LOW-TROPHIC AQUACULTURE IN OFFSHORE WIND FARMS

THEMATIC ROADMAP

Operations & Maintenance



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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101093888. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

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Operations & Maintenance



Introduction

Low-trophic aquaculture in offshore wind farms combines seaweed and/or mussel farming with renewable energy. Operations and maintenance keep people safe, equipment working, and day-to-day activities aligned with wind-farm access rules.

This thematic roadmap showcases the operations and maintenance insights learned during the ULTFARMS project by sharing:

- what needs to be organised
- what ULTFARMS pilots learned in practice,
- how needs differ by sea area,
- an example of how one pilot adapted after a setback.

Why This Matters

Offshore sites face wind, waves, currents, migrating bedforms, and limited access. Without regular checks and timely repairs, lines, anchors, and floats can fail, creating safety risks and downtime. Good planning operations and maintenance means:

- agreeing on access and safety rules with the wind farm operator,
- using suitable vessels and lifting gear,
- scheduling work inside available service windows.

Doing this well protects people and equipment, reduces downtime and builds trust between stakeholders.





Lessons learned

Routine operations and maintenance

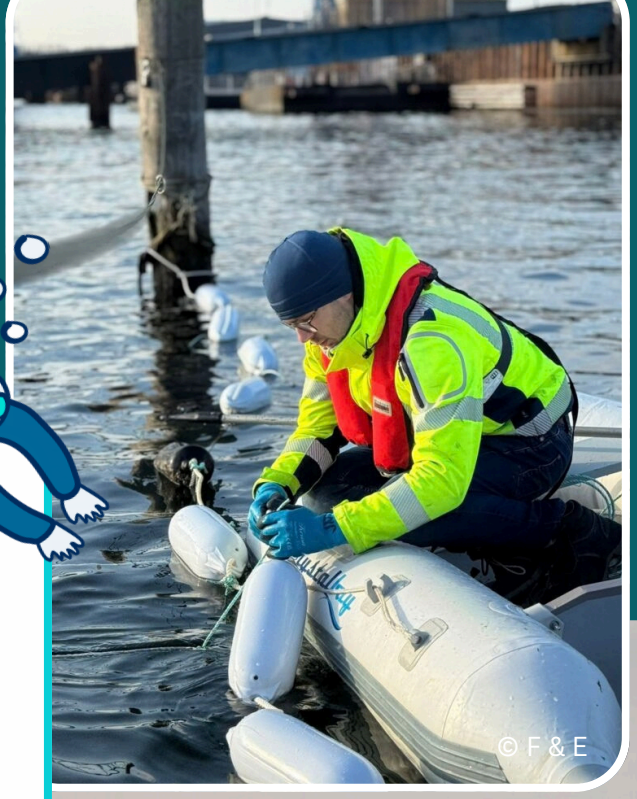
- Core tasks across ULTFARMS pilots: inspections (divers where allowed, or underwater drones), removing marine growth, and replacing worn parts.
- Offshore work needs a workboat with lifting gear and deck space, plus trained crews, clear work procedures, and bad-weather backup plans.
- Because site time is limited to wind farm service windows, joint trips should be planned early and vessels shared where possible to cut cost and delay.

Regional Strategies

- **North Sea:** higher waves and stronger winds call for sturdier equipment and tighter weather planning; German pilots used heavy anchors and strong mooring lines to limit movement and damage.
- **Baltic Sea and calmer basins:** smaller boats and lighter gear can be enough, allowing shorter, more frequent trips.
- Tasks are similar everywhere; the timing differs, from quick visits in calm water to fewer, carefully timed visits in rough seas.

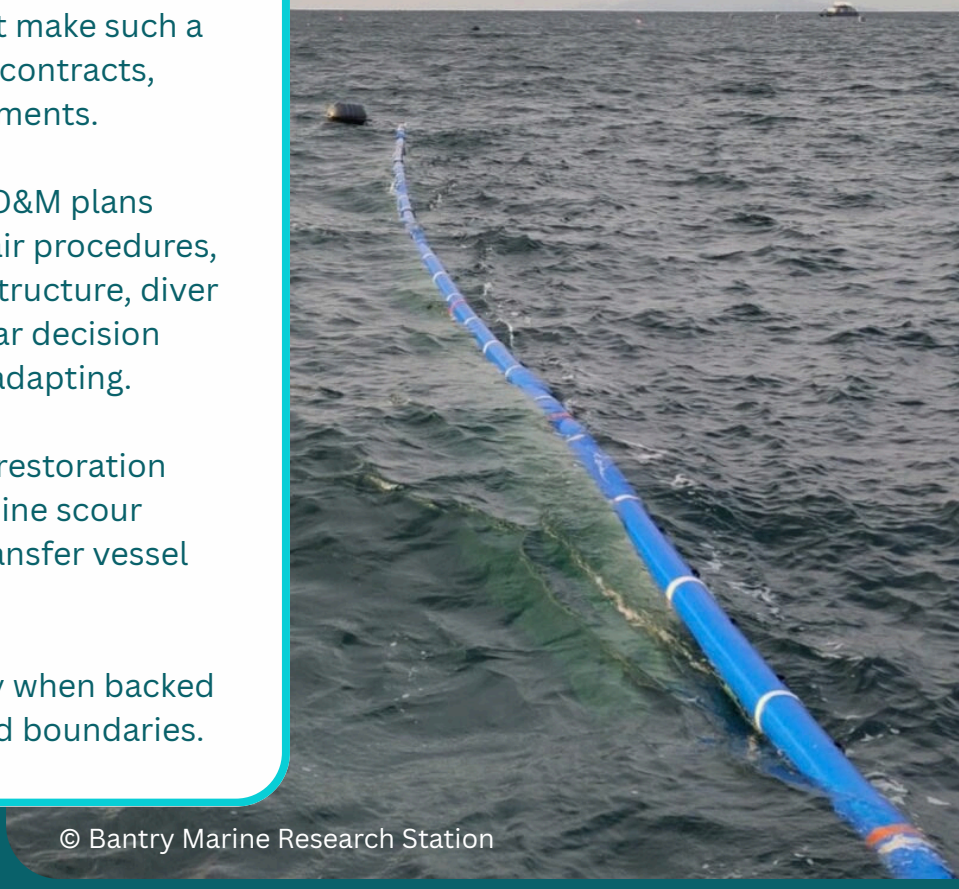


Lessons learned: Belgian Pilot Example



Contingency Planning

- A mooring failure at the Belwind site forced a move to the partly exposed Bantry Marine Research Station in Ireland, where the submersible longline survived several severe storms over the 2024 to 2025 winter.
  - A commercial farm could not make such a shift without prior planning, contracts, licences and market arrangements.
- Build contingency options into O&M plans before deployment: agreed repair procedures, alternative use of existing infrastructure, diver and vessel access rules, and clear decision points for pausing, repairing or adapting.
  - For the Belgian pilot, oyster restoration tables were installed on turbine scour protection, avoiding crew transfer vessel areas and cable zones.
- ***Key lesson:*** flexibility works only when backed by clear planning and pre-agreed boundaries.



Historical Note: Building on UNITED

The submersible longline design used in the Belgian and German pilots was first developed and installed under UNITED; ULTFARMS adapted it for commercial-scale mussel and seaweed cultivation.

The Way Forward

Plan jointly, not separately

To scale up multi-use projects, operations and maintenance must become predictable and easier to organise across sites. This requires clear agreements between aquaculture and wind farm operators on access, safety, and responsibilities, so activities can be planned jointly rather than separately.

Reflect offshore realities

In practice, planning needs to better reflect offshore realities. Weather, long travel distances, and limited vessel availability often delay work, so projects need realistic time buffers and alignment with available service windows. At the same time, site layout and access must be considered from the start. Aquaculture systems should be designed in a way that keeps clear corridors for vessels to reach turbines, ensuring that wind farm operations are not affected.

Share resources, standardise procedures

Efficiency can then be improved by sharing resources and aligning schedules, for example, by using vessels that can support several tasks in one trip, such as inspections, small repairs, lifting, transport and monitoring. In parallel, standardising basic procedures – such as inspections, repairs, and safety checks – helps make operations repeatable and easier to scale.

Reduce the need for offshore visits

This will matter increasingly. Sensors, cameras and underwater devices can support inspections and remote monitoring, making operations safer and less dependent on short weather windows.

Further Reading

ULTFARMS Deliverables:

- D3.2 Design, numerical modelling of a submersible longline
- D3.3 Design and implementation of mariculture structures
- D3.4 Sensor technology design
- D4.1 Design, adaptations for deployment in offshore regions
- D10.2 Technical innovation for LTA implementation within OWF

OLAMUR Deliverables:

- D1.2 Guidelines for safe multi-use operations
- D5.2 Service tools delivery

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Cover photo: © F & E

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