



Pole for Doctoral Studies  
Center for Doctoral Studies  
Sciences, Technologies, and Medical Sciences

## ANNOUNCEMENT OF DOCTORAL THESIS DEFENSE



**Ms. BOUAZZATI Hasna**

**Will present here research work with the aim of earning a  
Doctorate**

**Doctoral program: Biology, Chemistry and Geology  
Discipline: Earth Sciences  
Specialty: Oceanography; Environmental Sciences**

**On 18/07/2025 at 10H00 at the meetings room of the chemistry  
department, Faculty of Sciences of Tetouan, UAE  
Under the Theme**

**THE RESILIENCE OF MARINE PROTECTED AREA OF  
AL HOCEIMA (NORTH OF MOROCCO) TO CLIMATE CHANGE**

**Front of the jury composed of :**

First Name & Last Name	Establishment	Designation
Pr. STITOU EL MESSARI Jamal Eddine	FS of Tétouan, UAE	President
Pr. ABOUMARIA Khadija	FST of Tangier, UAE	Reviewer
Pr. EL OUARGHI Houssain	ENSA of Al Hoceima, UAE	Reviewer
Pr. EL MOUTCHOU Brahim	FS of Tétouan, UAE	Reviewer
Pr. EL TALIBI Hajar	FST of Al Hoceima, UAE	Examiner
Pr. MORARECH Moad	FS of Tétouan, UAE	Examiner
Pr. NACHITE Driss	Independent Researcher	Expert
Pr. EL M'RINI Abdelmounim	FS of Tétouan, UAE	Supervisor

**Research Laboratory:** Research Laboratory in Applied and Marine Geosciences, Geotechnics and Georisks  
(LR3G): FS - Tetouan, Abdelmalek Essaadi University

## Abstract



The resilience of marine ecosystems to the multifaceted pressures of climate change and anthropogenic activities is a pressing concern, particularly in the Mediterranean. This thesis investigates the Al Hoceima Marine Protected Area (MPA) in Morocco, a critical biodiversity hotspot within the Mediterranean, and its resilience to such challenges. The Al Hoceima Marine Reserve, known for its rich biodiversity and critical habitats, faces significant threats due to climate change and pollution. These challenges are compounded by the difficulties in designing and managing climate-resilient MPAs, which must respond to dynamic and widespread climate effects.

The research aims to address key gaps in understanding the resilience mechanisms within the Al Hoceima Marine Reserve. Current strategies in the Mediterranean, while emphasizing ecological resilience, often lack site-specific assessments that integrate socio-economic, ecological, and technological data streams to provide holistic insights. This thesis highlights the importance of understanding resilience mechanisms and how innovative approaches, such as the use of Autonomous Underwater Vehicles (AUVs) and platforms like Odyssey, can contribute to data-driven conservation efforts. The research objectives focus on assessing the role of the Al Hoceima Marine Reserve in mitigating climate impacts, the effectiveness of innovative technological tools in marine conservation, and identifying gaps in existing management plans to propose sustainable adaptation strategies.

To achieve these aims, a multidisciplinary approach was applied. The methodology involved the deployment of AUVs, specifically SeaExplorer gliders, to collect high-resolution oceanographic data on parameters such as temperature, salinity, dissolved oxygen, and chlorophyll-a concentrations. Complementary datasets included microplastic counts, socio-economic data from local stakeholders, and satellite-derived indicators. Advanced statistical techniques and machine learning tools were employed to analyze spatial-temporal patterns, particularly focusing on microplastic dispersion and ecosystem variability.

The study's findings reveal significant seasonal and vertical variability in key oceanographic parameters, along with alarming patterns of microplastic accumulation in both surface and subsurface layers. The Al Hoceima Marine Reserve demonstrates an ecological buffering capacity, especially in seagrass and rocky habitats, contributing to local biodiversity resilience. However, critical gaps were identified in the management response to pollution threats and adaptive capacity to climate shifts. The research advocates for a more integrated, technology-supported management strategy, tailored to the dynamic conditions of MPAs in North Africa.

The study underscores the potential for replicating its findings in similar ecosystems, emphasizing the importance of innovative, data-driven approaches in marine conservation. Finally, the conclusion calls for future research to focus on long-term monitoring and the development of integrated adaptation measures that encompass ecological, technological, and socio-economic dimensions, thereby sustaining marine biodiversity and supporting the blue economy.

**Keywords:** Al Hoceima Marine Protected Area, Climate Change Resilience, Marine Conservation, Autonomous Underwater Vehicles, Odyssey Platform, Adaptive Management, Blue Economy.