

Cullen Scholarship: Assessing the use of Unmanned Aerial Vehicles (UAVs) to monitor Marine Protected Areas (MPAs) and provide best-practice advice for Ireland's MPAs (PhD Award).

Background

Marine Protected Areas (MPAs) are essential tools for the conservation of marine and coastal biodiversity (Lausche 2011), defined by the International Union for the Conservation of Nature (IUCN) as “any area of intertidal or subtidal terrain (...) which has been reserved by law or other effective means to protect part of all of the enclosed environment” (Day et al. 2012). The term itself embraces a wide diversity of definitions depending on the jurisdiction and legislation. Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) form a European network (Natura 2000) of protected areas aiming to protect habitats and species of importance at the European scale (JNCC 2012).

Up until now, Ireland's MPAs mainly consisted of SACs and SPAs, as well as Natural Heritage Areas (NHAs). The designation of such areas rely to a great extent on the identification of habitats and species referred to as “essential to their life and reproduction” (Council Directive 92/43/EEC). Although once these are designated, Member States are requested to establish conservation objectives and management plans, this is not always feasible due to many challenges involving law enforcement, lack of funding or even the need for political pressure to connect to scientific knowledge in terms of conservation management (Evans 2008).

In Ireland, SACs and SPAs are managed by the National Parks and Wildlife Service (NPWS) as part of the Heritage Division of the Department of Housing, Local Government and Heritage (DHLGH), which constitutes the responsible body for nature conservation and biodiversity. Conservation objectives have been set for all protected sites in Ireland, however no management plans are currently published, *inter alia* due to objectives and strategies drawn up as a management framework being superseded by the site's conservation objectives (NPWS 2023). Though it is required by the Department of Agriculture, Food and the Marine (DAFM) to establish management plans to ensure compliance with the requirements of the Habitats Directive, Fishery Management Plans (otherwise called Fishery Natura Plans) have been set for a number of sites with the identification of areas where fisheries may proceed with their operations, whilst ensuring these activities do promote sustainable fishing and the preservation of habitats and species within the protected areas. Although these plans confer some conservation benefits, most already established area-based management tools, such as fishery management plans, have yet to include biodiversity conservation as their primary goal (Grorud-Colvert et al. 2021). Unlike what a conservation management plan would ultimately do, as it would not only manage fishing, but manage site-specific activities as a whole.

The DHLGH has been looking at expanding Ireland's network of protected areas by first establishing a stand-alone national legislation for MPAs to enable their identification, designation and management in accordance with Ireland's national and international commitments (DHLGH 2022). In December 2022, the government approved the General Scheme of the Marine Protected Areas Bill, which will allow the MPA legislation to progress to the next stages of development. There is thus an urgent need to assess best monitoring practices that would allow the new legislation to establish a well-thought out management framework, and minimise a structure that jeopardizes conservation goals. Although there have been efforts made to make extractive uses sustainable and

minimise the impact of recreational and commercial activities, most are understudied, and in order to effectively manage MPAs, additional research needs to be undertaken to fill those gaps.

Having real time imagery of a designated site would be highly beneficial to acquire near real time data on vessels operating in the area, particularly operations that are not monitored by VMS or other means. This would be critical for those vessels under 12m?? that are not equipped for VMS. It could also be used to monitor other recreational activities occurring in the MPA, particularly fishing and ad hoc harvesting. Unmanned Aerial Vehicles (UAVs) are cost-effective compared to existing marine monitoring methods, non-invasive, and can be used in a wide range of environmental monitoring aspects. These include habitat and species distribution, air and water quality assessments, environmental parameters as well as detection of anchored, fishing and recreational vessels. For example, direct georeferencing of fishing activities using aerial drones is a simple option that could potentially improve fishery studies, especially for MPA research. However, there are currently very few studies assessing their use for effective management actions (Reis-Filho et al. 2021).

Recent advances in drones have allowed brighter and more detailed imagery, higher bit rate videos with more advanced compression and wider dynamic ranges, coupled with visual and infrared sensors detecting obstacles on its path. Drones thus constitute an exciting and innovative approach to coastal and marine environmental monitoring that could potentially redefine traditional monitoring methodologies. However, in order for this to happen, it is important to address the challenges and limitations involved in using such devices in environmental research.

Proposal

We propose a **structured four-year PhD** on a full-time basis to assess the use of Unmanned Aerial Vehicles (UAVs) to monitor Marine Protected Areas (MPAs) and provide best-practice advice for Ireland's MPAs. The project will aim to:

- Develop previous work conducted on assessing the challenges and opportunities of using small drones to monitor fishing activities in a marine protected area (Reis-Filho et al. 2021). This will include comparing results with already available VMS data in MPAs that are monitored through fishery management plans.
- Develop a methodology to assess how UAVs can be operated efficiently in marine environments.
- Understand and analyse the extent of the challenges and limitations linked to using drones for environmental monitoring.
- Expand on habitat and species distribution information using Before and After Control Impact (BACI) designs to evaluate natural and/or human-induced perturbations in case study MPAs.
- Contribute to recreational activity data collection in coastal MPAs.
- Identify any data gaps involved in site-specific MPA monitoring and assess the effectiveness of UAVs to fill in those gaps.
- Review the use of UAVs as a potential tool to inform of best-practice monitoring for MPAs.

Location of Scholar

The scholar will be based for circa 50% of their four years at the Marine Institute HQ Rinville, Galway.

Outcome

The expected outcomes from this project will be to improve our understanding of UAVs as potential environmental monitoring tools and demonstrate how drones can be used to obtain a dataset of fishing effort and human-induced activities that are otherwise not monitored or recorded, and will be potentially useful for better MPA monitoring and management. This work will generate novel approaches to monitoring, complementing the objectives of the National Marine Planning Framework by outlining how human activities interact with each other in MPAs. It will also provide initial analyses of the previously unmonitored extractive activities or any other activities that could compromise the objectives of the case study MPA sites examined.

Links with the Marine Institute Strategic Plan 2023-2027

This proposal falls principally under the Strategic Priority: Climate and Biodiversity, Meeting the Climate, Biodiversity and Food Security Challenges by providing integrated scientific advice and services to inform government on the optimum location and spatial extent of marine protected areas (MPAs) in Ireland's maritime area for ocean protection and restoration (e.g. through biological, physical and economic assessments). It will also contribute to an "integrated marine environmental monitoring programme to map sensitive habitats, manage biodiversity, and increase support to the development of MPAs by 2030", a strategic outcome for the MI by 2027.

The project also links to other Strategic Priorities, i.e.:

- **Inspiring Stakeholders and Society.** The project will involve stakeholder engagement within the case study MPA areas. Deliver Impact Through Research. The monitoring of MPAs is a critical requirement for their success, and this research will help achieve this at reduced cost.

Specific Requirements

The scholar should have a primary degree in marine science or a related field and ideally a master's level degree in an appropriate field. The scholar should be computer literate and able to carry out statistical analyses with appropriate software. They should have a strong interest in marine conservation, biodiversity, and the protection of our important marine ecosystems, as well as the human use of these ecosystems. Ideally, they should have experience working with stakeholders in MPAs in Ireland or elsewhere.

Financial Details

Scholarships will be up to €27,500 per annum (maximum funding of €110,000 over four years). This amount comprises a maintenance award of €18,500 (Irish Research Council rate effective 1-Jan-21*) to the student as well as payment of fees to the host higher education institution (HEI). The maximum fees payable to the HEI will be €6,000 per annum. The scholarship award also includes a budget of up to €3,000 per annum for eligible research costs (travel & subsistence, publication costs, consumables and other costs e.g. laptop) for the sole use of the student, and are payable on a reimbursement basis direct to the host institution where the postgraduate student (scholar) is registered. There are no overheads payable on the scholarship. Publication costs are intended to cover publications on which the scholar is listed as first author and are published under Open Access.

Scholars can also supplement this funding by applying to the Marine Institute's Networking & Marine Research Communication Awards annual call.

*There is a national review underway of the PhD annual student stipend payment, which is expected to result in a rate increase, and the Marine Institute will adjust the total funding accordingly following the completion of this review.

Marine Institute Co-Supervisor

Prof. Dave Reid, Fisheries Ecosystems Advisory Services (FEAS)
david.reid@marine.ie

References

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal L 206, 22/07/1992 P. 0007-0050.

Day, J., Dudley, N., Hockings, M., Holmes, G., Laffoley, D., Stolton, S., Wells, S. 2012. Guidelines for applying the IUCN Protected Area Management Categories to Marine Protected Areas. Gland, Switzerland: IUCN. 36pp.

DHLGH. 2022. Marine Protected Areas. Publication. Department of Housing, Local Government and Heritage. Available at: <https://www.gov.ie/en/publication/e00ec-marine-protected-areas/#>

Evans, P.G.H. 2008. Selection Criteria for Marine Protected Areas for Cetaceans. Proceedings of the ECS/ASCOBANS/ACCOBAMS Workshop. ECS Special Publication Series No. 48.

Grorud-Colvert, K., Sullivan-Stack, J., Roberts, C., Constant, V., Horta e Costa, B., Pike, E.P., Kingston, N., Laffoley, D., Sala, E., Claudet, J., Friedlander, A.M., Gill, D.A., Lester, S.E., Day, J.C., Goncalves, E.J. Ahmadiya, G.N. Rand, M., Villagomez, A., Ban, N.C.,... Lubchenco, J. 2021. The MPA Guide: A framework to achieve global goals for the ocean. Science. 375: 1215.

JNCC. 2012. The difference between Natura 2000 and Marine Conservation Zones. Natural England and the Joint Nature Conservation Committee.

Lausche, B. 2011. Guidelines for Protected Areas Legislation. IUCN, Gland, Switzerland. xxvi + 370 pp.

NPWS. 2023. Conservation Management Planning. National Parks and Wildlife Service. Available at: [Conservation Management Planning | National Parks & Wildlife Service \(npws.ie\)](https://www.npws.ie/conservation-management-planning)

Reis-Filho, J.A., Joyeux, J.C., Pimentel, C.R., Teixeira, J.B., Macieira, R., Garla, R.C., Mello, T., Gasparini, J.L., Giarrizzo, T., Rocha, L., Pinheiro, H.T. 2021. The challenges and opportunities of using small drones to monitor fishing activities in a marine protected area. Fisheries Management and Ecology. 00:1-8. DOI: 10.1111/fme.12557.