



The first smolt reef in the world: how do we get sustainable populations of brown trout?

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habitat



#26

for en vild verden

Dansk Zoologisk Selskabs magasin



Tema: Havet

The first smolt reef in the world:

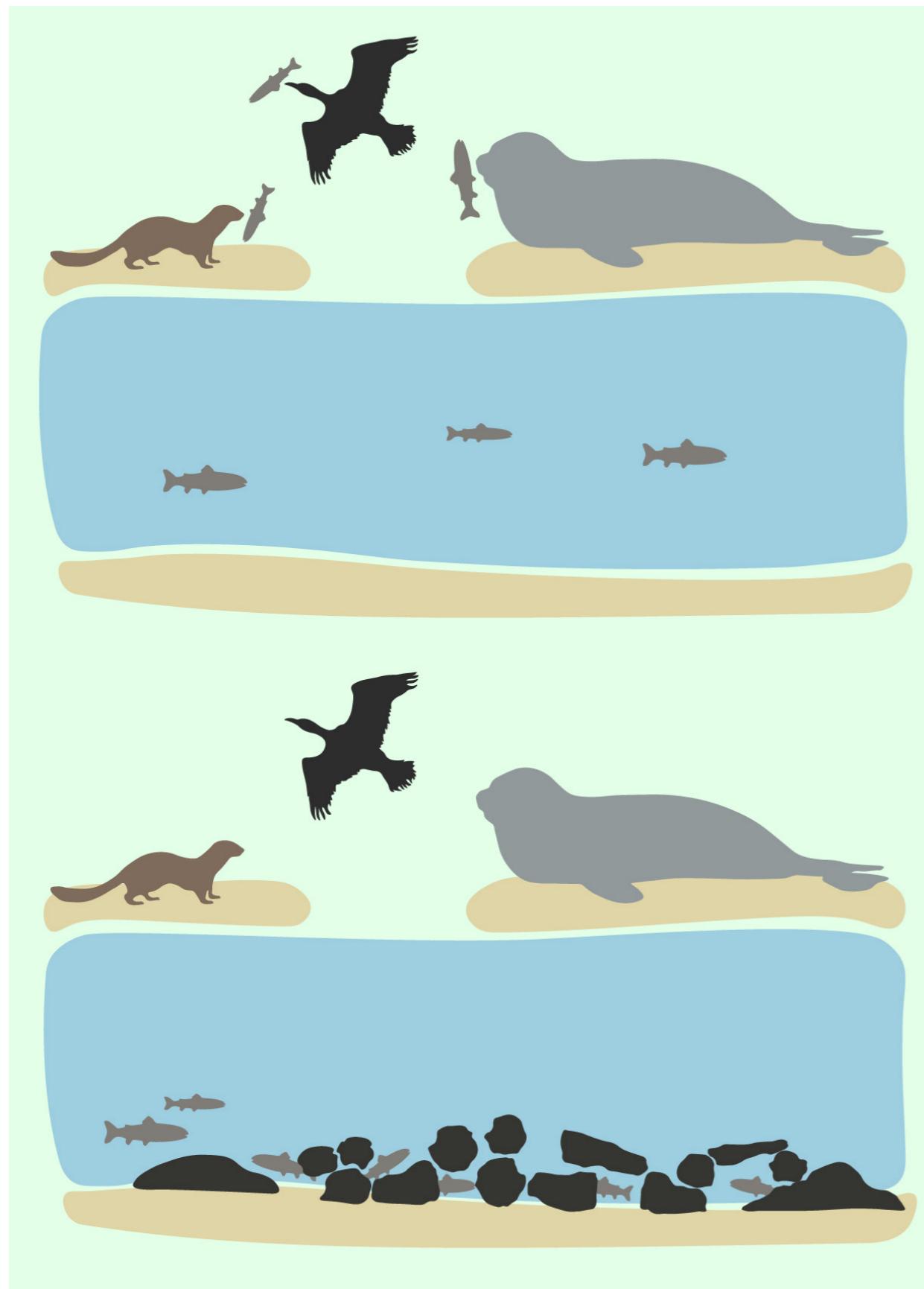
how do we get sustainable populations of brown trout?

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Drone footage taken in spring 2022 of the study area, where the River Storå meets the sea off the coast of Varbjerg.



The figure shows how we assume a smolt reef might work. The image above illustrates a situation without a reef where hiding places are missing. In this case, the smolts in the area are visible to predators and many of the fish are eaten. The lower picture shows a situation where smolts have many opportunities to hide, after the deployment of our smolt reef. Here, the fish have a better chance of avoiding predators, which have difficulty seeing the smolt.

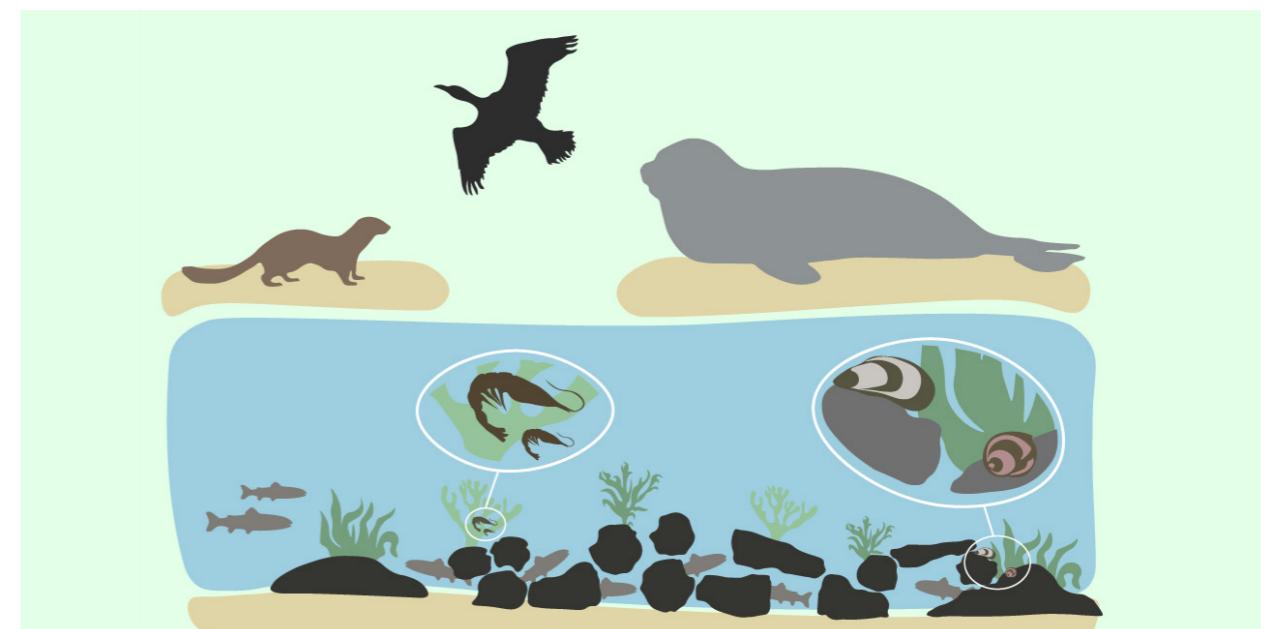
“ This migration from freshwater to saltwater is a natural part of brown trout’s life cycle”

PROBLEM

Thousands of juvenile brown trout, also known as smolts, migrate to the sea along Danish coastlines each year. This migration from freshwater to saltwater is a natural part of brown trout’s life cycle. It is considered an adaptive mechanism in which some individuals migrate to more suitable areas for foraging and body growth. Therefore, the migration, may ultimately improve their overall fitness (1). Smolt must endure substantial physiological, morphological, and behavioural changes while migrating towards saltwater systems. This process, known as smoltification, leaves young trout vulnerable and susceptible to a wide range of predators such as northern pike, zander, seal, mink, heron, etc. Many of the fish are being eaten on their way to the sea, especially in the vicinity of river mouths (2). Additionally, smolt makes an attractive meal for cormorants. Cormorant population growth in recent years has made the transitional phase of downstream migration more chal-

lenging for brown trout. The EU adopted its first piece of environmental protection in 1979, and it consists of a legislative act that protects many bird species throughout Europe, including cormorants. Since then, the number of cormorants has been increasing due to restricted steps to control bird populations below a specific level, translating into an estimated loss of 50% of smolt population on average in many areas of Denmark mainly because of cormorants (3).

Moreover, anthropogenic buildings that restrict fish access to important breeding habitats, such as hydropower plants, dams, or weirs, have a significant impact on local fish stocks. This is in addition to the extraction of marine substrate that has been carried out for decades in shoreline areas, removing and exploiting natural rocky reefs for the sake of coastal development (4). As a result, when migratory trout reach the sea, they may have a hard time estuarine areas with suitable hiding spots and adequate foraging opportunities.



In addition, seaweed and mussels adhere to hard surfaces. Many small animals live in kelp forests. Therefore, the deployed smolt reef is expected to form a good food base over time.

SOLUTION?

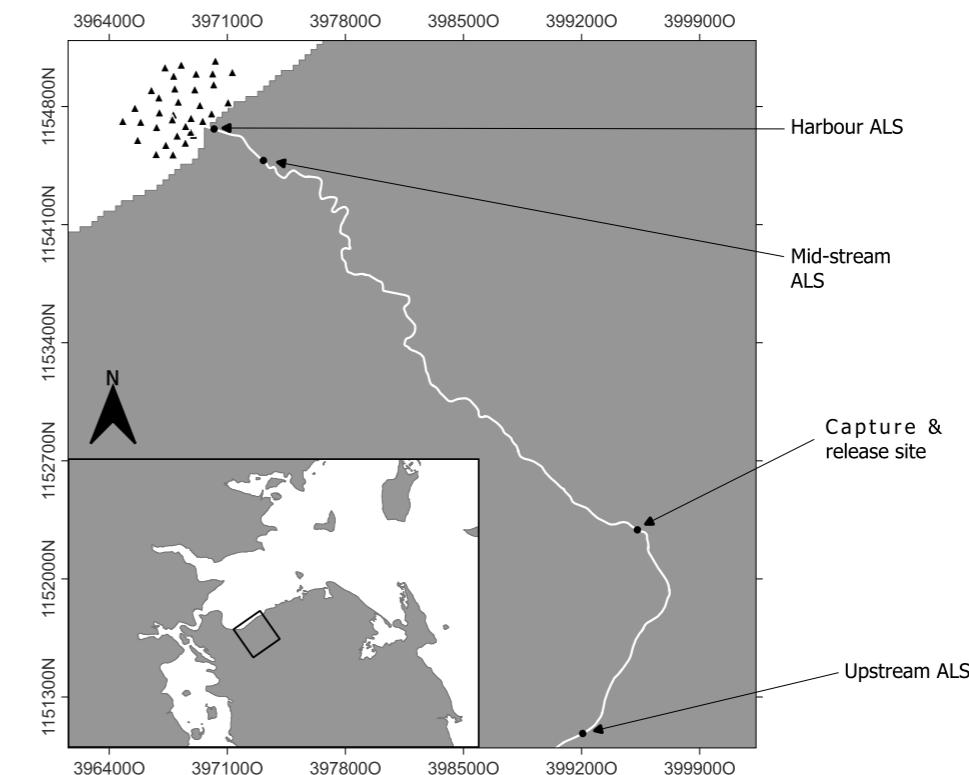
Efforts are therefore being made to establish artificial reefs in river estuaries which may provide a sustainable solution to restore habitats and support fish populations. This is the situation in Båring Bay in Denmark where the River Storå meets the sea on the shoreline near Varbjerg. This area is located on the northwest coast of Fyn (Funen island) and is situated in the Lillebælt Naturpark. A custom-made rocky reef for smolts is projected to be established in the following months near the outlet of the river, next to Varbjerg Harbor. Potential positive effects of boulder reefs include limiting currents, increasing shellfish abundance or serving as substrate for vegetation (5). In this case, a rocky reef might therefore provide a long-term solution by providing shelter and food for smolt, relieving the pressure caused by anthropogenic changes to the area and elevated predation, which might enable better recreational fisheries in the future. However, the effectiveness of restoration measures needs to be assessed using sampling before and after the smolt reef is implemented. It is crucial to understand the

behaviour and the abundance of brown trout around the estuary area near the Storå River. Therefore, a study is being carried out with the aim of documenting the effects of the reef on the presence of smolts in the estuary. For this purpose, the migration of smolt prior to reef deployment has been investigated.

HOW?

Positional telemetry, meaning the recording of animals' positions over time, is a well-established method for studying the behaviour and movement patterns of animals on a large spatial and temporal scale. Our positional telemetry methodology involved the deployment of 37 acoustic listening stations (upstream, midstream and harbour acoustic listening stations (ALS) and 34 coastal ALS throughout the estuary area) prior to the capture and tagging of a significant sample of migratory brown trout. The methodology enabled acoustic tracking of individual fish. The capture of the fish was performed with a fyke net, which was installed in the upper part of the Storå Stream in mid-March.

The migration success of smolt was determined by the presence or absence of acoustic



The figure illustrates the capture and release site as well as each zone where acoustic listening stations (ALS) are deployed to collect data (detect migrating fish).

The figure illustrates the process of data collection during smolt migration, using acoustic telemetry devices. The monitoring is performed by DTU Aqua and Naturpark Lillebælt.



signals emitted by each tiny transmitter inside the tagged smolt and received at each of the listening stations deployed. It was noticeable that the number of detected smolts decreased as the fish approached the estuary. More specifically, 78 % of the tagged individuals were detected immediately before entering the estuary at the last river station, located inside the harbour. However, data from the listening stations in the estuary revealed that 62 % of the smolts actually reached the estuarine sea, which seems comparable to the results of similar studies.

This might be explained by many fish making a stop-over in the harbour area before entering the estuary which is supported by the fact that numerous smolt, as well as other species of fish, were observed between the boats inside the harbour. Loss of tagged fish along - the river might be related to predation by birds, which was the primary cause of loss in other studies. This is also supported by the presence of many cormorants in the field.

In addition, 40 snorkelling transects around the estuary were conducted during April and May to complement the data collected with acoustic tracking. During the snorkelling surveys, not only the abundance of brown trout but also cod and flatfish were observed in order to quantify the abundance of fish in the estuary area.

Comparing both sides of the area where the reef is expected to be established, it was

Several local volunteers and organisations are involved in the study by providing crucial assistance to this project:

Finn L. Pedersen, Jørgen Brorsen and Flemming Rahbek from Varbjerg Motorbådsklub and Søren Knabe and Ole Aggeboe from Vends Sportsfiskerforening

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The Velux Foundation and the national Rod and Net Fish License Funds of Denmark

“

During the snorkelling surveys, not only the abundance of brown trout but also cod and flatfish were observed in order to quantify the abundance of fish in the estuary area.”

observed that the absolute number of smolt was higher on the western side, while the number of flatfish was higher in the eastern side of the study area. It is worth mentioning that not even a single cod was observed.

Furthermore, data analyses showed that the number of smolts is negatively correlated with distance from shore (i.e., more abundant smolts near the shore line). This link indicates that smolts selected shallower, near-shore areas, possibly due to the greater vegetation and shelters in these areas, as opposed to the rather flat seabed in the deeper, eastern areas chosen by the flatfish.

These behaviours appear to be related to the habitat degradation, lack of shelter and food for smolt, which is expected to be alleviated by the boulder reef implemented as part of the smolt reef project in the Lillebælt Naturpark. The data collection is expected to be repeated with the same procedures once our smolt reef is in place near Varbjerg. The efficacy of the reef will then be assessed by comparing the results acquired in the present study (2022) with data collected a posteriori (2025) where the presence of smolts is expected to be greater.



SÅDAN BLIVER DU MEDLIEM

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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.



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Du kan vælge mellem vores to typer medlemskab: fagmedlem eller støtte-medlem. 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 kontigent eller 250 kr (eller valgfrit derover) for et PLUS kontigent. For studerende er kontigentet 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 kontigent, 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

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 en oversigt over artikler om hav-emner i tidligere numre af Habitat - i alt 57 artikler.

Fortsat god læselyst!





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

- s. 06 Strandede læderskildpadder i Danmark
- s. 62 Using trapezoid concrete reef elements to build artificial reefs



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

- s. 34 Ørreder med hedeslag i Roskilde Fjord
- s. 62 Blåmuslingens evne som vandrenser, fødekode og habitat
- s. 96 Nyttig viden om havskildpadder



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

- s. 06 3 arter af næbhvaler strandet i Danmark
- s. 32 Restoring marine landscape and its wildlife back to how H.C. Andersen knew it



HABITAT #19 (DZS.DK/HABITAT-19/)

- s. 40 Miljøfremmede stoffer truer tandhvalernes overlevelse



HABITAT #23 (DZS.DK/HABITAT-23/)

- s. 06 Et årti med strandede hvaler 2010-2020
- s. 20 Underwater plant that is more important and more threatened than coral reefs: eelgrass



HABITAT #17 (DZS.DK/HABITAT-17/)

- s. 07 Village based marine reserves in Fiji: A viable management tool for edible snails?
- s. 24 Knowledge for conservation of green turtles from citizen science efforts
- s. 52 Marine beskyttede områder - Filippinerne som eksempel



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

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- s. 58 The unique history of two recaptured brown trout in Roskilde Fjord
- s. 70 Camouflagens mester



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

- s. 06 Gamle biologiske samlingers betydning – et eksotisk, zoologisk eksempel (om Neptunbægeret)
- s. 20 Det pelagiske dyb hav – unikke og ekstreme selvlysende tilpasninger i verdens største habitat
- s. 30 Muligheder ved ændret mindstemål og indførelse af vinduesmål for pighvarre
- s. 38 Livet i det kolde mørke (om ishavet)
- s. 50 Dokumentation af marin biodiversitet i tropiske Cambodia
- s. 62 Dykning ud for Hurghada har det hele: skibsvrag fra 2. Verdenskrig, smukke revdyk og fantastisk dyreliv



HABITAT #21 (DZS.DK/HABITAT-21/)

- s. 06 Havlampretten – en underlig fisk



HABITAT #15 (DZS.DK/HABITAT-15/)

- s. 06 Sortmundet kutling – spredet sig på bekostning af hjemmehørende danske arter
- s. 20 Havskildpadder – alle kan bidrage til viden
- s. 36 Havet – kort om det store blå



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- s. 58 Hajen og mennesket, mennesket eller hajen



HABITAT #14 (DZS.DK/HABITAT-14/)

- s. 32 Snæblens tilbagegang i Anthropocæn – hvordan redder vi danmarks eneste endemiske vertebrat?



HABITAT #9 (DZS.DK/HABITAT-9/)

- s. 08 Conservation med succes – søelefant
- s. 23 Narhval – Enhjørningens hemmelighed
- s. 68 Skifter fisk farve?



HABITAT #13 (DZS.DK/HABITAT-13/)

- s. 10 Et hav af uundværlige specialister



HABITAT #8 (DZS.DK/HABITAT-8/)

- s. 19 The value of nature – coral reefs in the Red Sea
- s. 26 Flydende affaldsøer i verdenshavene
- s. 32 Gråsælen – en solstrålehistorie i en kold tid
- s. 40 Phi Phi – Paradis i frit fald
- s. 50 Mangfoldigt liv – Monterey Bay, Californien



HABITAT #12 (DZS.DK/HABITAT-12/)

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- s. 30 Lungefisken og andre luftåndende fisk
- s. 34 Dansk ekspedition undersøger verdenshavene for plastik



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- Seabirds in the arctic
- s. 11 Big Brother i hvalernes verden -
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- s. 48 Balancegangen mellem turisme og
naturbevarelse - om tropiske havgræs-
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livet i havet



HABITAT #2 (DZS.DK/HABITAT-2/)

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- s. 38 Goplerne kommer...! - om vandmænd,
dræbergopler og andre gele-dyr



HABITAT #1 (DZS.DK/HABITAT-1/)

- s. 12 Rødehavets unikke dyreliv

The collage includes several magazine pages from the Habitat series:

- KÆMPEN VI IKKE LÆNGERE HAR PLADS TIL I DANMARK**: A spread featuring a snake coiled among leaves. Text on the left reads "VAGTAGELSER AF JESKA" and "Takat & Peter Henrik Brinksgaard".
- REWILDING**: A spread featuring a collage of animals including bison, horses, and a coral reef.
- Habitat #0 FOR EN VILD VERDEN**: A spread featuring a large elephant. Text on the left reads "ACTION MED SUCCES ELEFANT".
- Habitat #13 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #12 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #11 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #10 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #9 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #8 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #7 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #6 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #5 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #4 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #3 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #2 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.
- Habitat #1 FOR EN VILD VERDEN**: A spread featuring a bison and a horse.

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