Finding unknown mussel areas in Roskilde Fjord

how drones can aid in reef protection

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

Published in:
Habitat

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

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

”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 Nordskov*. 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.

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^2.
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 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.

"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.

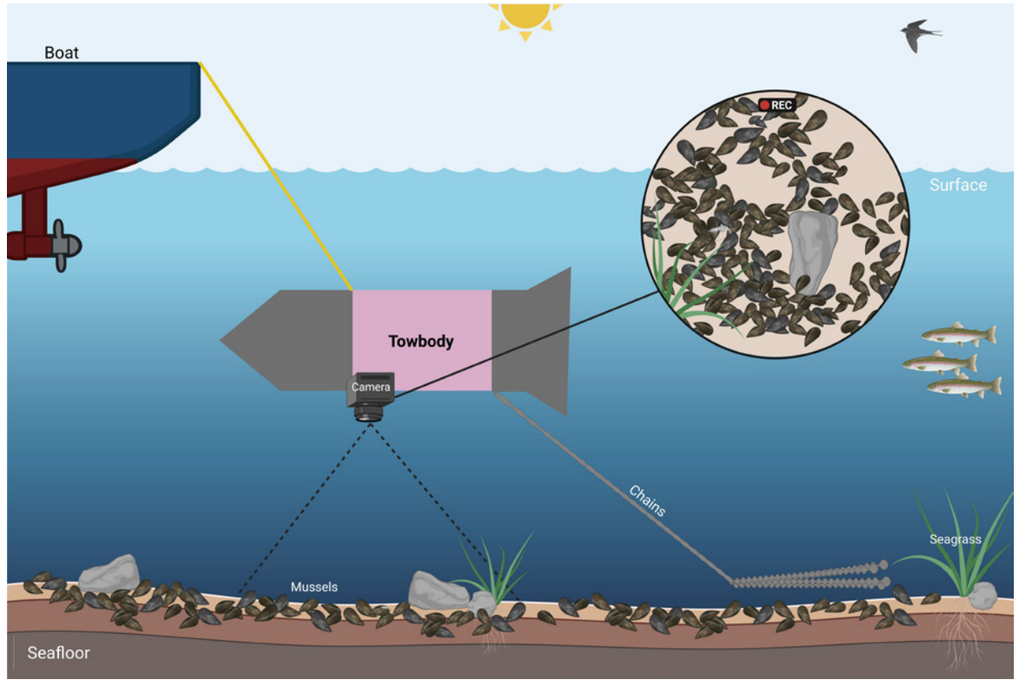


Figure 4: Local fishermen Kim Jørgensen (right) and Jonn Poulsen during the data collection in Roskilde Fjord. Photo by Michelle Melin.

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.”

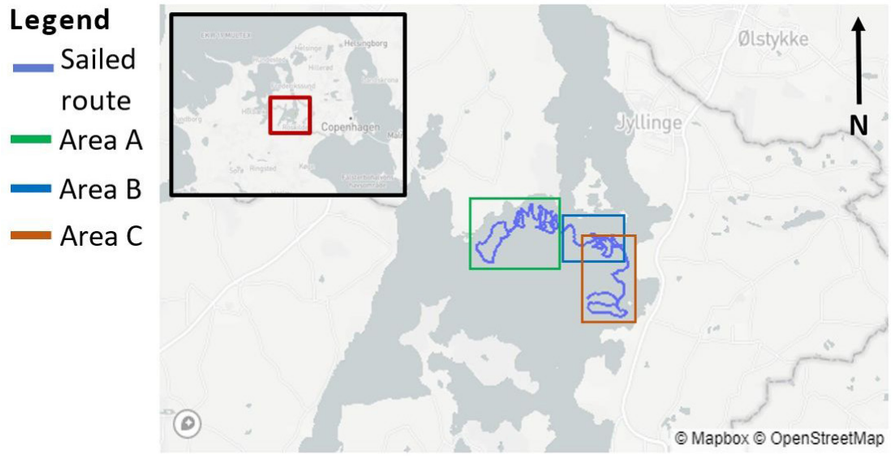
EXPLORING REVEALS A NEW REEF

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



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

New area sailed on day 3

The sailed route on the 30th 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.

REFERENCES:

Hillman, J. R., O'Meara, T. A., Lohrer, A. M., & Thrush, S. F. (2021). *Influence of restored mussel reefs on denitrification in marine sediments.* Journal of Sea Research, 175. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S1385110121001052

Micallef, A., Krastel, S., & Savini, A. (2017). *Submarine Geomorphology.* New York, United States: Springer Publishing.

Miljøstyrelsen. (2018, March 23). *Definition af biogene rev.* Retrieved 10 September 2022, from https://mst.dk/service/publikationer/publikationsarkiv/2018/mar/definition-af-biogene-rev/

Miljøstyrelsen. (2020). Natura 2000-basisanalyse 2022-2027. In Miljø- og Fødevareministeriet (No. 978-87-7038-875–7). Retrieved January 19, 2023, from https://mst.dk/media/194350/n136-basisanalyse-2022-27-roskilde-fjord-og-jaegerspris-nordskov.pdf

Natura 2000. (n.d.). Natura 2000. Retrieved January 19, 2023, from https://www.natura2000.nl/

ACKNOWLEDGEMENTS

The authors are grateful for the help provided by the local fishermen Kim L. Jørgensen and Jonn Poulsen. Specifically, the local fishermen did the boating for the present project and shared their knowledge about Roskilde Fjord during the data collection.

SÅDAN BLIVER DU MEDLIEM

DANSK ZOOLOGISK SELSKAB

Er du ikke allerede medlem af Dansk Zoologisk Selskab, så er det meget let at blive det.

Og så koster det blot 100 kr om året i kontingent! Med et medlemskab støtter du aktivt op om foreningens arbejde for et stærkt dansk engagement i bevarelsen af vilde dyr og deres levesteder.

FAGMEDLEM ELLER STØTTEMEDLEM?

Du kan vælge mellem vores to typer medlemskab: fagmedlem eller støttemedlem. Fagmedlem er dig, som har en baggrund eller viden inden for vilde dyr, biodiversitet og/eller naturbevarelse, hvor støttemedlem er dig, der blot ønsker at støtte op om vores arbejde.

Derudover har du valget mellem at betale et årligt kontigent på 100 kr for et almindelig kontingent eller 250 kr (eller valgfrit derover) for et PLUS kontingent. For studerende er kontingentet kun 50 kr.

Som medlem kan du være med til at forme foreningens arbejde. Du er altid velkommen til at deltage i vores møder, bidrage med kompetencer inden for fundraising, regnskab, IT eller hvad du nu er god til, komme med gode idéer til arrangementer og bistå i planlægningen heraf, og skrive indlæg og artikler til hjemmesiden, vores Facebook-gruppe og ikke mindst Habitat.

Send os en mail til **info@dzs.dk,** hvis du ønsker at deltage mere aktivt i vores arbejde. Vi hører meget gerne fra dig! Også hvis du har ris og ros.

Med et medlemskab vil du være den første til at modtage Habitat i din indbakke, når det udkommer (to gange årligt). Desuden bliver du inviteret til vores arrangementer til fordelagtige priser. Ikke mindst, så vil du som medlem bakke op om et arbejde, som vi i Dansk Zoologisk Selskab mener er helt essentielt - bevarelsen af en vild natur og dens dyr. Jo flere vi er, jo stærkere står vi også, når vi søger fonde om midler til vores projekter.

SÅDAN GØR DU

1) Gå ind på www.dzs.dk/medlem
2) Indbetal det årlige kontingent, vælg mellem MobilePay (19303) eller overførsel til vores konto Danske Bank (0260 - 3123241312)
3) Udfyld medlemsformularen med dine oplysninger (email, navn, adresse, medlemstype mm.)

Du vil snarest herefter modtage en velkomst-pakke med nogle af vores flotte gadgets

En vild historie til Habitat?

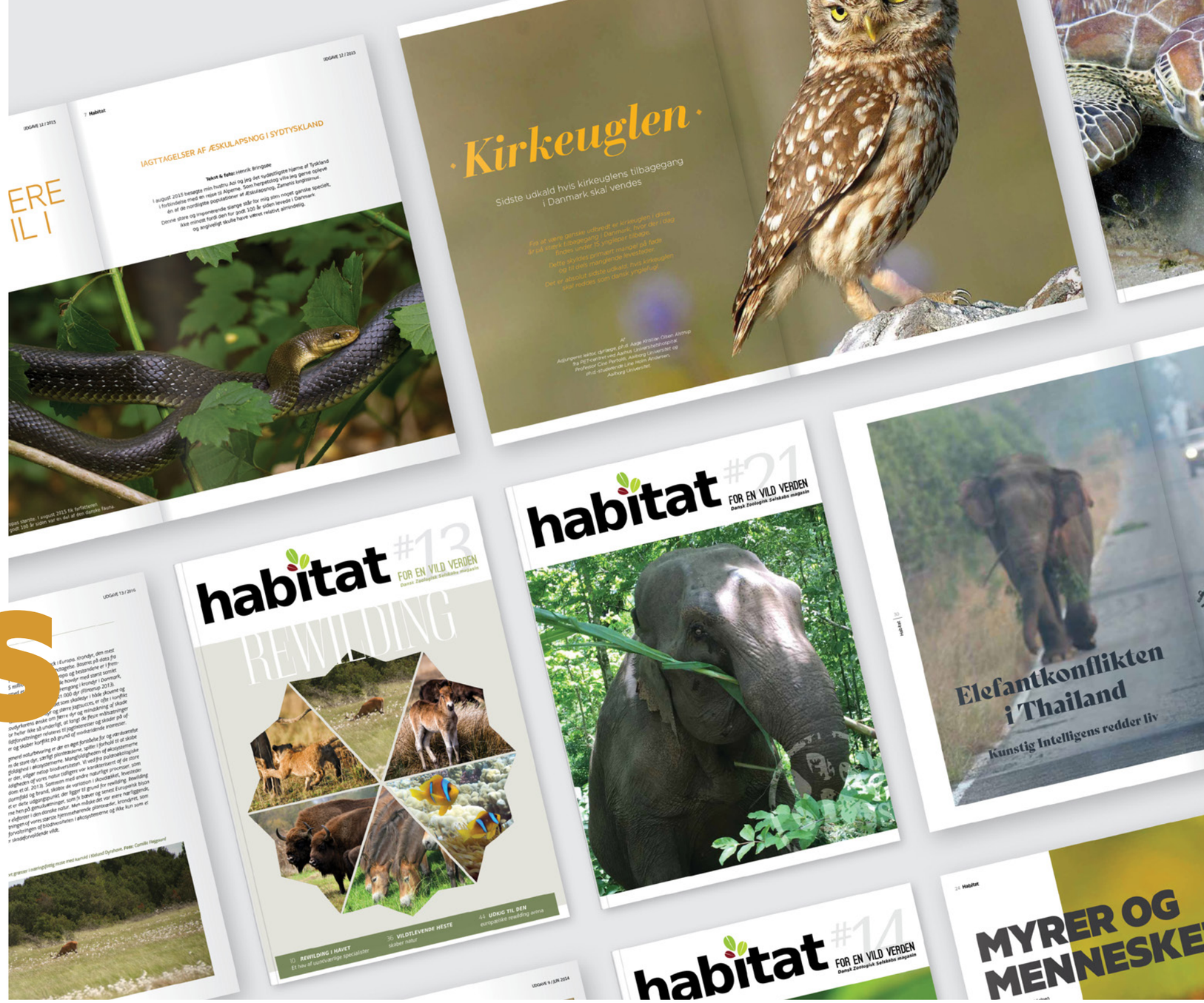
FÅ DIN ARTIKEL MED I NÆSTE NUMMER

Kunne du tænke dig, at skrive en artikel til det næste nummer af Habitat?

Magasinet Habitat har eksisteret siden 2009 og formidler verdens natur ud til danskerne.

Så kunne du tænke dig at skrive et indlæg eller har du andet på hjerte, så må du endelig kontakte vores redaktion på **red@dzs.dk**

LÆS ELLER GENLÆS



Af Lotte Endsleff

Igennem alle de år, vi har udgivet Habitat, har vi skrevet om en lang række dyr og naturområder fra store dele af verden samt forskellige temaer. På vores hjemmeside dzs.dk finder du alle numrene af Habitat (https://dzs.dk/category/habitat/).

Her er inspiration til læsning om emner, der er beslægtet med emnerne i dette nummer af Habitat.

Fortsat god læselyst!

HABITAT #26 (DZS.DK/HABITAT-26/)

s. 46 Livet forsvinder i havet

s. 100 Deep learning assists detection of mussel reefs in Roskilde Fjord

HABITAT #25 (DZS.DK/HABITAT-25/)

s. 62 Using trapezoid concrete reef elements to build artificial reefs

HABITAT #24 (DZS.DK/HABITAT-24/)

s. 32 Restoring marine landscape and its wildlife back to how H.C. Andersen knew it

HABITAT #22 (DZS.DK/HABITAT-22/)

s. 32 Hvad kan naturebased solutions gøre for naturbevarelse?

s. 44 Optur for de vilde haver

s. 48 En oase i Limfjorden – et stenrevs evolution

HABITAT #20 (DZS.DK/HABITAT-20/)

s. 62 Blåmuslingens evne som vandrenser, fødekilde og habitat

HABITAT #16 (DZS.DK/HABITAT-16/)

s. 31 Muligheder ved ændret mindstemål og indførelse af vinduesmål for pighvarre (*Scophthalmus maximus*)

habitat