Ålegræs og andre marine habitater

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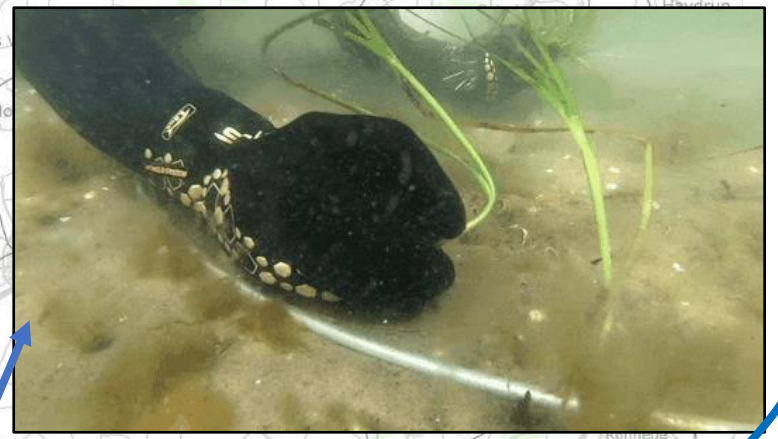
THE VELUX FOUNDATIONS
VILLUM FONDEN × VELUX FONDEN

4 ha eelgrass
21 ha mussels
8 ha stone reefs

Combine habitats
☺

Roskilde Fjord

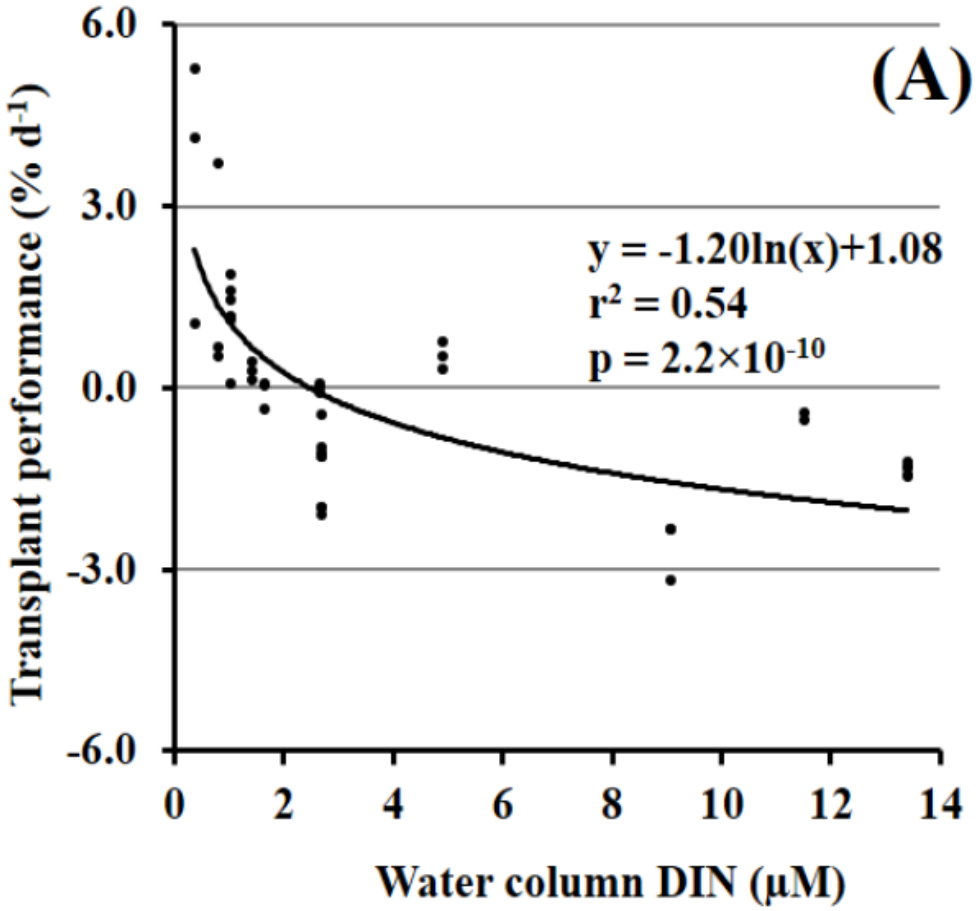


- Succes (test eelgrass)
- Loss (test eelgrass)
- New (test eelgrass)
- Succes (large-scale eelgrass)
- Succes (large-scale mussel)
- Succes (large-scale sandcap)
- Loss (large-scale sandcap)
- Stone reef (new)

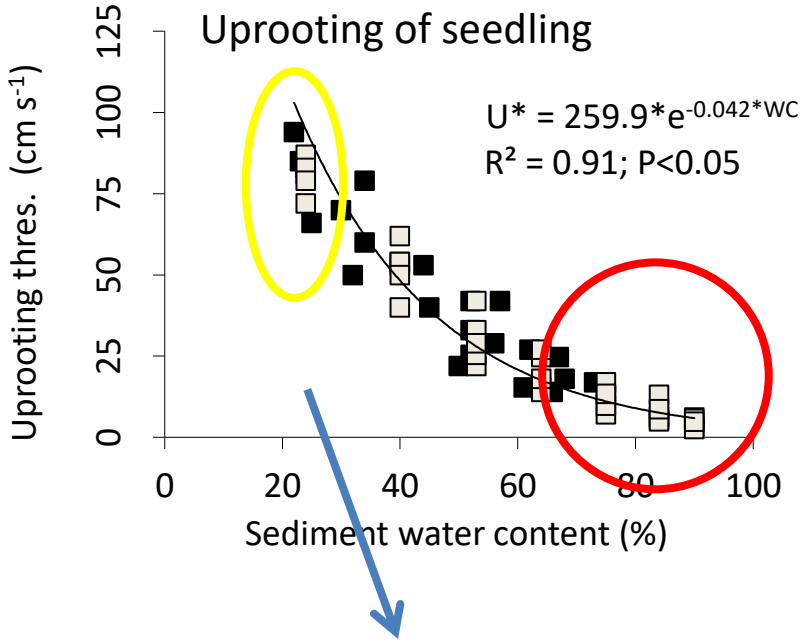
10km

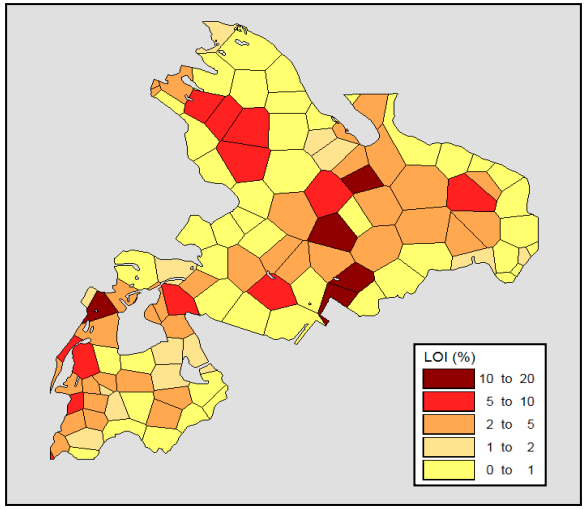
Ålegræsudplantninger

Hvad skal der til for at retablere ålegræs

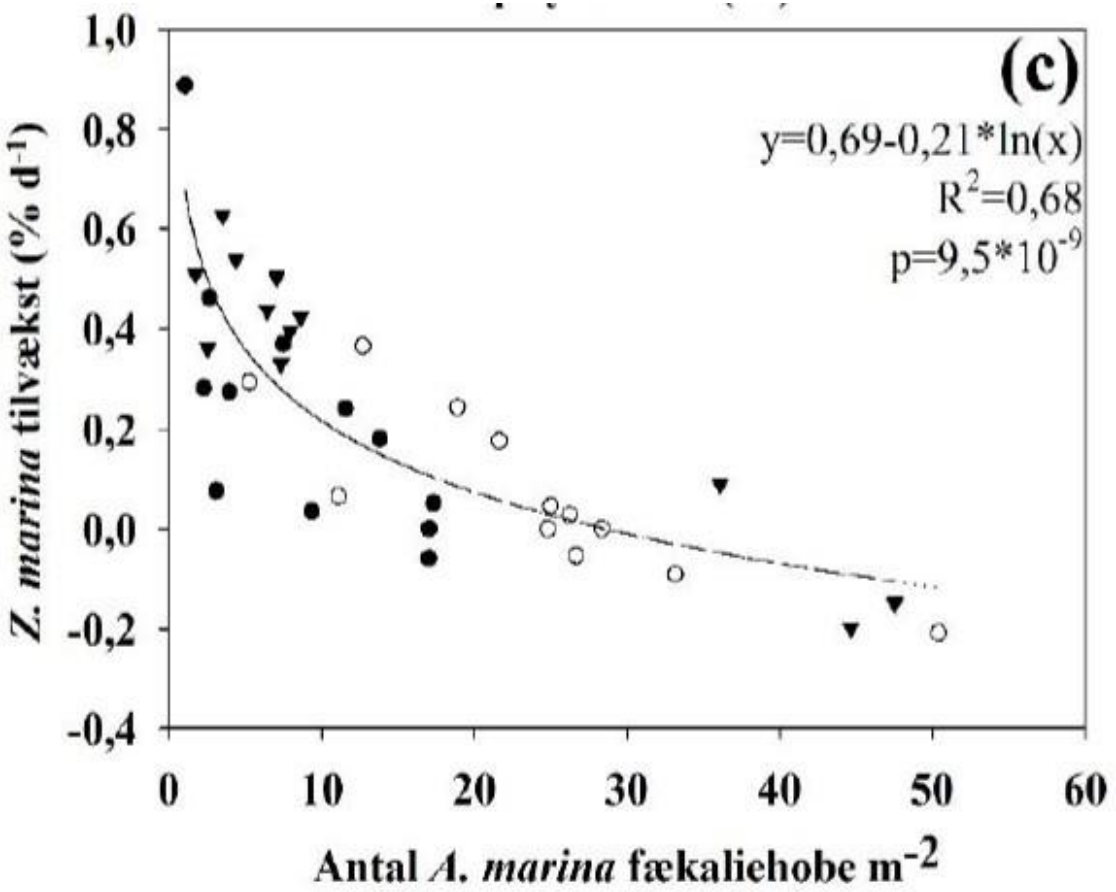


Dårlige bundforhold!

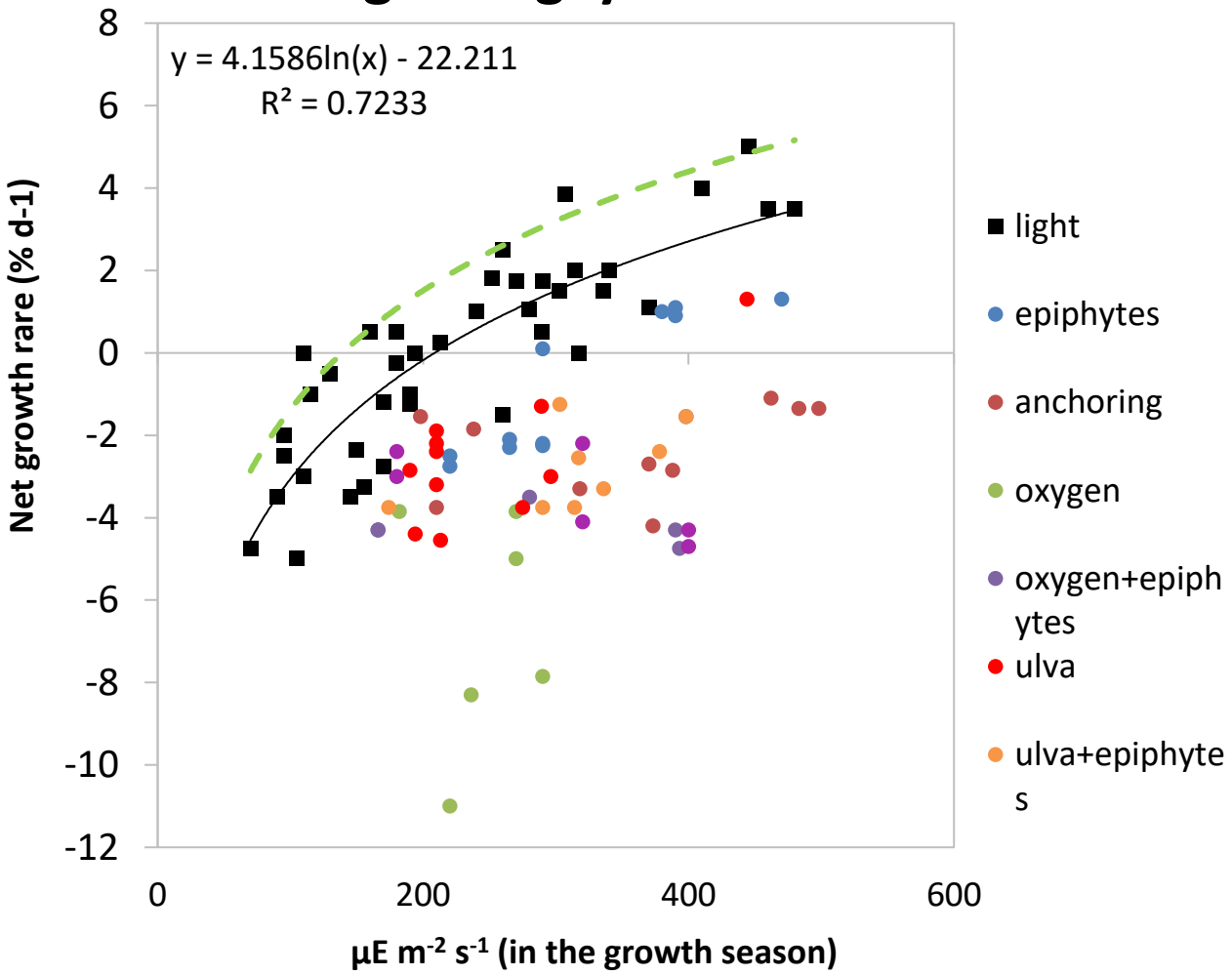


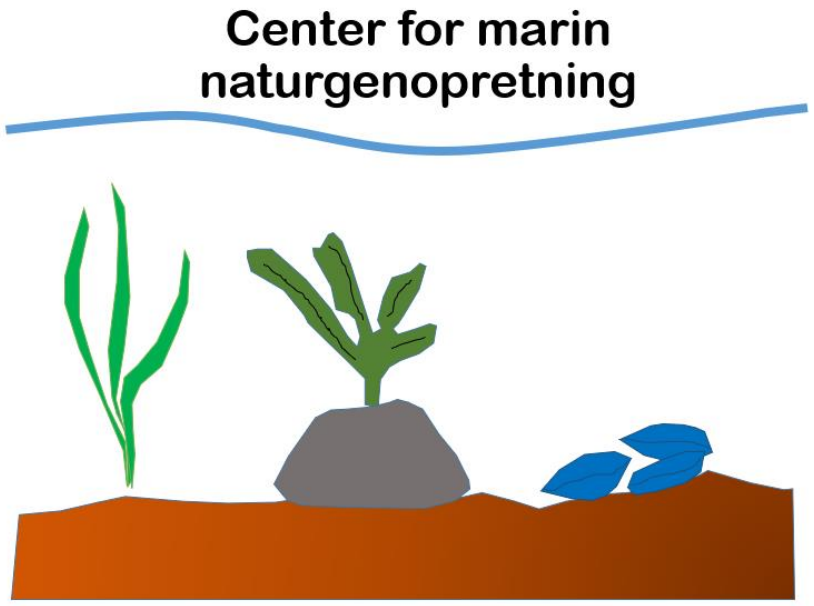


Ålegræs versus sandorm



Ålegræs og lys





Finansiering

- Velux og Miljøministeriet

Partnere

- Limfjordsrådet (Torben Bramming Jørgensen)
- DCE (Peter Stæhr)
- DTU-Aqua (Jens Kjerulf)
- SDU (Mogens Flindt)

Formål:

- Understøtte vidensbaseret marin naturgenopretning
- Definere habitater:
- Ålegræsenge
- Algeskove
- Biogene rev
- Stenrev
- Uddigning (coastal realignment)

Guidelines for habitat-genopretning

Vejledning af projektinitiativer

Ålegræs

Guideline til udpegning af optimale storskala udplantningsområder

Udarbejdet af

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Benjamin Nielsen, Niels Svane, Erik Kristensen, Cintia Quintana,

Gary Banta & Paula Canal-Verges

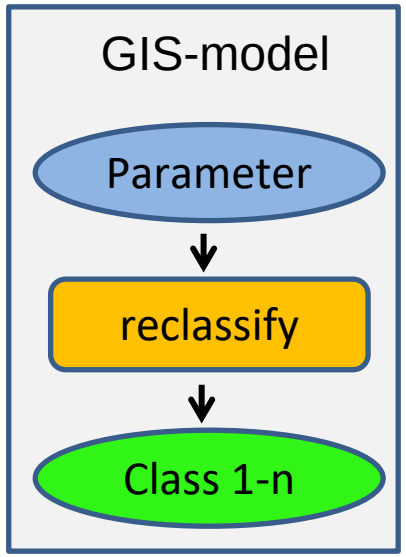
SDU

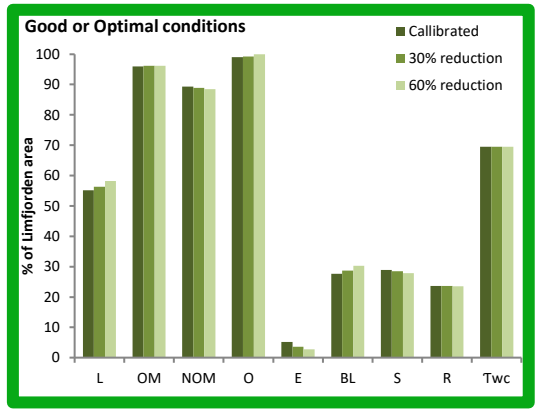
Screeningsværktøj
Ålegræs

<u>Input</u>

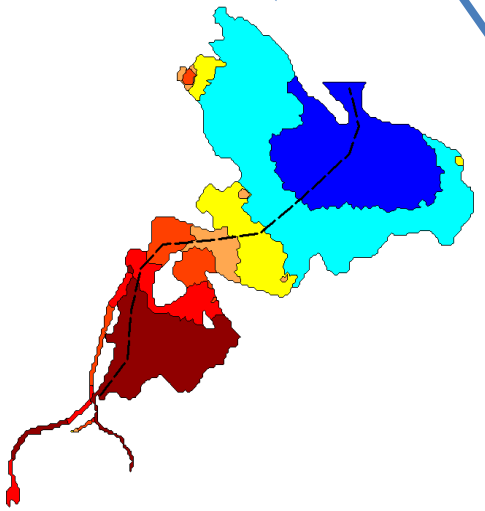
Model sim. results
Monitoring data
Research data

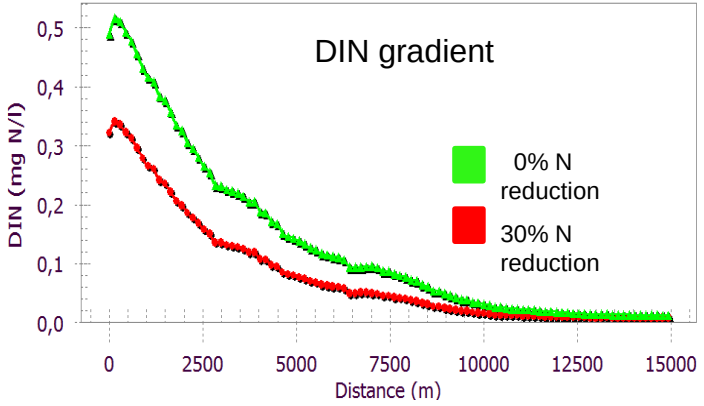
Drone data





	DIN conc (mg/l)		area	area
	Lower	Upper	km²	%
	0,000	0,025	15,7	24,0
	0,025	0,050	24,6	37,7
	0,050	0,075	5,9	9,0
	0,075	0,100	2,0	3,1
	0,100	0,150	3,6	5,4
	0,150	0,200	3,5	5,3
	0,200	0,500	10,1	15,5





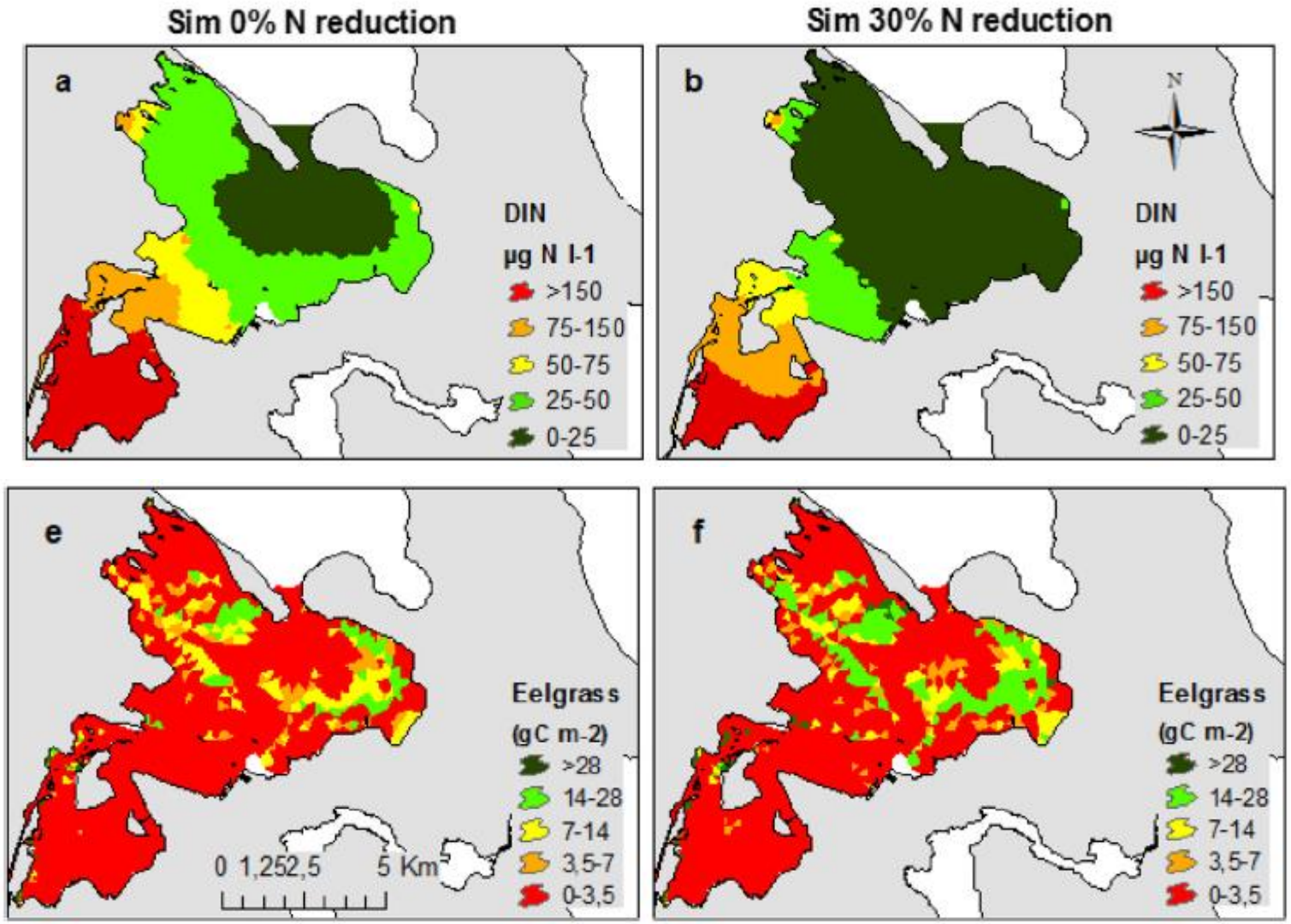
<u>Outpu</u>
<u>t</u>
Tematiske kort (5 klasser)
Gradient analyser
Histogrammer
Figurer

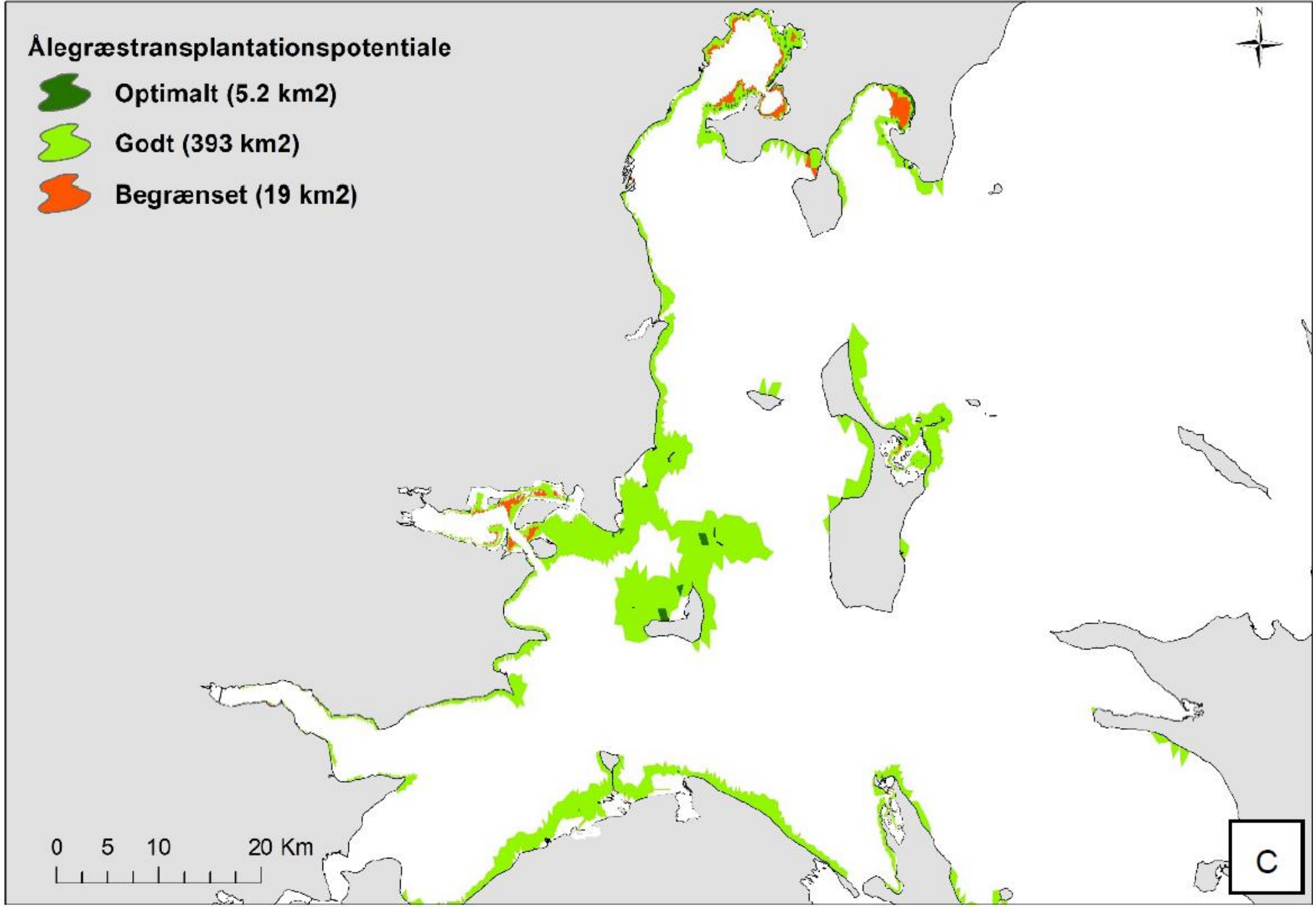
Multible stress layers are used for analysis of environmental condition/state and restoration potential

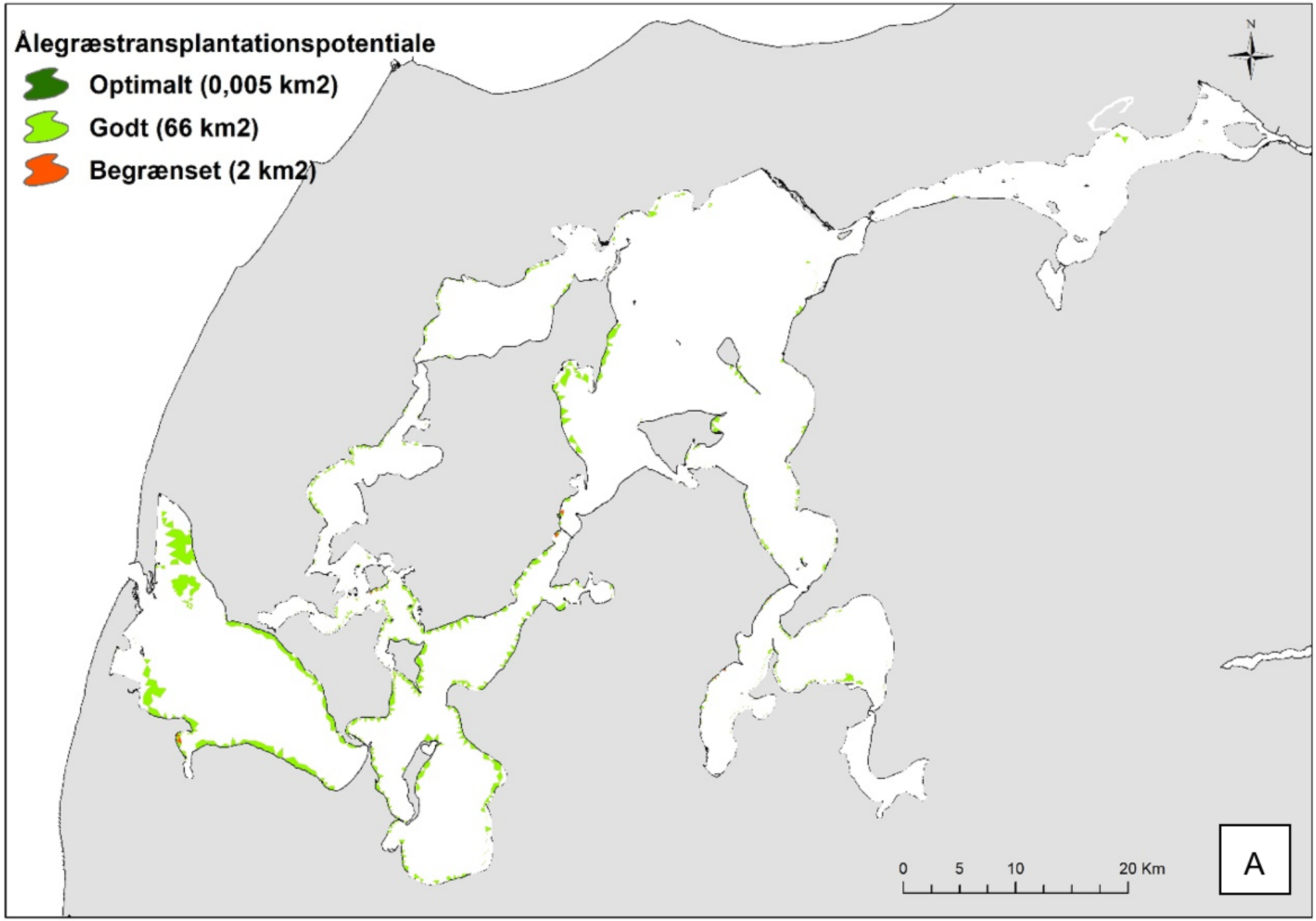
Tabel 1. Viser de individuelle presfaktorer og deres tærskelværdier.

		Recovery				
Parameter (layer)	Unit	Very poor	Poor	Threshold	Good	Optimal
T_{wc}	N m^{-2}	>1	0.7-1.0	0.5-0.7	0.2-0.5	0.0-0.2
Sediment LOI	%	>10	5-10	2-5	1-2	0-1
DIN	µg N l^{-1}	> 150	75-150	40-75	25-40	0-25
DIP	µg P l^{-1}	>30	15-30	10-15	5-10	0-5
Resuspension	Frequency	> daily	daily	monthly	Biannual	< Biannular
Benthic light	µE m^{-2} s^{-1}	0-100	100-200	200-300	300-400	> 400
O_2 limitation	Period	3 Week $^{-1}$	2 Week $^{-1}$	Weekly	Monthly	< Monthly
Opp. Macroalgae	g C m^{-2}	>26	13	10	6	< 2
Non-opp. Macroalgae	g C m^{-2}	>26	13	10	6	< 2
Lugworm	g WW m^{-2}	>50	40	25	10	<9
Eelgrass	g C m^{-2}	< 3	< 7	< 14	< 28	> 28

Salinity
Temperature

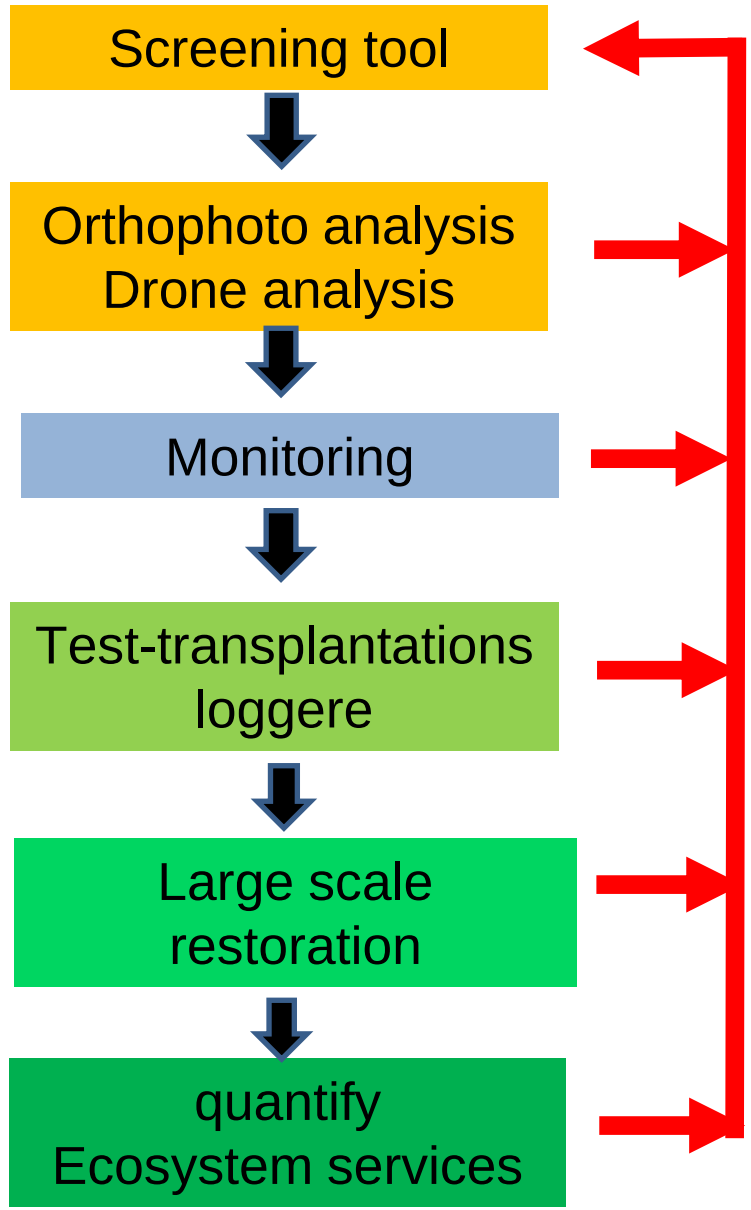

Sim 0% N reduction
Sim 30% N reduction
a
b
e
f
N
DIN
µg N l-1
>150
75-150
50-75
25-50
0-25
Eelgrass
(gC m-2)
>28
14-28
7-14
3,5-7
0-3,5
0 1,252,5 5 Km


Ålegræstransplantationspotentiale
Optimalt (5.2 km2)
Godt (393 km2)
Begrænset (19 km2)
N
0 5 10 20 Km
C


Ålegræstransplantationspotentiale
Optimalt (0,005 km2)
Godt (66 km2)
Begrænset (2 km2)
N
0
5
10
20 Km
A

Time (months)	Work flow
0	GIS/model-analysis
0-3	Visuel/Machine learning
3-5	Diver obs. + data analysis
6-17	Test-transplantations + monitering Datalogger-analysis
18-42	Monitoring (manuelt → drone) Datalogger-analysis
43 →	Measurements of ecosystem services: Nutrients, CO_2-buriel + biodiversy

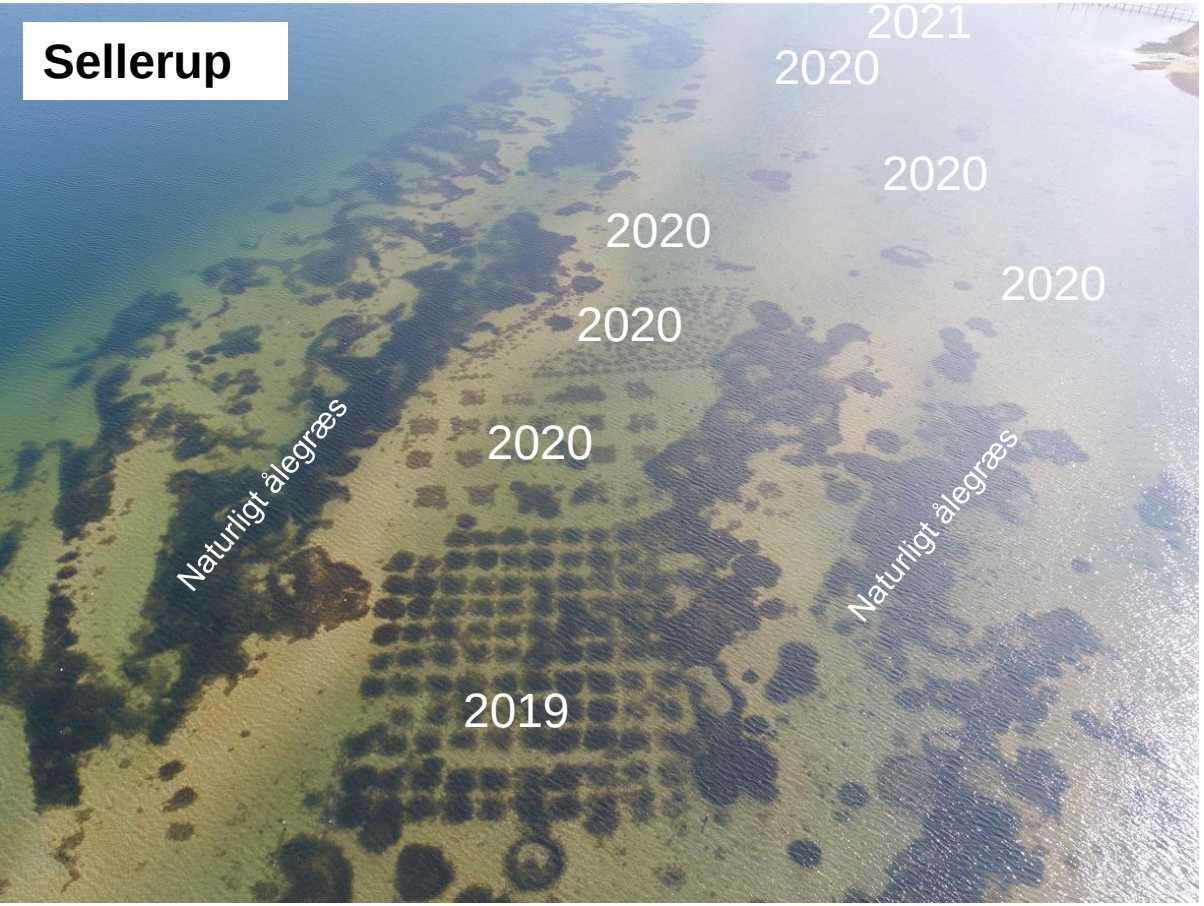
Udpegningsprocess

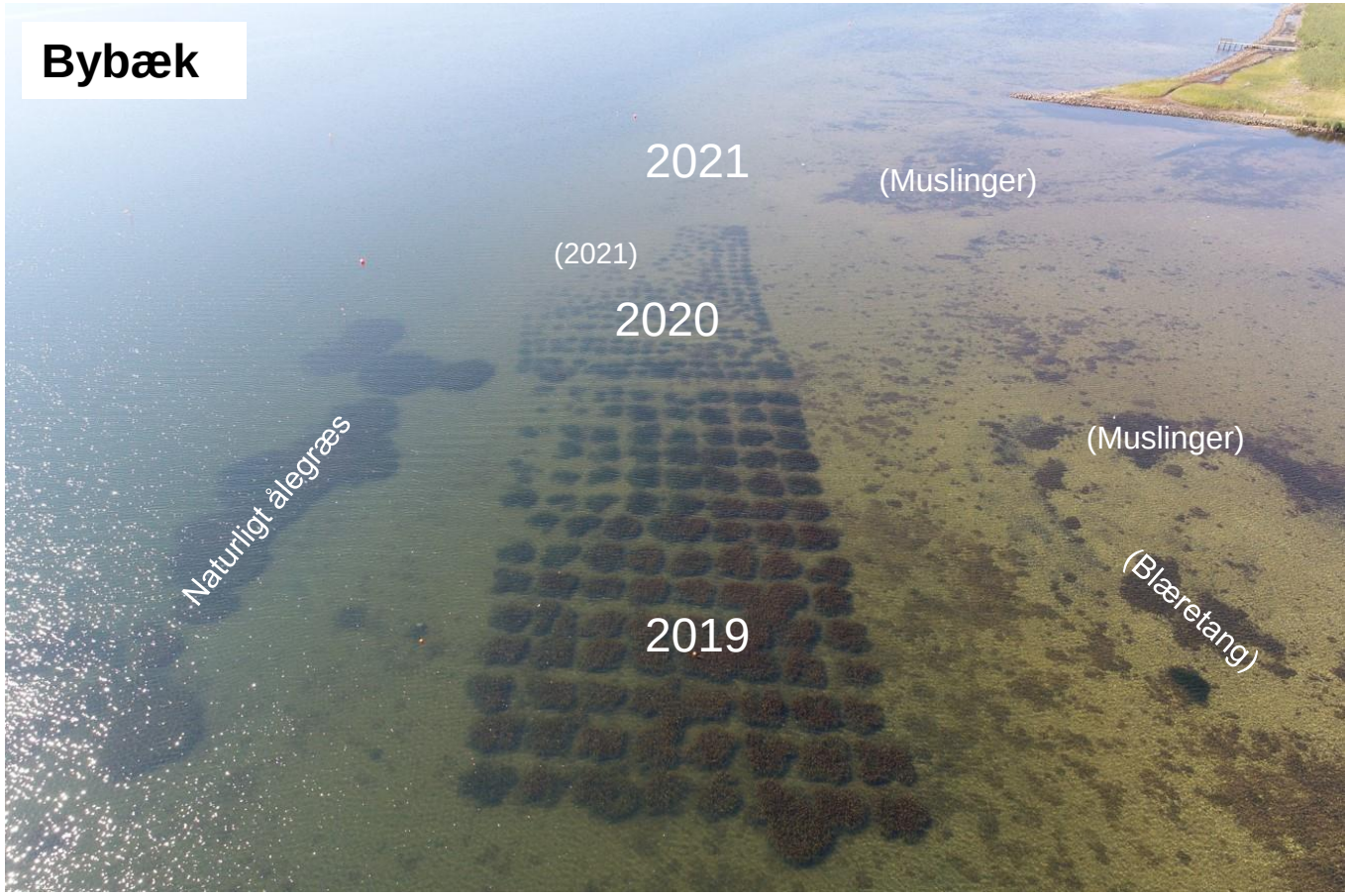


Dronefoto af ålegræsudplantninger (Timi Banke)

Det skal typisk være >1år gammelt for at være reelt visuelt med dronekortlægning

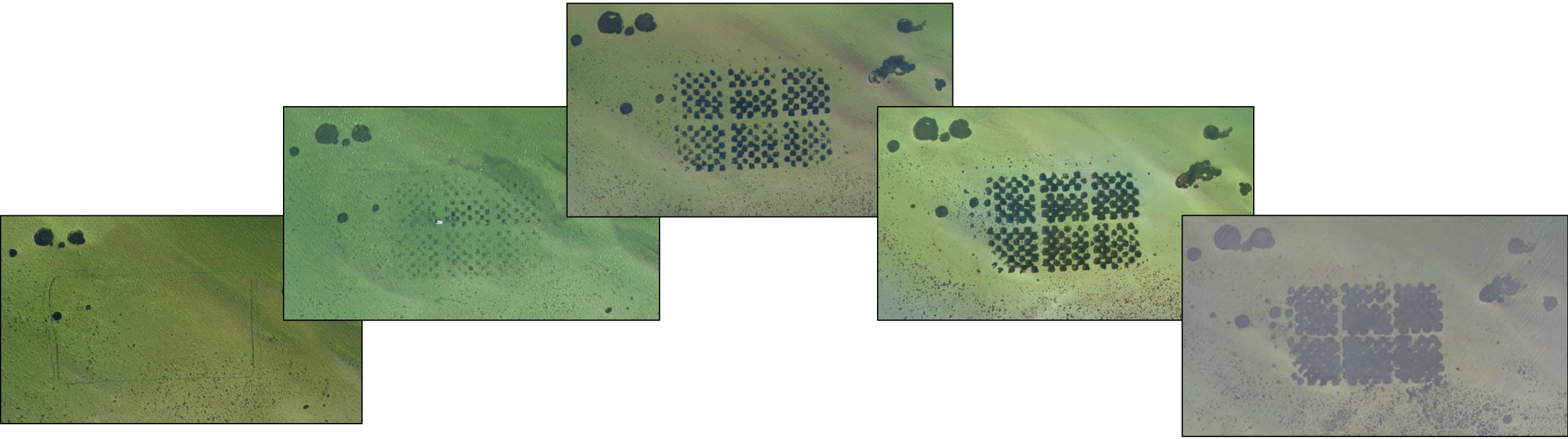
Foto: September 2021



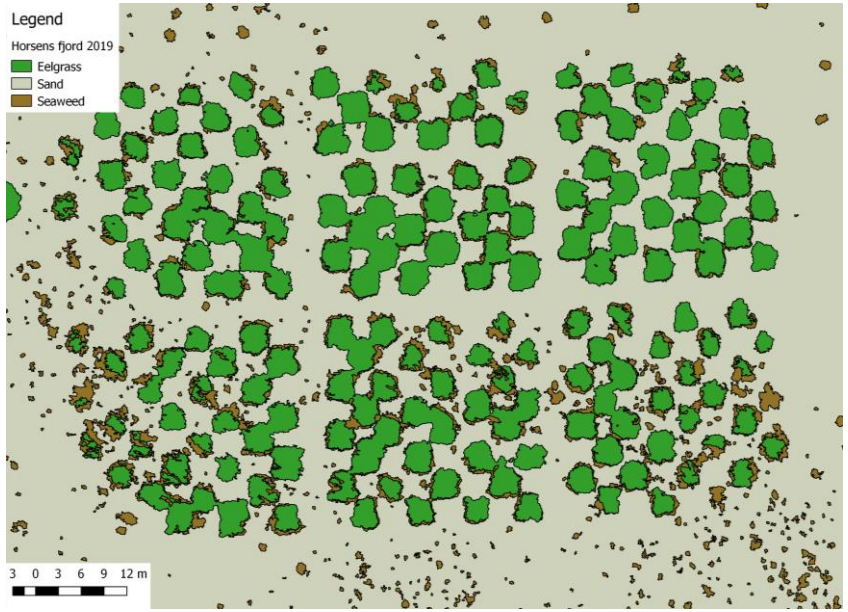


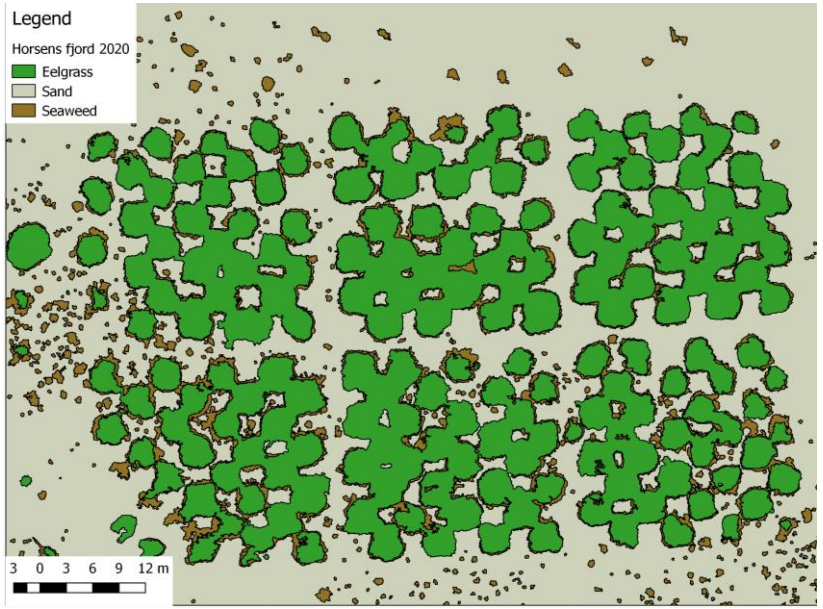
August 2021 blev der gennemført en større fauna-indsamling ved Sellerup, som skal analyseres. Det kan bl.a. relateres til effekterne af krabbefangst ved Sellerup.

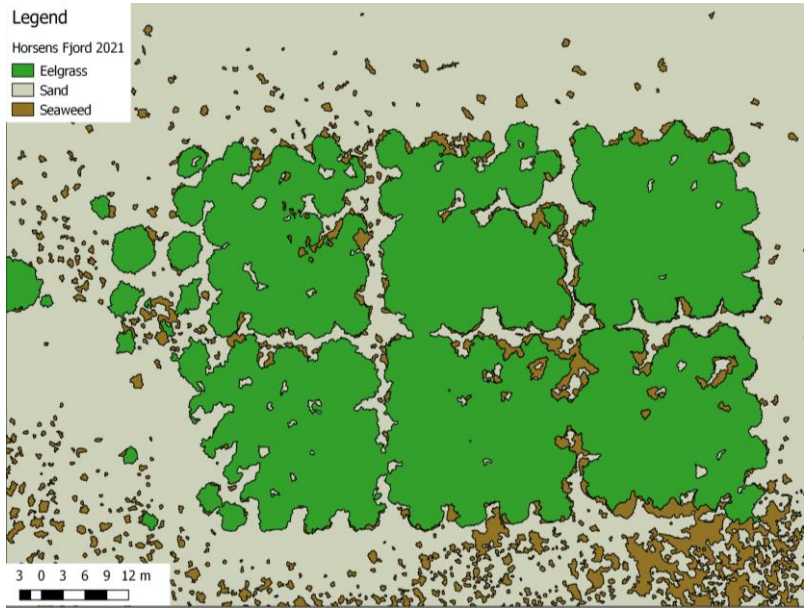
Development in shoot densities and coverage after restoration in 2017



2017 2018 2019 2020 2021







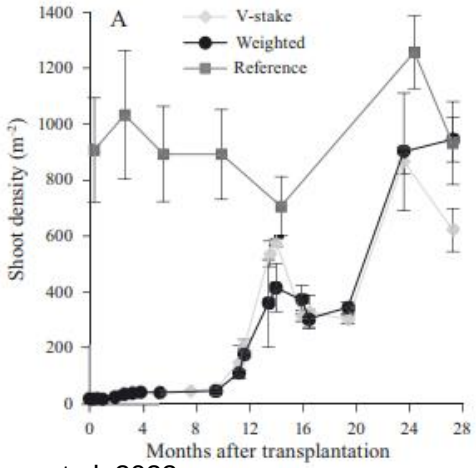
2019
Area: 1324 m^2;Tot.biomass: 718 kg dw

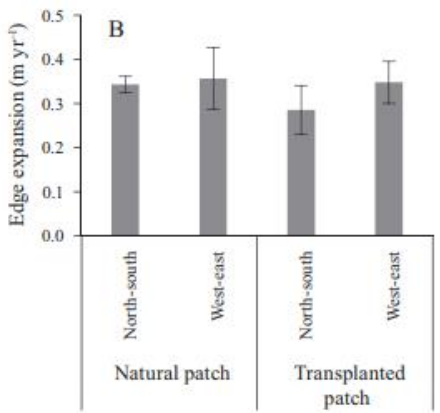
2020
Area: 2125 m^2 ;Tot.biomass: 1152 kg dw

2021
Area: 3225 m^2; Tot.biomass: 1749 kg dw

61 % growth

52 % growth





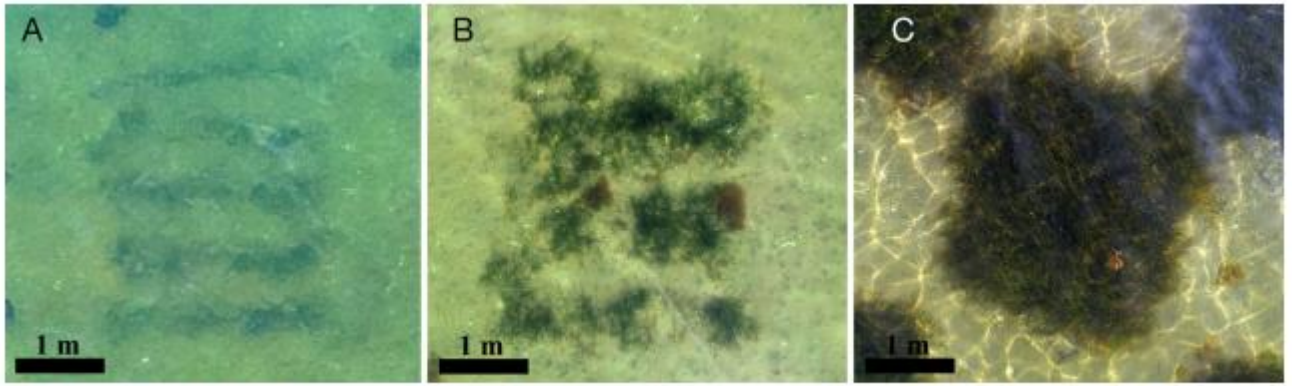


Fig. 6. Low-altitude (5 m) drone monitoring of the development in coverage and areal expansion of one specific 2 × 2 m transplanted plot in the years (A) 2017, (B) 2018 and (C) 2019

Lange et al. 2022

Table 1. The yearly change in C, CO_2, N, P pools in the restored eelgrass area in Horsens Fjord from 2017 to 2019. Data is corrected for baseline (bare bottom areas), so they represent net project contributions.

Changes in pools	kg ha^{-1} y^{-1}			
	C	CO_2	N	P
Growth - shoots	525	1925	21	4
Growth - roots and rhizomes	925	3391	37	7
Sloughed leaves	1750	6416	70	13
Acc. in sediment	355	1301	66	30
Denitrification			50	
Growth – infauna	340	1246	39	4
Total immobilization	3895	14282	283	58
- Permanent immobil.	2145	7865	213	45
- Temporary immobil.isering	1750	6417	70	13

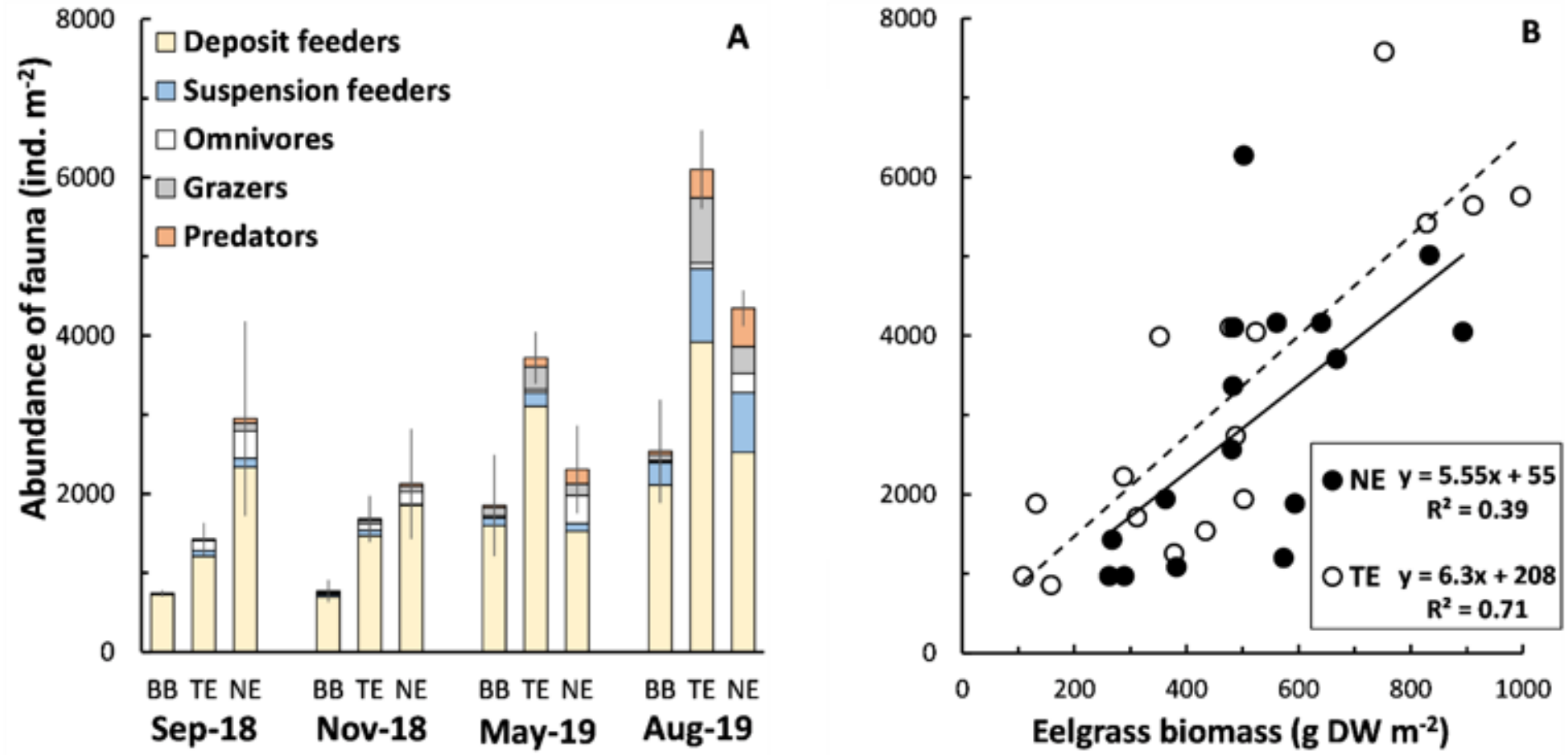


Figure: A) Average abundance of benthic fauna on bare bottom (BB), transplanted eelgrass (TE) and natural eelgrass (NE) during each sampling period. B) Correlations between dry eelgrass biomass (g DW m^{-2}) and abundance of benthic fauna (ind. m^{-2}) for natural eelgrass (NE, black) and transplanted eelgrass (TE, white).

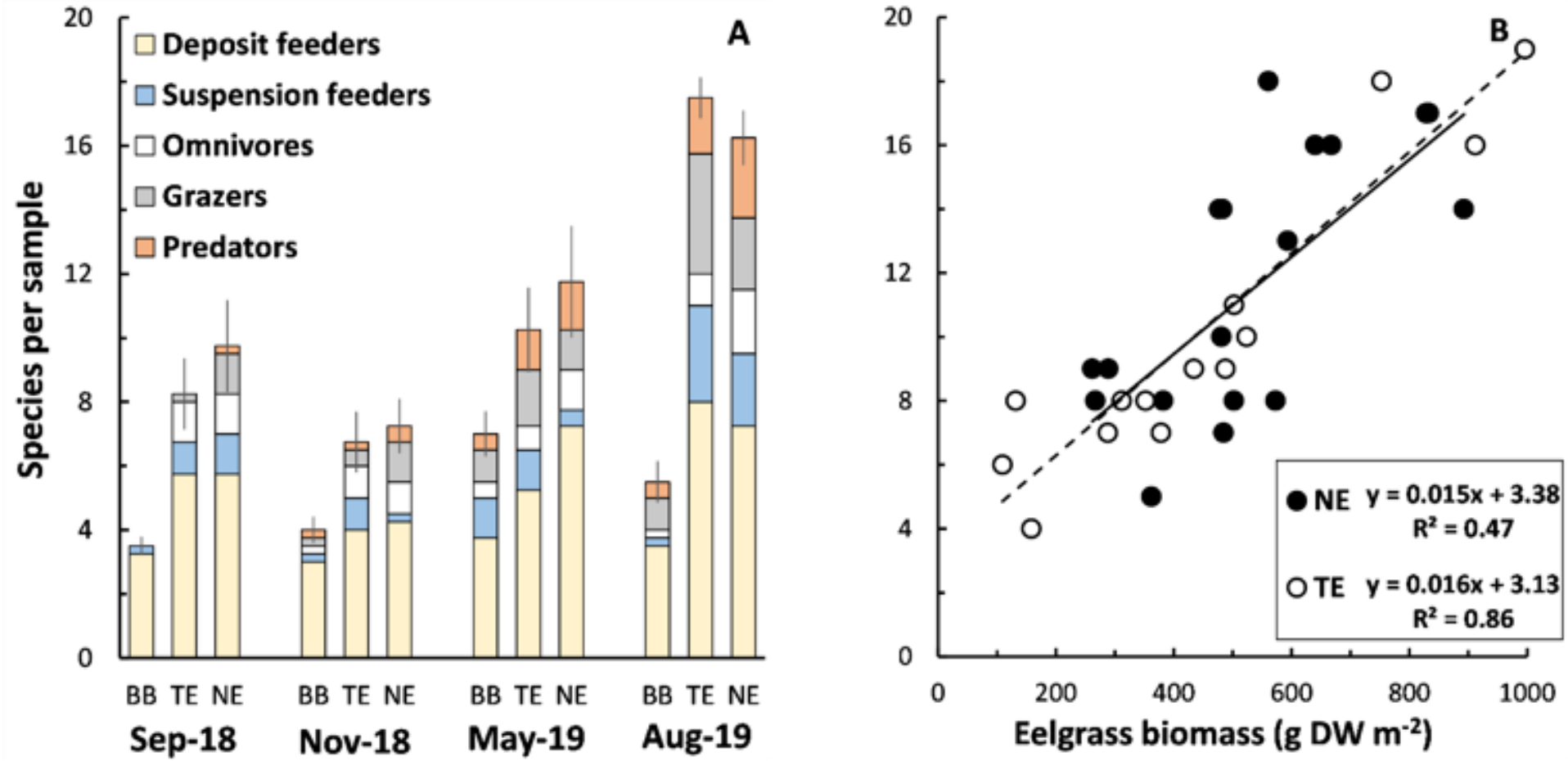


Figure: A) Average number of species per sample on bare bottom (BB), transplanted eelgrass (TE) and natural eelgrass (NE) during each sampling period. B) Correlations between dry eelgrass biomass (g DW m^{-2}) and number of species per sample for natural eelgrass (black) and transplanted eelgrass (white).

Konklusion

Skudtæthederne i udplantningerne = naturlige bede efter 2 år.

Det er muligt at kvantificere økosystemtjenester 2 år efter udplantning.

Signifikante økosystemservices → immobilisering og begravelse af C, N & P, fauna tætheder og fauna biodiversitet.

Sediment-akkumulering (N/P-ratio=2) → extra P-adsorptionskapacitet i rodzonen.

Ålegræssets økosystemtjenester bør ikke oversælges – der er begrænsede arealer vi kan retablere. Der er behov for yderligere næringsstofreduktioner!

Nye aktiviteter – kombinere habitater

Gyldensteen kystlagune

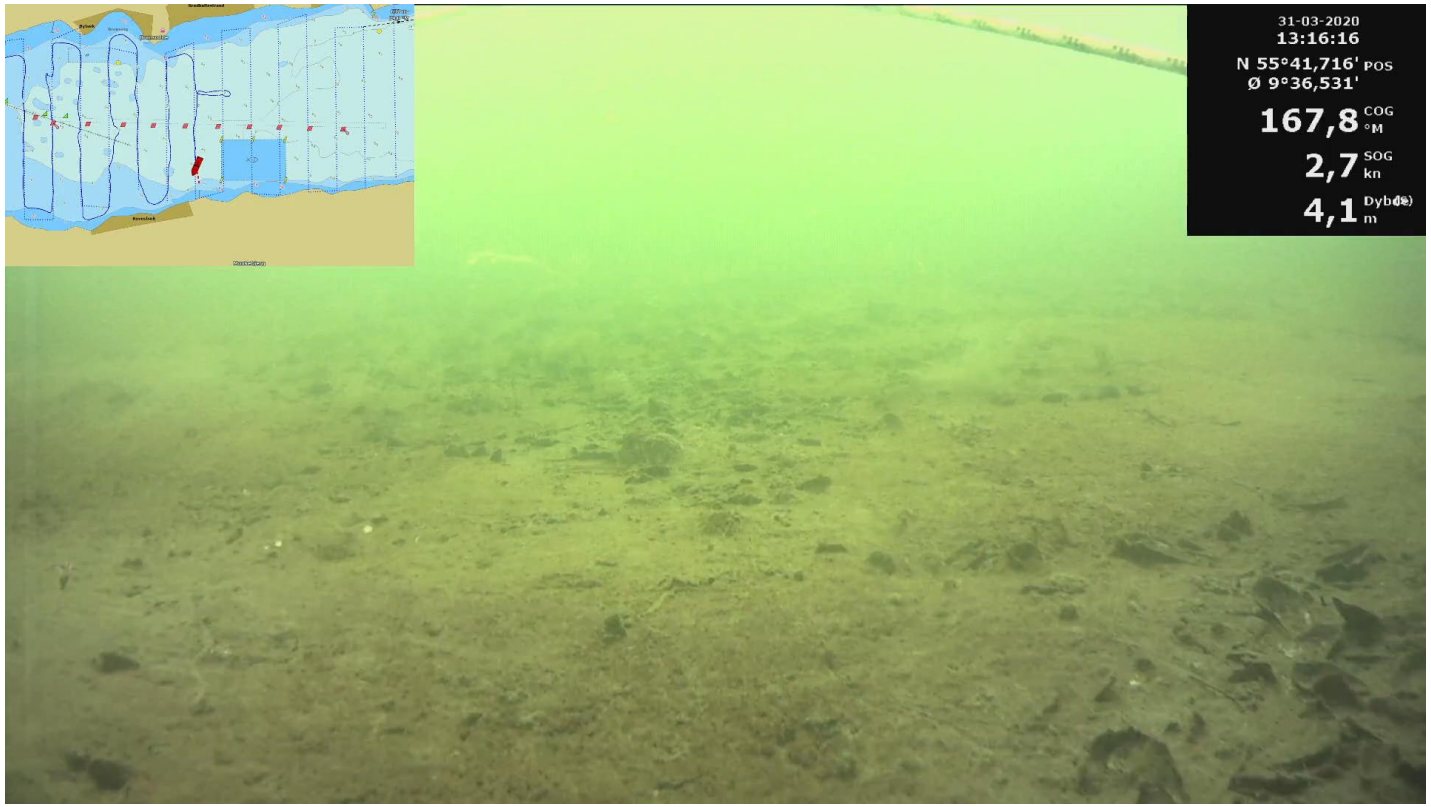
ålegræs
sandcapping
stenrev

Vejle Fjord

muslinger
ålegræs
stenrev

Tilbagegang af *Mytilus* populationer

Årsager:
Iltsvind
Overfiskning
Forøget prædationsrater
”Mesopredator release”
(Christie et al. 2020, Baden et al. 2021)

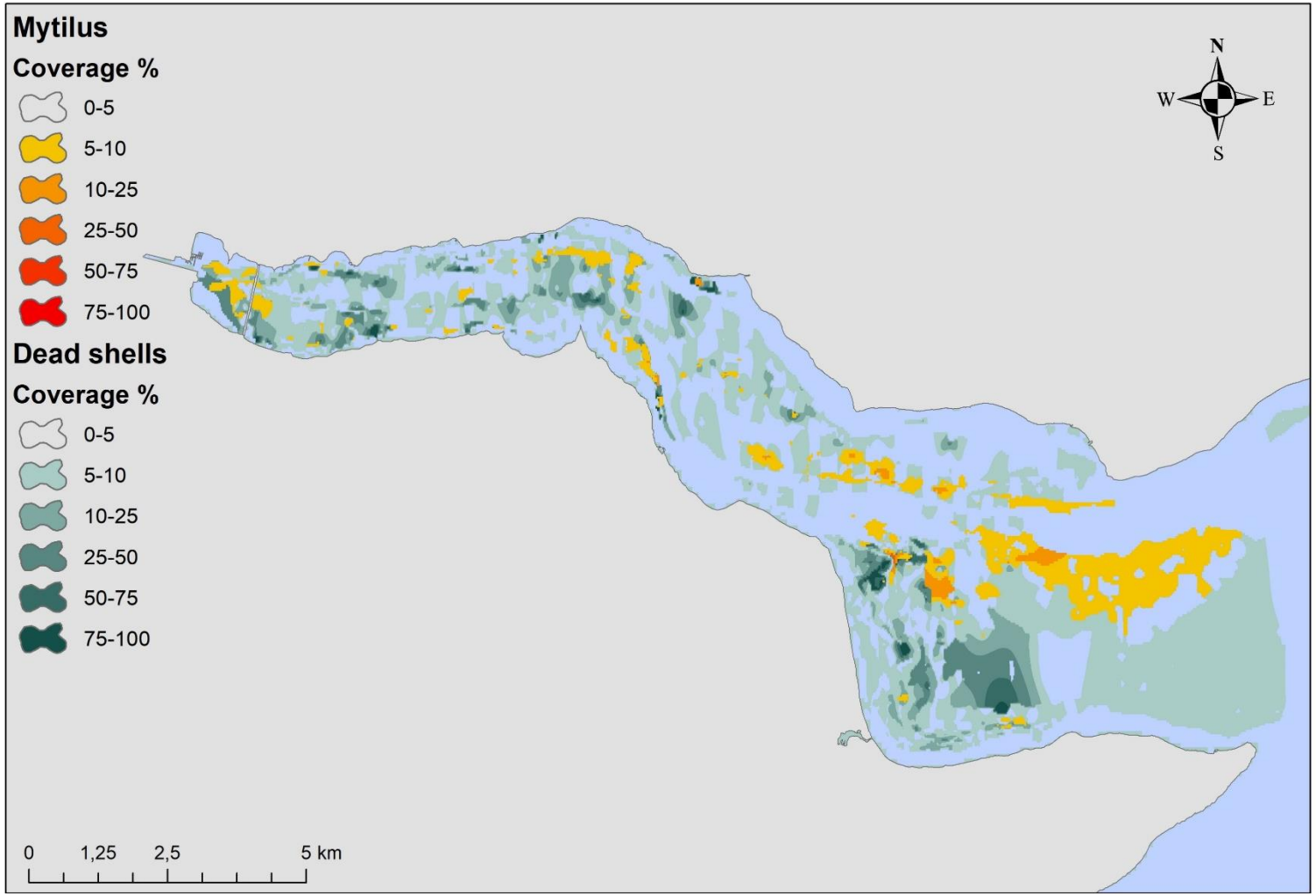


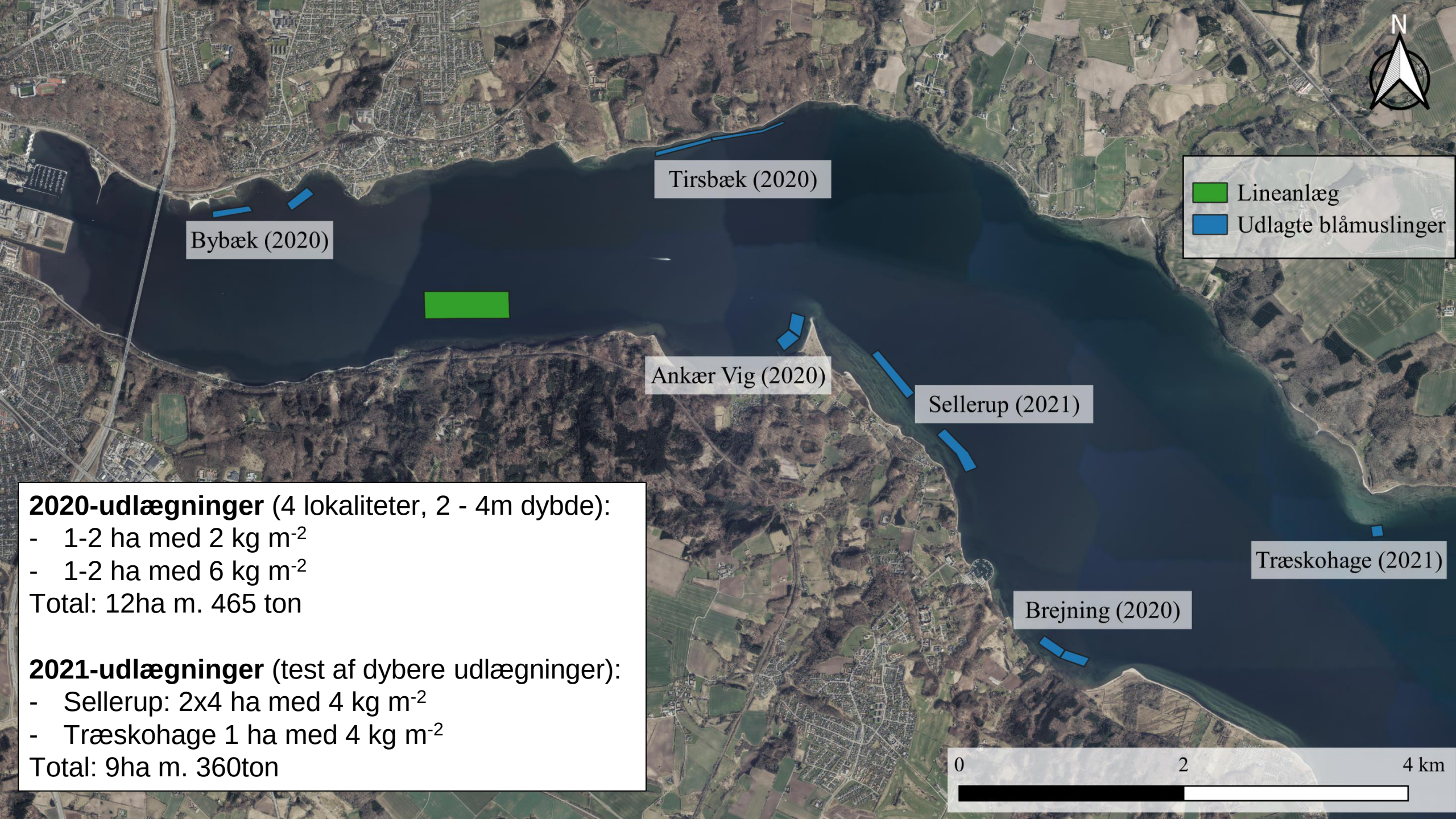
Video transekt af tidligere muslingebanke

Tilbagegang af *Mytilus* populationer

Hvorfor ikke prøve at retablere muslingebankerne i Vejle Fjord?

Årsager:
Iltsvind
Overfiskning
Forøget prædationsrater
”Mesopredator release”
(Christie et al. 2020, Baden et al. 2021)





2020-udlægninger (4 lokaliteter, 2 - 4m dybde):
- 1-2 ha med 2 kg m^{-2}
- 1-2 ha med 6 kg m^{-2}

Total: 12ha m. 465 ton

2021-udlægninger (test af dybere udlægninger):
- Sellerup: 2x4 ha med 4 kg m^{-2}
- Træskohage 1 ha med 4 kg m^{-2}

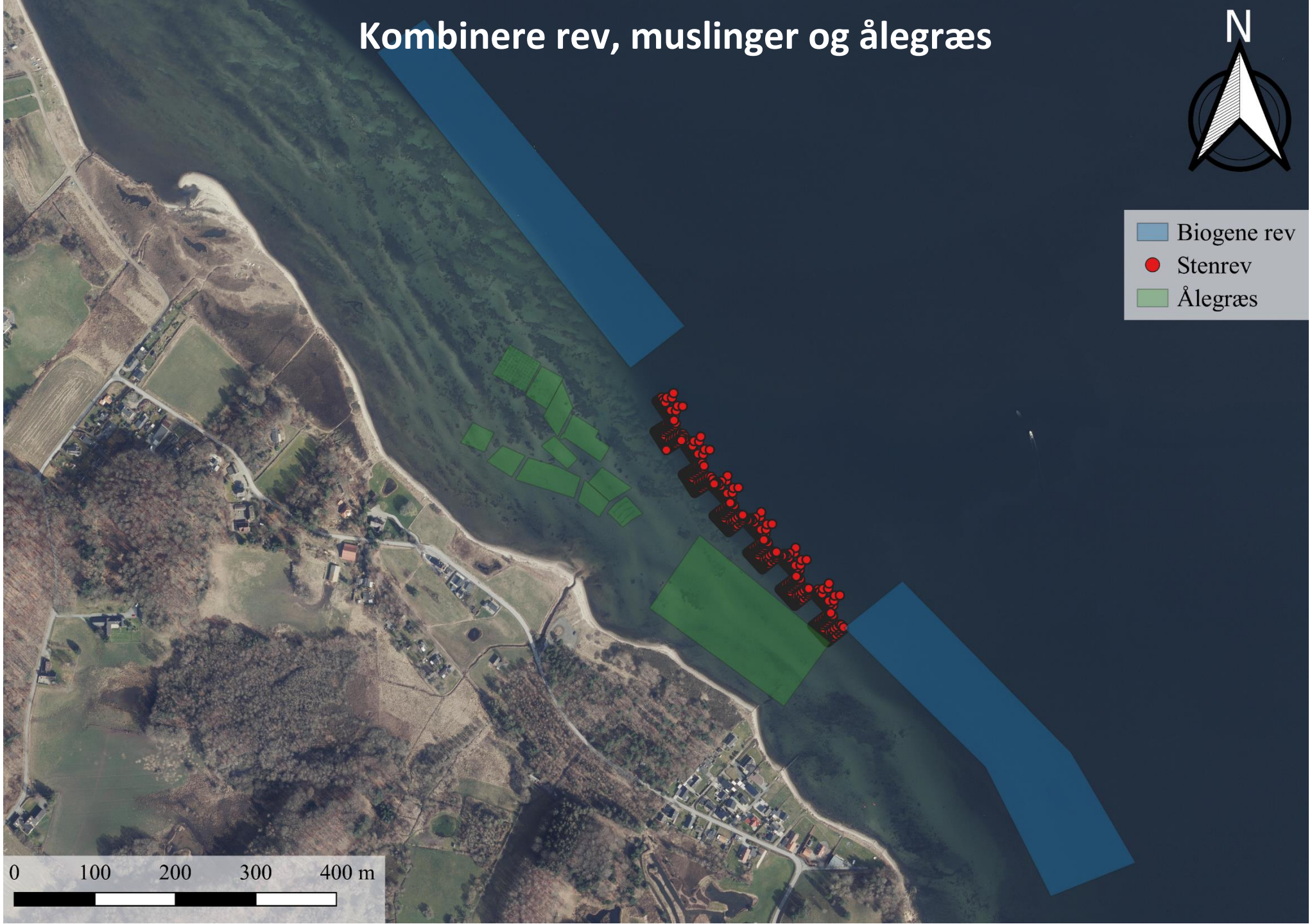
Total: 9ha m. 360ton

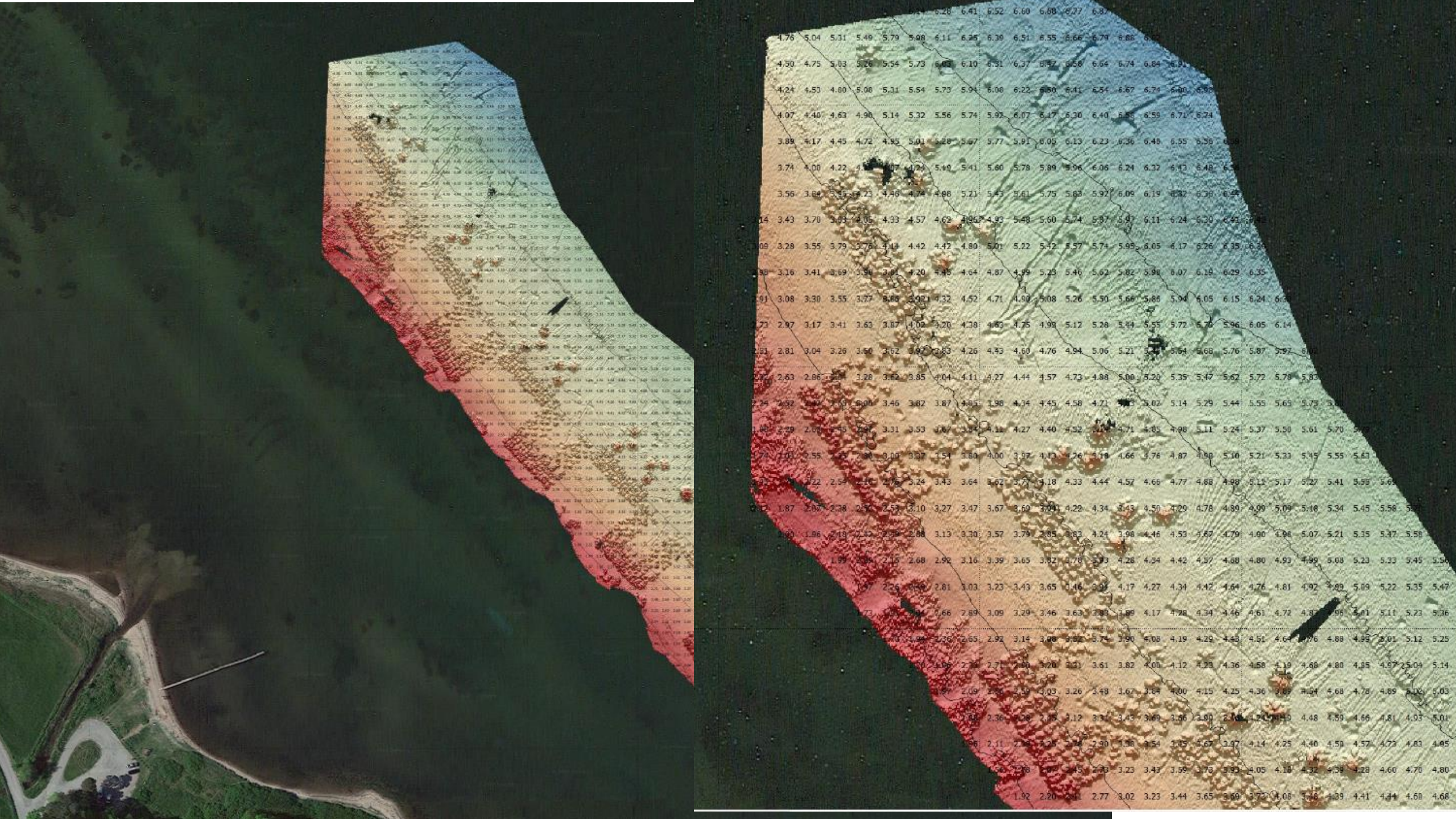
Økosystemfunktioner

- Vandrensning forøger bentisk lysintensitet – 15%
- Forøger biodiversitet og individtæthed af epifauna

Nyanlagte stenrev i Vejle Fjord

Kombinere rev, muslinger og ålegræs





Kombinering af habitater er ved at blive undersøgt.

Forventninger: muslinge banker/ålgræs – forbedre lysforholdene → ekstra ålegræs vækst
Udfordringer: prædation hindrer rekrutering.

Stenrev/ålegræs - skaber læ – reducerer tabet af skud – ekstra biodiversitet??
Udfordringer: potentielle ændringer i sedimentmobilitet.

Ålegræs – fremadrettet

- **Pt. kan vi ikke naturgenoprette ålegræs vhja. frø.**
- **Problem: Frø modnes i juli-august og skal blive på optimale lokaliteter vinteren igennem.**
- **600 mio frø over 20 år er blevet til 4 små ålegræsbede**
- **Det skal der investeres i effektive metoder til frøbaseret restaurering – og første konkurrence starter om lidt.**

Undskyld forstyrrelsen

☺

Skakterns-udplantning i Horsens Fjord efter 2 år