Richard Fitzgerald Memorial Best Aquatic Environment Poster

Non-Invasive Marine Species Detection: Rapid, Field-Deployable eDNA Assays using CRISPR-Cas Technology in the MariBiome Project

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GLOSSARY

MEANING

eDNA - **e**nvironmental **DNA**
PCR - **P**olymerase **C**hain **R**eaction
RPA - **R**ecombinase **P**olymerase **A**mplification
CRISPR - **C**lustered **R**egularly **I**nterspaced **S**hort **P**alindromic **R**epeats
Cas - **C**RISPR **as**sociated proteins
HAB(s) - **H**armful **A**lgal **B**loom(**s**)

eDNA is genetic material shed into the environment (e.g. skin cells, waste) and with the right tools can be detected in water samples to determine the presence of species. This technique has revolutionised non-invasive monitoring of marine species by offering an alternative to labour intensive and error-prone observation methods which typically necessitate morphological expertise. The most commonly used **eDNA** detection methods are **PCR** assays, which involve thermal cycling for DNA amplification and require central laboratory facilities or expensive equipment. These constraints limit both accessibility and the capacity for a prompt response. Thus, this project focuses on creating rapid and accessible assays for monitoring marine environments by deploying an isothermal and affordable alternative, utilising **RPA** and **CRISPR-Cas**-based technologies (Fig. 1). This would enable on-site water testing for the presence of specific species for biodiversity monitoring, as well as **HABs** and norovirus to monitor ecosystem and human health concerns.

Following the selection of indicator species relevant in an Irish coastal context, based upon ecological importance and stakeholder interest, species-specific **RPA-CRISPR-Cas** assays will be designed for use. It is expected that this research will contribute to advancing the practical implementation of **CRISPR-Cas**-based **eDNA** detection and demonstrate its applicability for continuous monitoring. This approach also enables the production of biosensors, which will be integrated into an autonomous marine sensing platform as part of The MariBiome Project. This multi-institutional research comprises five PhD researchers specialising in molecular biology, analytical chemistry, robotics, and artificial intelligence. Through interdisciplinary collaboration, the project aims to establish a baseline understanding of Irish coastal marine biodiversity and develop and deploy an innovative water monitoring system to support Ireland's marine and environmental ambitions.

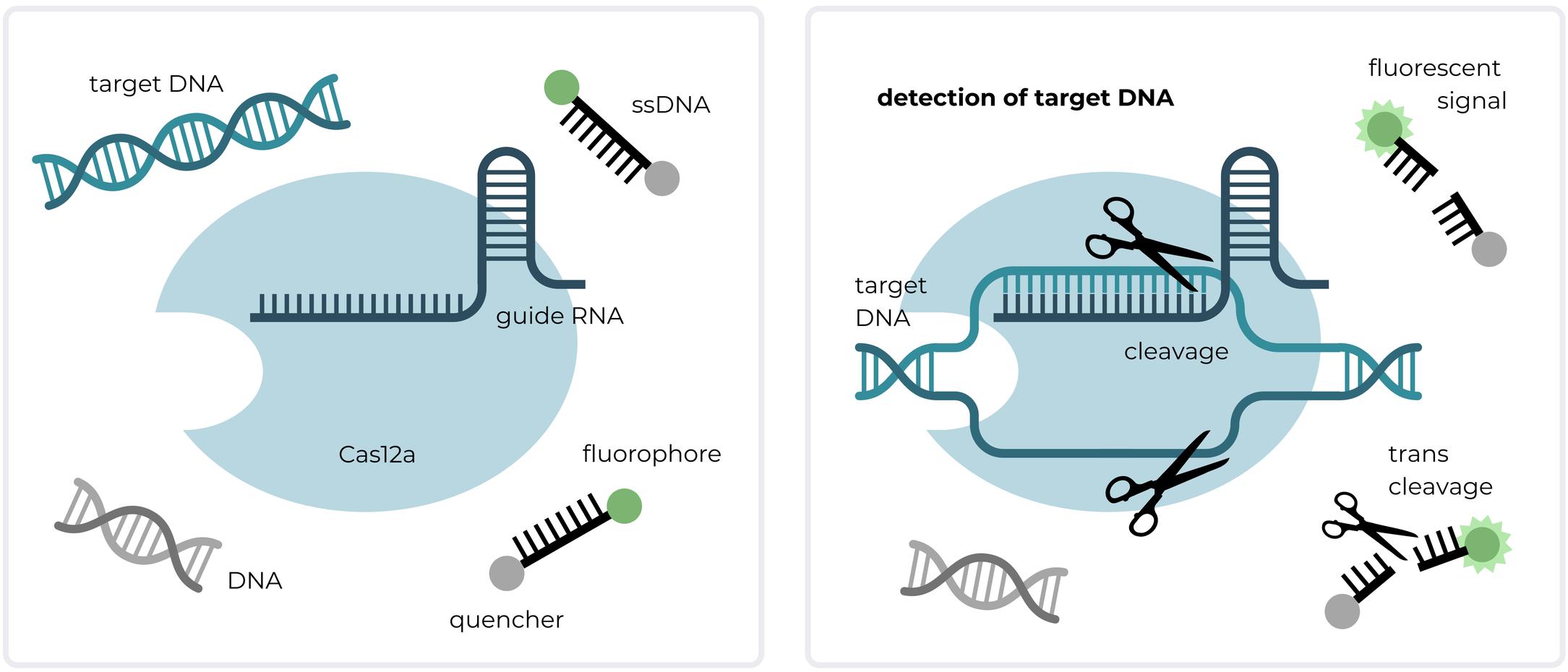

Figure 1: The Cas12a enzyme and guide RNA form a complex designed to recognise a specific target species. If target DNA is present, it will bind to the complex and activate DNA cleavage, which also affects surrounding single-stranded DNA (trans-cleavage). Short strands with a fluororphore and a light absorbent quencher break apart, emitting a fluorescent signal, indicating species presence in the sample.

MARIBIOME

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University

University of Limerick Ollscoil Luimnigh · Queen's University Belfast · Ollscoil Teicneolaíochta an Atlantaigh Atlantic Technological University · Foras na Mara Marine Institute

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