



## **Finding unknown mussel areas in Roskilde Fjord** how drones can aid in reef protection

**Keuter, Anna; Thompson, Fletcher; Mariani, Patrizio; Svendsen, Jon C.**

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# habitat #27

for en vild verden  
Dansk Zoologisk Selskabs magasin



# Finding unknown mussel areas in Roskilde Fjord:

how drones can aid in reef protection

DTU Aqua is developing new tools that enable mussel reef identification and mapping. The tools are applied in Roskilde Fjord where they helped locate a previously unknown mussel reef in the southern part of the fjord. The tools may be used for further mapping, and additional projects may uncover more unknown mussel areas that are present in Roskilde Fjord.

By

**Anna Keuter**, bachelor student, University van Hall Larenstein

**Fletcher Thompson**, researcher, DTU Aqua

**Patrizio Mariani**, professor, DTU Aqua

**Jon C. Svendsen**, senior researcher, DTU Aqua



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**Mussel reefs may also function as great fishing areas.”**

## THE DIVERSE AREA OF ROSKILDE FJORD

Roskilde Fjord is an important area, partly because it is part of the Natura 2000 area termed *Roskilde Fjord og Jægerspris Nord-skov*. Natura 2000 areas form a European network of protected nature areas. In fact, Natura 2000 areas are considered the largest network of protected nature areas in the world. In these areas, specific animals and plants, as well as habitats, are protected to maintain the biodiversity of the area. Roskilde Fjord has been specifically appointed as a Natura 2000 area because of its diverse maritime habitats such as bays, sand banks and long estuaries along the shoreline. The fjord also provides important breeding and feeding grounds for several bird species like the grebe, terns, and other waterfowl.

The birds benefit from the fjord's shallow waters and many small islands.

## THE ROLE OF MUSSEL REEFS

Reefs are protected within Natura 2000 legislation. More specifically, biogenic reefs are protected by this legislation. Biogenic reefs are reefs that are made of organic substrate, like oysters or mussels. Mussel reefs are formed by large aggregations of mussels (*Mytilus edulis*) that grow next to each other, forming dense beds. They filtrate the water, increasing the visibility in shallow areas and improving water quality. This is important for sunlight to reach the seabed, ensuring that vegetation can grow and provide oxygen and food for many fish and other species in the area. Mussel reefs may also function as great fishing areas (Fig. 1).

*Figure 1: Catching fish is a great hobby for many young people in Denmark. The picture shows garfish caught by recreational fishing in Roskilde Fjord. During April-June, garfish migrate into Danish inlets, and the fish are often more abundant near mussel reefs. Photo by Uffe Clemmensen.*





Figure 2: The picture shows the towbody before deployment. The towbody is easily handled manually, and it can be deployed from small boats. This allows local fishers to use the towbody without special equipment. Photo by Fletcher Thompson.

of local knowledge and experience, 2) collecting data in a relatively cheap fashion, and 3) getting reefs mapped in the inner Danish waters. Stakeholders are people with a direct interest in the results or the course of a project, like environmental organisations, recreational divers, or local fishermen. The toolbox includes an underwater drone - also termed a remotely operated vehicle (ROV). A classic ROV is controlled by a pilot and can film the seabed with an underwater camera. This is a rather complicated process. The achieved video recordings are then analysed, and in this way, a biogenic mussel reef can be identified, mapped and eventually protected in relevant Natura 2000 areas.

In the future, the stakeholders will apply a ROV and use this tool to film the seabed. The resulting video recordings will then be transferred to DTU where the recordings can be processed and analysed. By having these analyses available, biogenic mussel reefs can be identified and mapped. Eventually, the biogenic mussel reefs can be included in the protected areas of specific Natura 2000 areas.

#### TESTING A NEW DRONE

While the main aim of this study is to locate biogenic mussel reefs in Roskilde Fjord, this project also included testing of a new system: a towed torpedo-shaped body that houses a camera and depth sensor. Due to the low-cost of components and access to a navigation system, the "towbody" is simpler to operate and cheaper than a classic ROV. The test was carried out to understand if the towbody may be used as a tool for local fishermen as an easy and cost-effective way of video recording seabed areas in the inner Danish waters. The towbody is shown in figure 2.

During this project, the towbody was developed, applied and tested by DTU Aqua.

In 2019, a dive survey indicated a potential biogenic mussel reef in Roskilde Fjord but reefs are not listed in the Natura 2000 legislation for Roskilde Fjord. To determine if biogenic mussel reefs exist in the area, the reefs must meet specific requirements:

1. The mussel area covers at least 2500 m<sup>2</sup>.
2. The average coverage by mussels is at least 30%.
3. The mussels include at least 3 cohorts.

This definition provides a guideline for the identification and mapping of biogenic mussel reefs. However, identifying biogenic reefs is both expensive and time consuming since the conditions under water can be rough, inaccessible, and the areas are large. To address this challenge, DTU Aqua has an ongoing project where a toolbox is being developed for mapping biogenic mussel reefs. Ideally, the toolbox should work for local stakeholders so they can assist in the mapping of their local biogenic reefs. By engaging local stakeholders, the DTU project aims at 1) taking advantage

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**The towbody has a lot of potential. It is easy to deploy, and can be used while fishing and sailing recreationally.”**

The basic principle is that the towbody is being towed behind a boat, instead of being remotely piloted like classic ROVs. During the towing, the towbody is filming the seabed below. This approach allows fishermen to catch fish while they are mapping the seabed. The towbody is attached to the boat by a cable, as shown in figure 3. Five light chains hang from the towbody to ensure it does not capsize underwater and remains stable near the seabed. Inside the towbody is the camera which is facing down towards the seabed below. The camera is sending the recorded

video directly through the cable to a laptop on the moving boat. The recordings are being stored on the laptop. In this fashion, the towbody is simultaneously recording the seabed while it is located via GPS from the boat.

The data of this study were collected on the 21st, 22nd and 23rd of September in 2022 in collaboration with the two local fishermen Kim Jørgensen and Jonn Poulsen (figure 4). Nearly 9 hours of footage were collected, and the mussel seabed coverage on the recordings were analysed.

Figure 3: This figure shows how the towbody works when recording the seabed. The towbody is being pulled by the yellow cable which is attached to the top of the towbody. The five chains hang behind the towbody to keep the device stable. The circle displays what the towbody camera is recording. In the present case, the camera is recording mostly mussels on a sandy seabed with the occasional stone or patch of seagrass. Created with BioRender.com.

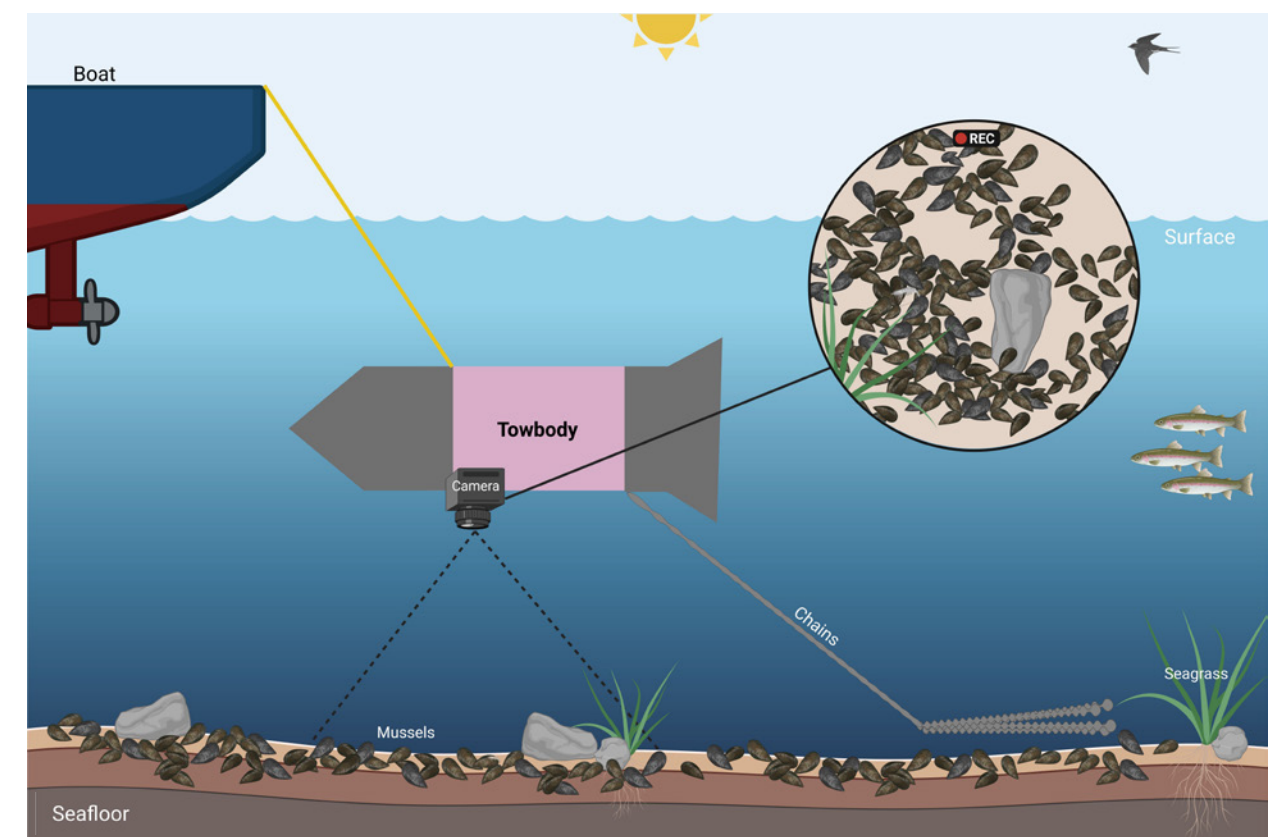






Figure 4: Local fishermen Kim Jørgensen (right) and Jonn Poulsen during the data collection in Roskilde Fjord. Photo by Michelle Melin.

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**Widespread protected mussel reefs may not only support recreational activities, but may also allow the fjord area to start meeting the environmental requirements from the EU.”**

#### EXPLORING REVEALS A NEW REEF

Video and GPS data were collected from different parts of Roskilde Fjord. The first examined area was an area where a biogenic reef had already been identified. Data from this area were collected to get more information about this reef. This was in area A, as shown in figure 5. Later, other areas were examined as well, specifically area B and area C. This was done to examine if there are mussels present in areas B and C at the same densities as in area A. Surprisingly, to the east and south of area A, mussels were present, and

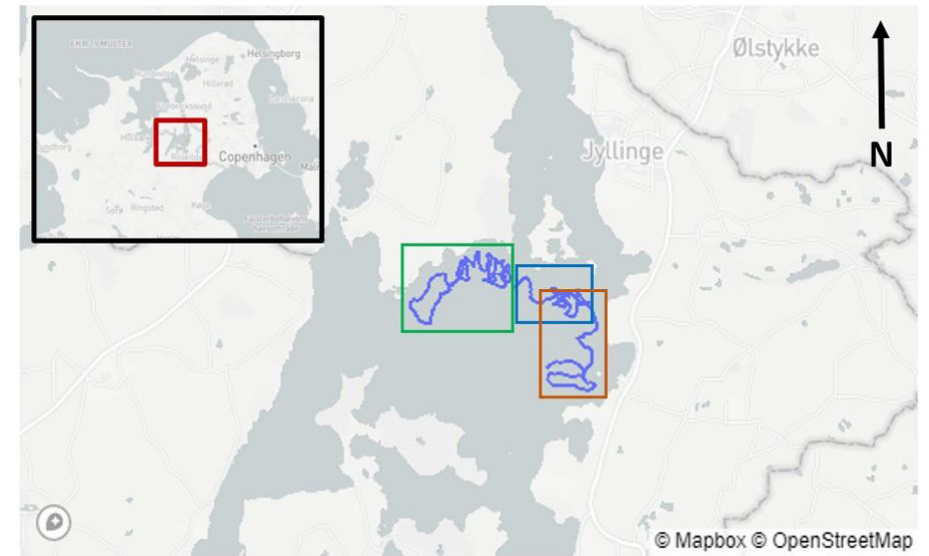
in high numbers. In particular, the mussel seabed coverage in area C is high, as shown in more detail in figure 6. On average, the mussel seabed coverage in this area is 40-50%. This range is higher than the mussel seabed coverage required for mussel reef identification (30%, see above). This could indicate another potential biogenic mussel reef present in Roskilde Fjord.

#### CHALLENGES DURING DATA COLLECTION

During the data collection, some intermittent problems with the towbody occurred. The

## Research area in the Roskilde Fjord

**Legend**  
 — Sailed route  
 — Area A  
 — Area B  
 — Area C



The sailed route on the 21<sup>st</sup>, 22<sup>nd</sup> and the 30<sup>th</sup> of September in the Roskilde Fjord.

## New area sailed on day 3



The sailed route on the 30<sup>th</sup> of September in the Roskilde Fjord.

- ↑ Figure 5: This picture shows the areas where video data were collected in Roskilde Fjord in 2022. Area A is an area where a potential biogenic reef has been previously identified and mapped. Area B and area C are newly analysed areas.
- ↓ Figure 6: This figure shows area C in more detail (see figure 5). High mussel seabed coverage was observed in area C. The average mussel seabed coverage of the sailed route in area C was 40-50%, indicating the existence of a potential mussel WWreef in area C.

Advantages	Disadvantages
The towbody does not require manual control and can therefore be used with less experience and effort.	It is difficult to manoeuvre the towbody while it is being towed, and it may go upside down when the boat is turning.
The towbody can be used while doing other activities on the water like recreational fishing.	The towbody is vulnerable to boulders on the seabed which may damage the equipment.
The towbody is easy and quick to set up, deploy and retrieve.	Seagrass must be removed manually from the towbody if it accumulates in front of the camera, taking effort and time.

Table 1. This table shows an overview of the advantages and disadvantages of applying the towbody for video data collection in Roskilde Fjord.

weights added to the towbody turned out to be too light, making the device susceptible to currents and movements of the boat. This resulted in some upside-down footage which could not be used for seabed mapping. The towbody is also vulnerable to the presence of boulders on the seabed. The five chains are around one meter long, making the towbody float close to the seabed, and on the last day of data collection, the towbody hit a boulder and was damaged.

HOW THE TOWBODY CAN HELP SHAPE THE FUTURE

During this project, it became clear that the towbody has a lot of potential. It is easy to deploy and can be used while fishing and sailing recreationally because it does not have to be remotely operated. This makes the towbody more convenient than most ROVs since these have to be manually operated while the boat is anchored. The set-up of the towbody takes some practice, and there are many topics to be aware of. A total overview of the advantages and disadvantages of the towbody is presented in Table 1. With a few adjustments to the towbody, the new tool is ready to

explore and map more unknown biogenic mussel reefs in Roskilde Fjord and elsewhere. Over time, the outcome could be an improved habitat protection in Roskilde Fjord with diverse marine habitats. This would benefit marine life and attract recreational activities in the area. This includes different types of recreational fishing, snorkelling and SCUBA diving. Widespread protected mussel reefs may not only support recreational activities, but may also allow the fjord area to start meeting the environmental requirements from the EU. This could be relevant for the EU Water Framework Directive where Roskilde Fjord is currently not meeting the EU requirements. In conclusion, the present study has shown how a new tool is being developed by DTU Aqua to identify and map biogenic mussel reefs in Roskilde Fjord. By engaging local stakeholders, the project outcome could be mussel reefs listed under the Natura 2000 legislation for Roskilde Fjord. In the long run, mapped and protected mussel reefs could support recreational activities and a better environmental status in the local area.

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Af Lotte Endsleff

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