sean susceptibles al actual proceso de cambio climático, siendo una incógnita cómo van a responder. De igual forma, el aumento de las actividades humanas genera un gran volumen de contaminantes que se vierten al medio. La conjunción de ambos factores, cambio climático y contaminación

ambiental, hacen que los invertebrados se vean sometidos a condiciones de multi-estrés que ponen en riesgo su supervivencia.

En los ambientes acuáticos los invertebrados son básicos. Al mismo tiempo, las aguas continentales y marinas son sumideros a los que llegan los contaminantes, afectando a los organismos que viven en ellas. Las respuestas son diversas e implican distintos niveles de complejidad. A nivel molecular, no se tiene mucho conocimiento de los efectos que se producen en los invertebrados acuáticos frente al cambio climático y la contaminación ambiental. Los objetivos que se ha marcado el grupo son:

•Incrementar los biomarcadores moleculares disponibles en los estudios ecotoxicológicos.

•Analizar la relación evolutiva entre ellos, identificar biomarcadores que no sean de naturaleza proteica.

•Estudiar cómo afecta el multiestrés combinado de cambio climático y contaminación ambiental a los invertebrados acuáticos, base de la cadena trófica de los ecosistemas de agua dulce y marina.

•Estandarizar la metodología de análisis de biomarcadores moleculares para poder aplicarla a organismos no modelo.

Conseguir estos objetivos permitirá alcanzar un mejor conocimiento de los invertebrados acuáticos que es necesario para desarrollar nuevas formas de valoración del impacto de la actividad humana en el medio ambiente. También ayudará a actualizar los métodos de evaluación ecotoxicológica ya que hoy en día aún no han incorporado las novedades tecnológicas de los últimos veinte años.

El grupo está compuesto por dos investigadores de la UNED que colaboran con varios investigadores nacionales y extranjeros.

LINEAS DE INVESTIGACIÓN

English

•Invertebrates' transcriptome study as a source of biomarker identification.

•Impact of environmental pollution and climate change in the expression profile of molecular biomarkers.

•Characterization of invertebrate genes and the evolutionary relation in different invertebrates with relevance in Ecotoxicology,

•Identification of long non-coding RNAs (lncRNAs) with interest in Ecotoxicology.

Español

•Estudio de transcriptomas de invertebrados como fuente de identificación de biomarcadores.

•Impacto en el perfil de expresión de biomarcadores moleculares de la contaminación ambiental y el cambio climático.

•Caracterización de genes en invertebrados y su relación evolutiva entre los distintos invertebrados de interés en ecotoxicología.
•Identificación de RNAs no codificantes largos con interés en ecotoxicología.

PROYECTOS

•MINISTERIO DE CIENCIA E INNOVACIÓN - PID2022-136669OB-I00 (09/2023 - 08/2026)
TÍTULO DEL PROYECTO: **Ecotoxicología molecular y respuesta al multiestrés en un contexto de cambio climático en invertebrados acuáticos modelo y no modelo** (MIMESIS)
TITLE OF THE PROJECT: M**olecular ecotoxicology and response to multi-stress in a context of climate change in model and non-model aquatic invertebrates** (MIMESIS)
Summary
Climate change and pollution are two of the most relevant environmental problems today, causing multi-stress by various factors that act simultaneously and can affect homeostasis in living organisms. In aquatic ecosystems, invertebrates are a fundamental element for their maintenance. Not being able to regulate their body temperature, they may be affected by climate change, which alters their metabolism and modifies their ability to respond to chemicals from different human activities. Therefore, it is necessary to advance the knowledge of how the changes in progress affect these organisms and their ability to survive. Furthermore, a standardized methodology is mandatory to improve the current toxicity tests. Not only should the standard study conditions include multi-stress situations, but it is also necessary to incorporate new molecular technologies to develop impact assessment tools that assess the different levels of action. It will provide additional information on possible mechanisms of action to identify new adverse response pathways that integrate all the data, from the molecular to the ecosystem level. In addition, a simple experimental design can be applied to any organism, making it possible to obtain information on multiple species with a minimum number of specimens, helping to understand the current situation of the ecosystem and to develop new assessment and action tools for environmental conservation. The MIMESIS project uses two commonly used freshwater species in the laboratory to study their response to thermal and chemical stress due to climate change and pollution. By using toxicity tests and molecular tools, an experimental design will be developed combining the best of both approaches to find out how organisms respond, assess their ability to acclimatize to the changes in progress, and study the biological processes that can be affected both in the short, medium and long term. In addition, a first approximation to the analysis of a non-model marine species will be carried out to assess whether the methods used are helpful and present an adequate

•MINISTERIO DE CIENCIA, INNOVACIÓN y UNIVERSIDADES - RTI2018-094598-B-I00 (1/2019 - 12/2021)

TÍTULO DEL PROYECTO: **Cambio global y contaminación: estandarización del estudio de la respuesta celular y molecular adaptativa al multiestrés en invertebrados acuáticos** (ADAPTA)

TITLE OF THE PROJECT: **Global change and contamination: standardization of the study of the adaptive molecular and cellular response to multi-stress in aquatic invertebrates** (ADAPTA)

Summary:

Global change encompasses planetary-scale changes to atmospheric circulation, ocean circulation, climate, the carbon cycle, the nitrogen cycle, the water cycle and other cycles, sea-ice changes, sea-level changes, food webs, biological diversity, pollution, health, fish stocks, etc. Invertebrates are present in most aquatic ecosystems and have a central role in their functioning by their importance in the food webs, removing dead organisms, etc. Because of their physiology and metabolism, they are strongly dependent on the environment, and the present global change can affect their survival and alter their metabolism. Global change includes a wide variety of problems that question the ability of invertebrates to survive, making it essential to know their ability to manage these changes and their adaptation to them. On the other hand, toxicity tests mainly focus on the analysis of ecologically relevant endpoints. However, there is poor knowledge about the mode of action of the toxicants, their interactions, and the influence of other factors, such as temperature or pH, in the toxicity and the response of the organisms. This project seeks to improve toxicity analysis by standardizing the methodology by including molecular and cellular methods in toxicity tests. The study will focus on two main problems associated with global change: pollution and climate change. To validate the approach, we will evaluate the ability of two freshwater species belonging to different invertebrate groups, Chironomus riparius (insect) and Physella acuta (mollusk), to manage the multi-stress using different conditions mimicking environmental alteration (e.g., different temperatures combined with relevant toxicants of diverse nature). Using molecular and cellular tools, we will identify putative genes and mechanisms participating in response to multi-stress, providing information about the mechanisms of action of pollutants, the influence of physical factors, and the response of these organisms. By designing arrays to identify expression profiles and combining this information with enzymatic activity studies, protein analysis, and epigenetics, we want to conduct an integrative analysis and obtain conclusions about different aspects of toxicity. At the same time, the standardization of the methodology will speed up the analysis and optimize the resources, allowing for more information with less work and time.

Additionally, we will analyze a new element that is increasing its importance in the environment: microplastics and nanomaterials' role in pollution. On the other hand, we will incorporate lipid analysis to extend the study to these biomolecules also affected by toxicants. Furthermore, analysis of the toxicants in the culture medium during exposure will

provide information about their behavior along the time in the conditions used and provide a more precise picture of the animals' environment. All these data will provide information to the Adverse Outcome Pathway database and the environmental risk assessment. Finally, a secondary aim of the project is to extend our knowledge about the metabolism of these animals by studying pathways relevant to multistress adaptation, which helps to understand their physiology.

RESULTADOS

Publicaciones (últimos 5 años)/Publications (last 5 years)

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IGUALDAD DE GÉNERO

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