DTU Aqua
National Institute of Aquatic Resources

Ghost nets in Danish waters
Appendices

DTU Aqua Report no. 394a-2021

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Eva Maria Pedersen, Niels G. Andersen, Josefine Egekvist, Anders Nielsen, Jeppe Olsen, Fletcher Thompson and Finn Larsen

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Preface

These are appendices to the report “Ghost net in Danish waters” which is the final deliverable from DTU Aqua in the project drafted by the Danish Fisheries Agency about the occurrence of ghost nets in Danish waters.

Kgs. Lyngby, August 2021

Content

A.1. Detailed description of the selected areas (Phase 1)

First priority areas

We have in total selected 5 first priority areas. Three of these, Gule Rev, Store Rev and Jammerbugten are in the North Sea/Skagerrak area and have in total 7 smaller focus areas that in total covers 127 1x1 km squares. Two of these areas; Gule Rev and Store Rev are stone reef areas and the last area Jammerbugten is selected as a sand area mainly because of the location between the two reef areas.
In the Inner Danish waters, the two, first priority areas are the area West of Bornholm and the Langelandsbælt. These two areas also have 7 smaller focus areas and cover in total 227 1x1 km squares. In the Langelandsbælt area, focus area 3 and 4 cover stone reef and all areas have sand or mixed sediment. In the areas West of Bornholm, all bottom types are found, from fine mud to hard substrate and rocks.

All the first priority areas are described in detail in the following section. First, a description of the North Sea/Skagerrak areas and then a description of the Inner Danish water areas.

North Sea/Skagerrak area
First priority stone reefs

<u>Gule Rev</u>
The Gule Rev area is one of the smallest selected areas but still includes three potential study areas: Gule Rev 1, Gule Rev 2 and Gule Rev 3 with a total number of 5, 14 and 21 1x1 km squares in each study area respectively. In Gule Rev area 1 and 2 we only see 1 day with overlap between active and passive gears in the period 2014-2018. However, these two areas are from another project known to be fished by foreign beam trawlers, which are not included in the Danish VMS data. In the Gule Rev 3 area there is found some overlap between passive and active gears, and it is also fished by Dutch beam trawlers (Fig. 1 & 3). The average number of days for overlap between active and passive gears in this area is between 0 – 1.2 days (Fig. 1, Table 1). The average fishing intensity with active and passive gears for the period 2009-2018 can be seen in Figure 2.

According to the EUNIS map the sediment type in Gule Rev area 1 and 2 is mixed and in Gule Rev 3 it is mainly sand, however according to Figure 4 (left) it is mapped as stone reef in a Natura 2000 area (Fig 4, Table 1).

The area is difficult to survey due to the large average depth in the area >40 m (Table 1), which means that with the current techniques for locating lost fishing gear there is not a good chance that they can be identified if there are any present.

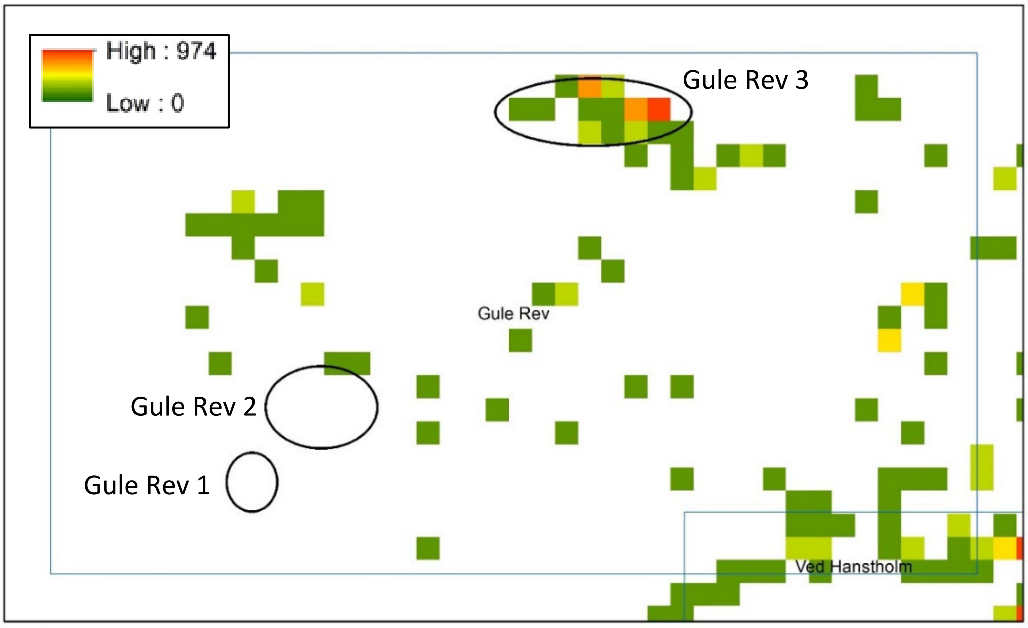


Figure 1. Map of the Gule Rev focus area and the three potential study areas, the colour of the squares illustrates the number of days with overlap between active and passive gears, from 2014-2018 in a 1km grid. The scale goes from green (low) to red (high) and white is 0 days.

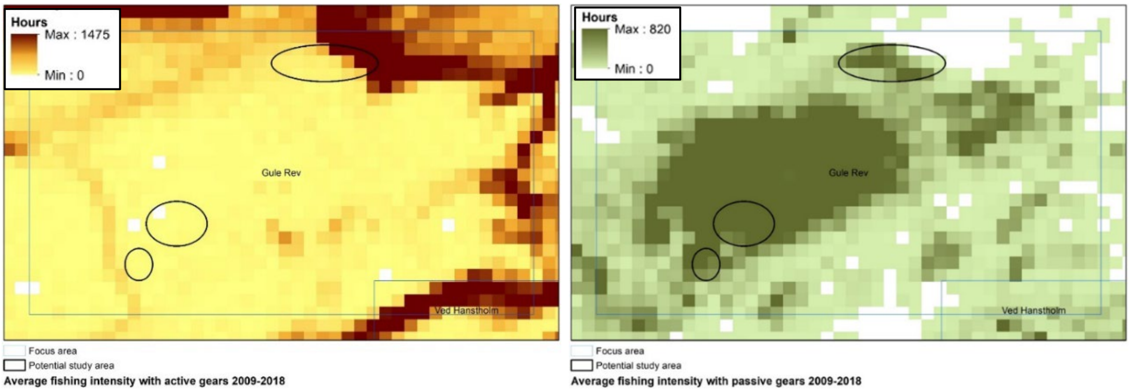


Figure 2. Left) Average fishing intensity in hours with active gears in the Gule Rev area for the period 2009-2018. Right) Average fishing intensity in hours with passive gears in the Gule Rev area for the period 2009-2018.

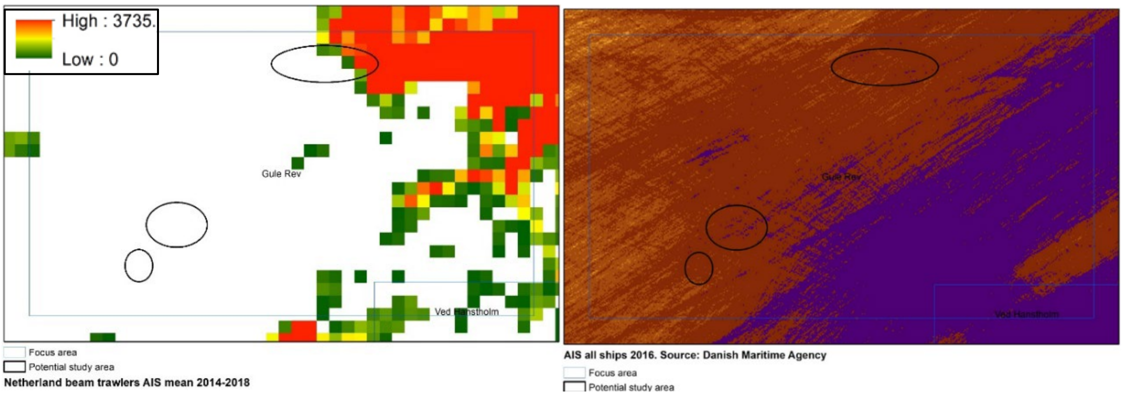


Figure 3. Left) AIS pings from 12 Dutch beam trawlers in the Gule Rev area. Right) AIS pings from marine traffic (2016) in the Gule Rev area.

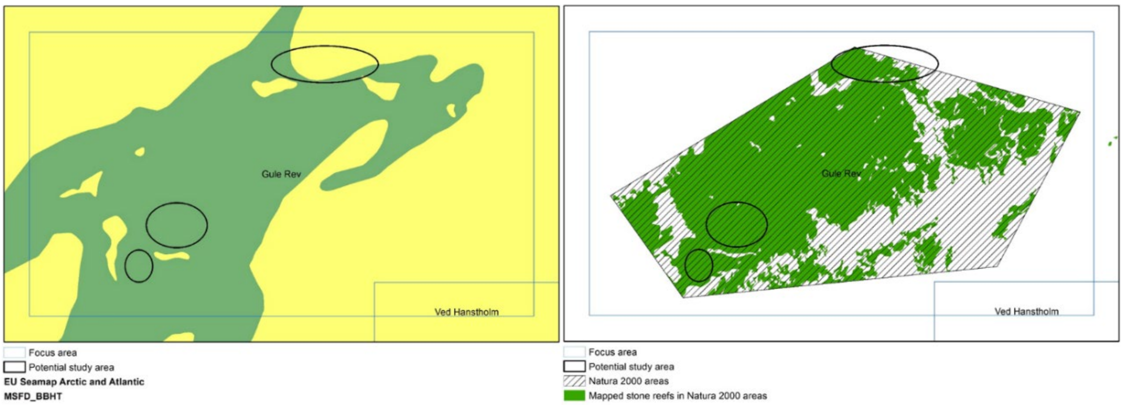


Figure 4. Left) The EUNIS habitat map for the Gule Rev area. Yellow is sand areas and green is mixed sediment. Right) The Gule Rev Natura 2000 stone reef area. ▨ Natura 2000 areas, ■ Mapped stone reef in Natura 2000 areas.

Table 1. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Gule Rev area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. Area
Gule Rev 1	47.5	38.4	43.5	0.0	0.0	0.0	0 (5)	Mixed sediment	4.4	100
Gule Rev 2	47.0	37.0	41.4	1.0	0.1	1.0	1 (14)	Mixed sediment	13.5	100
Gule Rev 3	55.3	42.2	48.5	5.0	1.2	25.0	12 (21)	Mixed sediment	5.9	30.3
								Sand	13.6	69.7

Store Rev

The Store Rev area is one of the smallest selected geographical areas but still includes two potential study areas: Store Rev 1 and Store Rev 2 with a total number of 13 and 30 1x1 km2 squares in each study area respectively. In the Store Rev areas, we find the highest average value of 8.5 overlaps between active and passive gears per square in Store Rev 1 and the highest number in single cell with 42 overlaps in Store Rev 2 (Fig. 5, Table 2). Part of Store Rev 2 is fished by Dutch beam trawlers and both areas have a lot of marine traffic (Fig. 7)

According to the EUNIS habitat map the sediment type in Store Rev 1 is half mainly mixed sediment and half sand and in the Store Rev 2 area its mainly sand with some mixed sediment areas. However, according to Figure 8 (right) it is mapped as stone reef in a Natura 2000 area (Fig 8, Table 2).

If you study the passive and active fishery individually, you see a pattern with a large fishery with active gear just around the reef and a large fishery with passive gears on the reef (Fig. 6).

The area is difficult to survey because the average depth in Store Rev area 2 is >40 m and in Store Rev area 1 very close to an average depth of 40 m (Table 2). This means that with the current techniques for locating lost fishing gear, there is a risk that they will not be identified if there are any present.

Figure 5. Map of the Store Rev focus area and the two potential study areas, showing the number of days with overlap between active and passive gears from 2018-2018 in a 1km grid.

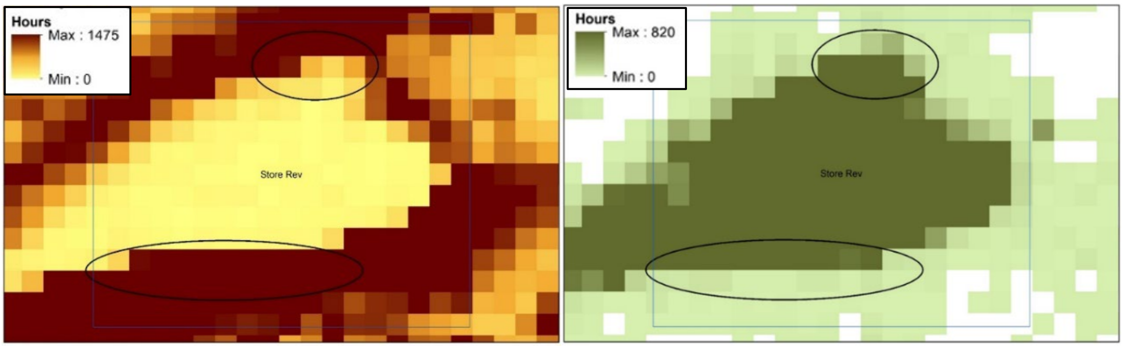


Figure 6. Left) Average fishing intensity with active gears in the Store Rev area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Store Rev area for the period 2009-2018.

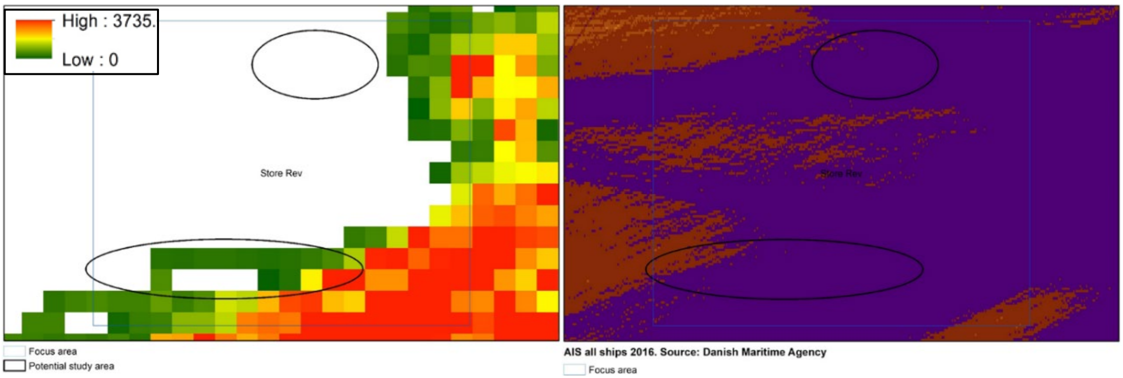


Figure 7. Left) AIS pings from Dutch beam trawlers in the Store Rev area. Right) AIS pings from marine traffic (2016) in the Store Rev area.

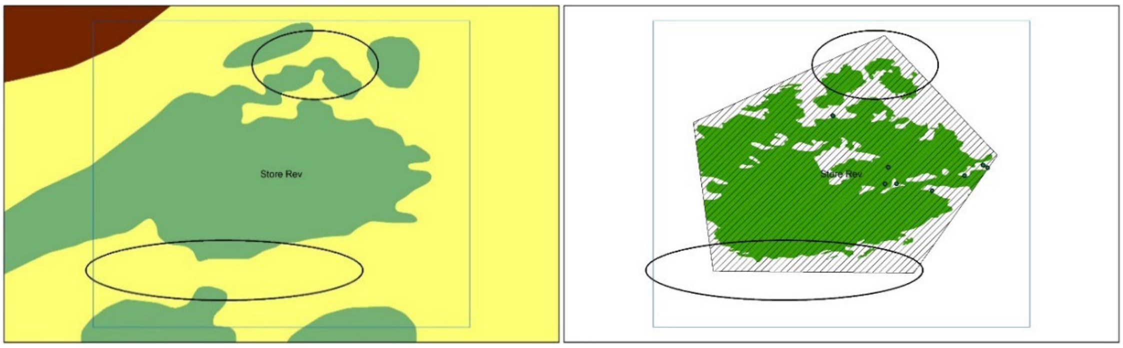


Figure 8. Left) The EUNIS habitat map for the Store Rev area. Yellow is sand areas and green is mixed sediment. Right) The Store Rev Natura 2000 stone reef area. [hatched] Natura 2000 areas, [green] Mapped stone reef in Natura 2000 areas.

Table 2. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Store Rev area.

Name	**Depth**			**Number of days with overlap between active and passive gears. Sum 2014-2018**			**Number of cells with overlap (total number of cells)**	**EUNIS habitat type**		
	Max depth (m)	**Min depth (m)**	**Mean depth**	**MAX**	**MEAN**	**SUM**		**Substrate**	**Sum area km²**	**pct. Area**
Store Rev 1	76.1	31.1	50.3	34.0	8.5	111.0	12 (13)	Mixed sediment	7.1	48.2
								Sand	7.6	51.8
Store Rev 2	50.3	30.7	39.1	42.0	5.8	174.0	23 (30)	Mixed sediment	4.0	14.1
								Sand	24.3	85.9

First priority sandy/soft bottom area in the North Sea/Skagerrak area

<u>Jammerbugt</u>

The Jammerbugt area is relatively close to the coast, and it consists of two potential study areas: Jammerbugt 1 and Jammerbugt 2 with a total number of 21 and 33 1x1 km squares in each study area, respectively. In the two areas, there is a conflict day average of 1.6 and 1.3 in the period from 2014-2018, respectively (Fig. 9, Table 3). The average fishing intensity with active and passive gears for the period 2009-2018 can be seen in Figure 10. Both areas experience a high fishing intensity from Dutch beam trawler and are heavily affected by marine traffic (Fig. 11)

In both potential study areas in the Jammerbugt the sediment is classified as sand (Fig. 12, Table 3)

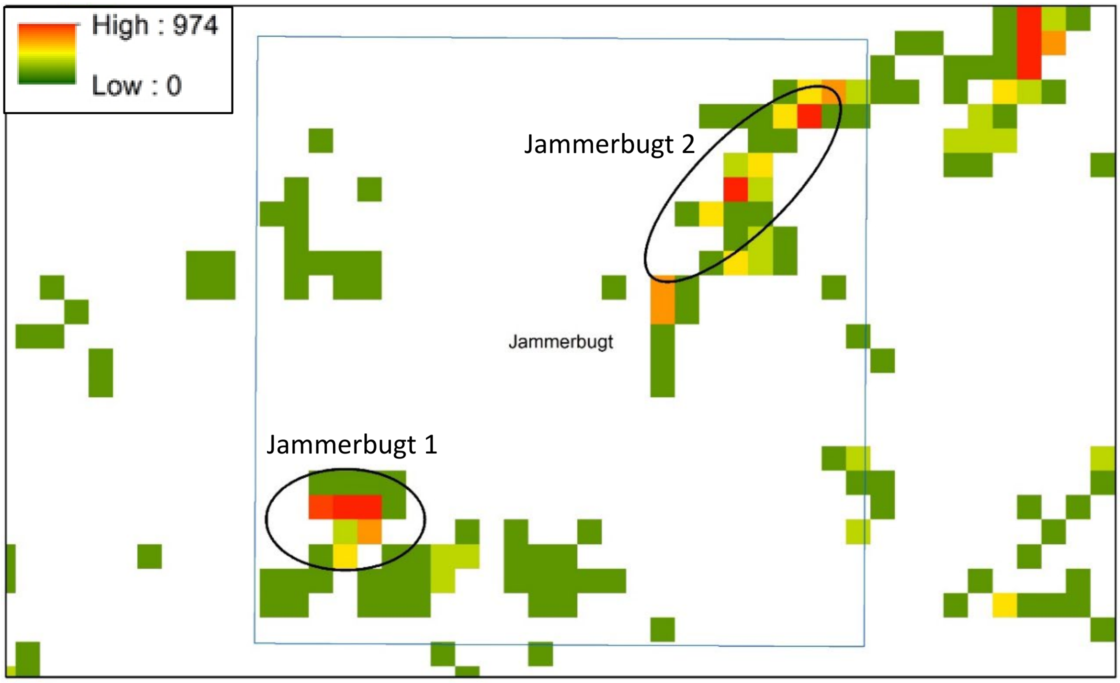


Figure 9. Map of the Jammerbugt focus area and the two potential study areas, showing the number of days with overlap between active and passive gears from 2018-2018 in a 1km grid.

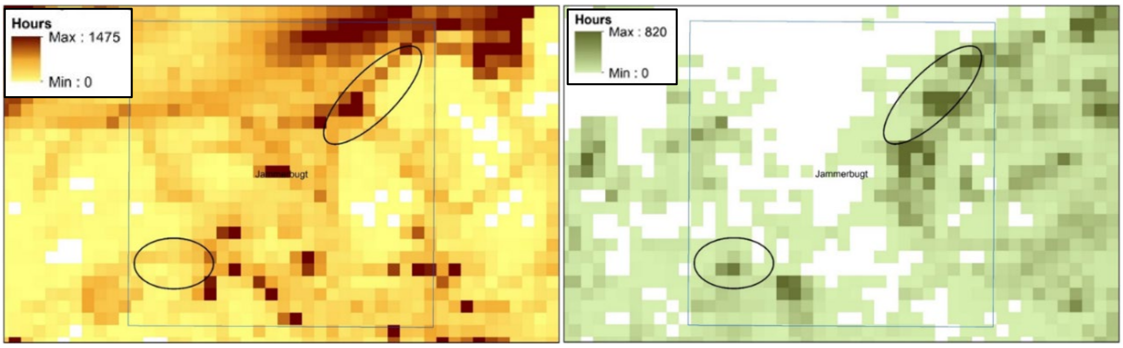


Figure 10. Left) Average fishing intensity with active gears in the Jammerbugt area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Jammerbugt area for the period 2009-2018.

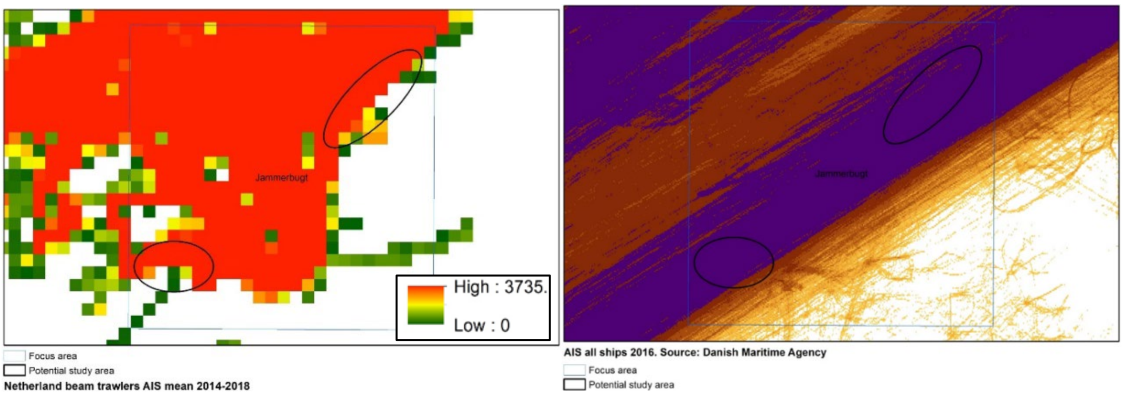


Figure 11. Left) AIS pings from 12 Dutch beam trawlers in the Jammerbugt area. Right) AIS pings from marine traffic (2016) in the Jammerbugt area.

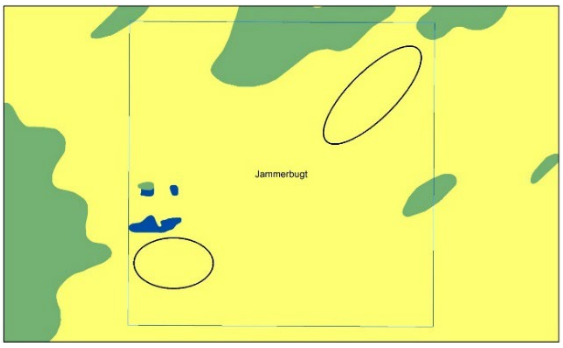


Figure 12. Left) The EUNIS habitat map for the Jammerbugt area. Yellow is sand areas, green is mixed sediment and blue is coarse sediment.

Table 3. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type in the Jammerbugt area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. Area
Jammerbugt 1	23.5	13.6	18.5	7.0	1.6	33.0	12 (21)	Sand	21.1	100.0
Jammerbugt 2	24.5	11.4	17.6	8.0	1.3	44.0	18 (33)	Sand	32.2	100.0

Inner Danish waters
First priority stone reefs and sandy/soft bottom area

<u>*Langelandsbælt*</u>
The Langelandsbælt area includes four potential study areas: Langelandsbælt 1, Langelandsbælt 2, Langelandsbælt 3 and Langelandsbælt 4 with a total number of 12, 20, 55 and 25 1x1 km squares in each study area respectively.

In the two middle areas Langelandsbælt 1 and 2, we find areas with a large number of overlaps between active and passive gears. In area 1, we find both the highest average of 5.3 days with overlap and the highest maximal value for the Inner Danish waters, with 23 days of overlap. Area 2, 3 and 4 have an average of 1.3, 0.7 and 0.3 days respectively (Fig. 13, Table 4). The average fishing intensity with active gears are high in area 1 and 2 (Fig. 14 (left)) and high for passive gears in area 3 and 1 (Fig. 14(right)).

According to the EUNIS maps, the sediment type in Langelandsbælt 1 is mainly sand and mixed sediment. Area 2 is only mixed sediment and Langelandsbælt 3 and 4 is half mixed and half sand. (Fig. 15 (right), Table 4). However, according to Figure 15 there is a stone reef in the southern part of Langelandsbælt 3 and in the middle of area 4.

The Langelandsbælt 1 area is heavily affected by marine traffic, whereas the three other areas only have little marine traffic (Fig. 16).

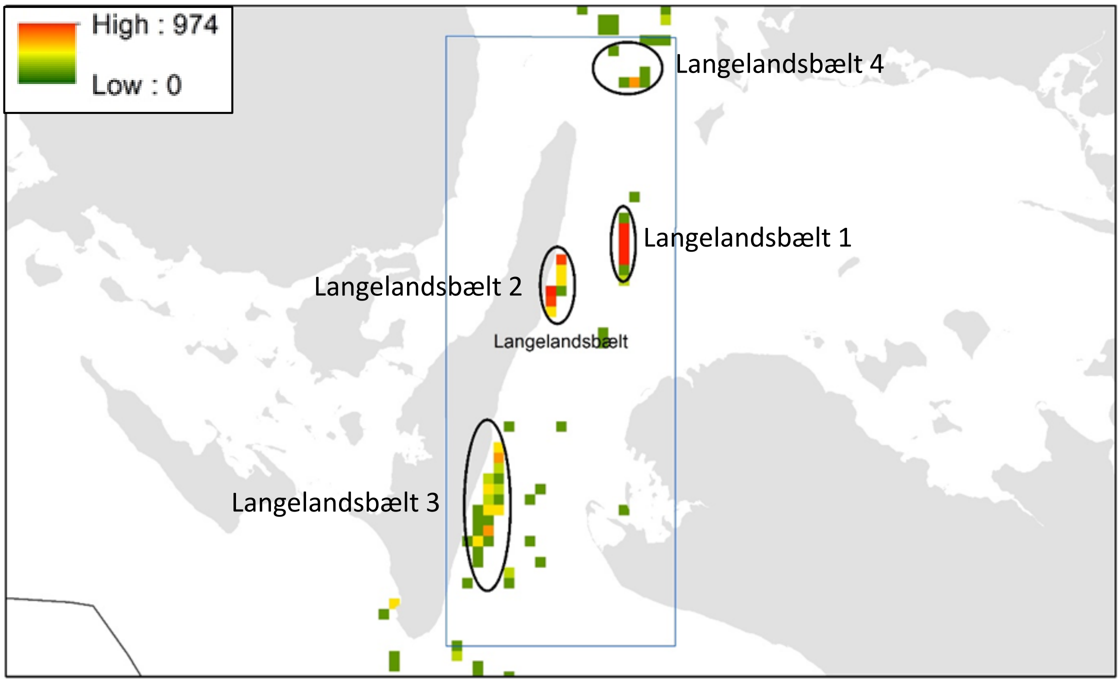


Figure 13. Map of the Langelandsbælt focus area and the four potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

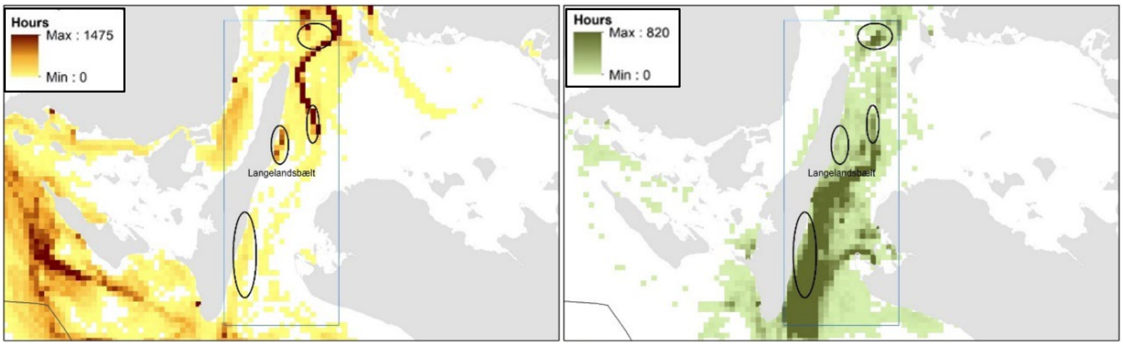


Figure 14. Left) Average fishing intensity with active gears in the Langelandsbælt area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Langelandsbælt area for the period 2009-2018.

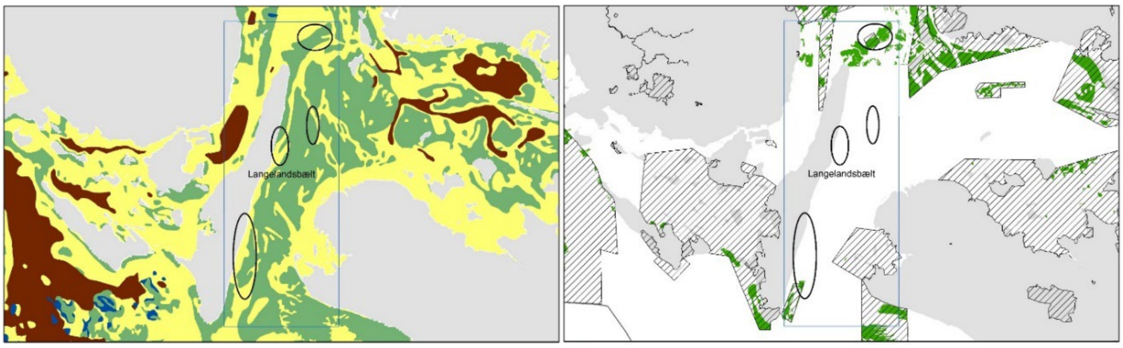


Figure 15. Left) The EUNIS habitat map for the Langelandsbælt area. Yellow is sand areas, green is mixed sediment, brown is mud and blue is coarse sediment. Right) The Natura 2000 stone reef areas around Langelandsbælt. Natura 2000 areas, Mapped stone reef in Natura 2000 areas.

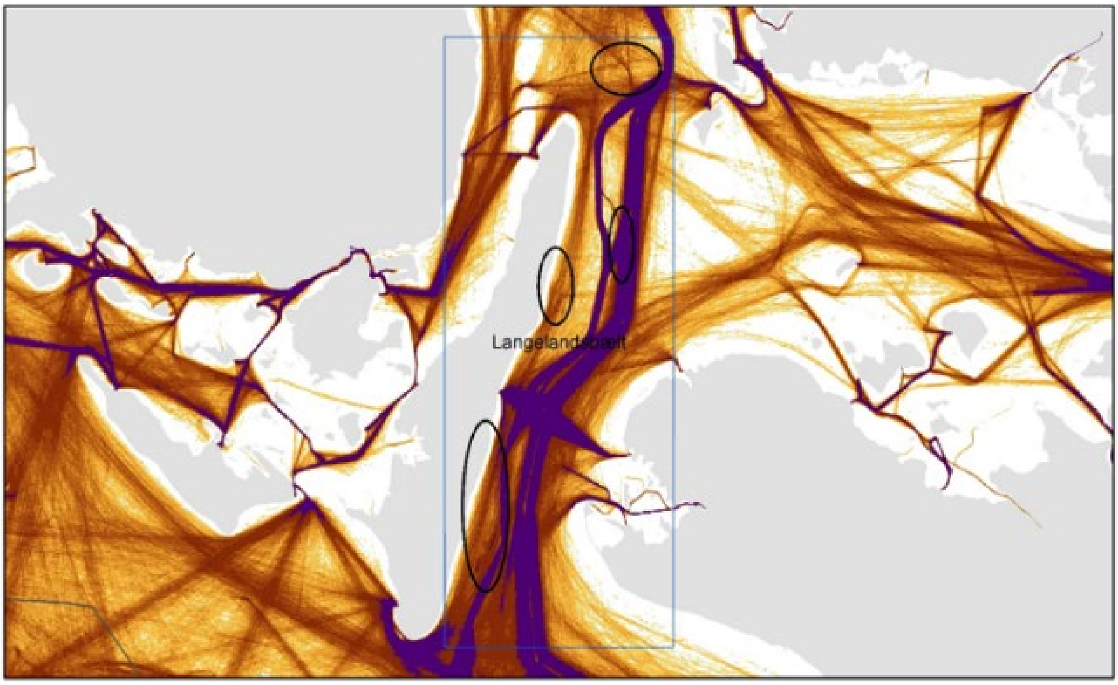


Figure 16. AIS pings from marine traffic (2016) in the Langelandsbælt area.

Table 4. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Langelandsbælt area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. Area
Langeland 1	42.3	18.0	26.9	23.0	5.3	64.0	6 (12)	Mixed sediment	10.6	79.2
								Sand	2.8	20.8
Langeland 2	17.1	1.0	10.3	6.0	1.3	26.0	7 (20)	Mixed sediment	6.7	43.4
								Sand	8.8	56.6
Langeland 3	49.6	1.0	17.4	4.0	0.7	41.0	21 (55)	Mixed sediment	19.1	44.0
								Muddy sand	7.0	16.0
								Sand	17.4	40.0
Langeland 4	36.5	6.5	17.9	4.0	0.3	8.0	6 (25)	Mixed sediment	13.4	51.5
								Muddy sand	10.1	39.0
								Sand	2.5	9.5

Area West of Bornholm

The area West of Bornholm consist of three potential study areas: West of Bornholm 1, West of Bornholm 2 and West of Bornholm 3 with a total number of 67, 35 and 13 1x1 km squares in each study area, respectively. In all three areas, we only see a small number of overlaps between active and passive gears, however a Swedish not yet published project has found more than 1km old nets in two locations (2x2 km) in the West of Bornholm area 1 (Fig. 20 (left)). In the recent period 2014-2018 we find days with overlap between active and passive gears to be only 0.1 – 0.2 days on average (Fig. 17, Table 5). All three areas have relatively high passive fishing intensity, and only in the southern part of West of Bornholm 2, there is a medium to high fishery with active gears (Fig. 18).

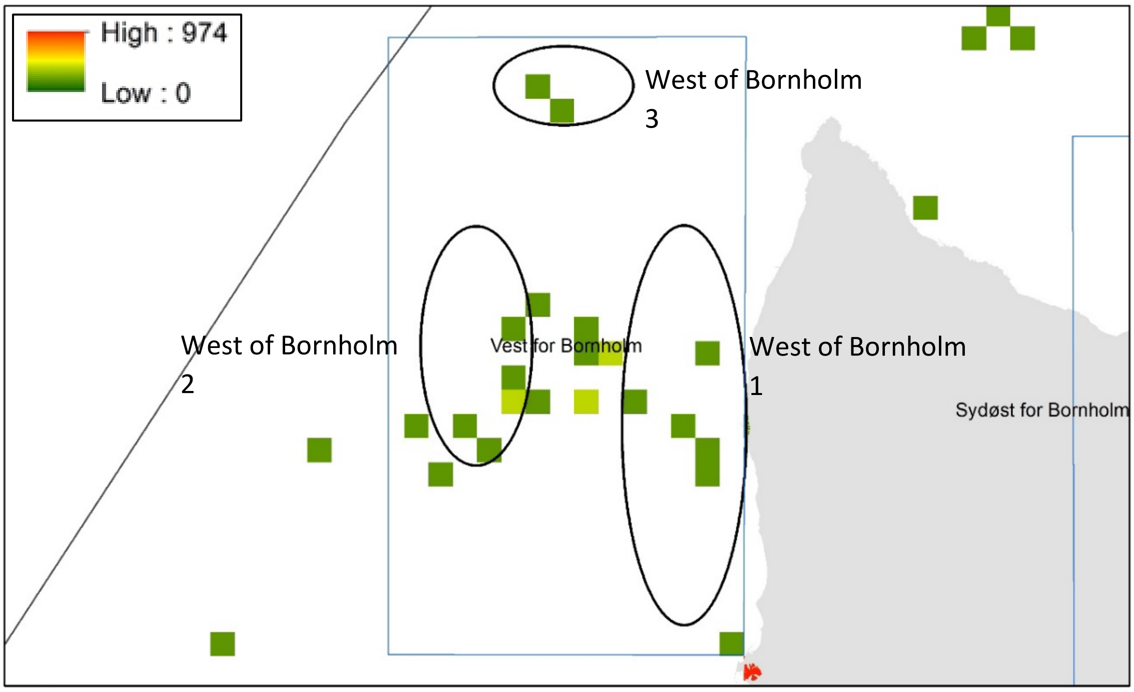


Figure 17. Map of the West of Bornholm focus area and the three potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

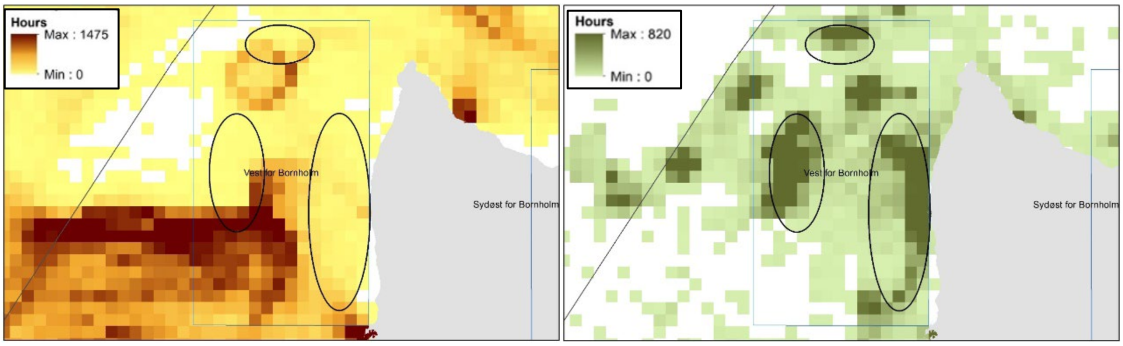


Figure 18. Left) Average fishing intensity with active gears in the area West of Bornholm for the period 2009-2018. Right) Average fishing intensity with passive gears in the area Vest for Bornholm for the period 2009-2018

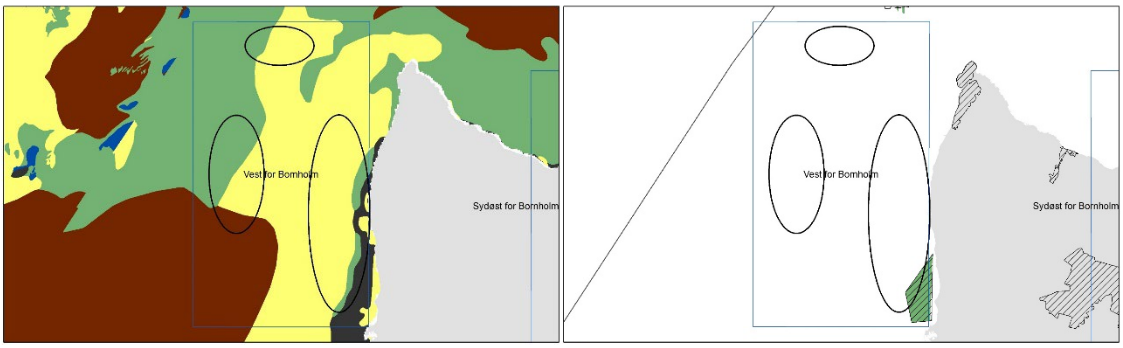


Figure 19. Left) The EUNIS habitat map for the area West of Bornholm. Yellow is sand areas, green is mixed sediment, brown is mud, dark green is rock and other hard substrata and blue is coarse sediment. Right) The Natura 2000 stone reef area west of Bornholm. Natura 2000 areas, Mapped stone reef in Natura 2000 areas.

According to the EUNIS maps, the sediment type in the area West of Bornholm 1, which is very close to the coast, is a complex area with mixed sediment, rocks and sand. In addition the southern part of Area 1 is classified as a Natura 2000 stone reef area. Area 2 is mainly sand and mixed sediment, and the area Vest for Bornholm 3 is all sand (Fig. 19, Table 5).
The depth differs much between the three areas. The coastal area 1 has a mean depth of 28.9 meters ranging from 0.6 – 41.6 meters, whereas the two other areas both have mean depths of >40 meters (Table 5).
Area 3 partly cover a marine traffic route and in the middle of the eastside of area 1 is a harbour, causing much marine traffic in parts of the areas (Fig. 20 (right)).

Table 5. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the West of Bornholm area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. area
West of Bornholm 1	41.6	0.6	28.9	1.0	0.1	5.0	5 (67)	Mixed sediment	6.4	9.6
								Muddy sand	1.4	2.1
								Rock or other hard substrata	7.0	10.6
								Sand	51.6	77.8
West of Bornholm 2	51.0	38.6	43.3	2.0	0.2	6.0	5 (35)	Fine mud	4.4	12.4
								Mixed sediment	17.5	48.9
								Muddy sand	13.8	38.7
West of Bornholm 3	50.4	35.1	46.4	1.0	0.2	2.0	2 (13)	Mixed sediment	3.7	24.8
								Muddy sand	10.4	70.8
								Sand	0.7	4.4

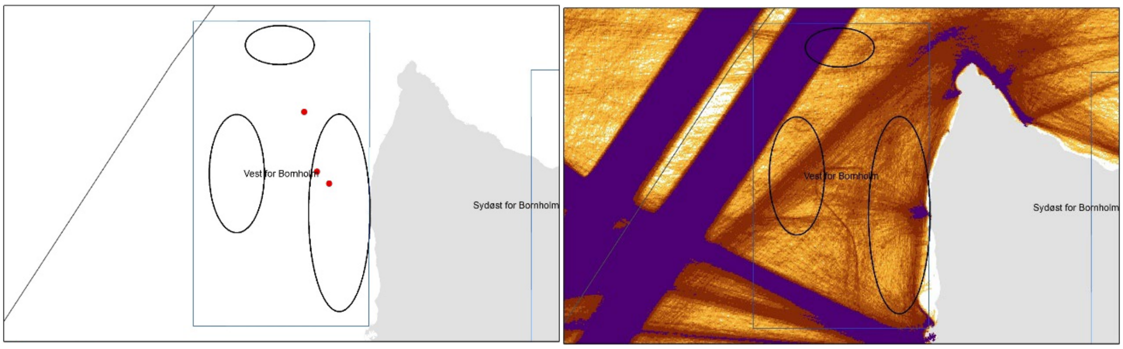


Figure 20. Left) Red dots indicate findings of >1 km old fishing nets within a 2x2 km square in a not yet published Swedish ghost net project. Right) AIS pings from marine traffic (2016) in the area West of Bornholm.

Second priority areas.

We have in total selected 6 second priority areas. Three of these, Hanstholm, Hirtshals and Jyske Vestkyst are in the North Sea/Skagerrak area and have in total 9 smaller focus areas that in total covers 334 1x1 km squares. The Jyske Vestkyst area actually covers both bottom types requested for this survey, but is not selected as first priority, due to the long steaming time associated with a survey in this area. The Hanstholm and Hirtshals areas are very conveniently located close to a harbour and the Hirtshals area even covers both bottom types requested for the survey. These areas are second priority, due to a lower passive fishing intensity than Gule Rev and Store Rev.

The three second priority areas in the Inner Danish waters are the area Southeast of Bornholm, Store Middelgrund and the Øresund. These three areas also have 7 smaller focus areas and cover in total 179 1x1 km squares. The area Southeast of Bornholm is the deepest area selected and too deep for this survey with the technologies available. The Store Middelgrund is a stone reef area and is second priority, due to the long steaming time associated with a survey in this area. The Øresund area have a ban on active fishing gear and have been selected as a second priority area due to this missing conflict between active and passive gears.

All the second priority areas are described in detail in the following section. First, a description of the North Sea/Skagerrak areas and then a description of the Skagerrak areas.

North Sea/Skagerrak area.
Second priority areas

<u>*Jyske Vestkyst*</u>
The Jyske Vestkyst area is the largest of the selected areas and includes four potential study areas: Jyske Vestkyst 1, Jyske Vestkyst 2, Jyske Vestkyst 3 and Jyske Vestkyst 4 with a total number of 135, 27, 13 and 36 1x1 km squares in each study area, respectively. In Jyske Vestkyst 1 you find a square with 20 conflict days from 2014-2018, which is the highest number for this area. The average number of days of overlap between active and passive gears in the Jyske Vestkyst area 1 to 3 is 1.8-1.9 days. Jyske Vestkyst area 4 is with an average of 0.1 days with overlap much lower but is selected due to the Natura 2000 reef (Fig. 20, Table 6). In the Jyske Vestkyst areas 1 and 4 areas with high fishing intensity with passive gears can be identified in the period 2009-2018 (Fig. 21)

There is little to moderate marine traffic in the areas, in Jyske Vestkyst area 2 we find some Dutch beam trawler activity (Fig. 22)

In all study areas, except Jyske Vestkyst 4, the sediment is mainly sand, with small areas of coarse sediment and/or mixed sediment. In area 4, most of the area is classified as Natura 2000 reef area and the EUNIS map describes around 70 % of the area as coarse substrate (Fig. 23, Table 6).

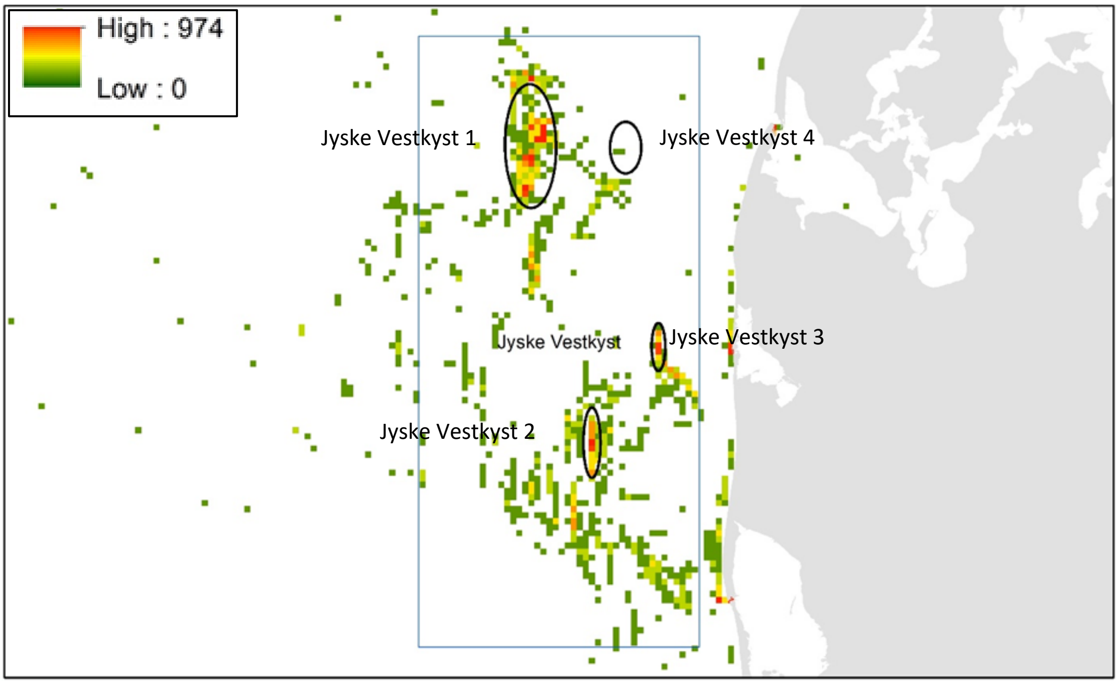


Figure 20. Map of the Jyske Vestkyst focus area and the three potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

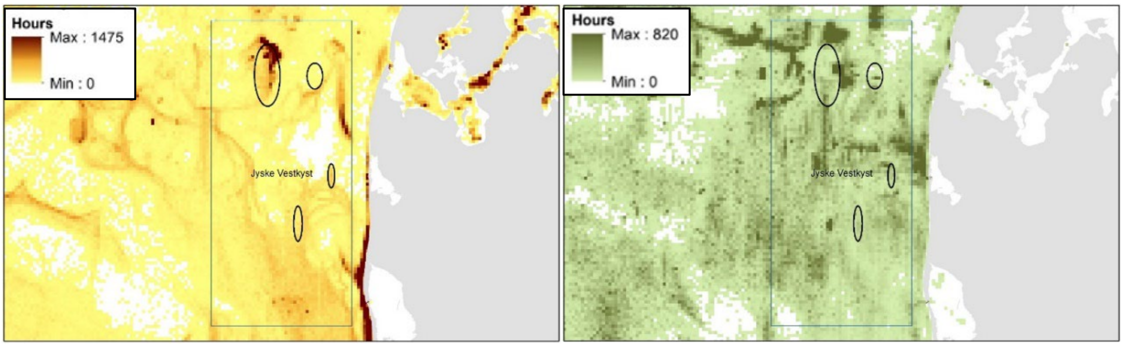


Figure 21. Left) Average fishing intensity with active gears in the Jyske Vestkyst area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Jyske Vestkyst area for the period 2009-2018

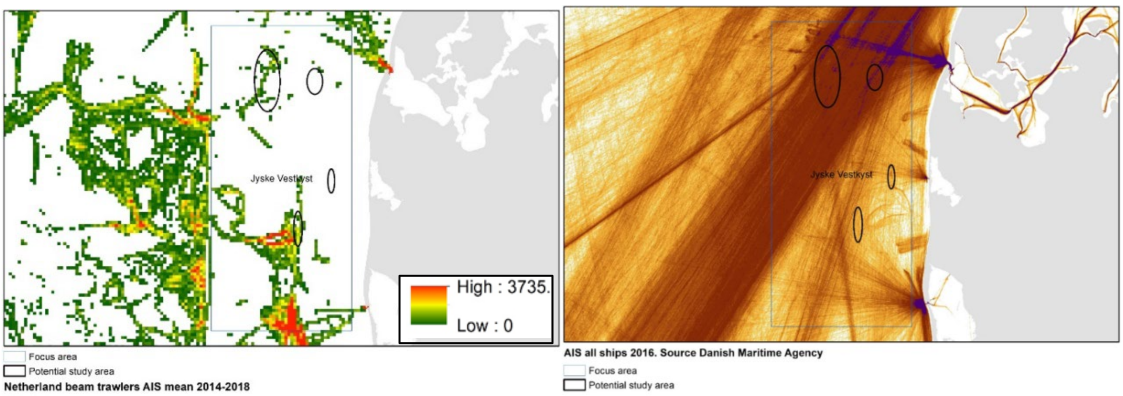


Figure 22. Left) AIS pings from 12 Dutch beam trawlers in the Jyske Vestkyst area. Right) AIS pings from marine traffic (2016) in the Jyske Vestkyst area.

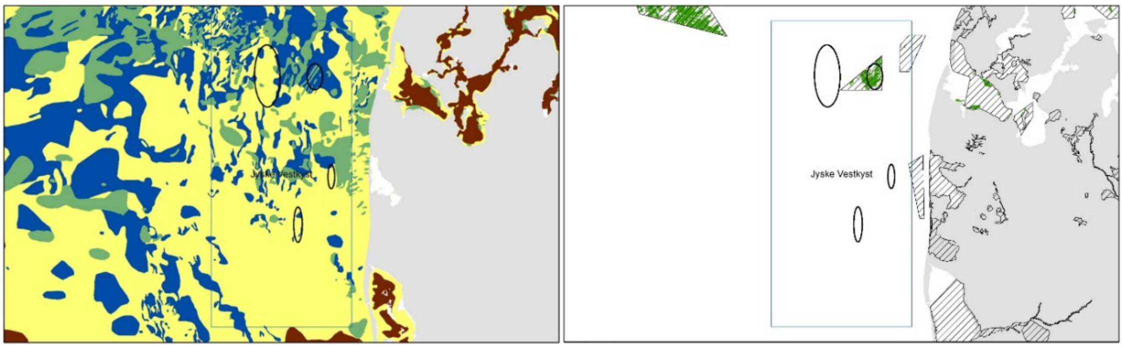


Figure 23. Left) The EUNIS habitat map for the Jyske Vestkyst area. Yellow is sand areas, green is mixed sediment, brown is mud and blue is coarse sediment. Right) The Jyske Vestkyst Natura 2000 stone reef area. Natura 2000 areas, Mapped stone reef in Natura 2000 areas.

Table 6. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Jyske Vestkyst area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. area
Jyske Vestkyst 1	40.3	7.9	31.0	20.0	1.8	245.0	92 (135)	Coarse substrate	18.9	13.9
								Mixed sediment	5.7	4.2
								Sand	111.0	81.9
Jyske Vestkyst 2	31.0	13.6	24.2	6.0	1.9	52.0	17 (27)	Coarse substrate	4.0	15.4
								Sand	21.7	84.6
Jyske Vestkyst 3	26.0	10.6	18.7	5.0	1.8	24.0	8 (13)	Coarse substrate	0.9	6.8
								Sand	13.0	93.2
Jyske Vestkyst 4	31.4	11.1	24.4	1.0	0.1	2.0	2 (36)	Coarse substrate	24.5	71.0
								Mixed sediment	9.6	27.7
								Sand	0.5	1.3

Hanstholm

The Hanstholm area is an area close to the coast and it includes two potential study areas: Hanstholm 1 and Hanstholm 2 with a total number of 37 and 27 1x1 km squares in each study area, respectively. In Hanstholm area 1, you find a conflict day average of 4.2 in the period from 2014-2018. In Hanstholm 2, the average number of days with overlap between active and passive gears is 2.4 (Fig. 24, Table 7). The average fishing intensity with active and passive gears for the period 2009-2018 can be seen in Figure 25.

In both potential study areas, there is only a minor activity from Dutch beam trawler, but there is much marine traffic in around half of each of the areas (Fig. 26).

In both Hanstholm areas the sediment type is mainly sand, in Hanstholm 2 can however also be found a minor area with mixed sediment (Fig. 27, Table 7).

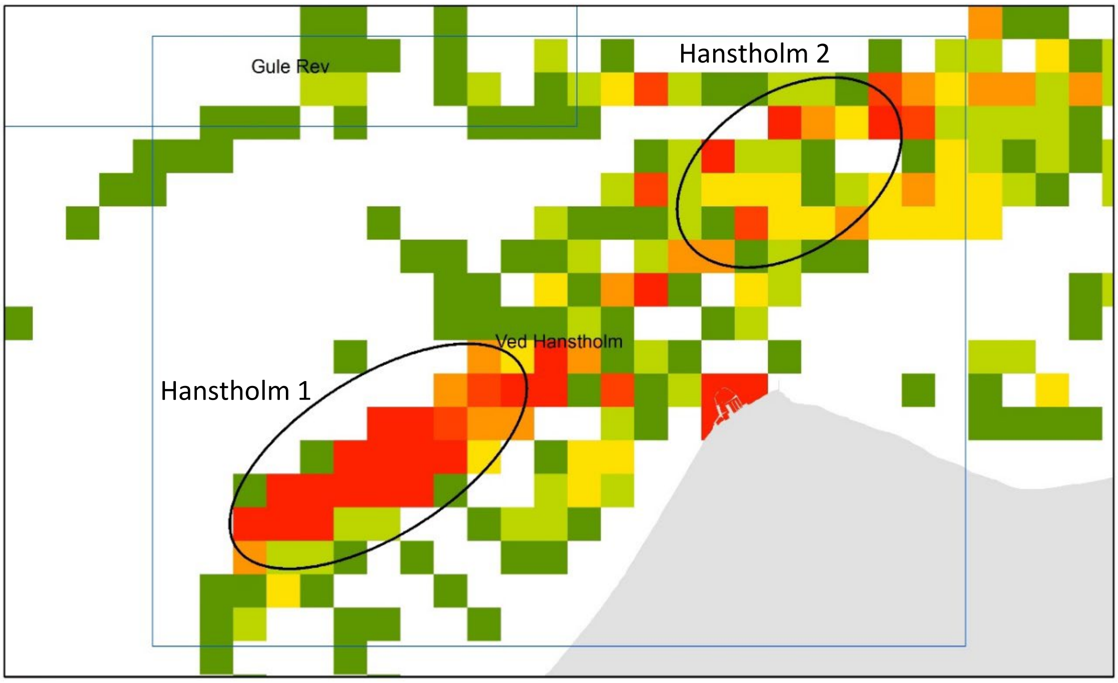


Figure 24. Map of the Hanstholm focus area and the three potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

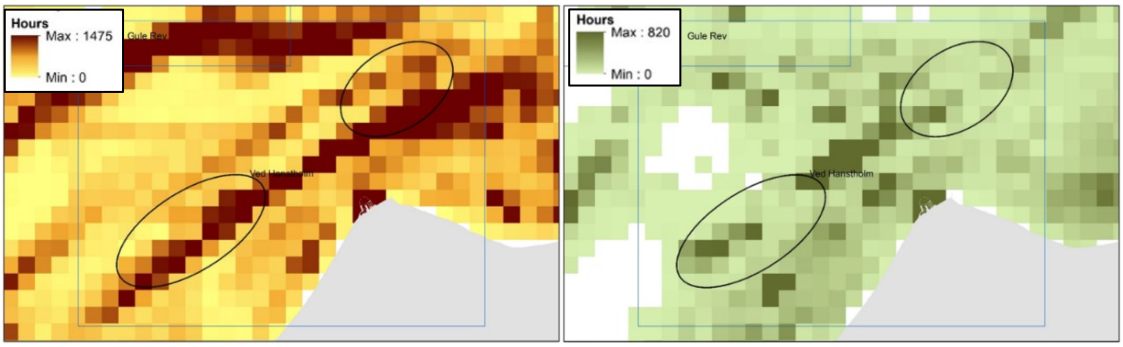


Figure 25. Left) Average fishing intensity with active gears in the Hanstholm area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Hanstholm area for the period 2009-2018.

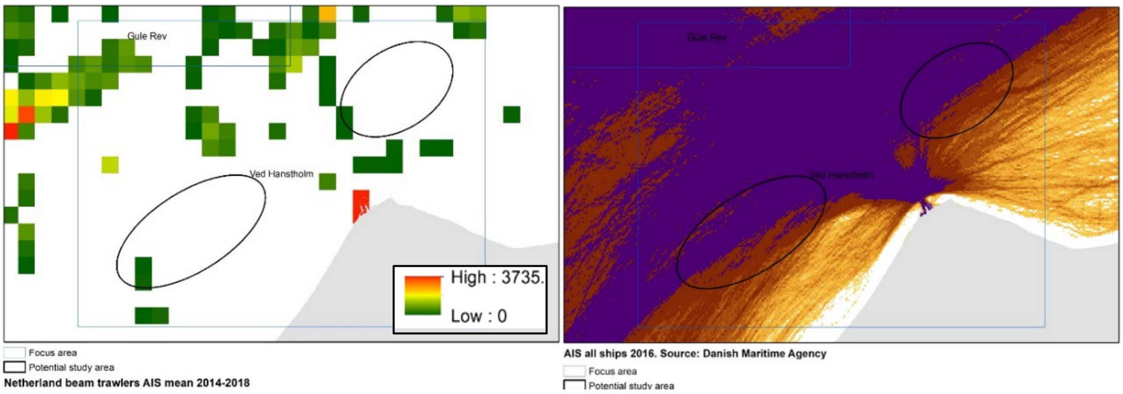


Figure 26. Left) AIS pings from 12 Dutch beam trawlers in the Hanstholm area. Right) AIS pings from marine traffic (2016) in the Hanstholm area.

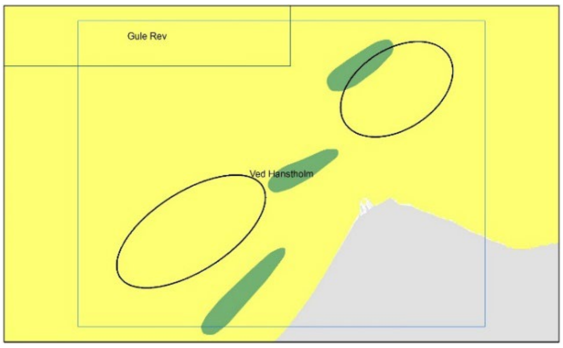


Figure 27. Left) The EUNIS habitat map for the Hanstholm area. Yellow is sand areas and green is mixed sediment.

Table 7. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Hanstholm area.

Name	**Depth**			**Number of days with overlap between active and passive gears. Sum 2014-2018**			**Number of cells with overlap (total number of cells)**	**EUNIS habitat type**		
	Max depth (m)	**Min depth (m)**	**Mean depth**	**MAX**	**MEAN**	**SUM**		**Substrate**	**Sum area km²**	**pct. area**
Hanstholm 1	34.0	12.6	23.3	13.0	4.2	155.0	26 (37)	Sand	37.5	100.0
Hanstholm 2	32.5	13.6	24.0	7.0	2.4	65.0	23 (27)	Mixed sediment	2.1	7.5
								Sand	25.6	92.5

<u>Hirtshals</u>

The Hirtshals area is an area close to the coast and includes three potential study areas: Hirtshals 1, Hirtshals 2 and Hirtshals 3 with a total number of 28, 9 and 22 1x1 km squares in each study area, respectively. In the Hirtshals 1 area, you find a square with 24 conflict days, in the period 2014-2018, which is the highest number for this area. The average number of days with overlap between active and passive gears is in the Hirtshals 1 and 2, very similar with 3.6 and 3.7 respectively, whereas Hirtshals area 3 have an average of 0 conflict days (Fig. 28, Table 8). The average fishing intensity with active and passive gears for the period 2009-2018 can be seen in Figure 29.

There is some Dutch beam trawler activity in the Hirtshals 1 area and in the area between Hirtshals area 1 and 2. It is also in and around these two study areas a heavy marine traffic is found (Fig. 30).

In the Hirtshals area 1, around half of the area is classified as mixed sediment and the other half is classified as sand. In Hirtshals area 2, a major part of the area is mixed sediment with some sand and in area 3 most of the area is sand with some mixed sediment. The mixed sediment in Hirtshals area 2 and 3 is classified as Natura 2000 stone reef (Fig. 31, Table 8).

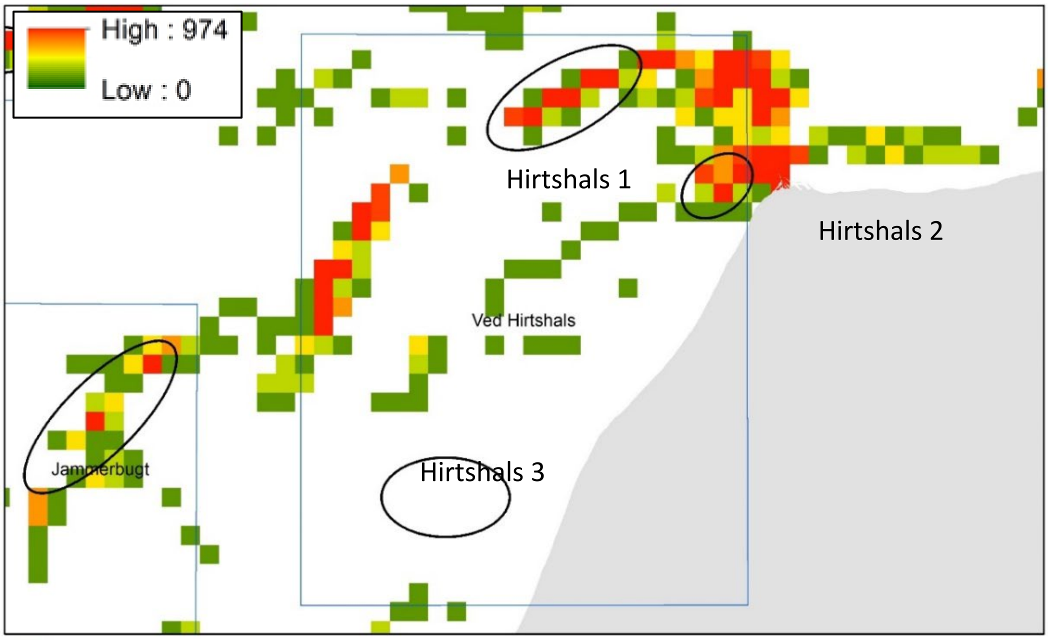


Figure 28. Map of the Hirtshals focus area and the potential study area, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

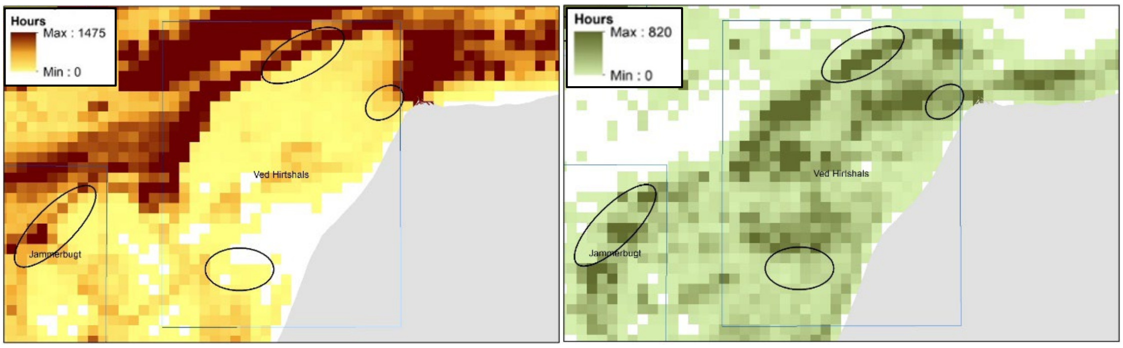


Figure 29. Left) Average fishing intensity with active gears in the Hirtshals area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Hirtshals area for the period 2009-2018.

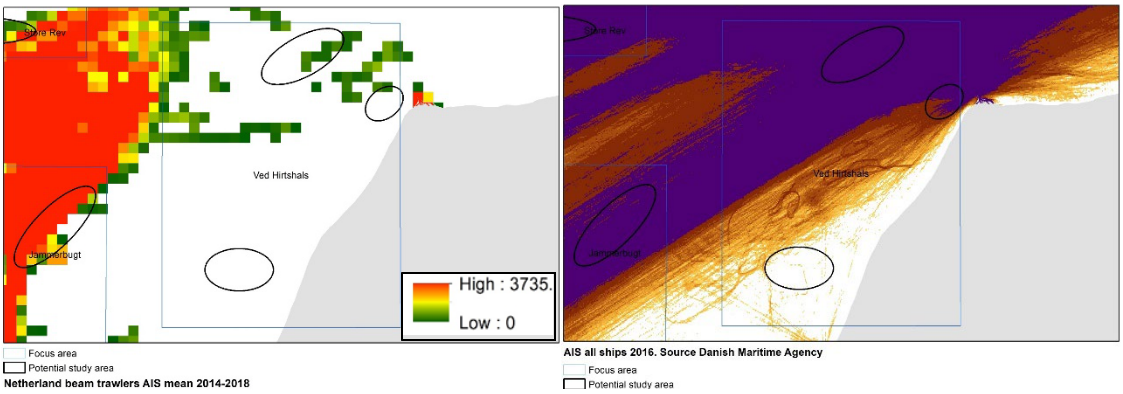


Figure 30. Left) AIS pings from 12 Dutch beam trawlers in the Hirtshals area. Right) AIS pings from marine traffic (2016) in the Hirtshals area.

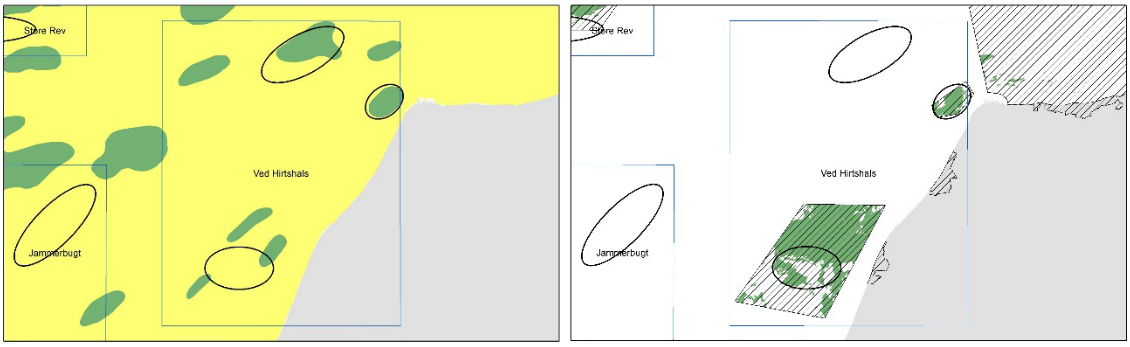


Figure 31. Left) The EUNIS habitat map for the Hirtshals area. Yellow is sand areas and green is mixed sediment. Right) The Natura 2000 stone reef areas around Langelandsbælt, ▨ Natura 2000 areas, ■ Mapped stone reef in Natura 2000 areas.

Table 8. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Hirtshals area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. area
Hirtshals 1	33.2	15.8	26.2	24.0	3.6	101.0	14 (28)	Mixed sediment	14.4	52.1
								Sand	13.3	47.9
Hirtshals 2	20.7	11.6	16.1	6.0	3.7	33.0	8 (9)	Mixed sediment	7.2	77.2
								Sand	2.1	22.8
Hirtshals 3	18.6	12.8	15.9	0.0	0.0	0.0	0 (22)	Mixed sediment	1.3	6.0
								Sand	20.7	94.0

The inner Danish waters.
Second priority areas

<u>Area Southeast of Bornholm</u>
The area Southeast of Bornholm includes three potential study areas: Southeast of Bornholm 1, Southeast of Bornholm 2 and Southeast of Bornholm 3 with a total number of 55, 29 and 35 1x1 km squares in each study area, respectively. In the area Southeast of Bornholm 2, we find a square with 11 overlaps between active and passive gears in the period 2014-2018. This is one of the highest values of the focus areas in the Inner Danish waters. The average number of days of overlap between active and passive gears in this area is however only between 0.4 – 1.2 days (Fig. 32, Table 9). The average fishing intensity with active and passive gears for the period 2009-2018 can be seen in Figure 33.

According to the EUNIS map, the sediment type in the area Southeast of Bornholm 1 is mainly mud with a small part of mixed sediment. Area 2 is mainly mixed sediment with a minor part of sand and the area Southeast of Bornholm 3 is all sand. (Fig. 34 (left), Table 9).

There is only little marine traffic in the three selected areas (Fig. 34 (right)).

The water depth in this area is very high with a minimum depth in each of the three areas of 82.5, 48.9, and 53.5m (Table 9), respectively. This makes the area unsuited for a survey with the current techniques for locating lost fishing gear, as there is large risk that lost fishing gears cannot be identified even if there are any present.

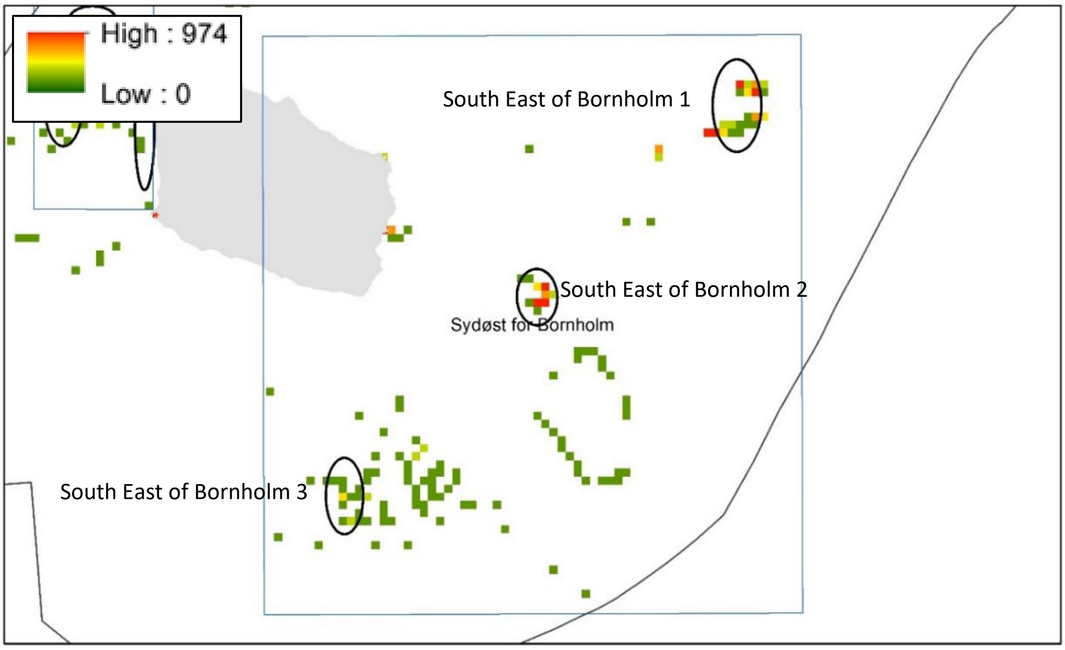


Figure 32. Map of the Southeast of Bornholm focus area and the three potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

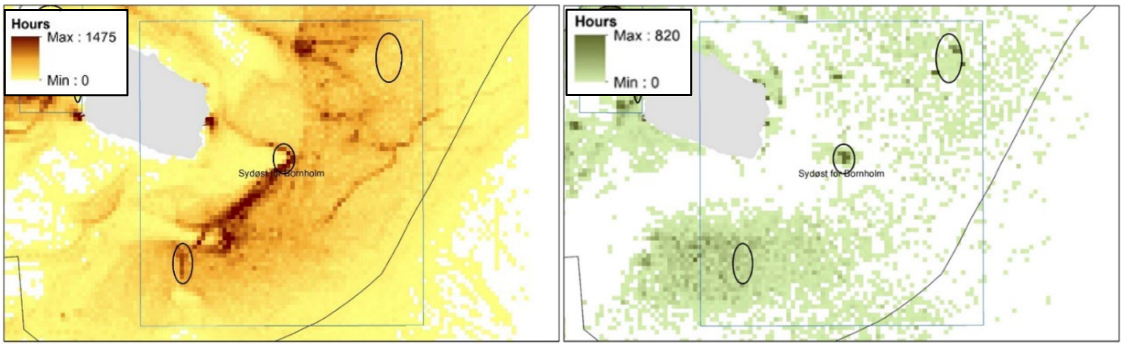


Figure 33. Left) Average fishing intensity with active gears in the area Southeast of Bornholm for the period 2009-2018. Right) Average fishing intensity with passive gears in the area Southeast of Bornholm for the period 2009-2018.

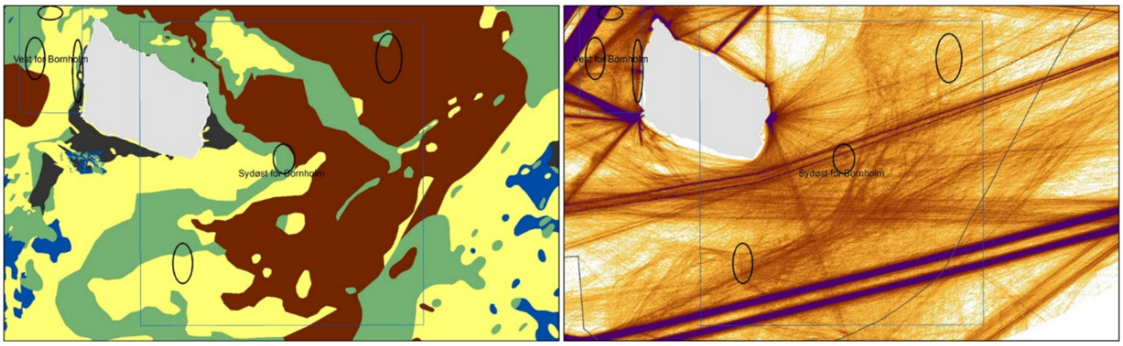


Figure 34. Left) The EUNIS habitat map for the area Southeast of Bornholm. Yellow is sand areas, green is mixed sediment, brown is mud, dark green is rock and biogenic reef and blue is coarse sediment. Right) AIS pings from marine traffic (2016) in the area Southeast of Bornholm.

Table 9. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Southeast of Bornholm area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. area
Southeast of Bornholm 1	95.7	82.5	89.8	8.0	0.7	41.0	16 (55)	Fine mud	47.5	87.9
								Mixed sediment	6.6	12.1
Southeast of Bornholm 2	80.9	48.9	67.4	11.0	1.2	36.0	10 (29)	Fine mud	1.7	6.3
								Mixed sediment	24.4	88.9
								Sand	1.3	4.8
Southeast of Bornholm 3	63.2	53.5	58.9	3.0	0.4	15.0	12 (35)	Mixed sediment	8.8	25.8
								Muddy sand	25.4	74.2

Store Middelgrund
The Store Middelgrund area includes two potential study areas: Store Middelgrund 1 and Store Middelgrund 2 with a total number of 23 and 16 1x1 km squares in each study area, respectively. In the Store Middelgrund area, we find a low number of days with overlap between active and passive gears. The two areas have an average of 0.7 and 0.6 days, respectively (Fig. 35, Table 10). The average fishing intensity with active and passive gears for the period 2009-2018 can be seen in Figure 36.

According to the EUNIS maps, the sediment type in the area Store Middelgrund 1 is mainly muddy sand and some smaller areas with mixed sediments. In area 2 there is mainly sand or muddy sand with a minor area of coarse sediment (Fig. 37, Table 10). According to Figure 36 (right) there is a Natura 2000 stone reef in close vicinity to the Store Middelgrund 2 area.

The average depth in Store Middelgrund 1 and 2 are 31.2 and 27.2m, respectively (Table 10). The Store Middelgrund 1 area is in the middle of a sail route and thereby heavily affected by marine traffic (Fig. 38).

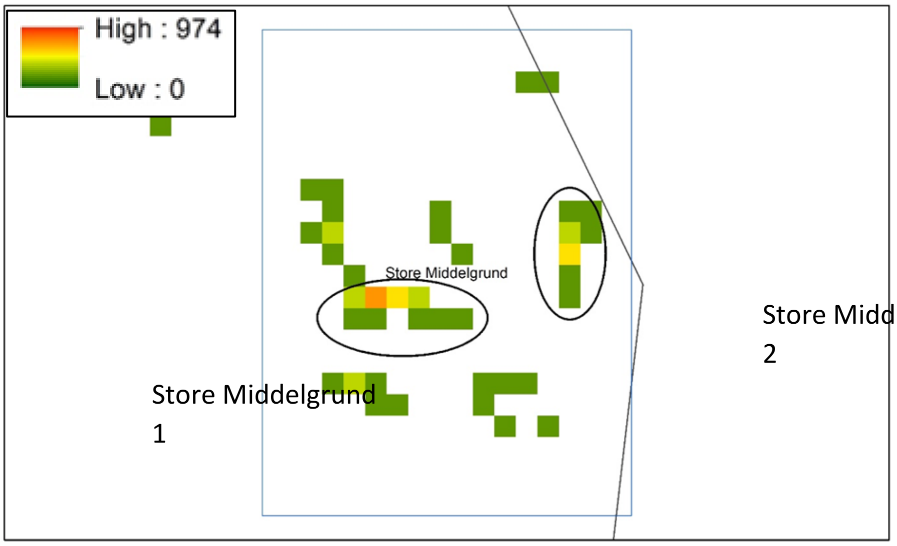


Figure 3.2.35. Map of the Store Middelgrund focus area and the three potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

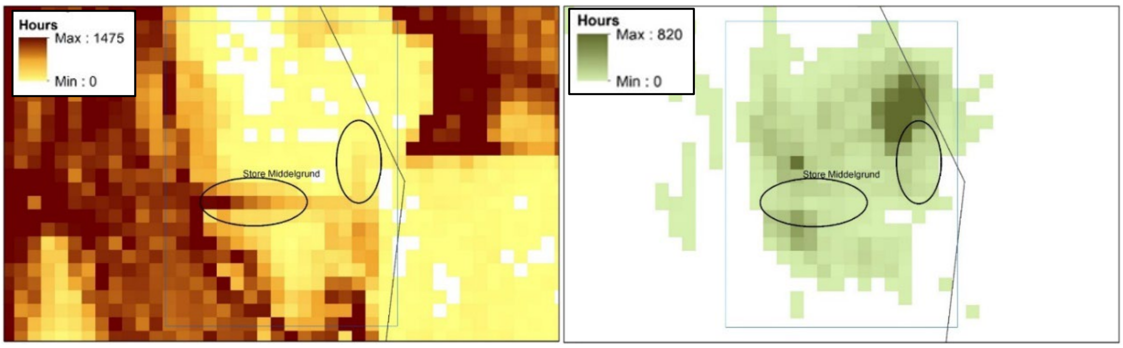


Figure 36. Left) Average fishing intensity with active gears in the Store Middelgrund area for the period 2009-2018. Right) Average fishing intensity with passive gears in the Store Middelgrund area for the period 2009-2018

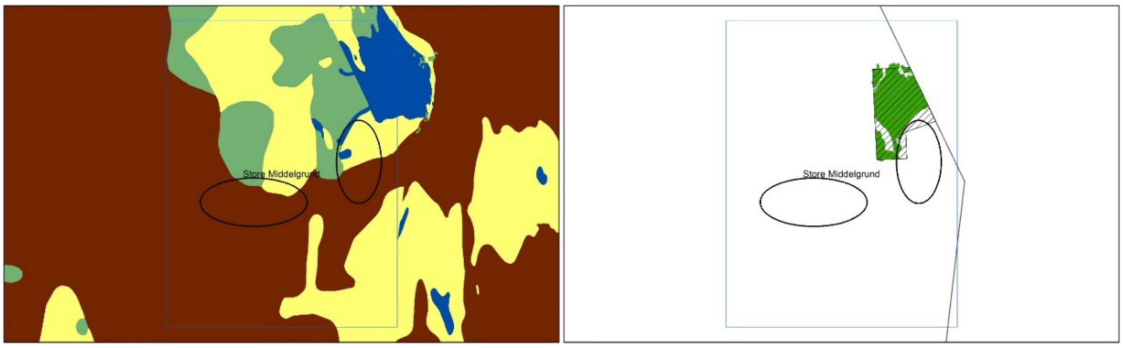


Figure 37. Left) The EUNIS habitat map for the Store Middelgrund area. Yellow is sand areas, green is mixed sediment, brown is mud and blue is coarse sediment. Right) The Store Middelgrund Natura 2000 stone reef area. Natura 2000 areas, mapped stone reef in Natura 2000 areas.

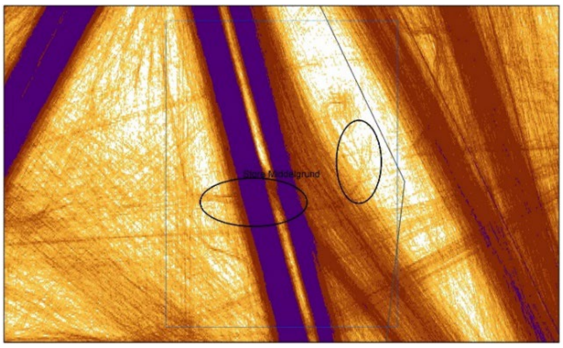


Figure 38. AIS pings from marine traffic (2016) in the Store Middelgrund area.

Table 10. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Store Middelgrund area.

Name	Depth			Number of days with overlap between active and passive gears. Sum 2014-2018			Number of cells with overlap (total number of cells)	EUNIS habitat type		
	Max depth (m)	Min depth (m)	Mean depth	MAX	MEAN	SUM		Substrate	Sum area km²	pct. area
Store Middelgrund 1	33.0	29.2	31.2	4.0	0.7	16.0	9 (23)	Mixed sediment	0.9	4.1
								Muddy sand	19.0	85.9
								Sand	2.2	10.0
Store Middelgrund 2	33.9	12.9	27.2	3.0	0.6	10.0	7 (16)	Coarse substrate	1.1	7.2
								Mixed sediment	0.8	4.8
								Muddy sand	7.2	45.2
								Sand	6.8	42.8

Øresund area

The Øresund area includes two potential study areas: Øresund 1 and Øresund 2 with a total number of 5 and 16 1x1 km squares in each study area, respectively.
In the Øresund area there is no conflict between active and passive gears as trawling is prohibited here (Figure 39, Table 11). The average fishing intensity with passive gears are according to Figure 40 (left) relatively high in both areas.

The EUNIS map show that the sediment type in both Øresund areas is mainly sand with some minor areas with coarse sediment in Øresund 1 and with mixed sediment in the Øresund 2 area (Fig. 41, Table 11).

The average depths in Øresund 1 and 2 area are 12.7 and 9.1 m, respectively (Table 11).
Part of the Øresund 1 area is in the sail route and thereby much affected by marine traffic (Fig. 41 (right)).

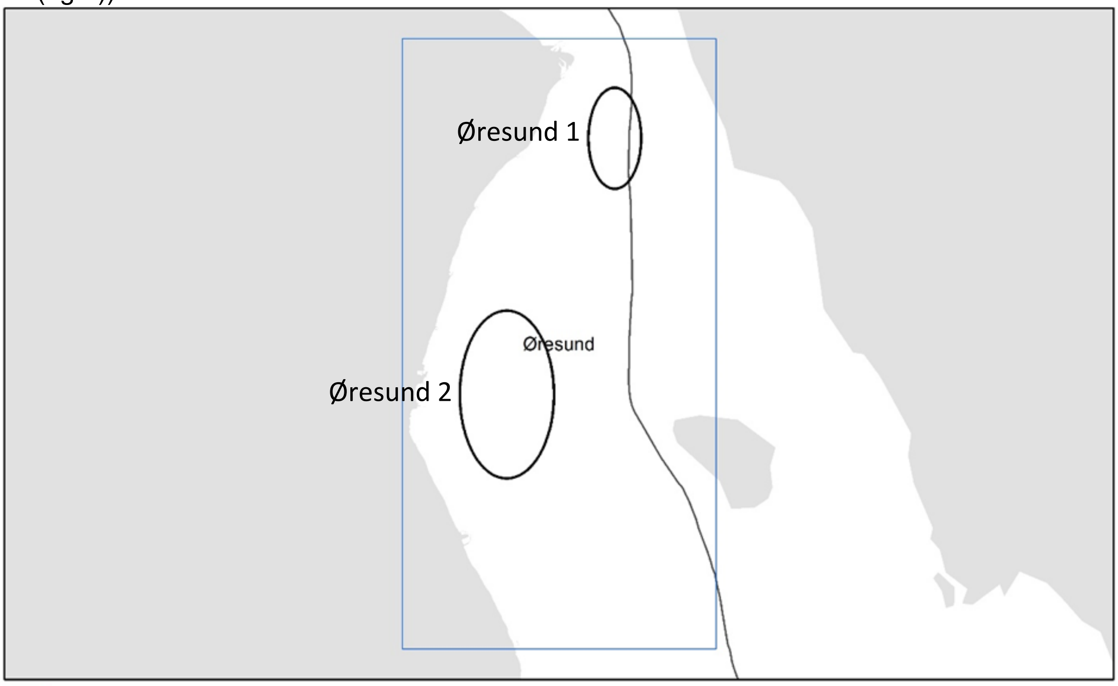


Figure 39. Map of the Øresund focus area and the three potential study areas, showing the number of days with overlap between active and passive gears from 2014-2018 in a 1km grid.

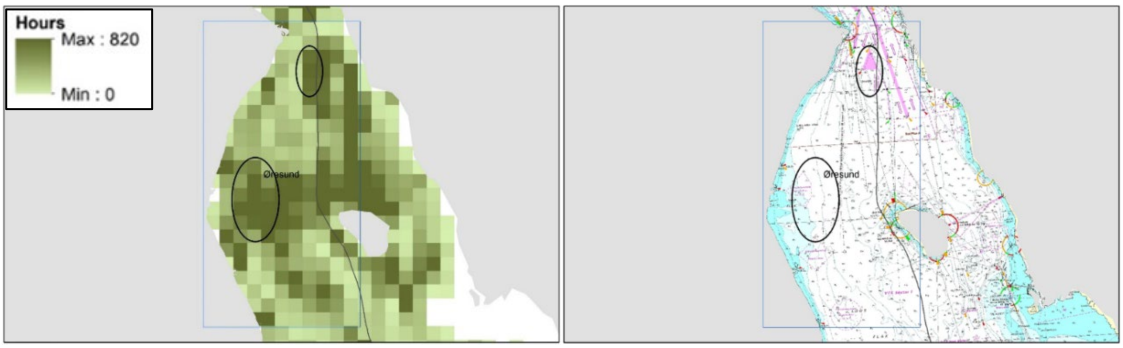


Figure 40. Left) Average fishing intensity with passive gears in the Øresund area for the period 2009-2018. Right) Sea chart of the Øresund area.

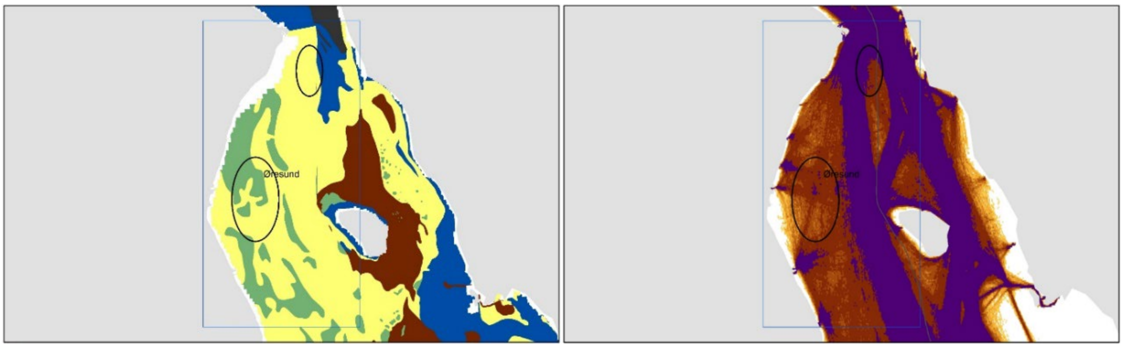


Figure 41. Left) The EUNIS habitat map for the Øresund area. Yellow is sand areas, green is mixed sediment, brown is mud, blue is coarse sediment and dark green is rock and biogenic reef. Right) AIS pings from marine traffic (2016) in the Øresund area.

Table 11. Table showing depth, number of days with overlap between gears, size of the potential study areas and habitat type for the Øresund area.

<table>
<tr><th rowspan="2">Name</th><th colspan="3">Depth</th><th colspan="3">Number of days with overlap between active and passive gears. Sum 2014-2018</th><th rowspan="2">Number of cells with overlap (total number of cells)</th><th colspan="3">EUNIS habitat type</th></tr>
<tr><th>Max depth (m)</th><th>Min depth (m)</th><th>Mean depth</th><th>MAX</th><th>MEAN</th><th>SUM</th><th>Substrate</th><th>Sum area km²</th><th>pct. area</th></tr>
<tr><td rowspan="2">Øresund 1</td><td rowspan="2">22.4</td><td rowspan="2">9.2</td><td rowspan="2">12.7</td><td rowspan="2">0.0</td><td rowspan="2">0.0</td><td rowspan="2">0.0</td><td rowspan="2">0 (5)</td><td>Coarse substrate</td><td>0.6</td><td>10.8</td></tr>
<tr><td>Sand</td><td>4.9</td><td>89.2</td></tr>
<tr><td rowspan="3">Øresund 2</td><td rowspan="3">14.5</td><td rowspan="3">4.0</td><td rowspan="3">9.1</td><td rowspan="3">0.0</td><td rowspan="3">0.0</td><td rowspan="3">0.0</td><td rowspan="3">0 (16)</td><td>Mixed sediment</td><td>5.8</td><td>35.3</td></tr>
<tr><td>Muddy sand</td><td>0.6</td><td>3.4</td></tr>
<tr><td>Sand</td><td>10.0</td><td>61.4</td></tr>
</table>

A.2. Dive survey

By: Eva Maria Pedersen, Jeppe Olsen & Finn Larsen, DTU Aqua.

Summary

Baltic, ICES sub-area 24) were examined by divers for the presence of ghost nets/lost fishing gear. Fishing gear was observed on four of the seven examined wrecks and gear was recovered from three of these wrecks.

The type of fishing gear observed was gillnets, trawls and recreational fishing gear. All the observed fishing gear was entangled with the wreck and some parts were buried in the surrounding sediment. Most of the nets observed were covered in a thin layer of silt, indicating that they were not newly lost. No dead fish or other vertebrates were observed in the nets, however, a large number of dead crabs were observed on M/S Johnny. This was probably caused by oxygen depletion in the area.

The fishing activity from vessels with AIS or VMS have been low for the last 15 years on all surveyed wrecks, supporting the impression from the images that the trawls and nets probably not are lost within recent years. The age of the lost recreational fishing gear is not to be determined based on the images.

Materials and methods

An 8-day dive survey was initially planned for the window 2nd to 15th of June 2020. However, due to the Covid-19 outbreak it had to be postponed to the backup period, 31st of August to 8th of September 2020.

A gross list of wrecks appointed for dive inspection were presented in Chapter 3.1.2 (Table 3.1.3) of the report. However, soon after the publication of the note we realized that the list needed to be revised and extended and we grouped some of the wrecks into priority groups (A-D) based on location, descriptions in databases and local knowledge. This was to optimize the diving time and include more areas that would take into account different weather conditions. During the survey, it became evident that we under the given windy weather conditions (Fig. 1) had still not included enough wrecks in the area around Hesnæs/Møn. We therefore had to get help from local divers, which would share positions on wrecks that were not on our extended list found in Table 1.

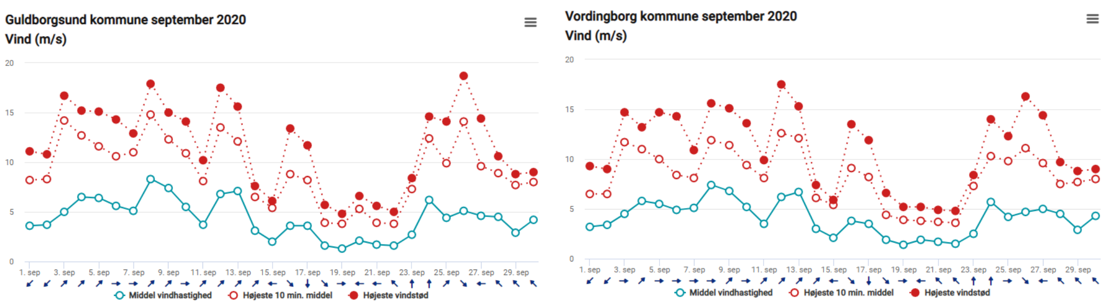


Figure 1. Daily wind speeds for September 2020 for Guldborgsund commune where Falster/Hesnæs is located (left) and Vordingborg commune where Møn is situated. Full red dots highest wind speeds, hollow red dots highest 10 min average, blue hollow average wind speeds, arrows below the x-axis illustrate the average wind direction (source, DMIs weather archive).

Table 1. Updated wreck gross list from the dive survey protocol.

Priority	Wreck name	Area	Wreck year	Depth/ bottom type	Position	Notes
A	Kanonvraget	East of Falster		22 m Sand/clay	54.40,xx 12.20,xx	
A	Calmar Castel	East of Falster	1677	15 m	54.42,56 12.09,06	
A	Dagny	East of Falster	1935	22m	54:41,03 12:16,00	fishing vessel
A	Tina Jack	East of Falster	1966	19m	54:42,49 12:24,58	40m , trawl on the stern
A	Jurbarkas	East of Falster	1998	14m	54:43,09 12:24,67	Trawler, 100x15m
B	M/S Johnny	East of Falster	1948	22 m Soft clay	54.48.31 12.16.67	
B	Leda	East of Falster	1937	20 m Soft clay	54.46.41 12.22.29	
B	Burg	Femern Belt , Around Rødby	1944	30 m Soft sand	54.34,56 11.13,90	
B	Motortorpedo-båd	Around Kramnitze	1945	19	54.39,73 11.11,31	
C	Island	Langelandsbæltet	1939	23m	54°43.88 10°47.79	
C	Skansen "Illebøllevraget"	Langelandsbæltet	1978	18 m	54:52,70 10:50,10	
D	Invandraran/ Indfødsretten	Øresund close to Middelgrundsfortet	1801	20 m Sand/mud	55:43,53 12:40,38	
D	Ceylon af Bergkvara	Øresund outside Humlebæk	1908	20 m Sand/mud	55:56.29 12:38.09	
D	Kalle	Øresund outside Espergærde		17 m Sand	55:58,80 12:38,08	
D	Minestrygeren M575	Outside Hornbæk	1945	26 m Sand/mud	56:08,76 12:28,66	
	Emanuel MS	Smålandsfarvandet	1945		55:00,45 11:32,16	Motor yacht
	Kaleva	Northern Langelandsbælt	1943	14-15 m	55:08,13 11:01,82	Not much left
	Pausen	West of Bornholm		18m Stone	55° 12.36 14° 41.82	
	Marianne S/S Stevnsvraget	The Sound	1946	20 m	55:19,71 12:32,28	
	Elak M/S	Langelandsbælt	1966	27m	55:06,48 11:02,86	
	Valencia S/S	Langelandsbælt	1940		55:04,83 11:03,73	

	Polarna	Langelandsbælt	1933	19-24m	55:03,32 10:59,36	
	Arente S/S		1942	13m	550140 110484	Not much left
	Vorvörts	Langelandsbælt		9m	55:00,71 11:07,83	

Survey area

The survey area is located in the Western Baltic, in ICES sub-area 24 and the starting point was Hesnæs harbor on Falster. The Western Baltic around Falster is a relatively shallow area with waters depths less than 50 m. The salinity in this area is 12-14 PSU depending on the in/out flow of saline/brackish water (Femern sund og bælt, 2013). This area was considered a good base, as there are many wrecks within reasonable sailing time and in relatively shallow water (< 30 m) both in the area around southern Falster and up towards Møn. In windy conditions there is the possibility to go into Grønsund or the Storstrøm and potentially move all the way towards the Langelandsbælt, which also has a number of wrecks (Fig 2).

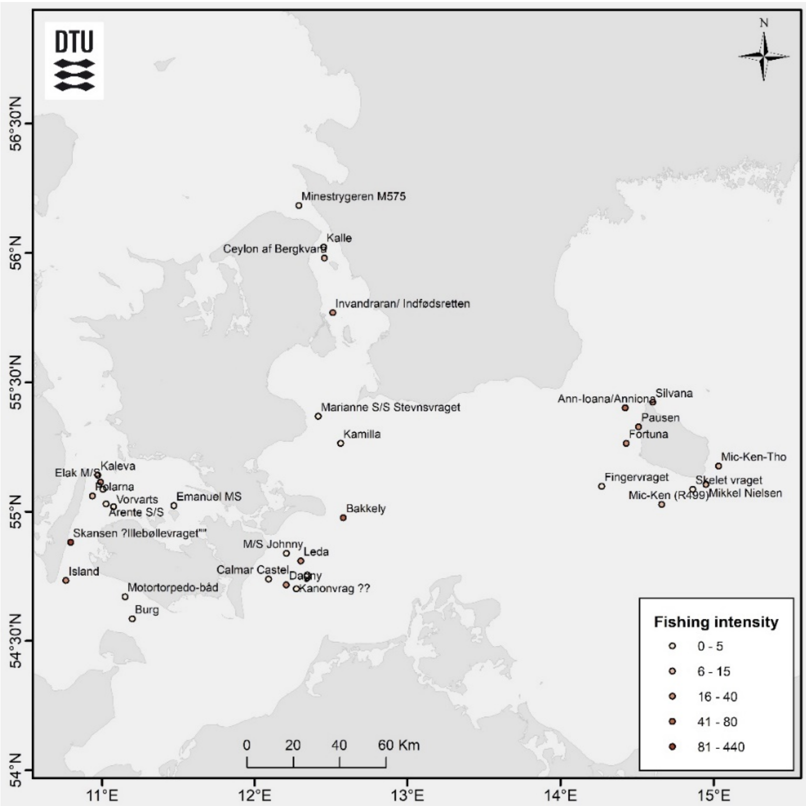


Figure 2. Map of all the wrecks on the updated gross list. Fishing intensity is calculated from vessels with AIS or VMS. Fishing intensity is defined as number of times a vessel that is considered fishing is within 100 meters of the wreck in the period 2005-2020.

Diving equipment

The divers were equipped with a LH-HD camera and one dive-light, with live signal transmitted to the surface. The camera was mounted on the right side of the mask and the dive-light on the left side (Fig 3). In addition, the divers were equipped with an Aquacom® MK2-DCI intercom system in the mask, connecting the diver and the dive leader on the deck, thereby making it possible to direct and ask questions to the diver. The diver brought on every dive a 1-meter long measuring stick with 10 cm wide black and white stripes, to estimate the size of the findings.

Figure 3. Left) The diving mask mounted with live streaming LH camera and one light. Right) Diver fully dressed and ready to dive

List of divers/crew

The diving company and divers were all professional divers with an education acknowledged by the Danish Maritime Authority. All divers in the water were in addition marine archaeologists, some of them working in Sweden and some in Denmark. The divers were: Daniel (Dana) Peter Dalicsek, Marie Johnsson, Staffan von Arbin and Thomas Bergstrand. Patrick Juhlin was the overall dive leader, skipper and is the owner of P-dyk. In addition, a local diver Rico Friis helped to get exact positions and additional information on wrecks of interest and Karina Juhlin (P-dyk) provided the catering during the survey.

Jeppe Olsen and Eva Maria Pedersen from DTU Aqua were onboard during the survey days; they secured the footage from the dives and filled in the station information (App. A.9). Finn Larsen, DTU Aqua, worked on land, processing the recovered fishing gear (App. A.19).

Wreck dive protocol

When arriving on a wreck location, the exact position, minimum and maximum depth and direction of the wreck was mapped using Baltic Explorers hull mounted sidescan sonar. Based on this, the dive team calculated the bottom time for the dive and agreed on safety stop/decompression time. The roles for the dive; diver, rescue diver and dive leader, were distributed among the divers. The ones appointed as diver and rescue diver dressed up in the diving gear while the dive leader checked the air mixture and the intercom. DTU Aqua’s personnel set up the LH-video system and the station information. When everyone was ready, the diver went into the water and dived to the bottom along the anchor line. When at the bottom, the diver on some occasions moved the anchor line to a better location either closer to the wreck or at a safer position. The diver then began mapping the wreck, while communicating swimming direction, depth and all observations to the surface along the way. Due to the two-way communication system, request from the dive leader or the Aqua personnel could be put forward to the diver. This could for instance be identification of the bottom type, a panoramic view or another look at a specific item. Just before the bottom type expired, the diver returned to the anchor line and went back up along the line. After each dive, a debriefing was held between the diver and DTU Aqua personnel to ensure that all relevant information about the divers' observations was noted in the station log.

In case of net observations on a dive, it was decided whether to do another dive to retrieve the nets. If this was decided, the roles shifted so that the rescue diver now became the diver, and the diver took the role as dive leader. Prior to the next dive, a plan was made on what to retrieve and how to retrieve it. The dive procedure was the same as described above for the first dive. The extra equipment needed for a retrieval dive was a wire cutter, lifting bags of 100L and 30L and an extra knife. If more dives were needed, the previous described procedure was repeated (Fig. 4).

If nets were brought to the surface, they were lifted onboard "Baltic Explorer" with the crane and put in a bigbag for later identification on land.

Figure 4. Equipment used for retrieving nets. Left) A wire cutter, Right) rolled up lifting bags.

Activity and decision log

The daily activities and considerations are described below and a map of the sail route can be seen in figure 5.

- August 31st: M/S "Baltic Explorer" relocating from Ystad, Sweden to Hesnæs, Falster
- September 1st: Survey and dive gear setup (e.g. the video cable was tied together with the air cable, fig. 6), approval by Danish Maritime Authority, safety drill dive in the harbour, dive on M/S "Johnny" (priority B) due to its proximity to the harbour. Sunny and calm weather.

- September 2nd: Dive on Kanonvraget (priority A), on the way to the location, two noted wreck positions were checked for wrecks, using the sidescan sonar without any findings ("Anna K" and "DKVrag"). Sunny weather with light winds from east.
- September 3rd: Dive on "Jurbarkas" (priority A). Multiple nets were observed on the first dive that covered around 1/3 of the wreck; based on these observations it was decided to prioritize recovering nets instead of mapping the rest of the wreck. Sunny weather with moderate winds.
- September 4th: Strong winds made it unsafe to dive any of the wrecks on the list (Table 1). It was decided to locate some more sheltered wrecks in Grønsund. The two wrecks "Ebenezer" lying just in the entrance to Grønsund and "Landgangsvraget" near to Smålandsfarvandet. "Baltic Explorer" harboured in Stubbekøbing.
- September 5th: Very strong wind during the day made it unsafe to dive anywhere and the forecast for the coming days were also too windy for safe dives on any of the wrecks on the list. There were discussions on moving towards the Langelandsbælt as it would be possible to find shelter for the wind, however the current in the area was forecasted to increase due to the wind and also creating a safety issue. It was therefore decided to move to Klintholm harbour to look for wrecks sheltered by Møns Klint. In the evening on the way to Klintholm harbour another dive on M/S "Johnny", to recover nets, was made.
- September 6th: Still windy, but safe conditions for dives on "Vibeke Høj", which was sheltered by Møns Klint. Nets were observed on the wreck, and it was decided to retrieve these. Sunny weather.
- September 7th: Still windy. Sailed towards the wrecks "Hjuldamperen" and "Explorer" but on both of these sites the waves were coming from multiple directions making it unsafe for the diver to re-enter the boat. The wreck M/S "Vita" was located and safe to dive on. No nets were observed and therefore a search for the two wrecks "Diana" and "Gustav Adolf" was initiated, with no luck.
- September 8th: Debriefing, packing and later relocation of "Baltic Explorer" to Ystad, Sweden.

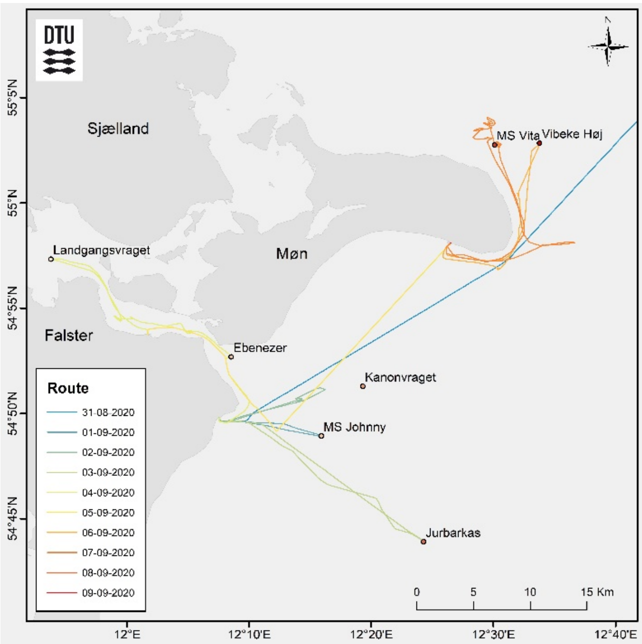


Figure 5. AIS registered sail routes of "M/S Baltic Explorer" during the dive survey

Figure 6. Left) Air cable and video cable tied together. Right) Safety drill dive in Hesnæs harbour.

Results

During the survey, 13 dives wre completed on 7 different shipwrecks. The wrecks were all located in the waters around Falster, from “Landgangsvraget” in Smålandsfarvandet to M/S “Vita” and “Vibeke Høj” northeast of Møn and “Jurbarkas” off the east coast of Falster (Fig. 7).

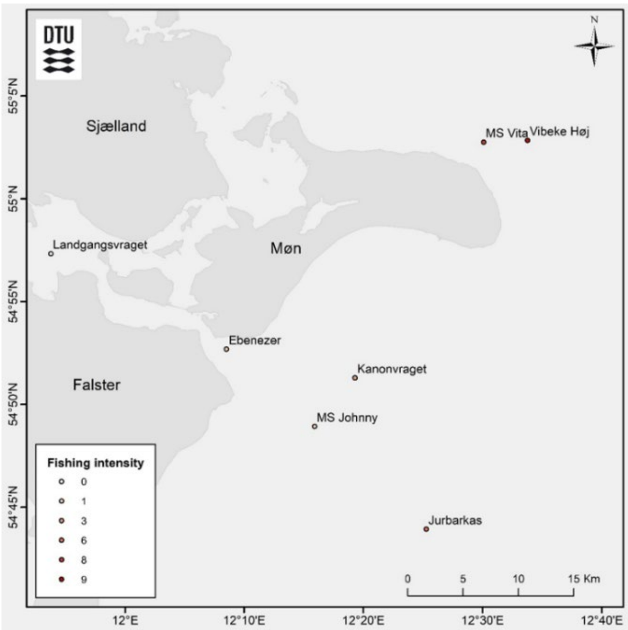


Figure 7. The seven wrecks examined during the dive survey. Fishing intensity is calculated from vessels with AIS or VMS and is defined as number of times a vessel that is considered fishing is within 100 meters of the wreck in the period 2005-2020.

The wrecks differed in size from the 20 m long “Ebenezer” to the 100 m long “Jurbarkas”, sunk on depths from 6 (“Ebenezer”) to 23 meters (“Vibeke Høj”). Most of the wrecks observed were lying on sandy bottom, only “Landgangsvraget” was found to be on gravel/stone (Table 2).

Table 2. Table describing the dimensions of the wreck, the depth of the wreck, the surrounding bottom type, the estimated complexity of the wreck, the number of dives and the dates for the dives.

Wreck name	Size (l,w,h)	Depth (m)	Bottom type	No dives	Dates for dives
M/S Johnny	22x7x3	19-22	Silty sand	2	1/9, 5/9
Kanonvraget	40x12x2	20-22	Soft mud on hard gravel	2	2/9
Jurbarkas	100x26x3	16-19	Slightly silty solid sand	3	3/9
Ebenezer	20x7x2	6-10	Fine sand	1	4/9
Landgangsvraget	38x8x4	6-10	Gravel/stone with mussels	1	4/9
Vibeke Høj	60x6x4	17-23	Silty sand	3	6/9
M/S Vita	28x9x2	17-18	Fine sand	1	7/9

Fishing net or trawl was observed on four of the seven wrecks and angling gear was observed on five of the wrecks. A short description of the wrecks with selected images of the findings can be found below. The name and time stamp on the image relate to the original video file (App. A.10). The findings of lost fishing gear are summarized in Table 3 and a detailed description of the dives and observations can be found in Appendix A.9.

The type of fishing gear observed was gillnets, trawls and recreational fishing gear. All the observed fishing gear was entangled with the wreck and some parts were buried in the surrounding sediment or heavily covered in mussels. All of the nets observed were covered in a thin layer of silt, indicating that they were not newly lost, but an exact age cannot be determined based on the images. No dead fish or other vertebrates were observed in the nets. However, a large number of dead crabs were observed on M/S “Johnny”. This was probably caused by a resent oxygen depletion in the area.

We do not have an effort estimate on the recreational activities in the area, but the locals would tell that large numbers of private angler boats were in the water during the season (both local and tourists). The VMS/AIS registered fishing activity around the wrecks has been very limited for the last 15 years, with a maximum of 9 registered fishing activities within 100m (Table 3, Fig. 7). However, small vessels <12m without VMS or AIS could have fished in the area.

Table 3. Findings of lost fishing gear on the wrecks and the VMS/AIS registered fishing activity in the area from 2005-2020. The observations are based on the video recordings and split into nets, trawls and recreational fishing gear.

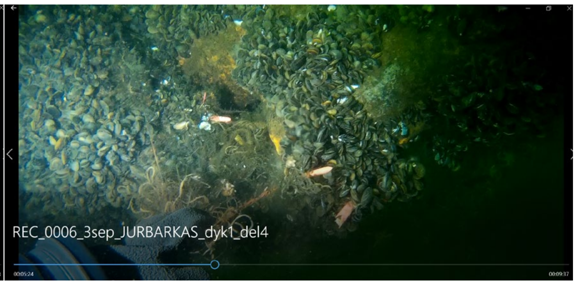
Wreck name	Nets observed	Trawl observed	Angling gear	Fishing activity (VMS data) close to the wreck (days)
M/S Johnny	-	2-3 trawl pieces	6-10 large jigs	Danish Seine: 1
Kanonvraget	1 gillnet	1 trawl	3 jigs	Demersal trawl: 2 Danish Seine: 1
Jurbarkas	3 gillnets	-	9-11 Jigs and lines	Demersal trawl: 1 Danish Seine: 5
Ebenezer	-	-	-	Demersal trawl: 1
Landgangsvraget	-	-	2 fishing lines	-
Vibeke Høj	-	1 trawl	1 jig	Demersal trawl: 6 Pelagic trawl: 2 Gill net: 1
M/S Vita	-	-	-	Demersal trawl: 3 Pelagic trawl: 4 Danish Seine: 1

Selected images from the video recordings of the findings on all surveyed wrecks

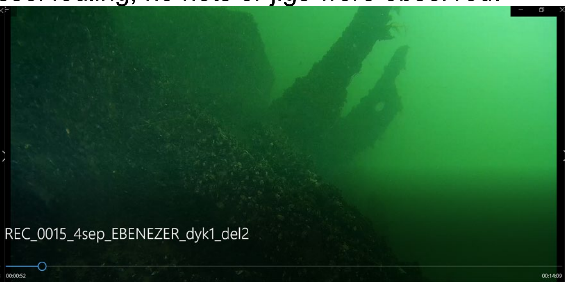
M/S “Johnny” is according to vragguiden.dk a wooden motor schooner that sunk in December 1948. It is largely covered in blue mussels. Based on the observations of mass death of crabs and black areas in the sediment, an oxygen depletion has recently occurred. 2-3 trawl pieces were observed and 6-10 jigs.

“Kanonvraget” is not present in the different databases but was appointed for the dive survey based on the knowledge of a local diver. The wreck has its name from the cannons lying around the wreck as can be seen on some of the images below. A trawl around the anchor, a net on the side and three jigs were observed.

"Jurbarkas" is according to vragguiden.dk a 5387 BRT trawler, around 100 m long and 15 m wide. It is an iron wreck with a significant blue mussel fouling. The wreck was blasted by the Danish authorities following the loss and lies scattered on the sea bottom. Due its size only around 1/3 of the wreck was mapped. Three to four different nets were observed, all covered in mussels and around 10 jigs.



"Ebenezer" is according to vragguiden.dk a fishing vessel on 32 BRT that sunk in 1994; the masts are removed. It has a significant blue mussel fouling; no nets or jigs were observed.



"Landgangsvraget". No written information on the wreck but the local guides said it had supposedly been used for making landfall during the war. No nets or jigs observed.

"Vibeke Høj" is according to vragguiden.dk a Danish stone fishing vessel that sank in the 1970'es when the load shifted. The wreck is intact and around 60m long, lying on the port side. The wreck is almost completely covered in blue mussels. A trawl and a jig were observed on the wreck.

M/S “Vita” is according to vragguiden.dk a wooden motor schooner loaded with paper mass, which sunk in December 1944. No nets or jigs were observed on the wreck.

Recovery of nets

Chapter 7 in the report describe the technique used for the recovery of nets and go into details on the types of gear recovered, the age and the quantity. The description and images of materials recovered, is found in Appendix A.19. Recovered materials.

A.3. Mapping conflict areas in the Inner Danish waters

Summary

During the eight-day survey a total of 31 1x1 km squares was surveyed using the sidescan sonar, covering both sandy bottom, mixed bottom and stone reef. Nine of the mapped squares were, however only scanned in the three north-south going transects due to a mix of time limitation and a very shallow coastal area (the keel on "Havfisken" is 3,5 meters below the surface). All of these 9 transects were located in the Langelandsbæltet 3 focus area.

A number of anomalies were observed and saved as targets during the sidescan sonar mapping, and seven of these were selected for ground truthing. On none of the positions ground truthed, lost fishing gear was identified. One target identified as cable/pipe, one could be the end of a rope and the others identified as natural structures like e.g. sand ribs or were not identified at all.

Materials and methods

Preparation

Monday the 6th of July 2020, all the technical equipment, the DGPS, USBL system, the sidescan sonar and the ROVs were mounted and tested on-board DTU Aqua's research vessel "Havfisken" in its home port Strandby Havn, getting ready for the survey planned for the North Sea/Skagerrak in the period 7th to 14th of July.

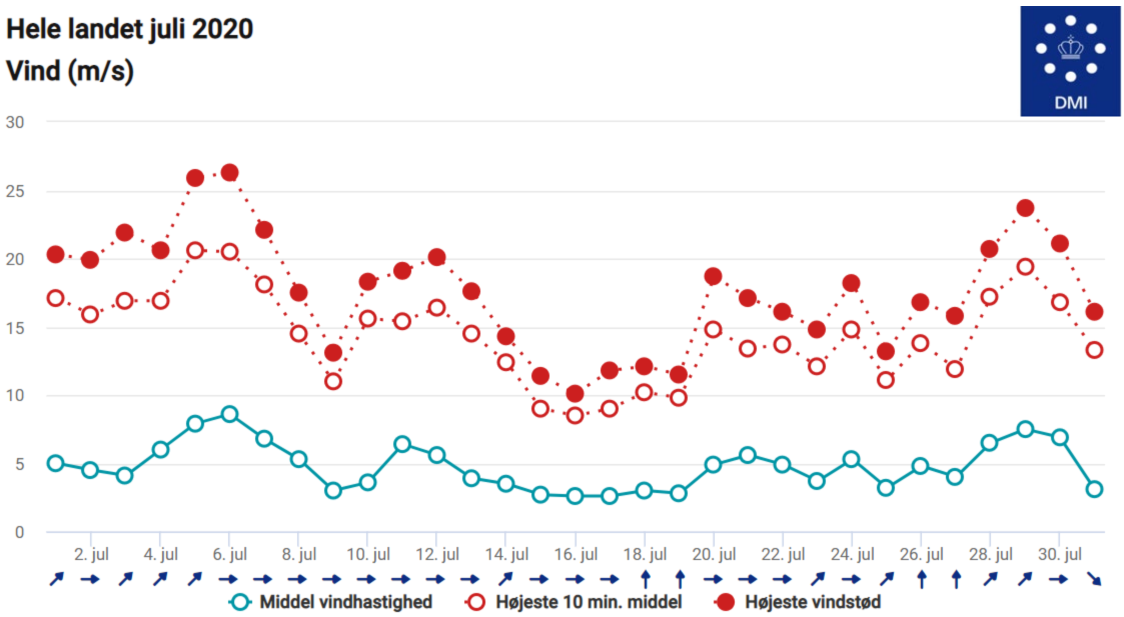


Figure 1. Daily wind speeds for July 2020 for Denmark. Full red dots highest wind speeds, hollow red dots highest 10 min average, blue hollow average wind speeds, arrows below the x-axis illustrate the average wind direction (source, DMIs weather archive)

There was however, very strong wind from west all over Denmark (Fig. 1) and the conditions for the North Sea/Skagerrak did not seem to improve much within the survey period. It was therefore decided to move the survey area into the Inner Danish waters and the first priority focus area here, Langelandsbælt (Fig. 2). Here it seemed possible to find shelter from the strong western wind during the survey period.

Area	Bottom type	Main reason for selection	Priority
Lange-landsbælt	Mixed sedi-ment Sand Stone reef in Natura 2000 area	Highest overlap in inner Danish waters be-tween active and passive gears. Heavy marine traffic, stone reef in Natura 2000 area	First priority It covers the requirements for both stone reefs and sand areas

Figure 2. Clipping from Table 3.1.2. (in the report) Gross list of selected areas in the Inner Danish waters from

Crew

The DTU Aqua crew during the survey on-board "Havfisken" was skipper Aage Thaarup, best man Søren Larsen Grønby, marine technician Rune Garmund (6-9/7), researcher Thomas Noack (6-9/7) and project leader Eva Maria Pedersen. In addition, electronic technician Eik Ehlert Britsch assisted on the preparation day in harbour.

Technical details

The equipment used for this mapping survey was a portable Edgetech 4125, 600/1600 kHz sidescan sonar with a 7 kg keel weight attached and equipped with a Sonardyne Micro-Ranger 2 USBL system, which again was connected to a DGPS (HGNSS-3276 Atlaslink A222 GNSS Smart Antenna). For ground truthing we used a BlueRov, a SeaRay, a Pralenz camera, a LH-HD camera and some GoPro's (Fig. 3). In addition, we used Havfiskens SBE 19plus SeaCAT Profiler to measure the sound velocity in every area before deploying the USBL system.

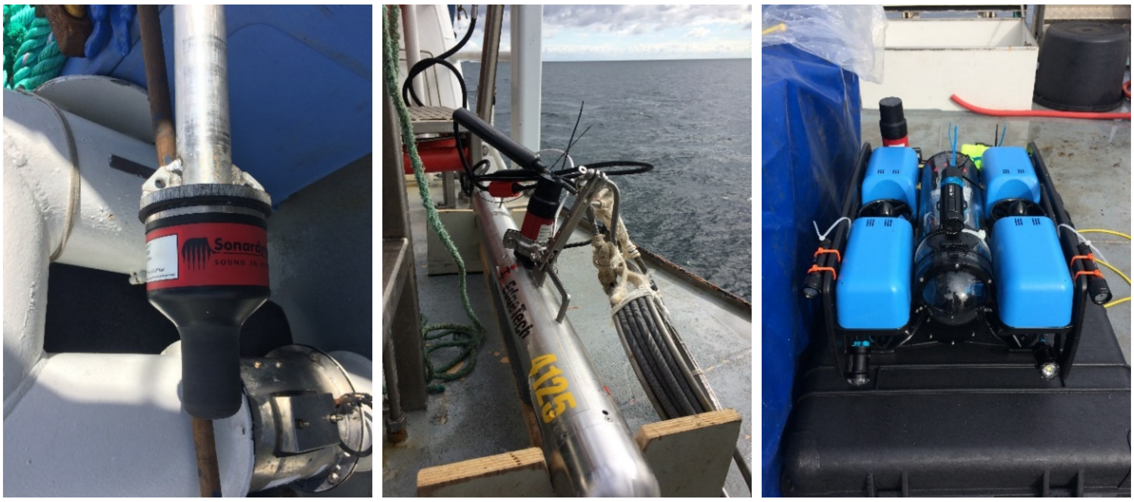


Figure 3. Images of the Sonardyne Micro-Ranger 2, USBL system used on the deployed equipment. Left) The pole-mounted transmitter. Middle) The beacon mounted on the sidescan sonar. Right) The beacon mounted on the BlueRov2. Photo DTU Aqua.

The USBL system was set up and calibrated according to the manual in the harbour, prior to survey departure. Every day on arrival to the survey area or when entering a new area, a water profile was made on arrival to adjust the sound velocity for the USBL system. As an extra check the beacon was mounted on the CTD so that the depth measurement could be checked. Prior to every deployment of the sidescan sonar, the pressure sensor was checked to be zero or otherwise reset to zero on deck.

In the Discover software for the sidescan sonar, the frequency was set to 600 kHz with a range of 50 meters (on each side). The required speed was max 3 knots and where possible, the fish was towed at 5 meters above the seabed. In some of the coastal areas where the water was shallow < 8m, the towfish was in the same depth as the keel of the boat resulting in shorter distance from the seabed and thereby also a more narrow range. In addition, this very short distance from the USBL transmitter resulted in some accuracy problems and in some areas, it was decided that the precision was better without the system.

For ground truthing a BlueROV2 was planned to be used with an extra Paralenz camera attached. However, due to a few accidents with our ROV's; an overheated battery, which caused the loss of a watertight lid and a flooding of the electronics, a creative solution for the video ground truthing was invented. The boats CTD was rigged with the cabled LH-HD camera, lights and a Paralenz camera, the CTD was deployed and the boat then drifted across the area of interest with the CTD very close to the bottom.

Survey design

In Appendix A.1., which identifies the areas of interest for this study, the underlying VMS conflict analysis was performed using a 1x1 km grid. A 100% coverage of one square would require at least 10 transects in one direction e.g. N/S or E/W, as one transect given optimal conditions cover area swath of 100 m. As sidescan sonar images in simple terms are based on the strength of the return signal and the shadows cast by the object on the seafloor, elongated objects lying perpendicular to the sail line are hard to detect. Based on this, we set up a search strategy for lost nets and decided on five transects per square to optimize the overall size of the area coverage instead of covering few squares at 100%. We decided on a pattern with three transects in north/south direction and two transects in east/west direction (the pattern can be turned 90° to adapt to the conditions in a given square) (Fig. 4). When an anomaly was observed, a target point was recorded, and if possible, more than one contact point was recorded for each anomaly in order to get a direction/size of the anomaly. Before leaving an area, all anomalies were evaluated and structures looking like ghost nets were selected for ground truthing.

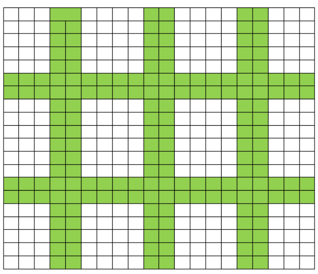


Figure 4. Schematic drawing of the survey pattern in a given 1x1 km square. The green areas illustrate the sidescan coverage using a 50 m range on each side.

Survey area
The survey area Langelandsbælt is located in the southern part of Storebælt between Langeland and Lolland and is considered a part of the Inner Danish waters. In the Langelandsbælt study area, four focus areas were identified, which all contain squares with potential conflicts between active and passive gear. The study area is described in detail in App. A.1.

Results

Area surveyed
During the eight-day survey a total of 31, 1x1 km squares was surveyed using the sidescan sonar, 9 of these where however only scanned in the three north-south going transect due to a mix of time limitation and a very shallow coastal area (the keel on “Havfisken” is 3.5 meters below the surface). All of these 9 transect were located in the Langelandsbæltet 3 focus area. An overall view of the four survey areas can be seen in figure 7 and the sidescan sail routes can be seen for each area in figure 8. A summary over the daily activities can be found in table 2.

Table 2. An overview of the activities during the survey. More details can be found in App. 11 Activity log inner Danish waters.

Date	Area	Activities
07-07-20	Relocating from Strandby to Korsør	
8-07-20	Langelandsbælt 2	CTD, Sidescan of area 2
09-07-20	Langelandsbælt 2	CTD, Sidescan of area 2, ROV target 51
10-07-20	Langelandsbælt 1	CTD, Sidescan of area 1
11-07-20	Langelandsbælt 3	CTD, Sidescan of area 3, ROV target 114-115, dragging target 114-115, camera on CTD target 135
12-07-20	Langelandsbælt 3	CTD, Sidescan of area 3, camera on CTD target 166-168 and 104-108
13-07-20	Langelandsbælt 4	CTD, Sidescan of area 4, camera on CTD target 238-241 and 247-251
14-07-20	Relocating from Korsør to Strandby	

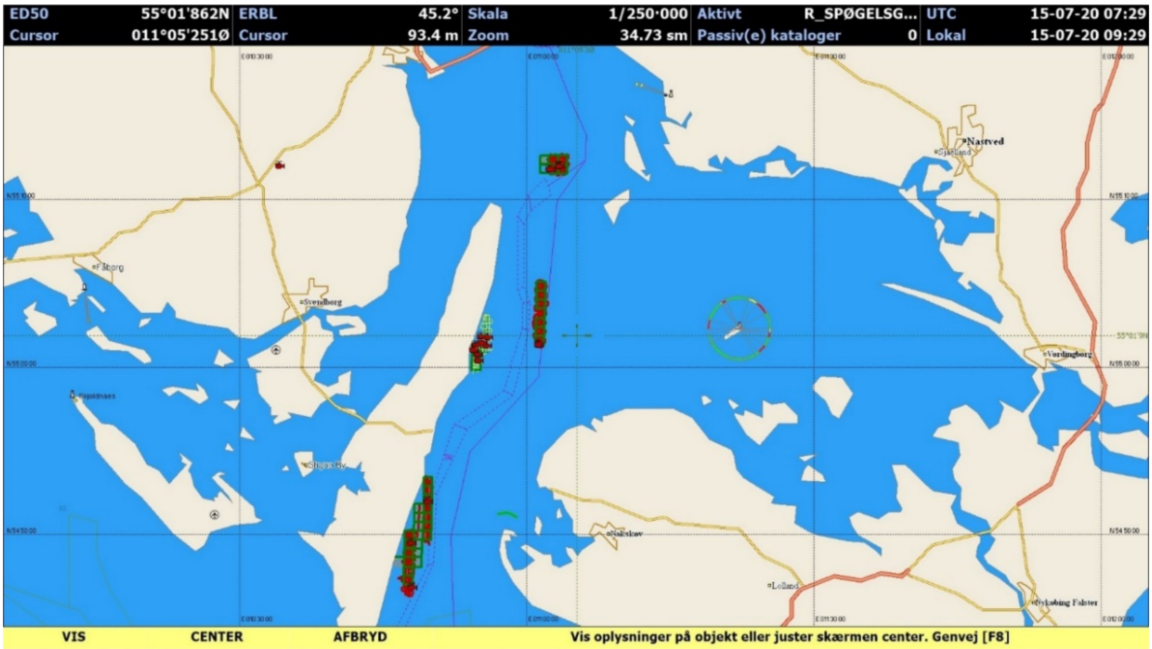


Figure 7. Print from the plotter system on "Havfisken" showing an overall map of areas surveyed with the sidescan sonar in the Langelandsbælt, July 2020.

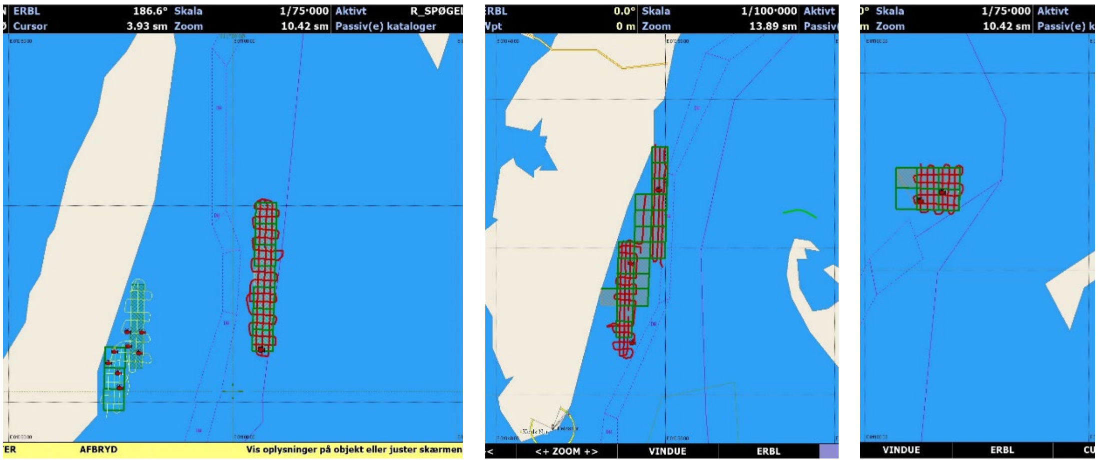


Figure 8. Sail routes for the sidescan survey in the Langelandsbælt. Left) Focus area 1 and 2, in which respectively 6 and 7 squares were covered. Middle) Focus area 3 where 5 squares were covered according to the plan and 9 only in the north/south direction. Right) Focus area 4 with four areas covered.

Anomalies selected for ground truthing

During the survey, seven anomalies pointed out as targets during the sidescan activities were selected for ground truthing (Fig. 9). The anomalies we focused on and that we believed could be lost nets/trawls or fyke nets, are elongated structures lying on top of the sediment either straight or slightly twisted around other object on the seafloor, an example of an active gillnet can be seen in figure 10. Four of the ground truthed targets fulfill these criteria, however one target (51) is more to be considered as a test of the technique and equipment and two targets (238-241 & 247-251) only had weak elongated outlines, but there was some time available, and the targets were considered the most interesting anomalies in area 4.

At target 166-168 a dark colored cable or pipe was identified and at target 104-108 what seemed like a rope ending on one video looked like a macrophyte algae on the other. The findings on all the other ground truthed areas were natural structures like sand ribs or cracks or grooves between the rocks. All ground truthed anomalies are described below and the observation summed in Table 3.

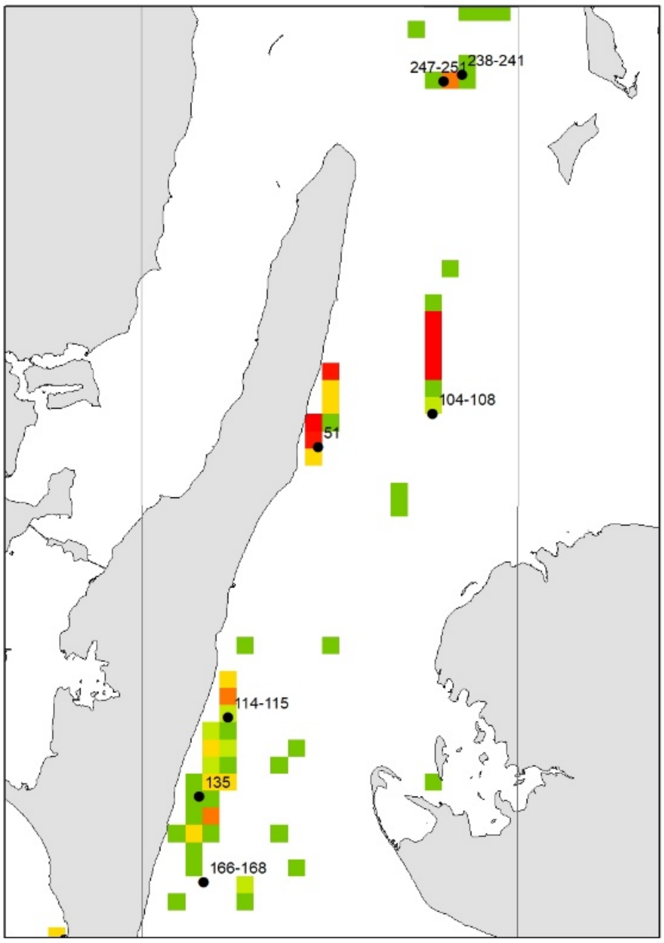


Figure 9. Map of the locations of the seven anomalies selected for ground truthing.

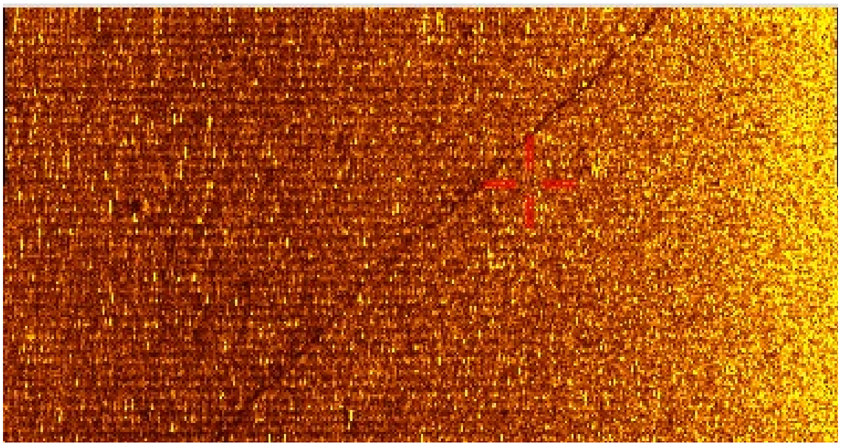


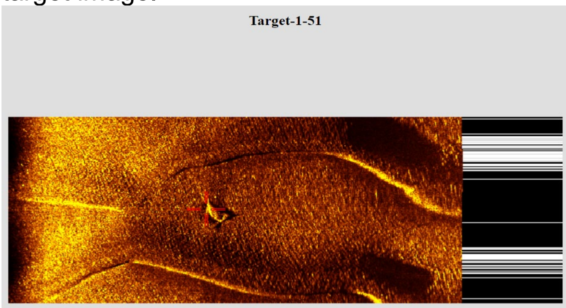
Figure 10. Target #127 is an example of an active gillnet observed the 11th of July in Langelandsbæltet.

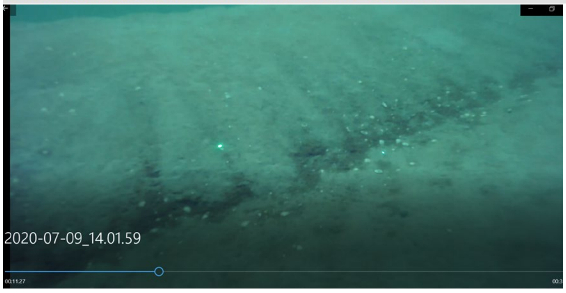
Table 3. Findings of the seven ground truthed anomalies

Target number	Reason for ground truthing	Notes	Findings
51	Test of system on believed sand ribs	Sandy bottom, OK visibility	Large sand ribs
114-115	Long structure lying on top of the hard bottom parallel to the sail direction	Hard bottom with spread out rocks, covered by tunicates, red algae and large Laminaria. OK visibility, depth around 19 meters.	The most elongated structures observed were the Laminaria; this was also the only catch of the drag
135	Sandy plain area with hard structures connected by lines	OK visibility, depth around 13 meters	No foreign obstacles were observed, and the structures are believed to be sand ribs and stones
166-168	Long elongated structure lying on a flat bottom with spread out rocks	Mainly gravel. Bad visibility, depth around 36 meters	Dark brown cable, rope or pipe identified
104-108	Long elongated structure lying on a flat bottom with spread out rocks	Mainly gravel Very bad visibility, depth around 30 meters	The object that looks like the end of tied up rope on one video, looks like macrophyte algae on the other
247-251	Long elongated structure lying on a flat bottom with many spread out rocks	Hard bottom with rocks covered by tunicates. OK visibility, depth around 15 meters	The most elongated structures observed were again Laminaria. The structures could be cracks or grooves between the rocks.
238-241	Long elongated structure lying on the bottom with spread out rocks	Hard bottom with rocks. Not so good visibility, depth around 18-20 meters	The most elongated structures observed were again Laminaria. The structures could be cracks or grooves between the rocks.

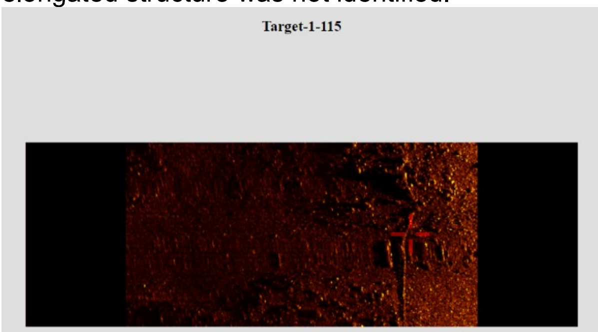
Target descriptions

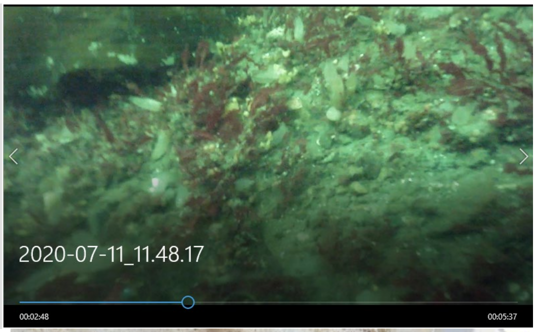
Target 51 (July 9th) using the BlueROV with the Paralenz camera. The target is not believed to be a net but a sand rib and was chosen to test the BlueRov with the USBL attached. The images from the video show that the large structures on the sidescan sonar image probably is sand ribs and it could be the branch with the algae that is mapped with the red cross in the target image.

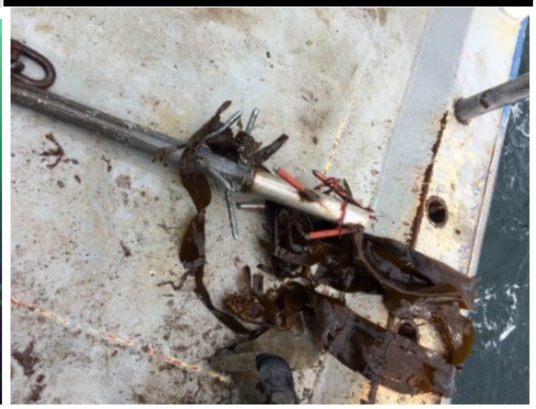




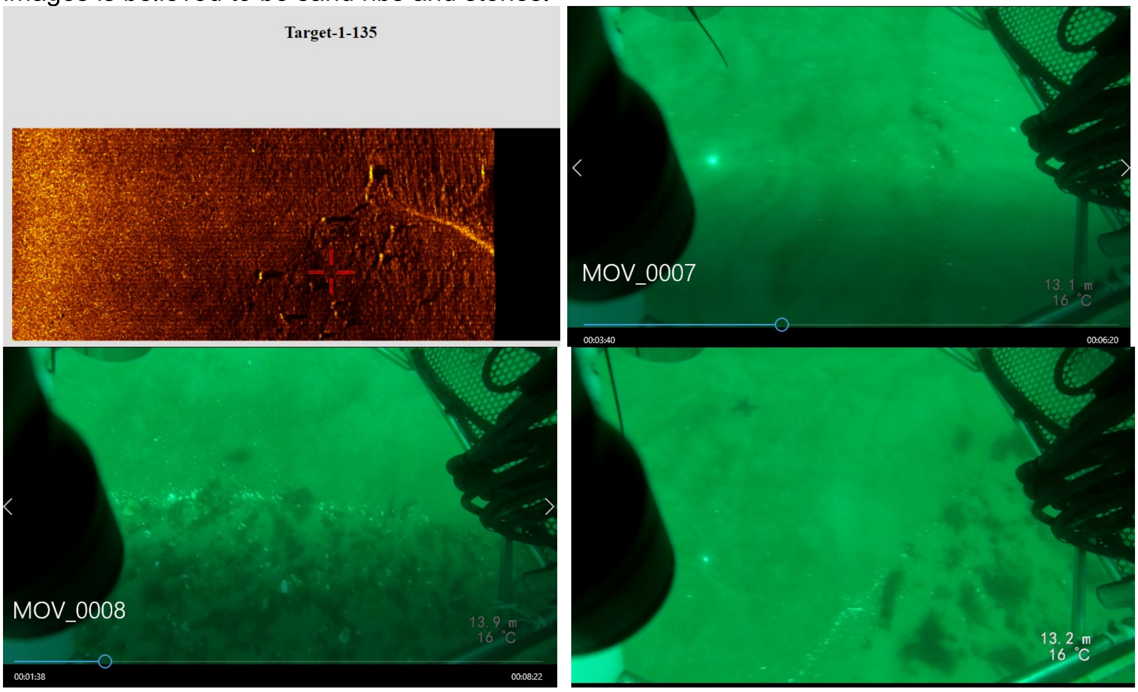
Target 114-115 (July 11th & 12th) is ground truthed twice using video and once using a drag. First time using the BlueROV with the Paralenz camera in strong current making it difficult to manoeuvre, second time with LH and Paralenz mounted on the CTD drifting above the area. A dragging attempt was made, but the only thing caught was the brown algae Laminaria. The elongated structure was not identified.



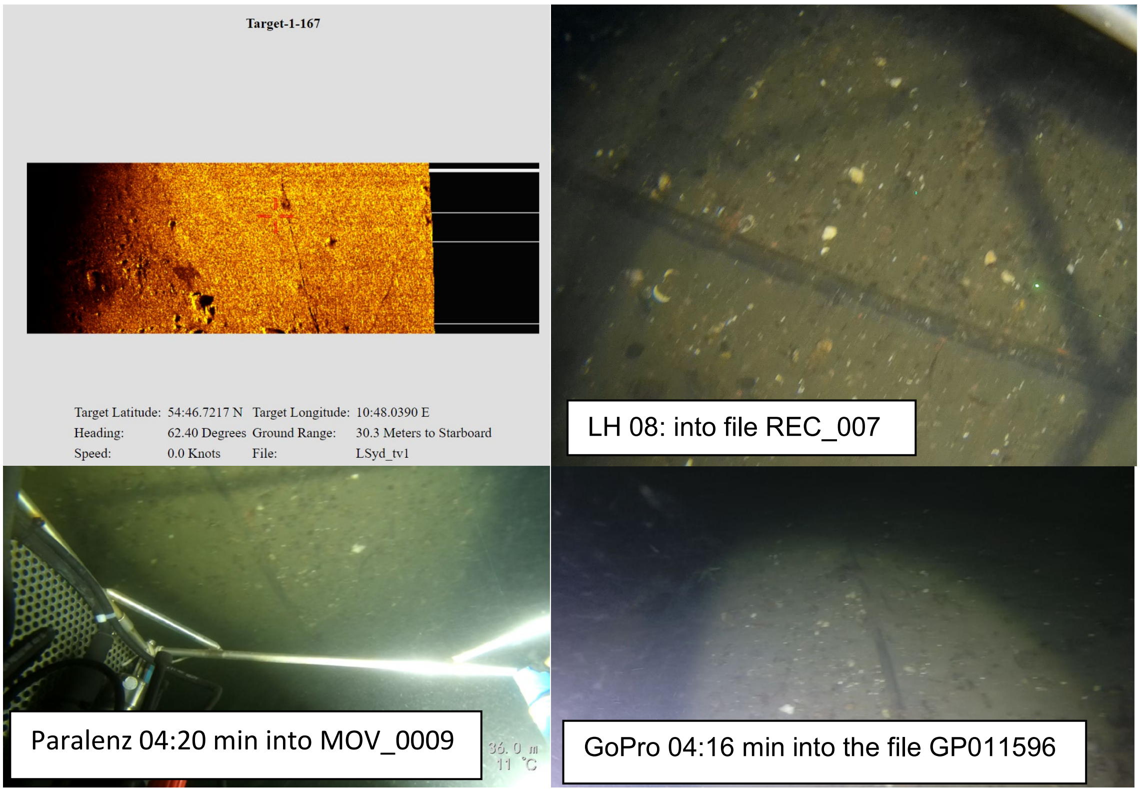




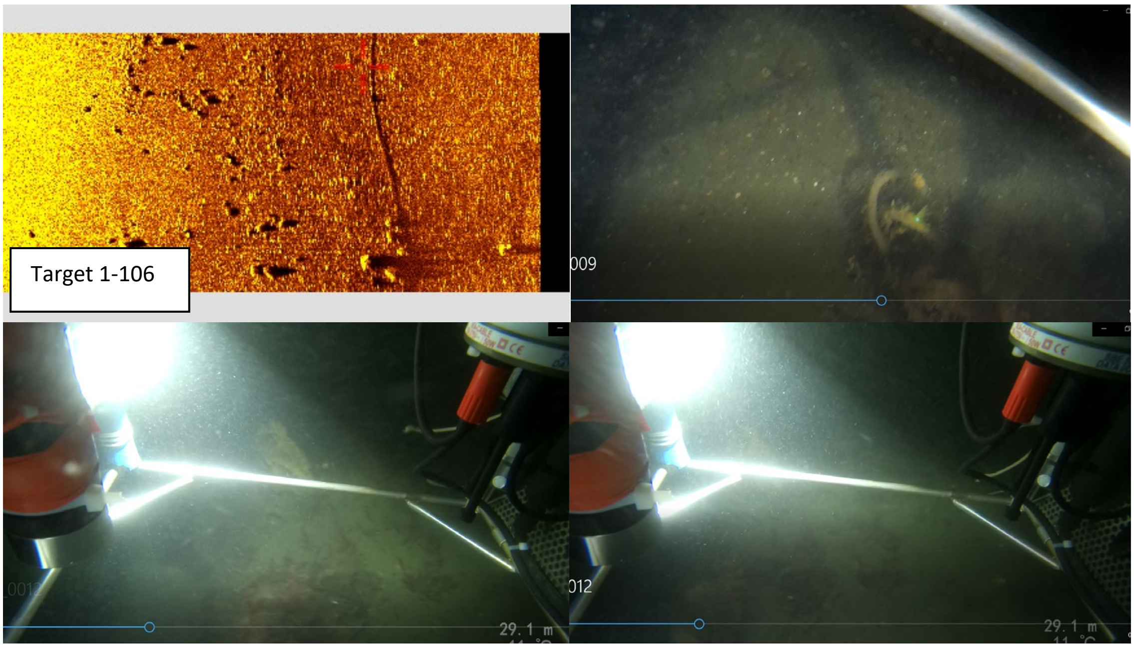
Target 135 (July 11th) was ground truthed using the CTD mounted with LH and Paralenz cameras. No foreign obstacles were identified and the structure observed on the sidescan images is believed to be sand ribs and stones.



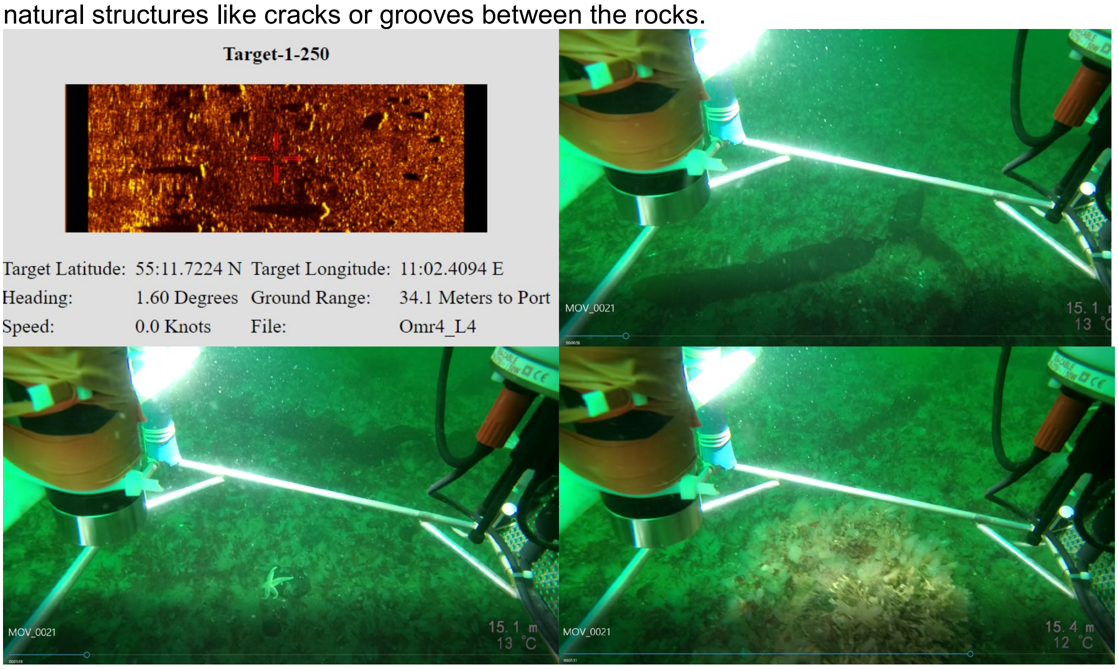
Target 166-168 (July 12th), was ground truthed using the CTD mounted with LH, GoPro and Paralenz cameras. An obstacle looking like a cable or a pipe were identified on all mounted cameras, the diameter of the pipe is estimated to be around 2 cm as it is about the same size as the frame for the CTD.



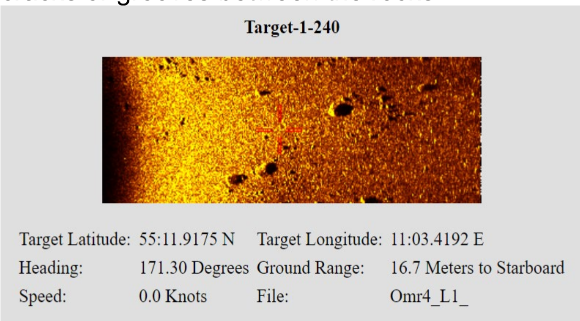
Target 104-108 (July 12th) was ground truthed using the CTD mounted with LH, GoPro and Paralenz cameras. The bottom type was gravel scattered with rocks. The visibility was very bad during the recording so only things close to the cameras and the light were visible. On the LH camera an item looking like the end of a rope was observed, but on the Paralenz camera it looked more like a macrophyte algae. Due to bad visibility, the GoPro recording could not be used.

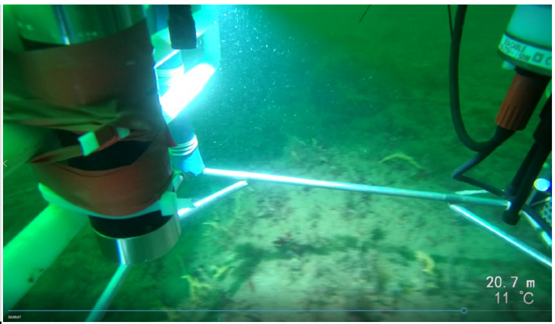


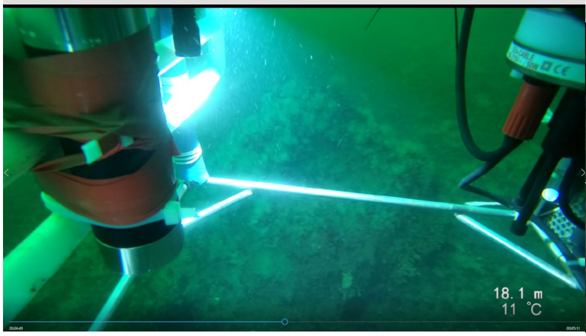
Target 247-251 (July 13th) was ground truthed using the CTD mounted with LH, GoPro and Paralenz cameras. The area is categorized as a Natura 2000 reef area and is hard substrate scattered with rocks covered in tunicates, the depth were around 15 meters. The visibility was OK but no foreign object was identified the structure identified on the sidescan image could be natural structures like cracks or grooves between the rocks.

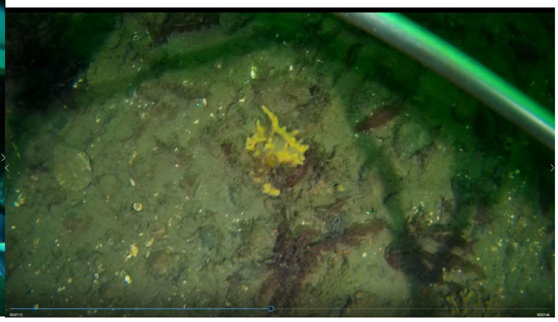


Target 238-241 (July 13th) was ground truthed using the CTD mounted with LH, GoPro and Paralenz cameras. This target is located in a Natura 2000 reef area and is hard substrate scattered with rocks. The visibility was not good and no foreign objects were identified. Like in target 247-251 the structures identified on the sidescan image could be natural structures like cracks or grooves between the rocks.









A.4. Mapping conflict areas in the North Sea/Skagerrak area

By Eva Maria Pedersen & Fletcher Thompson

Summary

During the five-day survey in the North Sea/Skagerrak area a total of 25 1x1 km squares was surveyed using the sidescan sonar, covering both sandy bottom, mixed bottom and stone reef. The focus areas surveyed were Hirtshals area 1 & 2, Jammerbugt 2 and Store Rev 2. Twelve of the mapped squares were, however, only scanned in the three east-west going transects due to time limitation. Ten of these squares were located in the Store Rev 2 focus area and two squares in the Jammerbugt 2 focus area.

A number of anomalies were observed and saved as targets during the sidescan sonar mapping, and five of these were selected for ground truthing. On one of the positions ground truthed, rope-fibres were stuck on the drag and based on the fibres, the pull from the boat and the acoustic images it is likely to be a lost trawl or piece of a trawl. On another position, a 240 m lost fishing net, an anchor and a buoy were retrieved.

Materials and methods

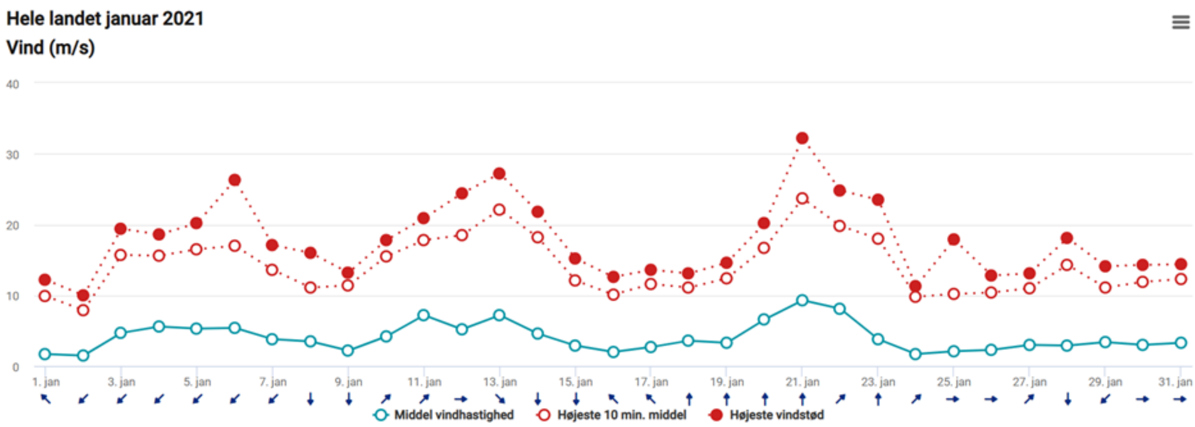


Figure 1. Daily wind speeds for January 2021 for Denmark. Full red dots highest wind speeds, hollow red dots highest 10 min average, blue hollow average wind speeds, arrows below the x-axis illustrate the average wind direction (source, DMIs weather archive). The survey period was 15th to 19th of January 2021.

There was an even wind coming from south or southwest during the survey period (15-19/1 2021) giving good survey conditions for five days in the Skagerrak area (Fig. 1.), where the three focus areas Store Rev, Hirtshals and Jammerbugt were located within a few hours of steaming time from Hirtshals. These three areas contained in total seven minor focus areas. The length of the survey was planned for 6 days, but the forecast for the 20th of January predicted increasing wind and it was decided to use the last survey-day for retrieval of a known ghost net in the Inner Danish waters, Øresund.

Area	Bottom type	Main reason for selection	Priority
Store Rev	Mixed sediment (Natura 2000 stone reef) Sand	The area with most overlap between active and passive fishing gears both on average and in a single square. Mapped as a Natura 2000 stone reef surrounded by sand bottom. 3h from Hirtshals.	First priority stone reef and sand area
Jammerbugten	Sand	Overlap between active and passive gears including foreign beam trawlers and marine traffic in the area. Large passive fishery in area 2.	First priority on the way between the two first priority reef areas
Hirtshals	Mixed sediment Sand	Overlap between active and passive gears and marine traffic in the area. Includes both sand and Natura 2000 stone reef area. Close to the shore and to Hirtshals harbour	Second priority

Figure 2. Clipping from Table 3.1.1. (in the report) Gross list of selected areas in the North Sea/Skagerrak, describing the reason for selecting the Store Rev, Jammerbugt and Hirtshals areas as focus areas.

Crew

The DTU Aqua crew during the survey on-board “Havfisken” was skipper Aage Thaarup, best man Per Christensen, Post doc. Fletcher Thompson and project leader Eva Maria Pedersen.

Technical details

The equipment used for this mapping survey was a portable Edgetech 4125, 600/1600 kHz sidescan sonar with a 7 kg keel weight attached and equipped with a Sonardyne Micro-Ranger 2 USBL system, which again was connected to a DGPS (HGNSS-3276 Atlaslink A222 GNSS Smart Antenna). For ground truthing we used a BlueRov, a Paralenz camera and some GoPro cameras (Fig. 3). In addition, we used Havfisken’s SBE 19plus SeaCAT Profiler CTD to measure the sound velocity in every area before deploying the USBL system.

Figure 3. Images of the Sonardyne Micro-Ranger 2, USBL system used on the deployed equipment. Left panel: The pole-mounted transmitter. Middle panel: The beacon mounted on the sidescan sonar. Right panel: The beacon mounted on the BlueRov2. Photo DTU Aqua.

The USBL system was set up and calibrated according to the recommended procedures outlined by Sonardyne in the harbour, prior to survey departure. By following the procedures, the positional accuracy of the USBL system relative to the ship is below 5 m for up to a 100 m distance. An AtlasLink differential GPS receiver (advertised positional accuracy of 0.5 m 95% Circular Error Probable) was attached on the monkey deck of Havfisken to provide high-accuracy global position data, which is fused by the USBL software to locate the transponder in WGS84 coordinates. The USBL transceiver (Fig. 3, Left panel) was mounted on a long pole, which was lashed to the port side of R/V Havfisken. During the sidescan surveys, the pole was extended to 1.5 m below the waterline to reduce ventilation from roll and wave effects as well as interference from the hull. While cruising between survey grid locations, the transceiver was swivelled out of the water onto the guardrails and secured.

The transceiver alignment calibration was executed on day 1 of the cruise with the transceiver deployed in the harbour and involved setting a mooring with the USBL transponder attached and sailing away from the mooring on a north-west heading until 100 m away (according to the USBL ranging). The calibration software then used the received ranging information to offset alignment errors made during deployment of the transceiver. Every day on arrival to the survey area or when entering a new area, a water profile was made on arrival to adjust the sound velocity for the USBL system. As an extra check, the beacon was mounted on the CTD so that the depth measurement could be checked. Prior to every deployment of the sidescan sonar, the pressure sensor was checked to be zero or otherwise reset to zero on deck.
In the Discover software for the sidescan sonar, the frequency was set to 600 kHz with a range of 50 m (on each side). The required speed was max 3 knots and where possible, the fish was towed at 5 m above the seabed. During one part of the survey where pitch motions were larger due to increased wave conditions, the USBL transceiver pole broke at a weld line. None of the equipment was damaged, but the pole had to be repaired upon return to port for that day, and no USBL-assisted position information was available for the few hours remaining.

For ground-truthing, a BlueRov underwater drone was used with an additional Paralenz and GoPro camera attached. It was limited by its 50 m tether, which only allowed it to explore small regions of the 40-45 m deep sea-bottom. Intense wave actions and ship drift also made additional tension on the tether, pulling the ROV out of position. On the last day of the Jammerbugt survey, the ROV's tether became entangled on the keel/skeg of R/V Havfisken, and shortly after lost video feedback due to a loosened wire. The ROV was successfully recovered but was not used for the last few hours of the survey.

Survey design
The survey design is described in detail in appendix A.3. and will we not be repeated here.

Survey area
In North Sea/Skagerrak a total of six focus areas were identified: Gule rev, Store Rev, Jammerbugt, Jyske Vestkyst, Hanstholm and Hirtshals. Due to limited survey time and the wind direction the areas within a few hours of sailing distance from Hirtshals harbour were prioritized. The areas selected were Store Rev and Hirtshals for mixed bottom and stone reef areas and Jammerbugt for a sand bottom area, in total seven potential study areas. The areas all are described in Appendix A.1.

Results

Area surveyed

During the five-day survey a total of 25 1x1 km squares were surveyed using the sidescan sonar, 12 of these where, however, only scanned in the three east-west going transects due to a mix of time limitation and ambition to search as many squares as possible. Ten of these transect were located in the Store Rev 2 focus area and two in the Jammerbugt 2 area. An overall view of the four survey areas can be seen in Figure 17 and the sidescan sail routes can be seen for each area in Figure 18. A summary over the daily activities can be found in Table 5.

Table 5. An overview of the activities during the survey. More details can be found in App. 15 Activity log, North Sea/Skagerrak.

Date	Area	Activities
15-01-21	Hirtshals 1	Relocating from Strandby to Hirtshals, calibration of USBL system, CTD, Sidescan of Hirtshals area 1, USBL pole broke
16-01-21	Store Rev 2	USBL pole fixed, calibration of USBL system, CTD, Sidescan in the Store Rev 2 area, drag at target 334-225
17-01-21	Hirtshals 1	CTD, ROV at target 281-283 followed by dragging. One ghost net recovered (se App. 5), sidescan in Hirtshals area 1, ROV at target 301-304
18-01-21	Jammerbugt	CTD, sidescan in the Jammerbugt 2 area, ROV at target 331-332 ROV was stuck under boat and 1 float lost.
19-01-21	Hirtshals 2	CTD, Sidescan of Hirtshals area 2, ROV and dragging at target 411-414 Relocating from Hirtshals to Strandby

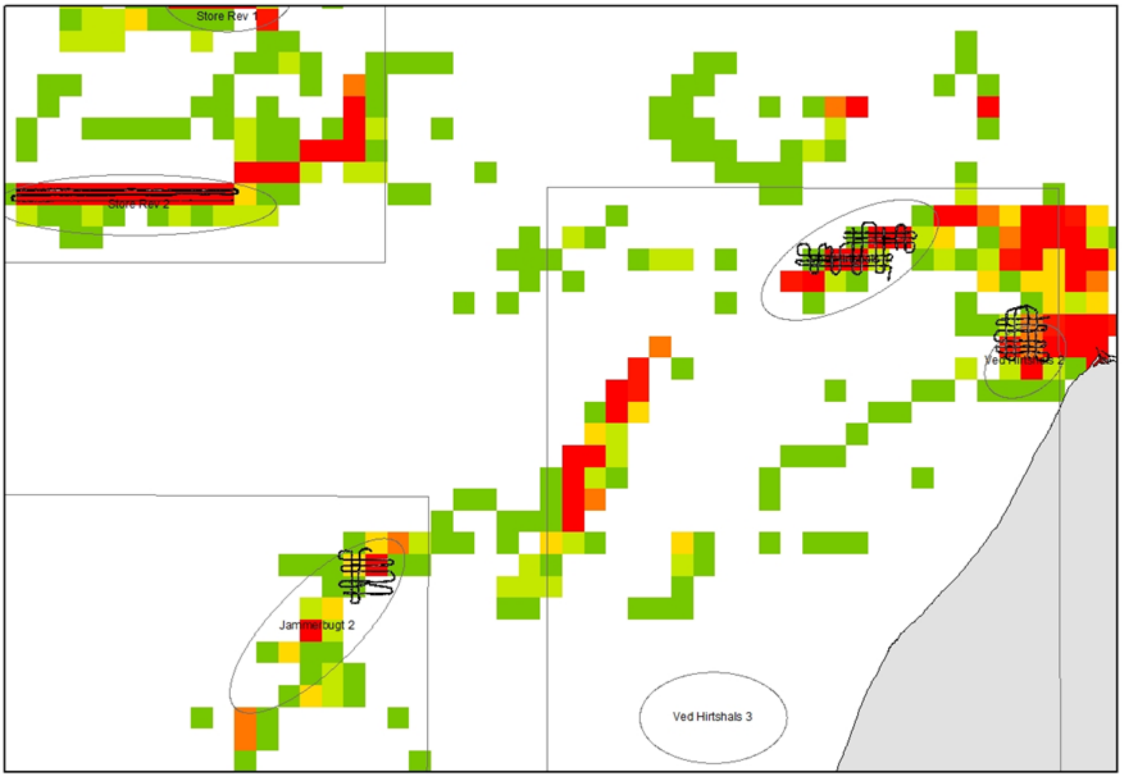


Figure 17. Overview of the mapping routes with the sidescan sonar in the North Sea/Skagerrak area, January 2021.

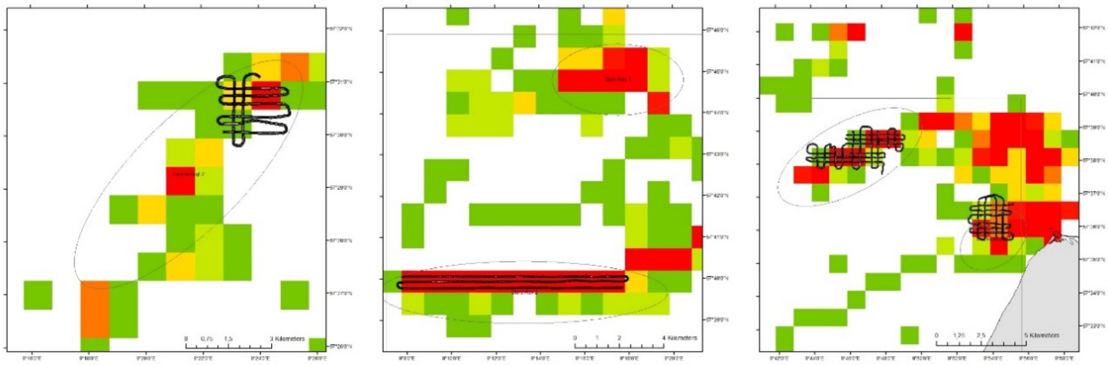


Figure 18. Sail routes for the sidescan survey in Skagerrak. Left panel: Jammerbugt 2 study area, in which four squares were covered, two of these were fully covered and two only in the east-west direction. Middle panel: Store Rev 2 study area, where 10 squares were covered, all only in the east/west direction. Right panel: Hirtshals study area 1 & 2, with respectively seven and four squares covered.

Anomalies selected for ground truthing

During the survey, five anomalies pointed out as targets during the sidescan activities were selected for ground truthing (Fig. 19). The anomalies we focused on and that we believed could be lost nets/trawls or fyke nets, are elongated structures lying on top of the sediment either straight or slightly twisted around other object on the seafloor.

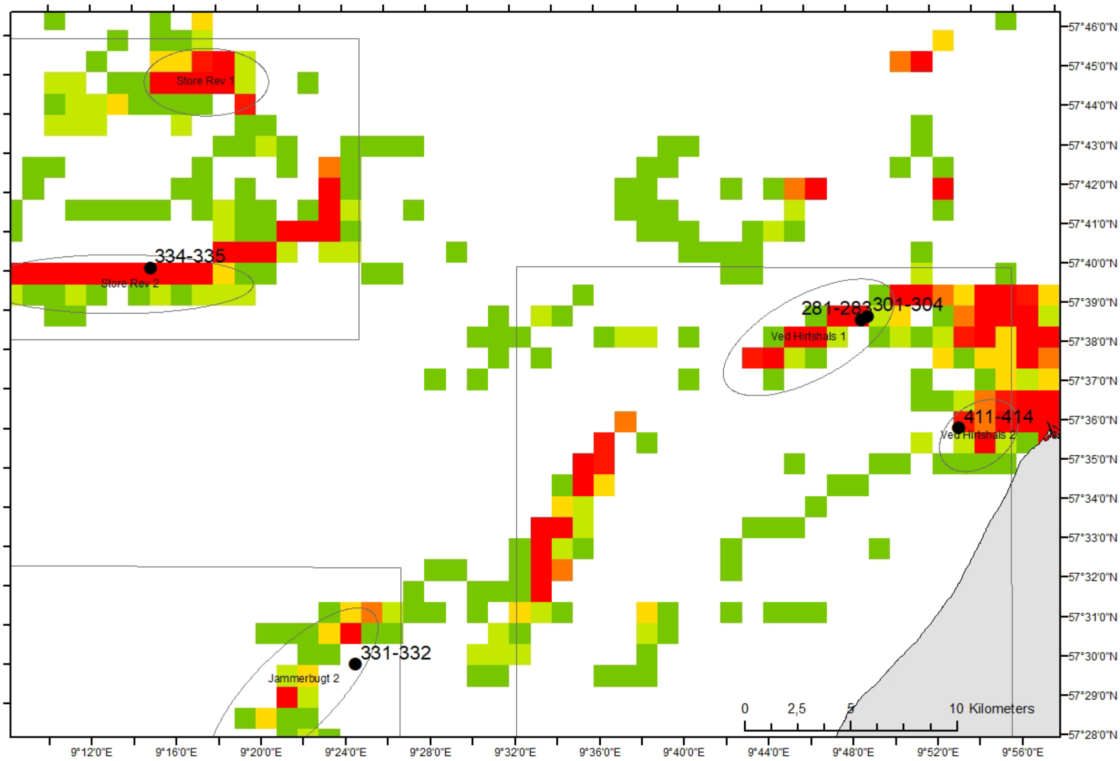


Figure 19. Map of the locations of the five anomalies selected for ground truthing. Target 334-335 could be a trawl or part of a trawl and on target 281-283 a 140 m gill net was recovered.

At target 334-335 pieces of rope fibers were recovered which are believed to be from a trawl or another heavy bunch of rope as we could not recover it using a drag. On target 281-283 a 240 m long gillnet, an anchor and a buoy were recovered, including a 40 kg catch of brown crabs. On the remaining ground truthed targets/anomalies, no unnatural structures were observed. All ground truthed anomalies are described below and the observations summarized in Table 3.

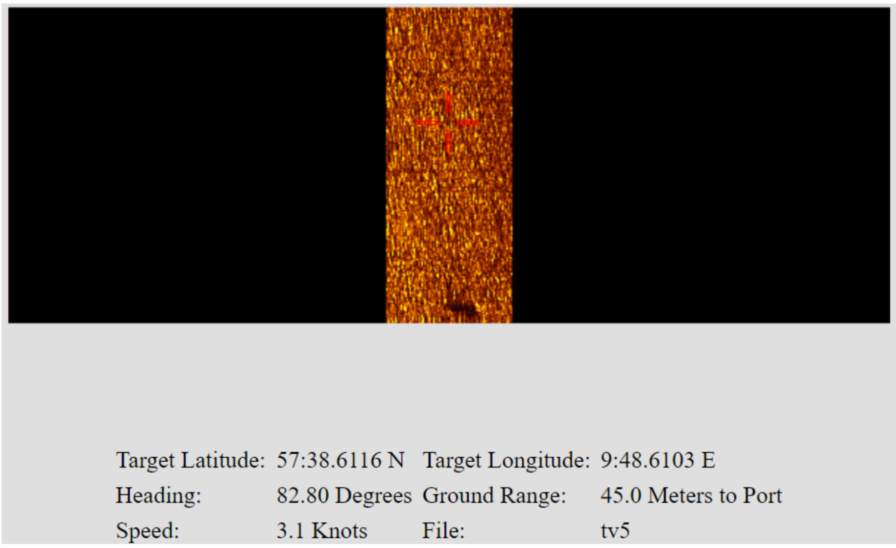


Figure 20. Target 1-282 is one of three targets set for the anomaly observed on the sidescan sonar in the Hirtshals 1 area. This later proved to be a gillnet.

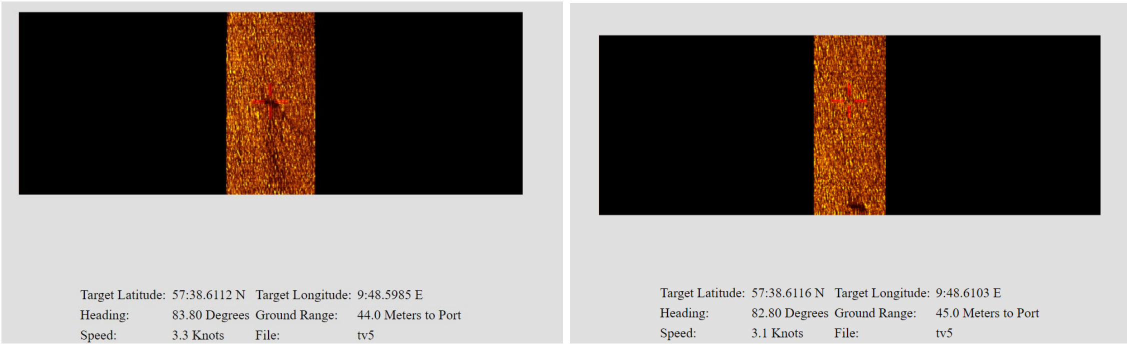
Table 6. Findings of the seven ground truthed anomalies

Target number Area	Reason for ground truthing	Notes	Findings
334-336 Store Rev 2	A line with a strong return and a shadow was observed	Due to limited time the drag and not ROV was used A pile/bump was also observed on Havfiskens echo sounder.	A pinch of rope, stuck on the drag. Based on the strength of the material and the images from the sidescan sonar and the echo sounder it is believed to be a trawl or part of a trawl.
281-283 Hirtshals 1	Long curved structure lying on the sand	Ground truthing with ROV had to be shortened due to a defect on the ROV, It was followed up by dredging between the target positions.	A small piece of rope can be identified on the video sequence prior to the defect on the ROV, the dredging revealed 240 m of net, an anchor and a buoy that were recovered, see App. 5 for details
301-304 Hirtshals 1	A line on target 301 which could be identified into the stony area, which potentially can host ghost nets due to the many structures where it can get caught.	Ground truthing with ROV, GoPro and Paralenz.	Many boulders, stones and rocks on sand with soft corals (*Alcyonium digitatum*)
331-332 Jammerbugt 2	Long structure lying parallel to an area with stone.	Ground truthing with ROV, GoPro and Paralenz. ROV got stuck below the ship but was recovered without serious damage	Very bad visibility. Area appointed as sand area in Phase 1! Sandy area & area with many boulders, stones and rocks on sand with soft corals (*Alcyonium digitatum*)
411-414 Hirtshals 2	Long curved structure lying on the sand and up along the edge of the stone reef	Ground truthing with ROV, GoPro and Paralenz. Drag in sand area.	Bad visibility. Mainly sandy area surrounding the Natura 2000 reef area. No unnatural structures/items observed.

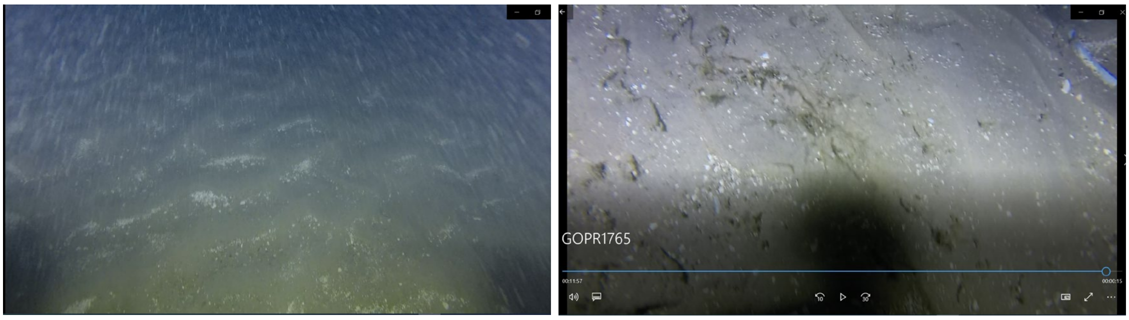
Target description

Target 281-283 (January 15th 2021) in Hirtshals study area 1, was ground truthed on January 17th using the BlueROV with the Paralenz and a GoPro camera. The target is according to the sidescan image located on sandy bottom, which also is confirmed by the downwards pointing GoPro camera and the EUNIS habitat map. However, it is very close to a mixed bottom area (Fig. 16).

The BlueROV mission had to be aborted due to a line in one of the propellers. However, on image #4 a small blue rope can be seen in the top right corner – this might be a part of the net that was later retrieved. When the BlueRov was on deck, an attempt of dredging at the targets was made. A 240 m long crab net (gillnet) was caught including an anchor, a buoy and 60 m of blue flag line. In the net was 70 brown crabs weighing in total 40 kg. No dead brown crabs were observed in the net. Details on the recovered material can be found in appendix. A.19.



Images of target no. 281 (left) and 282 (right)

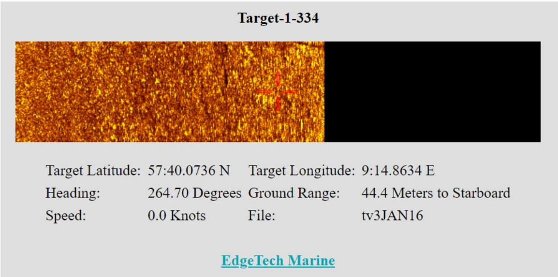


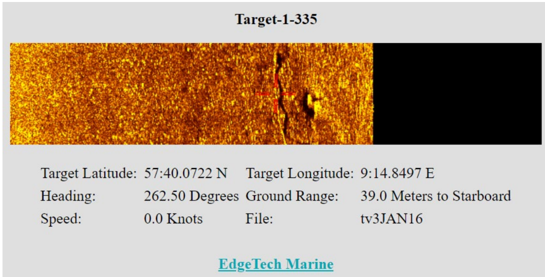
Two images from the GoPro mounted on the BlueRov used for ground truthing. A small piece of blue rope can be identified on the right-hand image.

Pictures of the recovery of the ghost net. Left panel: the drag (Havfisken's anchor) has caught the blue flag line from the ghost net. Middle panel: The ghost net on the trawl drum, including some of the brown crabs caught in the net. Right panel: The recovered ghost net lying on the deck of Havfisken.

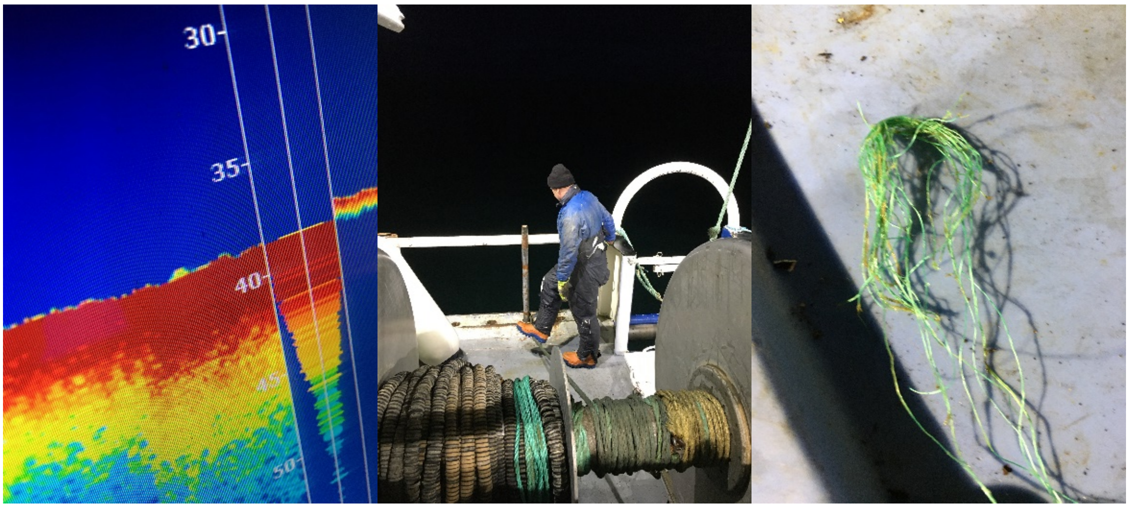
<u>Target 334-335 (January 16th 2021)</u> in Store Rev study area 2 was only ground truthed by dragging due to limited time and a water depth at around 40 m, which would make it very difficult to maneuver the ROV in the right direction due to drag in the cable. According to the EUNIS habitat map and the sonar image, the targets were in the sand area, but also very close to the Natura 2000 mapped stone reef (Fig. 4.4.8). We dredged at the positions three times. First time some rope-fibers were stuck on the dredge. In the second attempt, the dredge got stuck and a tooth on the drag was lost. Prior to the third attempt, a new drag was attached and this time some more rope fibers were caught and some plastic, but no large pieces. A pile was

also observed on the echo sounder of Havfisken, and it is likely that the anomaly could be a trawl or a piece of a trawl.



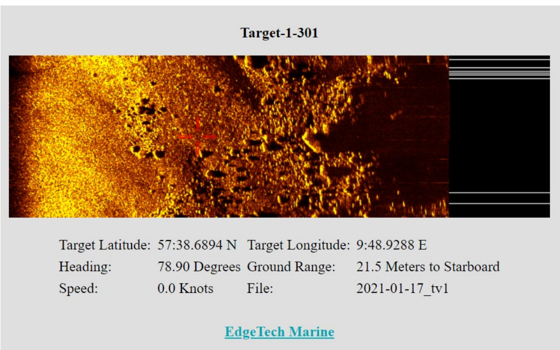


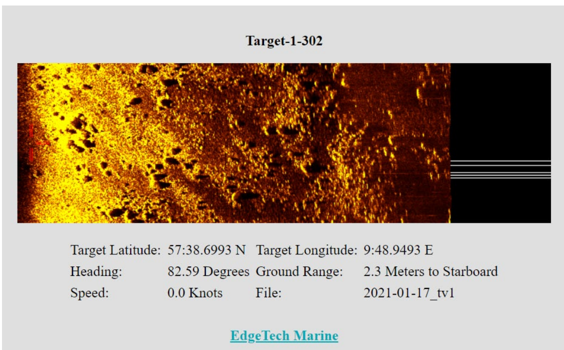
Images of target no. 334 and 335



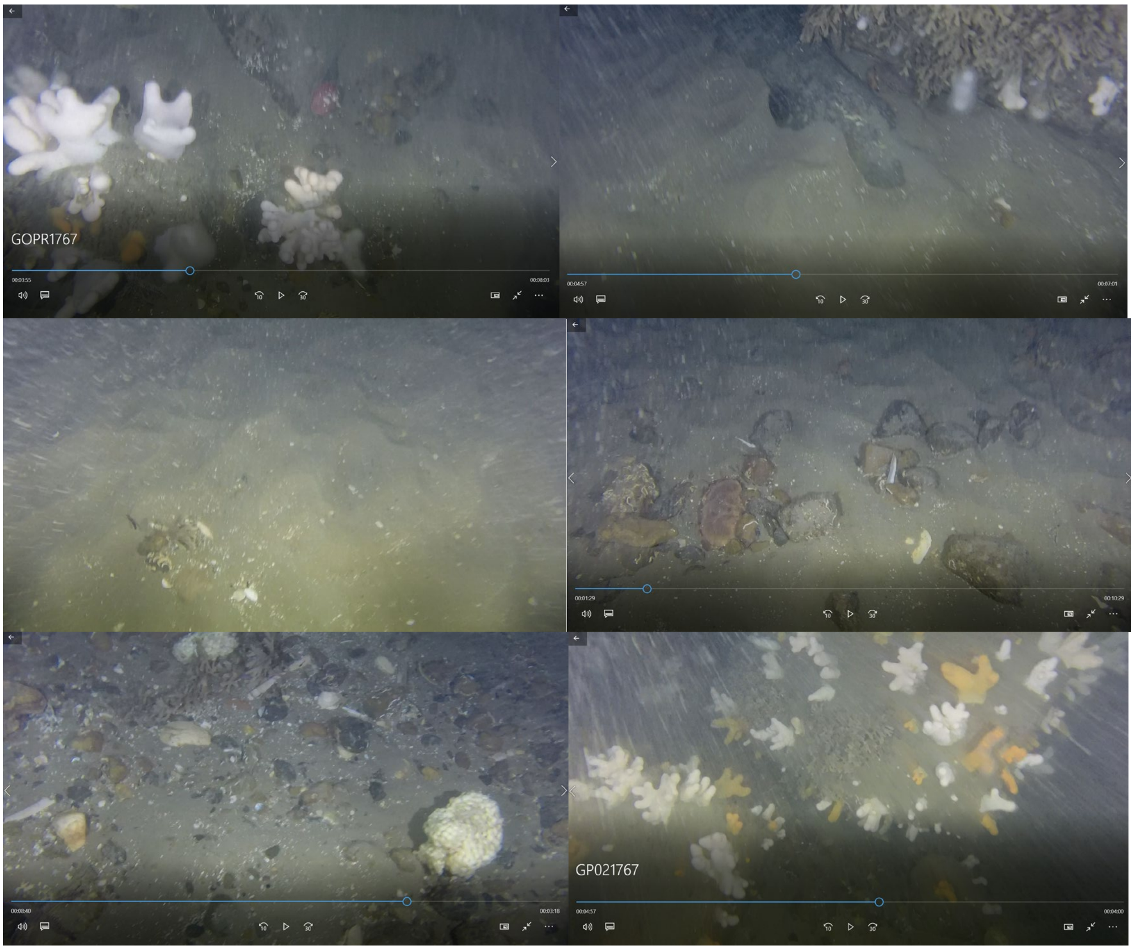
Left panel: Picture of the echo sounder image where a yellow "bump" can be observed. Middle panel: A crewmember from Havfisken feeling if the dredge is catching something. Right panel: Rope fibers caught with the dredge.

Target 301-304 (January 17th 2021) in Hirtshals study area 1 was ground truthed on January 17th using the BlueROV with the Paralenz and a GoPro camera. The targets are, based on the sidescan images, located on a mixed bottom or in the area going from sand to reef area. The bottom type is confirmed by images from the downwards pointing GoPro camera inserted below, and the EUNIS habitat classification mixed bottom area (Fig. 16). No signs of ropes or net materials were detected, and some aligned stones could have caused the illusion of a "line" in the image. These targets are very close to the area where the net was recovered and this kind of area with large stones/boulders on sand bottom could potentially be a host area for ghost nets as nets coming from the sandy area could be stock around the stones.





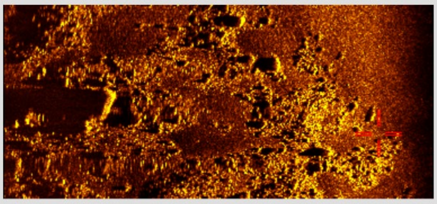
Images of target no. 301 and 302



Selected images from the GoPro mounted on the BlueRov used for ground truthing, showing boulders and stones covered in soft coral (Alcyonium digitatum), mixed bottom with brown crab, and sandy bottom.

Target 331-332 (January 18th 2021) in Jammerbugt study area 2 was ground truthed on January 18th using the BlueROV with the Paralenz and a GoPro camera. The entire study area was appointed as a sand area but was generally a mixed area with stones on sand. Two ground truthing trials were made with no observation of unnatural structures. By the end of the second trial, the ROV was stuck under the boat but was recovered without any further damage than loss of a float.

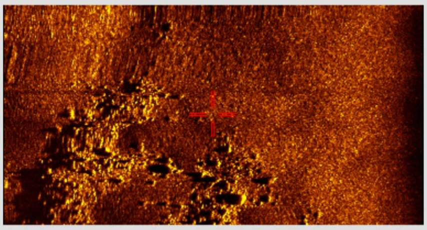
Target-1-331



Target Latitude:	57:29.9609 N	Target Longitude:	9:24.5131 E
Heading:	178.00 Degrees	Ground Range:	5.4 Meters to Port
Speed:	0.0 Knots	File:	tr1

EdgeTech Marine

Target-1-332



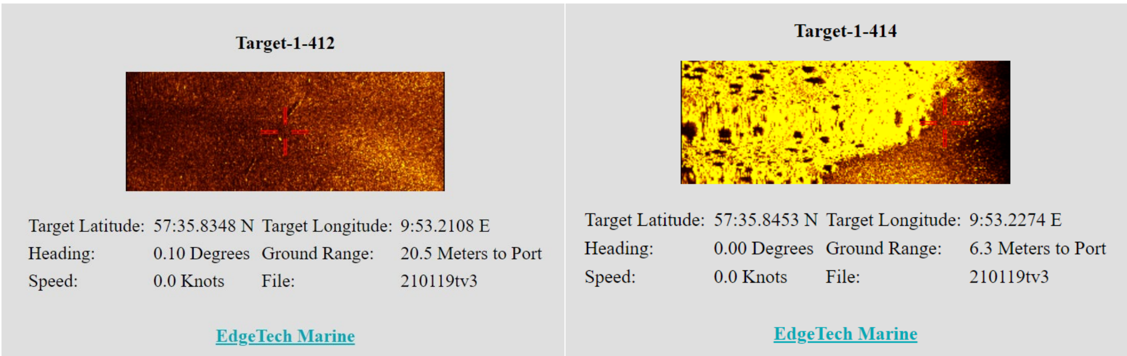
Target Latitude:	57:29.9518 N	Target Longitude:	9:24.5267 E
Heading:	179.00 Degrees	Ground Range:	20.2 Meters to Port
Speed:	0.0 Knots	File:	tr1

EdgeTech Marine

Images of target no. 331 and 332

Selected images from the GoPro and Paralenz mounted on the BlueRov used for ground truthing.

<u>Target 411-414 (January 19th 2021)</u> located in Hirtshals study area 1 was ground truthed on January 19th. The appearance of target 412 was similar to target 282, which proved to be a net. Therefore, three dives were made with the ROV to identify the structure, but without any luck. The majority of the area was fine sand, right up to the edge of the stone reef as target 414 nicely illustrates. Images of sand and the reef can be seen below. Due to the similarity of target 282 it was decided to drag for the item at the sandy area, but none unnatural items were caught.



Images of target no. 412 and 414

Selected images from the GoPro and Paralenz mounted on the BlueRov used for ground truthing.

A.5. Extra survey in the Limfjord

By Fletcher Thompson

Summary

This section details the planning and proceedings of an additional ghost net survey conducted in the Limfjord for four days (July 13th up to and including July 16th). The main objective of this survey was to investigate whether designated shellfish fishing areas (lobster, crabs, mussel farms have a higher abundance of ghost nets in comparison to non-shellfish fishing areas (roundfish or flatfish). Five sites (three shellfish, two non-shellfish) were selected and surveyed with a side scan sonar for ghost net targets, followed by visual confirmation/rejection of identified sonar targets using a Remotely Operated Vehicle (ROV). Of the five areas surveyed, two shellfish areas in close proximity to mussel farms contained heavy abundance of ghost net sonar contacts, of which one was visually confirmed. Additionally, one of the non-shellfish areas contained a single ghost net.

Site Selection Method

Shellfish fisheries, in particular mussels and lobster, have dominated the Limfjord for many years. The mussel industry is the current major fishery in the Limfjord, with lobster and brown crab in second and third position. Since mussels are harvested by dredging, the focus shellfish fisheries are lobster and brown crab as plastic fishing gear such as crab pots and nets are used. There was no shortage of possible survey sites for lobster and brown crab. However, identifying roundfish/flatfish fishing areas proved to be more difficult than expected.

In fact, since the fjord became brackish in the 18th century after exceptionally destructive winter storms brought seawater ingress on the Danish west coast, traditional roundfish and flatfish fisheries have steadily decreased to being virtually non-existent in the 1980s. Potential fishing sites were identified by the following criteria:

1. Historical fishing areas (whitefish and herring) as identified by fishing historians (Poulsen et al., 2007).
2. Areas outside of the reported shellfish fishing areas (DTU Aqua, 2021).
3. Ghost net reports provided by Limfjordsrådet's online reporting service (https://www.limfjordsraadet.dk/projekter/spoegelsesnet-i-limfjorden/oversigtskort-spoegelsesnet/).
4. Areas recommended by local fishermen.
5. Areas that have not already been visited by volunteers from DFPO for ghost net clean-up operations.

Of these, the last four were chosen as valid criteria as the historical fishing sites preceded plastic fishing gear technology and were located in areas either inaccessible or too far away from Nykøbing Mors to be surveyed effectively. Figure 1 and 2. present the assimilated data collected from fishermen, historical fishing sites from Poulsen et al. (2007) and the Limfjordsrådet's online reporting service for northern and southern sections of the Limfjord, respectively.

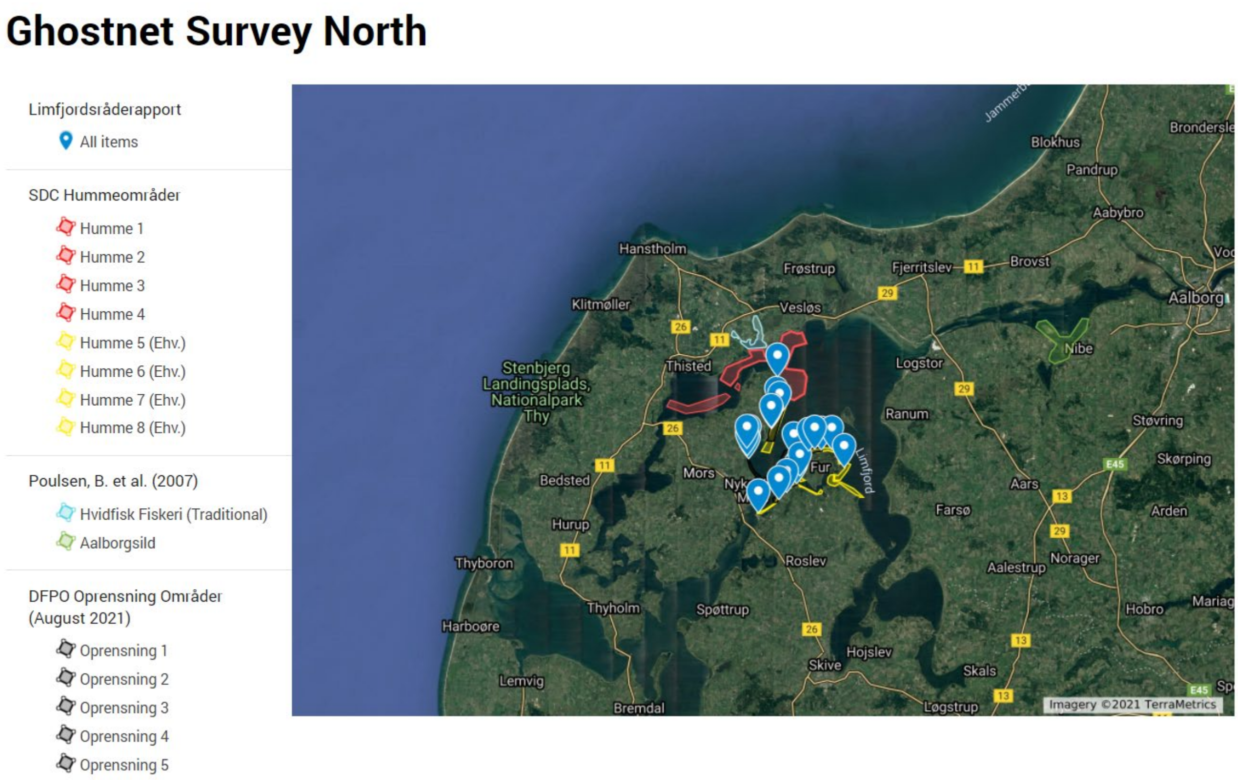


Figure 1 Northern potential survey sites in the Limfjord, data collected from the Shellfish Centre, Limfjordsrådet, members of DFPO, and Poulsen et al. (2007)

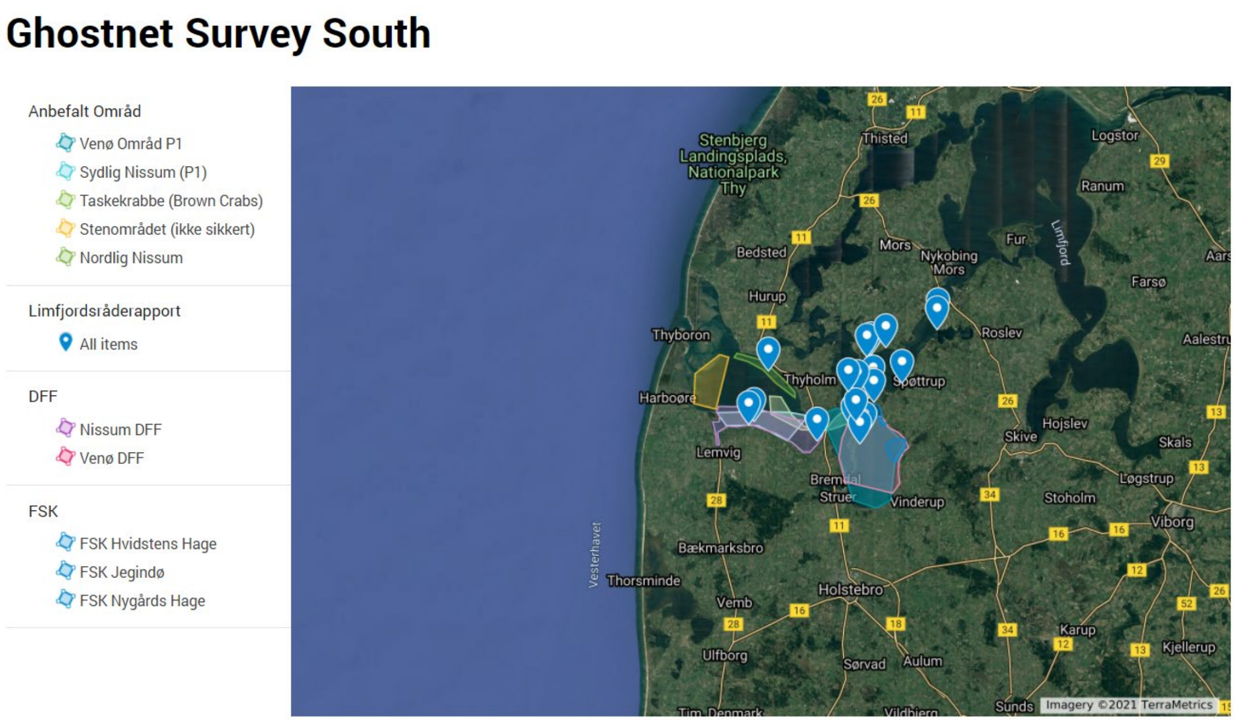


Figure 2 Southern potential survey sites in the Limfjord, data collected from the Shellfish Centre, Limfjordsrådet, members of DFPO, and Poulsen et al. (2007)

Equipment Setup

The Danish Shellfish Centre's 6 m vessel, *Fjordrejen*, was the principal vessel used for towing the sidescan sonar. An Edgetech 4125 dual frequency sidescan sonar 600/1600 kHz was hung from the starboard side of *Fjordrejen* at approximately 60 cm below the waterline, enough to allow the transducers clear soundings beneath the hull. The Edgetech system was supported with an Atlaslink A326 Smart Antenna GPS as the principal navigation aid. The antenna was set 2.5 m above, 2 m aft and 1 m to port of the towbody. The nominal range of the sonar was set to 25 m on either side of the tow body. Post-processing of the sonar data was performed using SonarWiz v7.08.00. A Blue Robotics BlueROV2 unit was also included to provide visual confirmation of marked targets (Fig. 3). Kasper Andersen from DTU's Shellfish Centre acted as pilot for *Fjordrejen* and assisted with setup, deployment and retrieval of equipment. Fletcher Thompson from the Observation Technology group acted as operator for the sidescan sonar and BlueROV2 and was responsible for processing of the collected data. Daniel Taylor from DTU's Shellfish Centre assisted with repair of the damaged sidescan sonar cable.

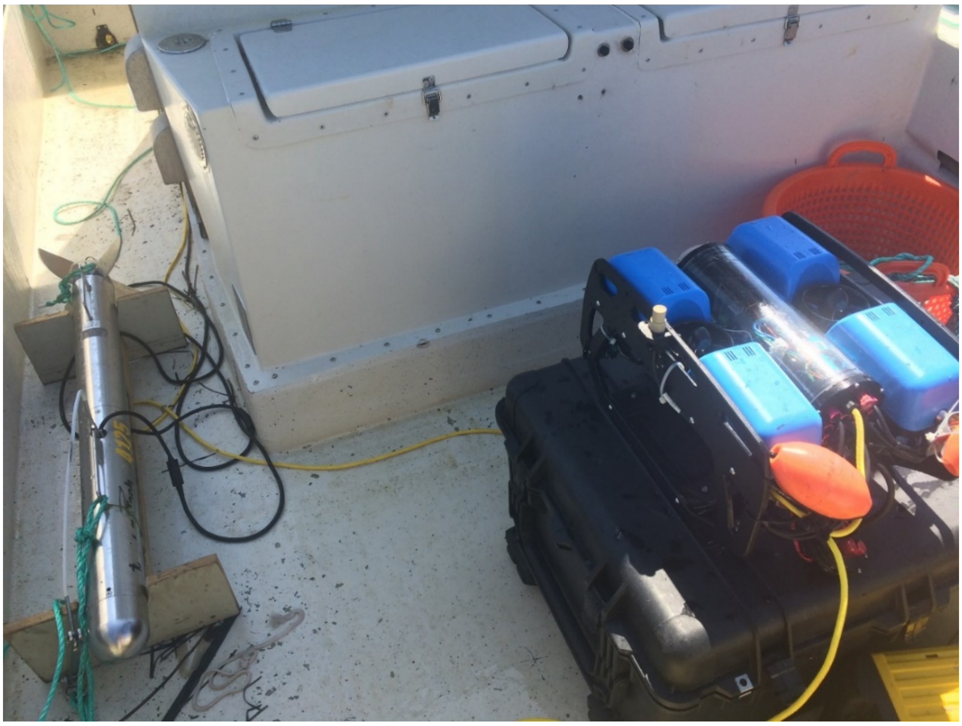


Figure 3. Edgetech sonar and BlueROV2 Vehicle aboard Fjordrejen during transit

Survey Plan

Five sites were selected from the northern section of the fjord (Fig. 1). To minimise the time spent travelling to and from the central deployment location of DTU's Danish Shellfish Centre at Nykøbing Mors. One day was allotted for each site with the aim of covering as much of the site as possible. The general procedure was to survey each site with the side scan sonar for the majority of the day, marking potential ghost net targets identified within the sonar waterfall. These targets were then revisited in the final part of the day. The ROV was deployed during the revisit phase to confirm or reject the presence of a ghost net close to the target area. The survey was executed at the same time as members from DFPO were performing ghost net clean-up operations. Care was taken to coordinate with the clean-up members so that all of the areas surveyed preceded any scheduled clean-up operations.

Survey Results

Overview

The areas in figure 4 were covered over four days. Targets identified during the survey are displayed as either blue rings (unconfirmed sonar targets) or filled green circles (confirmed ghost nets). Multiple ghost nets were sighted, indicating that at least two ghost nets were present (it was difficult to confirm whether multiple sightings in an area were part of the same net). In total 40 targets were identified, with 6 of the targets belonging to visually confirmed ghost nets.

Figure 4. Accumulated coverage of the survey, ranging from latitudes 56° 39' to 56° 57' and longitudes 8° 56' to 9° 1'. Unconfirmed targets are listed as blue rings, confirmed ghost nets are identified as filled green circles.

Day 1 – Lobster Fishing Ground 1

Marked mussel farms prevent complete "lawnmower" pattern coverage surveys in the area, so a simple boundary survey of the farms was conducted to cover two separate survey areas as quickly as possible (Fig. 5). There were many sonar contacts identified along the boundaries of the mussel farms. This is likely because the nutrients released to feed the mussel beds is an easy food source for lobster, and the fishers have identified this behaviour.

Figure 5. Coverage for day 1 of the survey. Areas were identified from the Shellfish Centre's report on lobster and crab fishing areas for 2020-2021

No time was allocated to revisit the southern area for visual confirmation, as it was scheduled for clean-up by volunteer fishermen from DFPO on the following day. Visual confirmation tasks were scheduled for the northern area during day 2.

Day 2 – Lobster Fishing Ground 2

Additional to completing the northern area marked in Figure 5, an area further north was selected for surveying as it contained 4 close reported ghost net sightings from the Limfjordrådet reporting system. Contacts were identified in the area but could not be confirmed with the ROV due to muddy conditions (see Figure 8). During the coverage survey of the southern area in Figure 6, the cable connecting the sonar towfish to the topside was overstrained during retrieval of the towfish for faster transit.

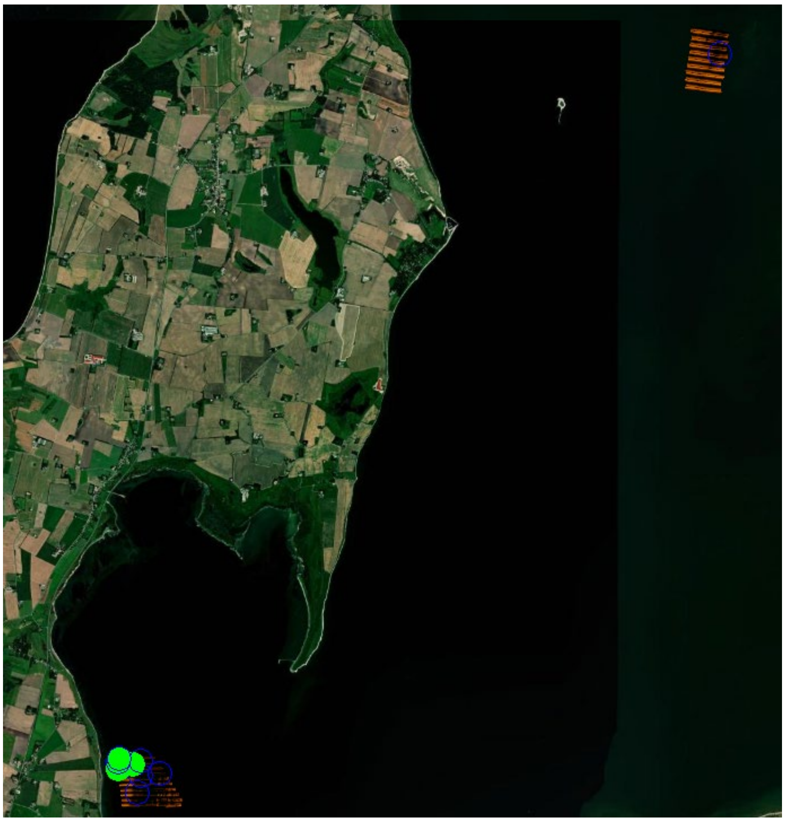


Figure 6 Coverage for day 2 of the survey. Areas were identified from advice from personnel at DTU's Shellfish Centre who are drafting the 2020-2021 lobster catch reports. Ghost nets were confirmed in the southern section (see green marks).

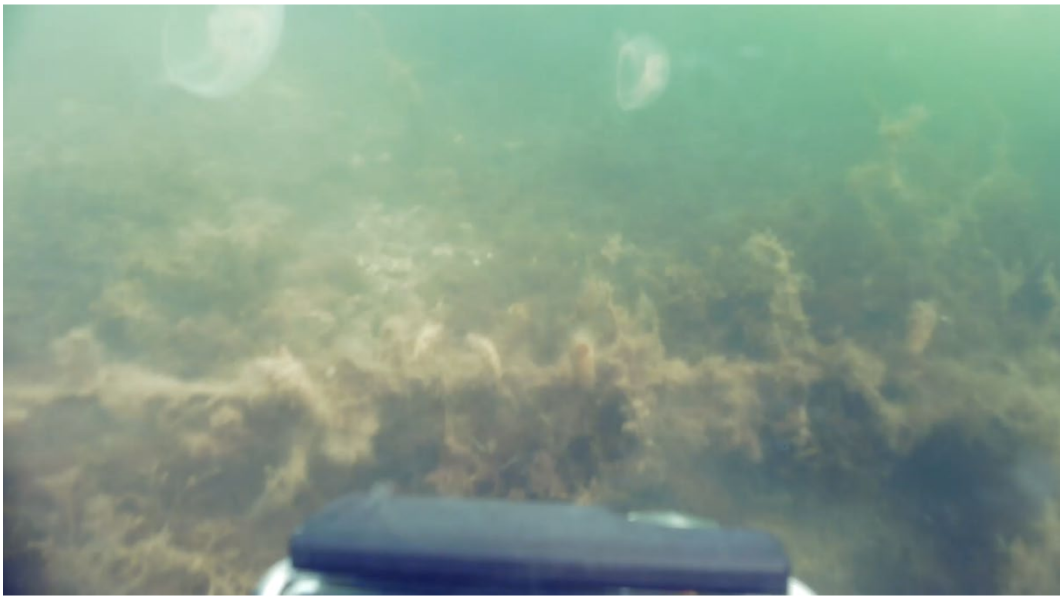


Figure 7. Image of a confirmed ghost net captured at approximately 56° 50.89785', 8° 50.63461'. Location information was shared with the fishers participating in the cleanup activites.

Damage to the towbody cable during retrieval of the towfish caused the survey to be postponed for the last half of the day while a suitable replacement cable was produced at the Shellfish

Centre. This gave more time for video confirmations of targets using the ROV. One long net (over 100 m long) that spanned across several acoustic targets was confirmed in the southern area (Fig. 7). Many of the targets identified during the survey could not be visually confirmed to be ghost nets, but this might be due to the poor visibility conditions of the Limfjord. Additionally, the Limfjord bottom consists mainly of a thick mud layer with a lot of loose sediment. Ghost nets may easily be observed on sonar but are concealed by the mud (Fig. 8)

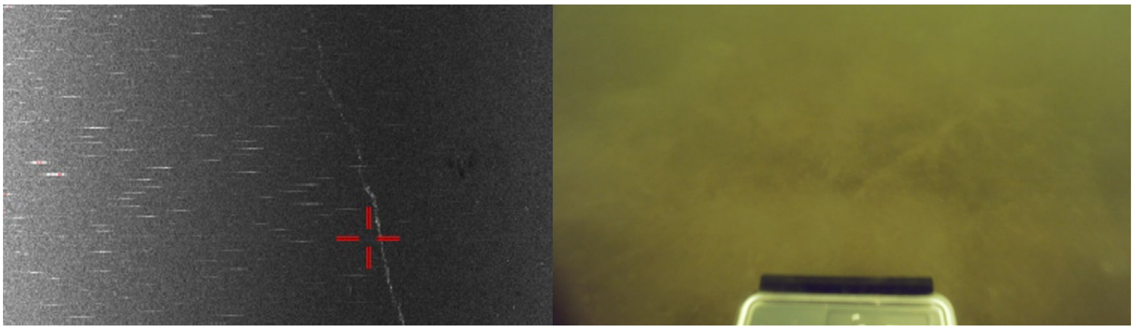


Figure 8. Acoustic target identified in sidescan sonar imagery in area 2 (left), compared with the visual observation of the same target (right). This could be a ghost net but attempting to dig the net out for visual confirmation with the ROV resulted in mud clouds released, completely impairing visibility. Several of these types of "concealed" contacts were observed.

Day 3 – Non-Lobster Fishing Ground 1

Two fishing areas were surveyed further south of Nykøbing Mors (Fig. 9). The southern area contained one confirmed fishing net (Fig. 10), likely a gillnet.

Figure 9 Coverage area for day 3. Areas (Nymølle Strand, and Harre Vig) were indicated by local fishers as roundfish and flatfish fishing grounds. At least one ghost net was identified in the southern sections of the survey (see green marks & Fig. 10).

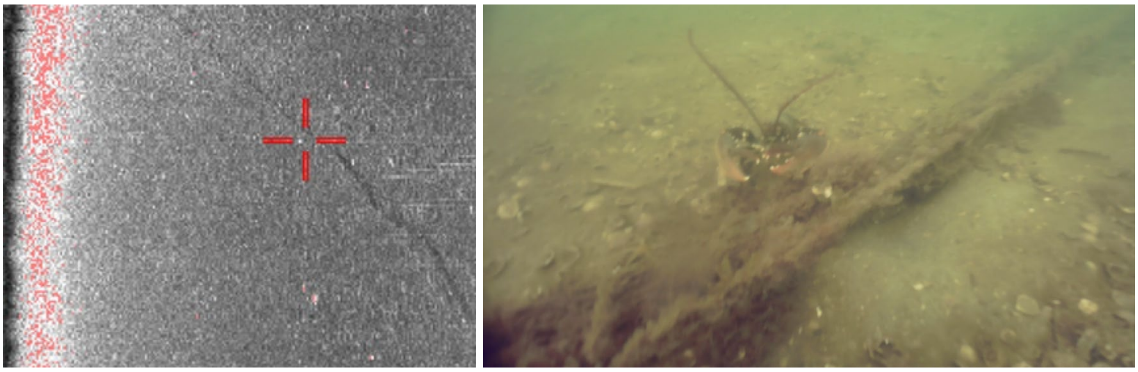


Figure 10 Net confirmed at approximately 56° 39.6596’, 8° 46.34308’. This information was shared with DFPO fishermen volunteering for clean-up activities.

Day 4 – Non-Lobster Fishing Ground 2

The final day of survey finished off the remaining area of Harre Vig (Fig. 11). The charted depths in this section were untrustworthy, which resulted in some deviations from straight line transects to avoid grounding. The area is popular for anchoring of sailing yachts. Targets were identified in the area, but all were confirmed to be false positives produced by anchors creating drag marks on the muddy bottom se example in figure 12.

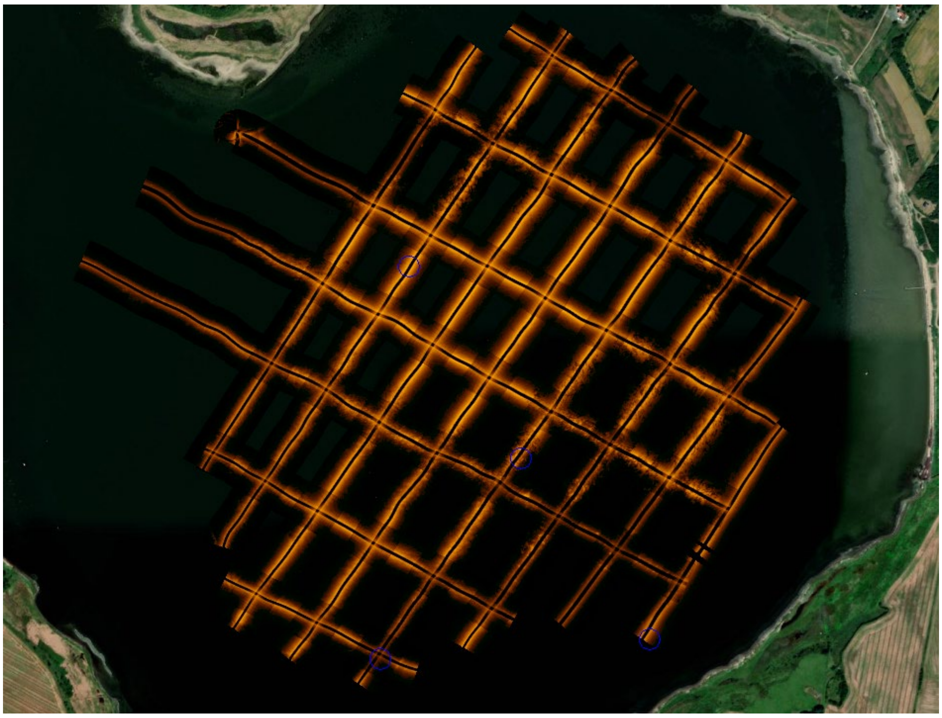


Figure 11. Covered area in Harre Vig for day 4.

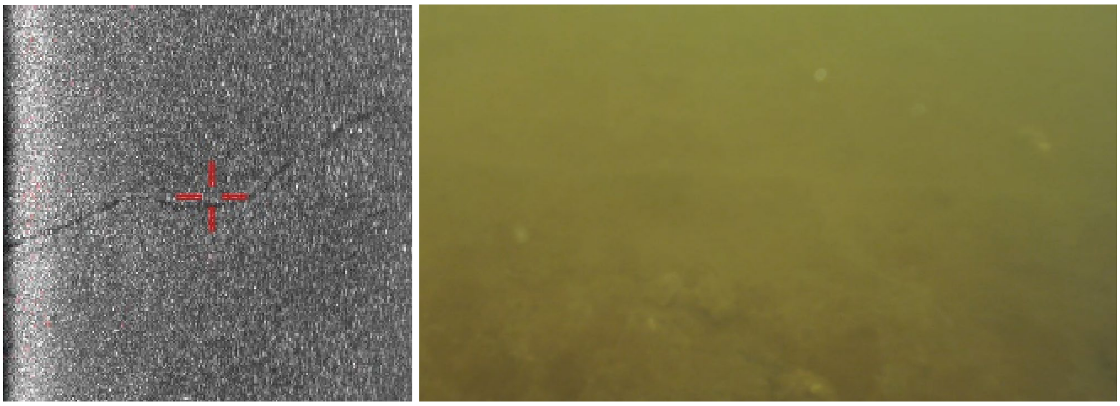
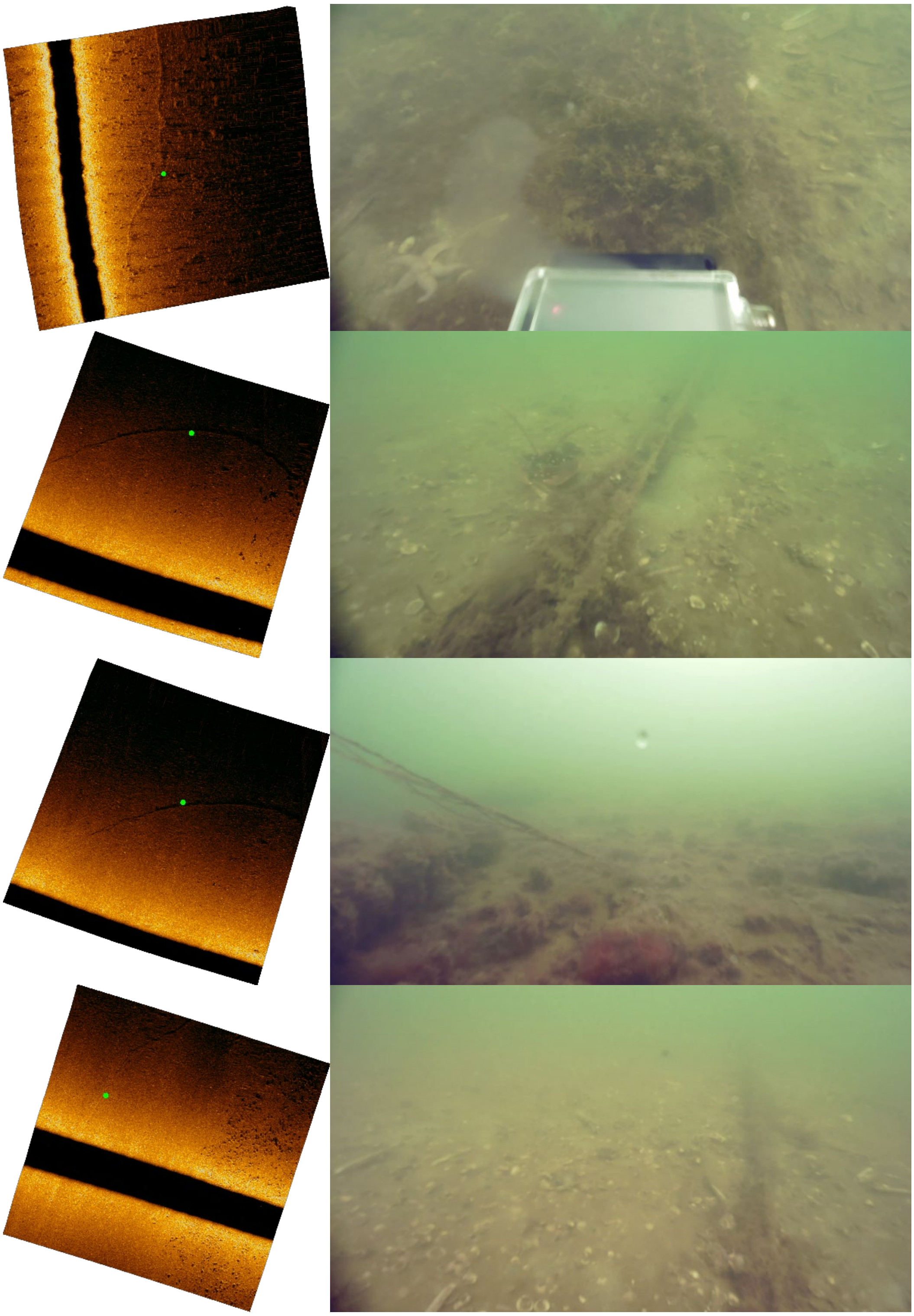


Figure 12. Anchor Tracks identified in sidescan sonar data in Harre Vig. Tracks were long enough to appear similar to a rope lying on the bottom.

Ground Truthed Ghost nets

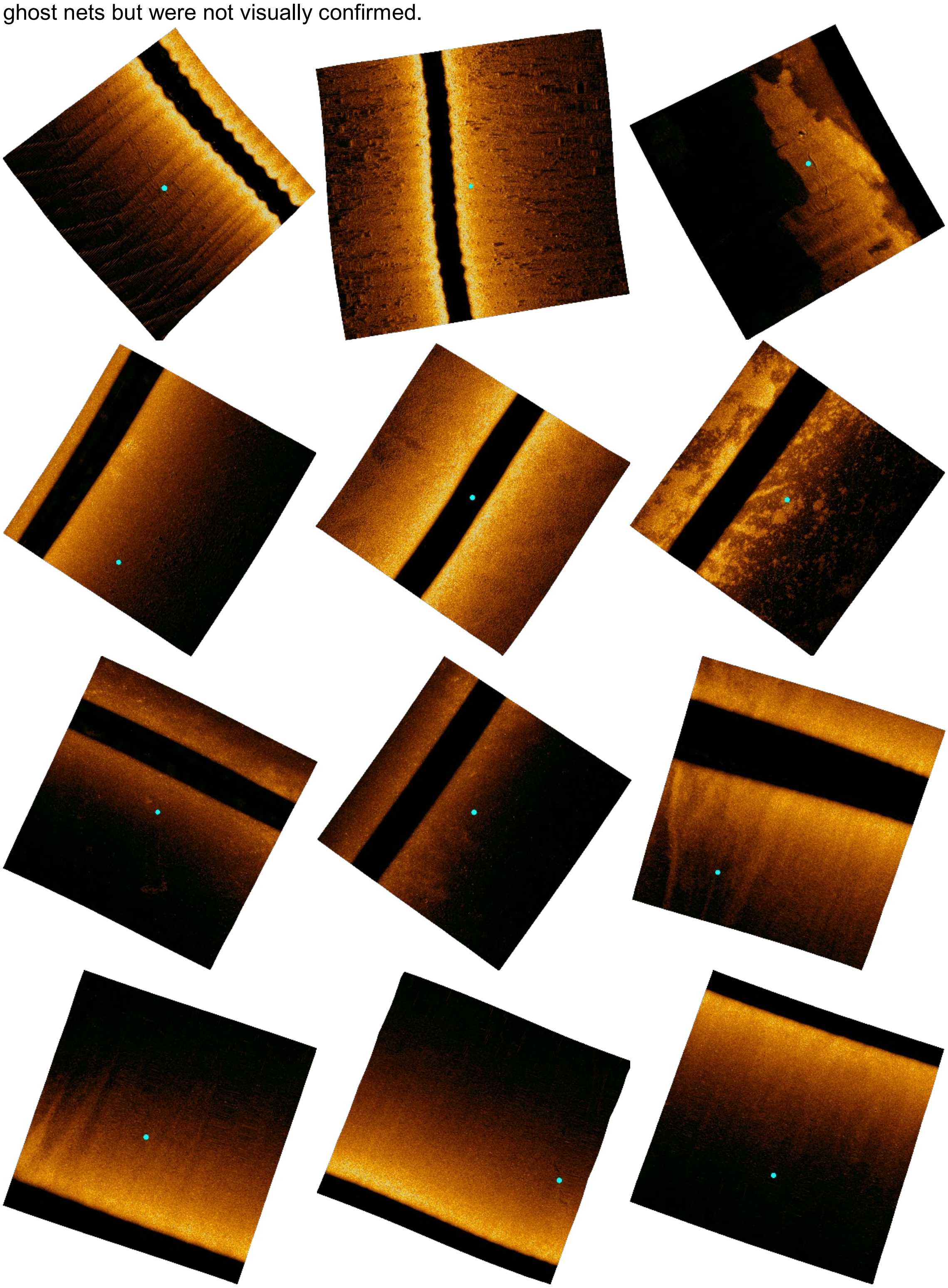
The figures in this section show the georectified (North up) of the sidescan sonar imagery with screen grabs of the net located near the GPS location.

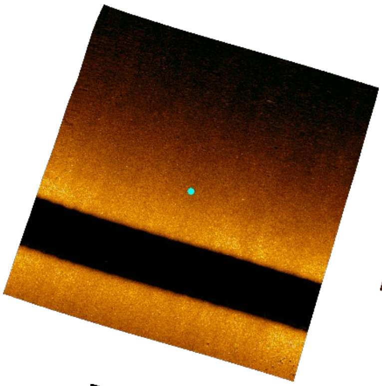
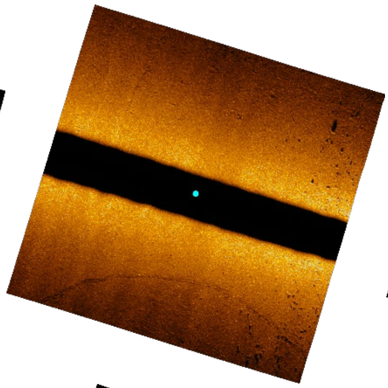
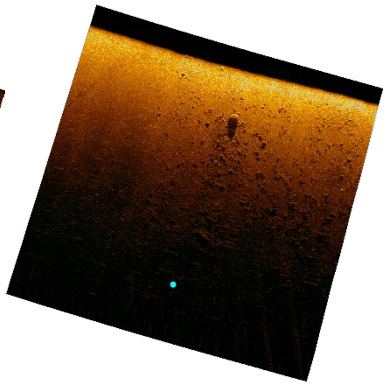
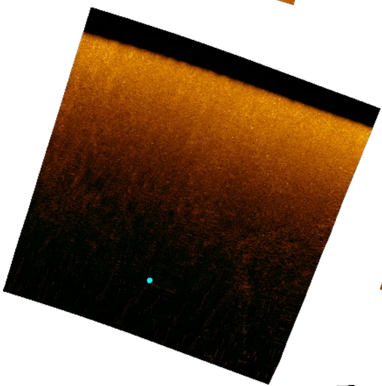
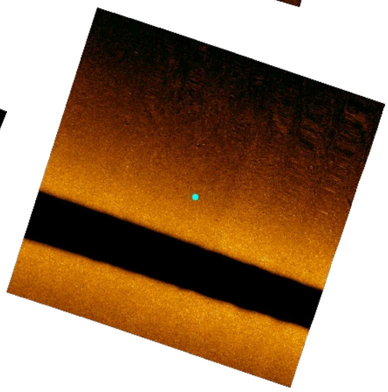


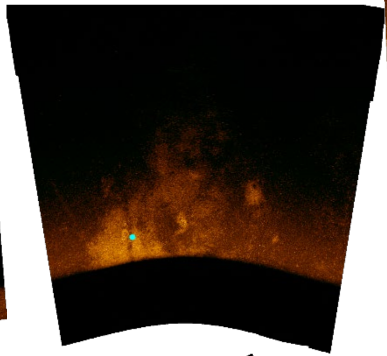
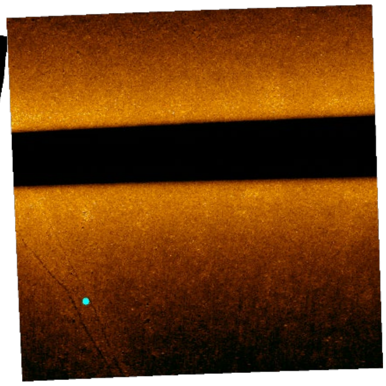
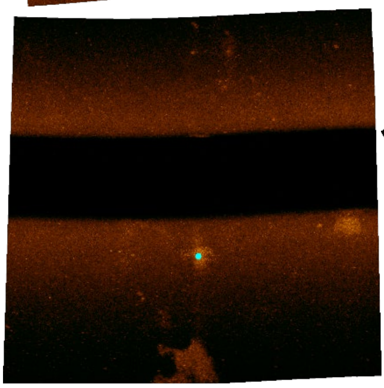
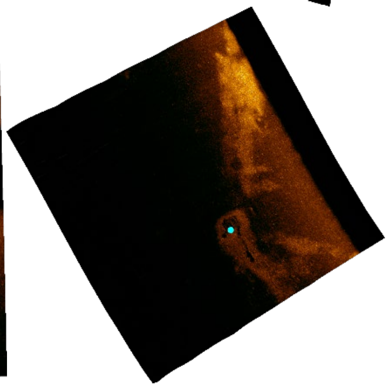
Georectified (North Up) side scan sonar targets (left) and corresponding visual confirmations (right).

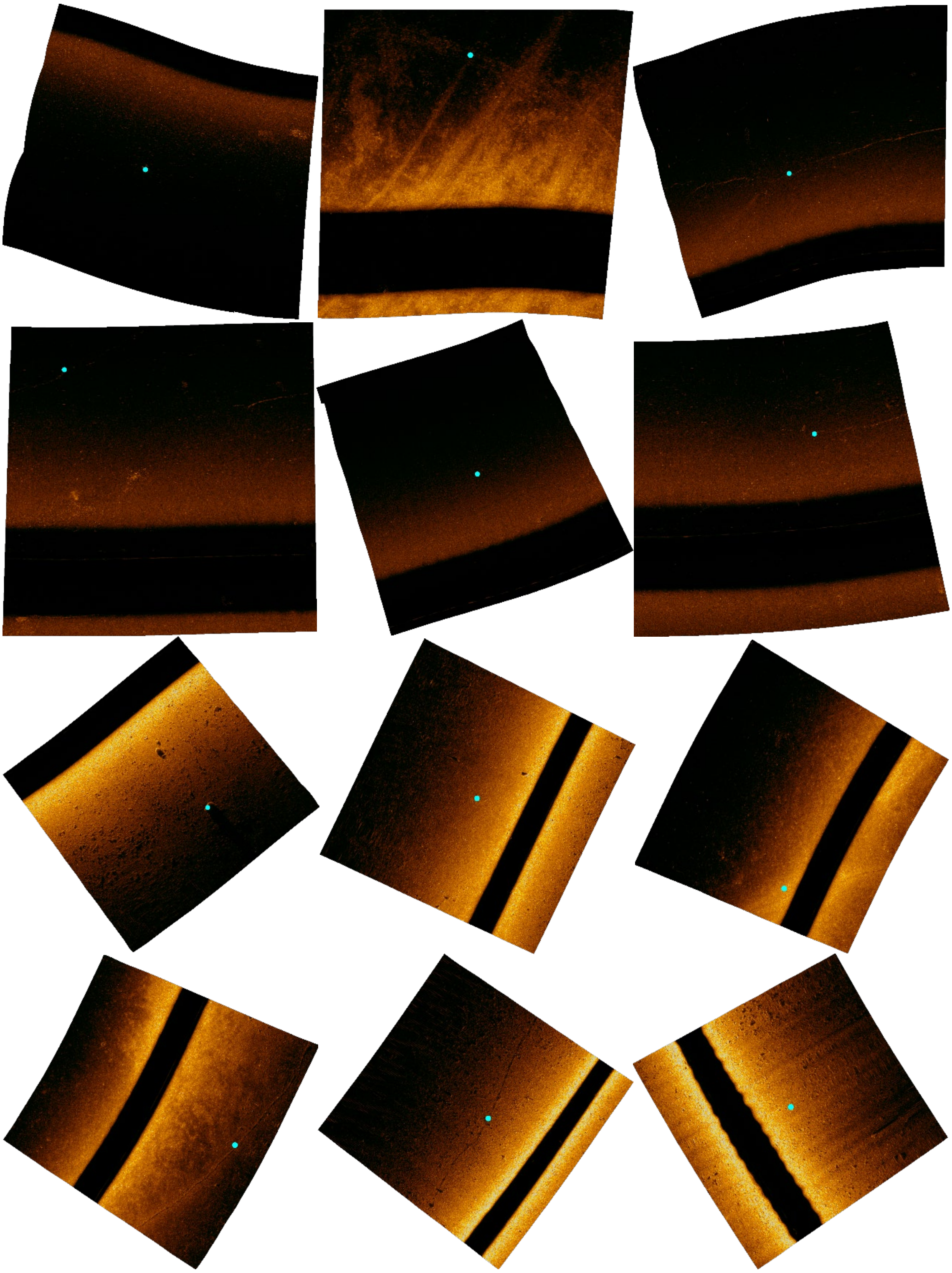
Unconfirmed Targets

The following set of images are georectified side scan sonar targets of objects that could be ghost nets but were not visually confirmed.





Georectified (North Up) side scan sonar images of targets that could not be confirmed visually but were flagged by the operator as likely net or lobster pots.

A.6. Methodologies for location and retrieval of derelict fishing gear – description and experience

By Niels Gerner Andersen

Previously applied methods for locating and retrieving derelict fishing gear (DFG) are presented here together with the experience relevant for Danish waters.

The report 'Methods to locate derelict fishing gear' by the GGGI Catalyse and Replicate Solutions Working Group (Drinkwin 2017) provides a general overview of the methods and techniques used globally to locate DFG in marine habitats. They are listed in short here:

1. *Sidescan sonar*. Acoustic surveys of the seafloor are an obvious way of searching for DFG. Sidescan sonar scanning is able to cover large areas when deployed from a moving vessel at low speeds. It is non-invasive and not limited by the visibility in the water.

2. *Surface visual surveys*. Visual surveys from boats are used to locate the buoys of shellfish traps or lost gillnets that have been abandoned or are drifted away from set locations. Due to costs in terms of fuel and search time, these surveys are most relevant in smaller areas with high concentrations of DFG.

3. *Aerial surveys*. Visual observations from airplanes or drones provide a way to extend the coverage of the surface visual surveys in cases where large areas are to be monitored for buoys.

4. *Underwater diver or drop camera surveys*. Divers have in some cases successfully been used in surveys on identified areas of suspected concentrations of DFG as well as to verify that targets identified by sidescan sonar actually are DFG. Underwater cameras or ROV's can also be deployed for these purposes. These underwater visual methodologies are however limited by the visibility in the water.

5. *Dredging surveys*. Systematic dredging can be an efficient location method in areas with known or suspected concentrations of DFG. Often, removal of the DFG is accomplished immediately after location using the same dredge. This method is most efficient in habitats with smooth seafloor. In areas with reefs or seagrass beds, the method can cause excessive damage to the habitat.

6. *Local knowledge*. Information about the exact location of specific DFG provided by local fishermen is an obvious source that has been repeatedly utilized.

Until 2003 (cf. FANTARED 2), permanent routine retrievals were only known to be operated in Norway. These retrievals are based on a requirement that the fishermen promptly report lost fishing gear. Areas hosting quantities of DFG are closed for fishery in a short period annually and a chartered trawler is dredging across the reported positions. This program yields up to 4–500 nets over a two-week period and is funded by the Norwegian Fisheries Directorate.
Since then, retrieval programs of DFG have been launched locally in Sweden, in Poland, and the deep-water net fisheries of the northeast Atlantic. This includes cooperation between

Norway and the European Community in gear retrieval programs in Norwegian and Community waters in 2005, which is set to continue on an annual basis in the future (Brown & Macfadyen 2007, www.8fjordar.se). DFG retrieval as a curative measure is used widely in other parts of the world as well, especially in the waters of North America, South Korea, Japan and Australia (Macfadyen *et al.* 2009).

Reported experience with the different search and retrieval methods relevant for the conditions in Danish waters is generally sparse. The exception is the MARELITT Baltic project (Predki *et al.* 2019), which is described below including the recommendations based on results and obtained experience. In continuation of this project, two new smaller projects on the application of dredging (Tschernij 2020) and sidescan sonar (Dederer *in prep.*) in the Baltic Sea have been reported. They are briefly described here as well. Finally, recent experience by Christensen (2020) with retrieval of abandoned gillnets used in the crab and lobster fisheries in the Danish Limfjorden is described.

Apps being used by recreational fishermen and stakeholders are briefly described at the end of this review.

The MARELITT Baltic project

Introduction
The focus of the MARELITT Baltic project was to reduce the impact of derelict fishing gear (DFG) in the Baltic Sea. It is the first region-wide initiative in the central Baltic Sea and included nine partners from Estonia, Germany, Poland and Sweden. The aim of the retrieval part of the project was to develop cost-efficient, safe and environmentally friendly DFG retrieval methods identified through demonstration actions. It included identification of areas with high probability of DFG occurrence, search and retrieval operations carried out by fishermen as well as location, identification and cleaning of shipwrecks conducted by divers in 2017 and 2018. This resulted in acquisition of important experience and eventually in maps of DFG host and hotspot areas as well as recommendations for future retrieval activities.

Identification of DFG host areas
Definition and mapping of DFG host areas were based on fishing effort data, knowledge about fishing patterns for two fleet components (gill-netters and trawlers), morphology of the seabed and other environmental conditions. Fishermen's knowledge was used to understand how fishing effort, spatial fishing pattern and environmental factors influence the fishing strategy and the use of fishing gear in various areas.

The fishing fleets and patterns as well as the environmental conditions differed among countries, which is reflected in the methodologies. Due to insufficient data on the spatial distribution of the fishing effort in Estonia and Germany, identification of potential retrieval areas here was primarily based on information collected by divers on potential hot spots including wrecks and other underwater obstacles. The principles for determination of the hypothetic geographical distribution of DFG in Polish and Swedish waters are described in the following.

A relationship between the geographical allocation of fishing activities and the number of areas with high probability of DFG occurrence was assumed. It was for example expected that the number of areas with high probability of DFG occurrence would be higher in Poland, where the overlap of gill netting and trawling is higher than in Sweden. In return, it was expected that the areas with high probability of DFG occurrence would be much larger in Sweden as compared to Poland.

The area covering depths down to 60 m were divided into squares of *c.* 2 × 2 km in Sweden and *c.* 10 × 10 km in Poland. These squares were then allocated to one of three categories of expected probability of DFG occurrence based on data on the annual fishing effort by gear type. These data were of higher resolution in Sweden compared to Poland, which was reflected by the difference in square size. The three categories were:

Category A – Bottom trawling areas
Assumed to hold a close to zero probability of DFG occurrence. It was assumed that DFG would be retrieved by another bottom trawl.

Category B – Gill netting areas
Assumed to hold the highest probability of DFG occurrence. As mentioned above, the spatial resolution of the information related to fishing effort in Poland is low. To increase the accuracy of the selection of areas in this category for search and retrieval several additional variables such as prevalence of underwater obstacles and rocky seabed were therefore taken into account.

Category C – Mixed fishing areas
Areas with overlap of gill netting and bottom trawling were assumed to hold lower probability of DFG occurrence compared to category B (gill netting) areas, but higher than category A (bottom trawling) areas, because the conflicts between the different types of fishing activities increase the risk of fishing gear loss, especially gill nets. At the same time, lost gill nets could be retrieved by bottom trawling, which is not the case in category B areas where bottom trawling is not conducted. Whether loss through conflict between the different fisheries or retrieval through trawling dominates in any given area could not be predicted.

Some areas were excluded from search for DFG by dredging. These included munition deposition areas due to high risk of explosion and contamination, Natura 2000 areas due to possible negative impact on protected species and their habitats, and areas with located wrecks. Search and retrieval on the latter areas were performed by professional diver teams.

Each 10 × 10 km square in Polish waters was divided into squares of the same dimension as in Sweden (2 × 2 km) to allow full coverage within each of the searching and retrieving areas. To test the above assumption about probability of DFG occurrence, a number of squares within each of the categories A, B and C corresponding to the search and retrieval capacity in each country, were randomly selected. The squares were grouped into 4 (Poland) or 3 (Sweden) to reduce steaming time and ensure high efficiency of search and retrieval. In Sweden 90 % of the selected squares were of category B, and 10% of category C, whereas those of category A were excluded considering the low probability of DFG occurrence. Based on practical experience, Polish fishermen additionally selected several hot spot areas with the highest probability of DFG occurrence.

Shipwrecks are hot spots, where DFG tend to accumulate. Additional effort was therefore allocated to identify exact GPS coordinates of shipwrecks from which DFG could be retrieves by divers. National legislation and range of available information related to shipwreck location differed among the countries – and accordingly did the process of identification and verification.

However, in general, a list of shipwrecks from public databases, previous DFG projects and personal knowledge acquired from divers and fishermen was established in the first place. Only shipwrecks located in areas of high probability of DFG occurrence were included in the candidate list of the next step. Excluded from the list were wrecks red-listed by cultural heritage boards as well as wrecks located deeper than 25 m (Germany), 30 m (Estonia) or 40 m (Sweden) due to safety reasons. Among the remaining wrecks, a number was selected based on consultation by local divers to ensure that there were still DFG on the wreck (Germany), and by sonar equipment to validate location (Poland). Detailed information about the selection methodology used by the individual countries is described in WP2 of the MARELITT report.

Sidescan sonar workshops and sea trials

Trials and workshops were held to examine non-invasive acoustic methods for detecting DFG on wrecks as well as different bottom types. The trials were promising and showed that sidescan sonar, with the right technique, can be used for identifying DFG on wrecks.

In the spring of 2018, the American sidescan sonar expert Creyton Fenn from Fenn Enterprises was invited to share his knowledge about the technique in a workshop in Stralsund/Germany. Later in the same year, he participated in a sea trial in Sweden to test if gill nets on both rocky and soft seabed in shallow water are clearly detectable with the sidescan sonar.

Based on these trials, sidescan sonar was recommended as a tool for DFG search and retrieval projects. Estonia started to use this method in a survey in February 2019 and WWF Germany’s later work and collaboration with Fenn Enterprises is based on this (see section below).

DFG search and retrieval in 2017

In Poland and Sweden, the stratified and randomly selected squares were systematically searched by dredging with one or more vessels at a speed of 1 knot in parallel transects 200 m apart. In Sweden, two additional transects perpendicular to first ones were performed. The 200-m distance between transect were chosen based on the experience that derelict gill nets in these areas are usually intact and thus at least several hundreds of meters long and fully stretched out.

In Estonia, the search areas were selected based on a variety of relevant information as to where high probability of DFG should be located. Large parts of the seabed here is rocky and the weather conditions are generally windy. The search had therefore to be undertaken with precaution and by use of light dredging devices, floating sidescan sonar and assistance of divers to avoid loss of equipment and ensure high efficiency of DFG retrieval.

Neither was the randomization process carried out in Germany. One part of the search was therefore carried out by dredging at speeds between 0.8 and 1.5 knots with the focus on three categories of areas: (a) Obstacles in active trawling areas to find entangled trawl elements. (b) Active gill netting areas where gill nets were lost in the past two years during accidents with non-fishing vessel. (c) Coastal areas where gill nets were lost several years ago in a winter storm event with severe amounts of ice. Trawling in German waters is only allowed outside a 3-mile zone. Search by dredging was carried out in parallel transects just beyond this zone. As the other part of the search, hot spots with lost gill nets were located by divers and then systematically searched, and nets were retrieved by dragging in coastal gill netting areas where DFG could pose a risk for swimming, snorkelling and surfing.

The search and retrieval devices used in the project consisted of multiple hooks or claws attached to a steel bar to keep the device on the seabed. The weight depends on depth, seabed morphology, and experience of operators. Gentle, lightweight versions of the device are allowed in marine Natura 200 areas in Germany, where gill netting is taking place. Detailed description of the search devices is presented in the report by Sahlin & Tjensvoll (2018), which is available on the MARELITT Baltic project webpage.

In the first year of retrieval (2017), dragging in trawling areas seemed less efficient as compared to the focus areas in Germany. In Poland, most DFG were found in areas where gill netting overlaps with trawling (category C). However, the division of the large 10 × 10 km areas into 2 × 2 km areas in Polish waters made this result less reliable. In Sweden, most DFG were found in pure gill net areas (category B) on stone, pebble or gravel bottom. Comparing neighbour squares of contrasting seabed structures, the systematically search revealed that DFG were most often found in the square with rocky seabed compared to the one with a smooth/sandy seabed. This was confirmed by the Polish observations of accumulating DFG in areas with rocks or other seabed obstacles, where the nets are intercepted and retained. In shallow water, the retrieval rates were low, probably because strong currents and waves fragment the nets and transport the fragments away from the area or bury them in the sediment. In the first year, retrieval operations at shipwrecks were only carried out by Germany and Estonia. Mostly trawl nets were retrieved here.

DFG search and retrieval in 2018

Based on the results and experience obtained in the first year, the selection of searching area in the second year (2018) was adjusted to better reflect the geographical distribution of fishing effort as well the seabed structure and detailed information from the fishermen.

In Poland, the original area categories did not reflect the geographical distribution of the gill netting effort due to the poor spatial resolution of the information about this fishery. Therefore, the focus was directed toward the distribution of trawling effort using VMS data, and the Polish part of the Baltic Sea was divided into 2 × 2 km squares characterized by:

1. High density of bottom trawling – low probability of DFG occurrence.
2. Low density of bottom trawling – moderate probability of DFG occurrence.
3. Close to zero bottom trawling – high probability of DFG occurrence.

Areas deeper than 60 m were excluded because of low efficiency of the search operations. Based on this classification, randomization of the search areas was undertaken in a number of steps. In addition, hot spot areas were identified in cooperation with fishermen. The type 2 squares provided most retrieved DFG even when the higher number of searched areas were accounted for compared to the other types of squares where small amounts were retrieved. This retrieval pattern was probably caused by conflicts between gill netting and trawling in these squares, where gill netting takes place as well. The small amounts of DFG retrieved from type 3 squares was surprising because most of the gill netting effort was concentrated here. The deeper water in type 2 squares also seems to play a role because previous observations indicate that the risk of net loss increases with depth. In addition, gill nets might be transported by currents from shallow to deeper water, where they accumulate. It was further discovered that most of the lost trawl nets are not carried by the water currents due to their high weight but tend to stay at their original location. Altogether, the retrieval activities in 2018 in Poland shows that the probability of DFG occurrence cannot be explained by a single variable. Furthermore, most of the retrieved DFG was older than 5 years and a large part older than 10 years. Acquisition of additional historical data on fishing effort is therefore important because the overall fishing intensity in the past and, in consequence, the loss of gear was much higher than today.

In Sweden, a combination of randomly selected areas and hot spots areas identified by fishermen were searched. This amendment allowed comparison with the methodology used in Poland. Because of the poor retrieval results, it was agreed not to put more effort into the large areas with shallow water and smooth seabed. Instead, the focus was redirected towards the steep slope following the eastern coastline of Öland. Here, large amounts of DFG were found, and fishermen confirmed that intensive gill netting has been going on from time to time and recommended complementary dredging at water depths between 20 m and 60 m. The dredging pattern in the randomly selected areas was changed to include several consecutive squares to decrease the number of executed tracks per square and thus to increase the efficiency of searching. More than 80% of retrieved gill nets were between 11 and 20 years old. High occurrence of DFG in deep water (>40 m) was in line with the results in Poland.

In Germany, the systematic search and retrieval during the first year did not yield significant success. The effort in the project was therefore partly concentrating on cleaning of shipwrecks during the second year of retrieval. This resulted primarily in retrieval of lost trawl gear. Also, other known DFG locations were searched. Based on the experience in the previous year, searching devices were not employed. Instead, a professional diving team was engaged to retrieve DFG from these locations. Most nets were retrieved from depths of 8–9 m.

In Estonia, recreational fishing with gill nets is allowed, which is not the case in Germany and Poland. This results in extensive loss of nets in shallow coastal areas. During the tests with use of ROV in Estonia, the ROV placed a hook on derelict gill nets and lifted it to the surface. Due to low visibility in the water, it is necessary that the ROV is equipped with a very sensitive sonar to see the net, and its thrusters should be protected by guards to avoid being stuck in the net. This requires further tests. It seems however possible to use the ROV to check points of interest obtained by surface sonars and to lift the derelict net, which would be safer and cheaper than engaging divers. All the nets were located in areas with depths between 2.5 m and 5 m, which frequently are used by recreational fishermen.

Recommendations based on results and obtained experience

The experience obtained from the MARELITT project resulted in the following recommendations on search for and retrieval of derelict fishing gear (DFG):

- A crucial part of the project was validation of the predicted area-specific probabilities of DFG occurrence by search and retrieval. These predictions were based on effort data on gill netting (passive gear) and trawling (active gear), data on water depth and seabed morphology, and the fishermen's knowledge about fishing patterns and environmental characteristics. The results clearly indicated that the actual DFG densities indeed are caused by multiple variables. Fishing effort can be used as a basis for designation of candidate areas, but it cannot stand alone to predict high densities of DFG. In Poland, for example, high densities are found in areas where gill-netters and trawlers are operating simultaneously. In contrast, hot spots in Sweden were exclusively found in areas where gill-netters were operating alone. However, areas with low or no fishing effort should not automatically be excluded as candidate areas, because water currents may transport DFG over long distances to areas with complex seabed morphology or underwater obstacles.

- The dredging cruises showed that most of the DFG were older than 5–10 years. It is therefore recommended to use also historic fishing effort data for the DFG density predictions, and at the same time to increase the accuracy of the selection of retrieval areas by improving resolution of fishing effort data, adding more relevant data, and using promising modern underwater survey technologies such as side-scan sonars.

- The project results also suggest that the DFG density increases with depth, which is consistent with the observations from previous DFG projects in Poland that the risk of fishing gear loss increases with increasing water depth. It is therefore recommended to allocate additional effort to search and retrieval operations at larger depths.

- Exact location and monitoring of shipwrecks prior to retrieval operations are of great importance. Several locations provided by national authorities were incorrect. This resulted in the loss of resources for retrieval activities on other shipwrecks. In addition, some shipwrecks recommended by divers a few months previously did not host DFG anymore probably because private diving teams or storm events have removed the DFG. Identification of shipwrecks and confirmation of the presence of DFG by use of modern techniques such as a multi-beam or side scan sonar is therefore recommended before engagement of a professional diving team for retrieval operations.

- Improving the cooperation with fishermen is crucial. It was proven that fishermen have vital knowledge and experience for planning and properly executing retrieval operations. Retrieval operations carried out by experienced fishermen were consequently efficient in terms of time, cost and amounts of retrieved DFG.

- Exact information on areas with high probability of occurrence of old ammunition from the Second Word War is needed for the designation of retrieval areas. An ammunition risk assessment was commissioned and made available through the project webpage. Maps of ammunition hot spots in the project areas are presented, and recommendations for avoidance and mitigation measures when encountering ammunitions are provided.

- In many cases, shipwrecks are or could become a national or regional cultural heritage and any activities related to the retrieval of derelict fishing gears might therefore be forbidden. It is recommended to engage archaeologist experts for developing a safe shipwreck cleaning methodology to avoid damage to the selected underwater objects. Consultation of the regional cultural heritage authorities is highly recommended to avoid conflict between cultural heritage and DFG cleaning interests. The project area map covering Polish and Swedish sea areas should be a new tool to forecast any possible overlap of interests and thus help planning cultural heritage and DFG retrieval activities (Marelitt Baltic (marelittbaltic-map.eu)).

From: Predki et al. (2019).

Epilogue
Subsequently, the Swedish dredging survey technique together with the recommendation of the MARELITT report has been used successfully in a hot spot gill netting area in Swedish water. An area of 276 km2 was surveyed by 7 vessels within 4 days in 2019, which resulted in recovery of 10 km gillnet of which 75% was assessed to have stayed at sea for more than 10 years and 24% more than 15 years.
From: Tschernij (2020)

Use of sidescan sonar by WWF Germany to locate DFG in the Baltic Sea

One important recommendation from the MARELITT Baltic project was to use new, modern underwater survey technologies such as side-scan sonar. The latter has been pursued by WWF (World Wildlife Fund) Germany, who finds that locating derelict fishing gear the traditional way by use of dredges or divers is cumbersome and often unsuccessful. WWF finds furthermore that the use of dredging is not an environmentally friendly way of searching and points additionally to the fact that the visibility for divers is often less than one meter in the Baltic Sea.

The use of sidescan sonars for locating DFG should present a non-invasive, fast and reliable method for searching areas suspected to host DFG. However, the technology requires specific skills to read the sonar images and identify any pursued target. Fenn Enterprises, Hydrographic Surveyors, located in Seattle, USA, holds a substantial experience and expertise in using sidescan sonar to locate and retrieve DFG. Conducting a pilot project for the purpose, WWF Germany advanced the use of this environmentally friendly methodology in the Baltic Sea together with Fenn Enterprises.

An area of about one square mile off the coast of Sassnitz, Island of Rügen, Germany was chosen as the test site for the pilot project. Active gill netting takes place here today, and historically this test site further represents an arena of intensive trawling.

The sonar search replaces the dredging surveys where creepers are towed across the seafloor or the cumbersome search by eye through divers, who often experience a visibility of less than one meter in the Baltic Sea. The short distance of the transducer just 5 meters above the seafloor ensures the high spatial resolution required to identify lines, ropes and nets. In addition, it seemed possible with the sidescan sonar to locate nets covered by thin layers of sand or mud

that would not be visible to searching by eye. Accurate GPS positioning furthermore allows rapid follow-up retrieval of the DFG.
From: Dederer (in prep.).

Abandoned gill nets in Limfjorden

An extensive edible crab and lobster fishing is going on in the inner Danish water, Limfjorden, by use of old gill nets previously employed in fisheries in the North Sea. “Landsforeningen Levende Hav” suspected that once worn-out these nets are abandoned in the Limfjord, rather than being brought to harbour, and therefore constitute an extensive problem as derelict fishing gear (DFG). They examined the extent of the problem by conduction of a series of single-day cruises on-board a 20 t cutter in an area (c. 1 × 5 km) of Nissum Bredning close to the harbour of Lemvig during the summer of 2020. The maximum depth in Nissum Bredning is 7 m, and the depth of the searched area ranged from 3 m to 6 m. They used a dredge (10–15 kg) for searching and retrieval of DFG. They retrieved around 300 nets as well as different trap nets and trawl parts. It was estimated that only around 10 % of the retrieved DFG was lost gear, whereas the absolute majority was abandoned nets. They still caught crabs and lobsters (but no fish, birds or mammals). Based on the results it was suggested to launch a large-scale retrieval operation in the Limfjord based on the experience that crab and lobster fishing is going on in large parts of this water. The relevant part of the Limfjord is however crowded with nets that make such an operation difficult. It was therefore suggested that the operation should take place in July and August when lobster is protected from fishing, and further to forbid all net fishing during this period.
From: Christensen (2020).

Sites for reporting lost and found fishing gear

The Fisheries agencies in our neighbouring countries Norway and Sweden both have online sites where fishermen can report loss of fishing gear, and other stakeholders can report observed DFG or maybe even retrieve it using the information from the sites. The information can thus be used to increase the efficiency of cleaning actions and preventive measures. “Havs- och vatten myndigheten” in Sweden holds a homepage called "GhostGuard", and the Norwegian Directorate of Fisheries has developed an App, "Fritidsfiske", which is available for downloading in Appstore or GooglePlay (https://www.fiskeridir.no/English/Fisheries/Marine-litter/Report-lost-and-found-fishing-gear-in-an-app-recreational-fishing). It is not mentioned whether the uploaded information is used for retrieval campaigns.

WWF in Germany has likewise released “The Ghostdiver App” available for downloading in Appstore or GooglePlay. The purpose of this App is to urge sport divers to check registered positions, found during sidescan sonar surveys, and to confirm in the App whether the anomaly is a DFG or some other structure. If the anomaly is confirmed to be a DFG, professional divers will subsequently retrieve it (www.ghostdiver.com). WWF Denmark used to have a site on their homepage where observations of DFG could be reported, however this is now only available through an old link “WWF's registreringer af spøgelsesnet i danske farvande”.

Limfjordsrådet have in the spring 2021 launched a webpage where everyone can report sightings of ghost nets in the Limfjord, Denmark. The aim is first and foremost to create a better overview of the extent of the problem in the fiord and on the longer term to get the registered nets removed from the fiord. https://www.limfjordsraadet.dk/projekter/spoegelsesnet-i-limfjorden/

A.7. Retrieval of nets

By Eva Maria Pedersen, Fletcher Thompson, Jeppe Olsen and Finn Larsen

Dredging for a ghost net in Øresund 2021. Photo DTU Aqua.

Summary

During the project, two methods for removing ghost nets have been tested. Removal by divers and removal by dredging. The retrieval trials with divers were completed during the diving survey in September 2020 (Appendix A.2.). Retrieval by dredging was tested using DTU Aqua's vessel "Havfisken" during the mapping survey in January 2021 (Appendix A.4.) and on a specific retrieval survey in Øresund on the 8th of April 2021 with DTU Aqua's small boat "Havørreden".

Two gillnets were successfully recovered using the dredging method, one net in Øresund with "Havørreden" and one in Skagerrak with "Havfisken". During the dive survey, the divers removed a codend, a "mouth" from a trawl, one long piece of gillnet incl. sink lines and multiple smaller pieces. Attached to this were more than 40 jigs and other angler gear. This fishing gear came from three wrecks in the area around Møn. The age of the retrieved material is estimated to range from contemporary to gear used in the 70s or 80s.

No vertebrates, dead or alive, were caught in the nets. Most retrieved nets had blue mussels, a few common littoral crabs and few sea stars attached. The crab net retrieved in Skagerrak had, however, 40 kilogram of live brown crab.

The methods used and the materials retrieved are described below.

Materials and methods

The materials and methods used for the retrieving activities by divers and by dredging are described separately below. More details from the surveys can be found in the Chapter 4. The dedicated recovery mission with DTU Aqua's small vessel "Havørreden" in April 2021 is only described below.

Removal of ghost nets by divers.

Both gillnets, trawls and angling gear was removed during the dive survey with “Baltic Explorer”. The materials were removed from three different wrecks: “Jurbarkas” (3/9-2021), “M/S Johnny” (5/9-2021), and “Vibeke Høj” (6/9-2021) in the area around Møn. Detailed descriptions of the dives can be found in app. A.2. & A.9. However, independently of the type of gear identified for retrieval, the same three steps were repeated when the gear was to be removed by divers:

- Diver #1 documented and described the ghost net and how it was situated on the wreck, so that a plan for the cutting and release could be made and the appropriate equipment prepared.
- Diver #2 brought the appropriate equipment, usually a hydraulic cable/wire/rope cutter, an extra knife, lines and rope to tie the ghost net together and a number of lift bags (Fig. 1). The net was cut and released from the bottom or the structure on the wreck, where it was caught (Fig. 2, 3 & 5).
- The net was prepared for retrieval, by tying it up and attaching the lift bags to the net. The material was then raised from the wreck to the surface by inflating the lift bags with air (Fig. 2, 4 & 5) and getting the recovered material onboard the vessel by a small crane.

Figure 1. Left) A selection of different sizes of rolled up lifting bags. Right) A hydraulic cable/wire/rope cutter.

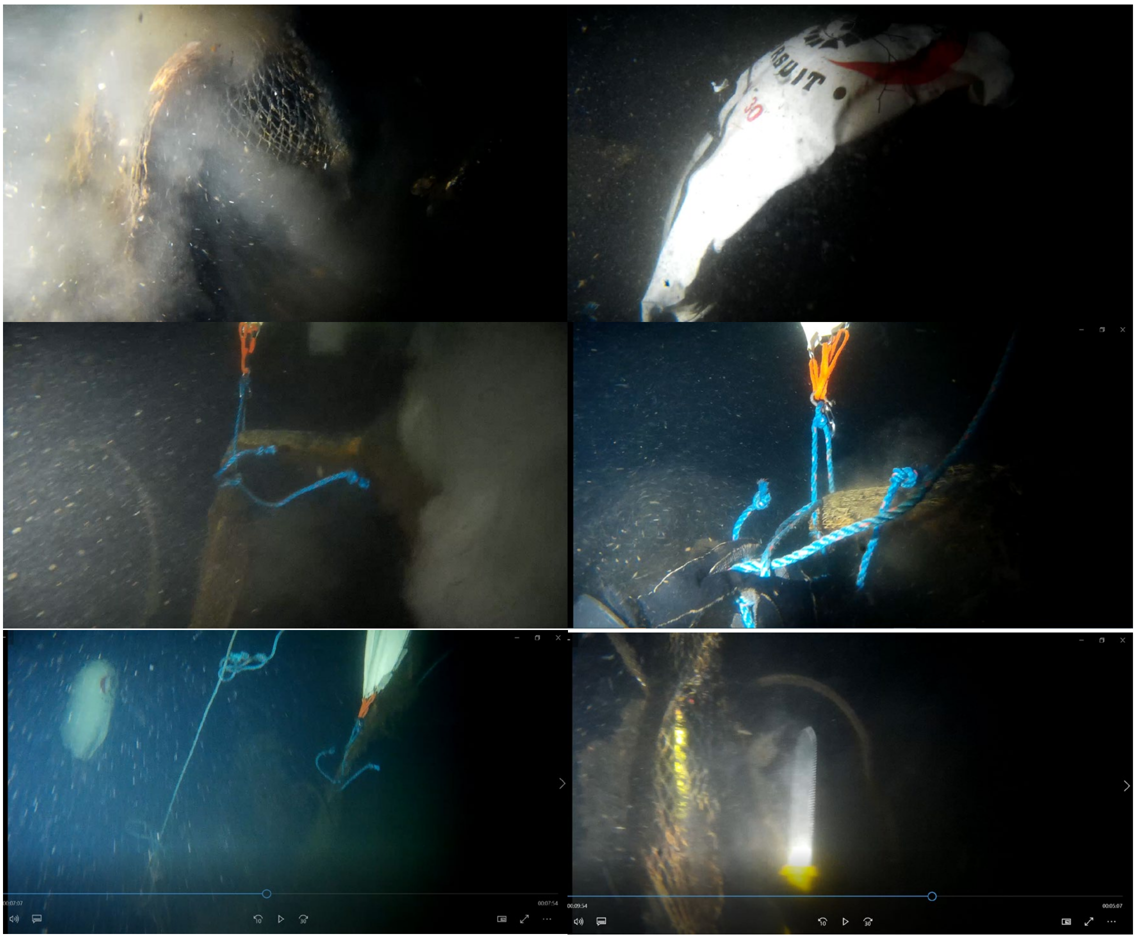


Figure 2. Pictures from the recovery of a trawl from “M/S Johnny”.

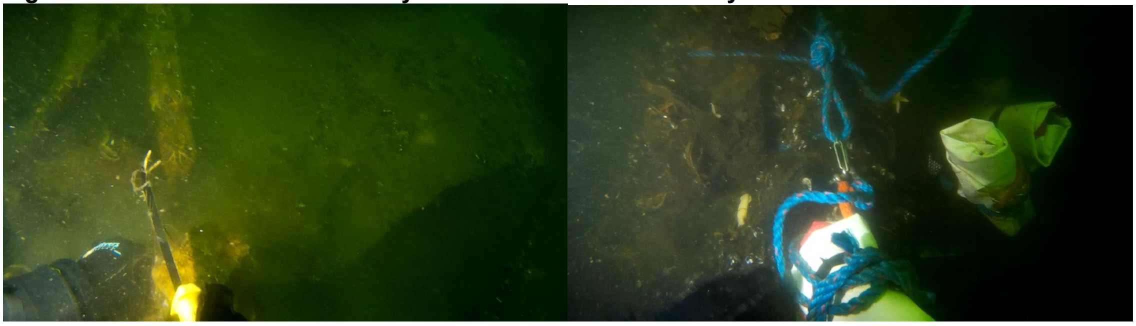


Figure 3. Freeing gillnet from the shipwreck “Jurbarkas”

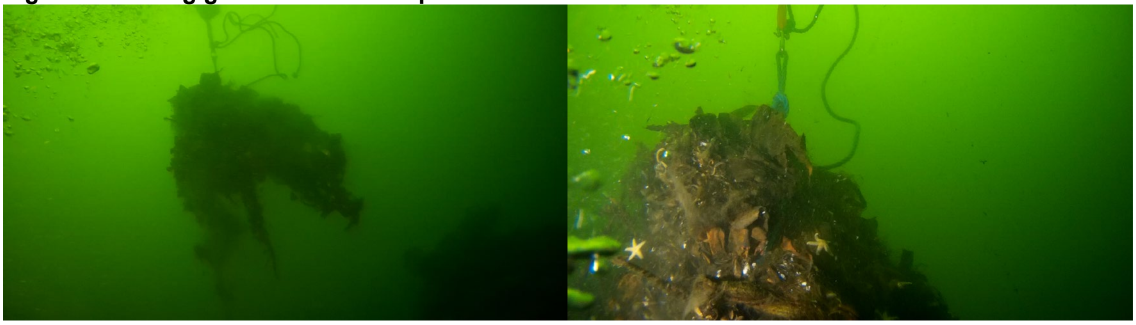


Figure 4. Gillnets from “Jurbarkas” hanging in midwater prior to the final cut and release towards the surface.

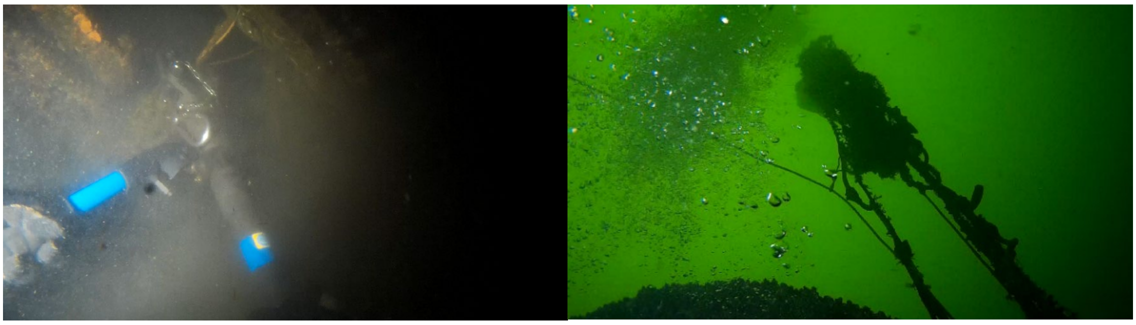


Figure 5. Left) Cutting a wire on the shipwreck "Vibeke Høj". Right) The recovered trawl form "Vibeke Høj" hanging in midwater lifted by three 30L lift bags and two 100L lift bags.

Removal of ghost nets by dredging.

The dredging method was tested successfully on two occasions: first during the mapping surveys with "R/V Havfisken", a 17m long trawler with trawl winches (app. A.4.), and on a dedicated retrieval survey in Øresund with "Havørreden", a 6,3m long dinghy (Limbo 699) equipped with an electrical net hauler. DTU Aqua first observed the net in Øresund in June 2018 during a student course and in September 2020 it was confirmed that the net was still at the same location. It was therefore decided that the last survey day within the project should be used to retrieve this net.

The 8th of April 2021, Thomas Møller, Dennis U. Andersen and Eva Maria Pedersen from DTU Aqua went with DTU Aquas small dinghy "Havørreden" to retrieve the net in Øresund outside Lynetten (Copenhagen Harbour) at around 8 m of water. First, the area was scanned with the Edgetech 4125 sidescan sonar to determine whether the net was still there. The net was located, and positions recorded (Fig. 6).

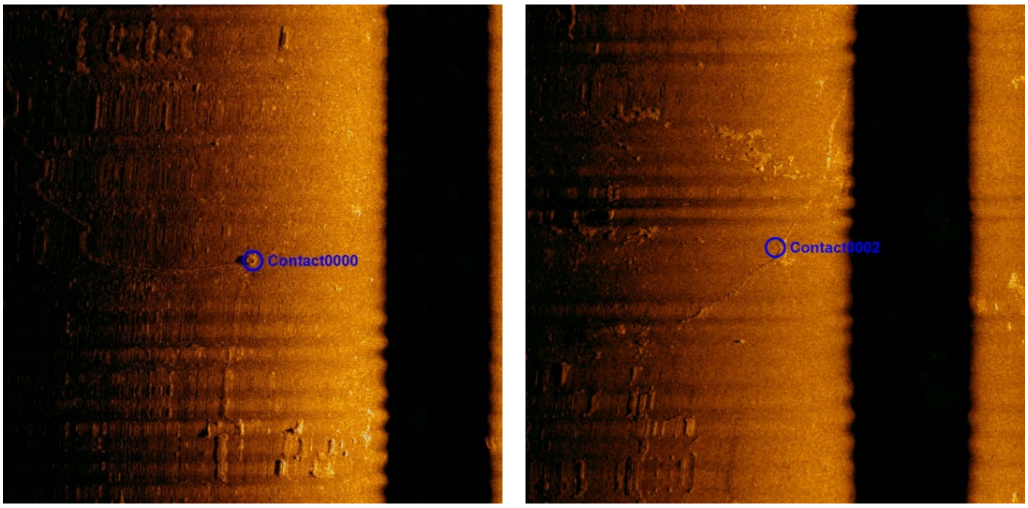


Figure 6. Examples of two contact points identified on the sidescan sonar. Left) Contact 0 position: 55.6966N 12.6480E. Right) Contact 2 position 55.6980N 12.6455E (WGS84). Both images are processed in Sonar Wiz 7.

When dredging for ghost nets observed on a sidescan sonar image, multiple contact/target points (positions on the net) are recorded so that the dredge can be pulled across the net. The aim is to traverse the net as perpendicular as possible, to increase the chance of a catch. The methods are in general terms the same independent of the size of the ship used and the trials will therefore be described in general terms that cover both of the successful tests.

For dredging activities, multiple types of dredges have been used in e.g. the Baltic, from simple hooks to complex structures with bobbins and multiple creepers (Sahlin & Tjensvoll (2018), Prędki et al. (2019)). Within this project two different types of “x-mas tree” dredges were used (Fig.7), a different one on each vessel. On “Havfisken” their standard dredge was used which is used if they lose a net or a piece of a net. The dredge used on “Havørreden” was built from the Marelitt Baltic drawings for the dredge used in Sweden. Both dredges were attached with a piece of chain to keep the dredge close to the bottom. The dredge was pulled at low speed (from 1 to 3 knot) with as much bottom contact as possible, in the area where a structure believed to be a net was observed. The optimal speed was adjusted according to the water depth in the dredged area, the weight of the dredge and the length of the tow cable/rope (source, the skippers of “Havørreden” and “Havfisken”). A crewmember had a hand or a foot on the rope/cable at which the dredge was attached, feeling for a tensioning of the rope/cable that would indicate that the dredge had caught something. The speed was then reduced and the rope/cable with the dredge was pulled in by the winch on “Havfisken” and by the net hauler on “Havørreden”, until the net was recovered. “Havørreden” experienced that the gillnet fell of the dredge. The dredging process was then repeated in close vicinity to where it was lost, and the net was recovered in the second attempt.

Figure 7. Two types of ”x-mass tree” dredges. Left) The dredge used on “Havfisken”. Right) The dredge used on “Havørreden”, identical to the one used in the Marelitt Baltic project in Sweden.

Retrieved materials

During the project period trawls, gillnets and angling gear was retrieved. No pots or fykes were observed and recovery trials of these types of fishing gear were therefore not conducted. In the following, the types of material retrieved by the two methods are described and the age of the fishing gear is roughly estimated as well as the biological material retrieved with the ghost nets. All retrieved material is summarized in Table 1.

Materials retrieved by dredging:

Two gillnets have been successfully retrieved by the dredge method, and some fibres from what was believed to be a trawl (Fig. 8). In Skagerrak, a net for fishing brown crab was retrieved and is estimated to be from a professional fisherman and lost recently as very little biological material aside from 40 kilos of crabs were attached to the net. The net for fishing cod/plaice is, due to the size and the materials used for anchors, estimated to be from a recreational fisherman. The net was overgrown with Laminaria saccharina and other algae as well as blue mussel indicating that it had been lost for more than a year. The gillnet was recent, and it is therefore estimated to have been lost within the last 5 years. In this net 5 jigs from anglers were also retrieved (Table 1). Details on the materials retrieved can be found in appendix A.19.

Figure 8. Ghost nets retrieved by dredging. 1) A gillnet for fishing cod/flatfish retrieved outside Lynetten in Øresund. 2) A gillnet for fishing brown crab, retrieved outside Hirtshals in Skagerrak. 3) Fibres from what is assumed to be a trawl, caught around Store Rev in Skagerrak. 4) Angling equipment attached to the gillnet from Øresund.

Materials retrieved by divers

Figure 7.2.9. Examples of the fishing gear retrieved by divers. Top left) The mouth of a small trawl. Top right) A cod end from a trawl. Bottom left) A gill net with sink line. Bottom right) Jigs and other angling equipment attached to nets retrieved from the wreck "Jurbarkas".

The type of fishing gear observed and retrieved was gillnets, trawls and angling gear. In total the mouth of small trawl, one cod end, multiple gillnets and more than 40 pieces of jigs and other angling gear, were retrieved by the divers (Fig.9). No dead fish or other vertebrates were observed or retrieved in the nets, but most nets contained blue mussels, common littoral crabs and few sea stars. Details on the retrieved material can be found in appendix A.19.

Table 1. This table summarizes all the ghost nets and the associated bycatches retrieved during the dive and dredge retrieval trials.

Location	Gear type	Amount	Estimated age/users	Bycatch
Skagerrak	Gillnet for fishing brown crab, 22 cm mesh size	240 m	< 5 years. Professional fishing gear	40 kilos of brown crab
Øresund	Gillnet for fishing cod/flatfish	70 m	< 5 years. Recreational fishing gear	Blue mussels and a few common littoral crabs and sea stars
"Jurbarkas"	Lead sink line	1,7 m + 1,6 m + 2 m.	The sale of sink lines containing lead was banned 1st of June 2012	Around 5 kilos of blue mussels and a few common littoral crabs and sea stars
	Black gillnet, 55 mm mesh size, monofil	0,5 kilos filtered together	Age and users not to be determined	
	Green/brown gillnet, 75 mm mesh size, 6 twines, for cod	0,1 kilos filtered together	Age and users not to be determined	
	Orange gillnet 65mm mesh size, 3-4 twines, incl. lead sink lines, for cod	14 meters	The age of the net could not be determined but the sink line contained lead which was banned 1st of June 2012	
"M/S Johnny"	Trawl codend	6,7 x 1,7 m 2,4 x 1,4m	From the 70s or 80s. Professional fishing gear	None
"Vibeke Høj"	Small trawl, 260 meshes 55-60 mm. incl. typhoon wire, chains and weights. Probably for herring or cod	19 meters, weight 30-40 kilos	From the 70s or 80s. Professional fishing gear	A vertebrae
All locations except Skagerrak	Jigs, lines, lures	48 pieces	0 – 10 years Angler gear	None

Based on the material used, the recovered trawl pieces were estimated to be >40 years old. The gillnets were estimated to be >30 years old to contemporary. The sink lines on the net contained lead which indicates that these were more than 5 years old as the sale of sink lines and seine ropes containing lead was banned 1st of June 2012 (BEK nr 856 af 05/09/20). However, these lead-containing sink lines are very popular among both recreational and professional fishermen and are known to being reused as long as possible. The VMS/AIS registered fishing activity have been low for the last 15 years for all surveyed wrecks, which in general fits well with the age of the retrieved nets (Appendix A.2). The angling gear was estimated to be lost within the last 10 years. Some of the hooks were completely eroded whereas others looked new and could be reused. The area is very popular with anglers and a local told us that many tourists come to the area with their own boats to go fishing. An overview of the retrieved material can be found in Table 1.

Conclusion

Both of the tested methods are efficient and reliable for retrieving ghost nets from known locations.

When dredging for a known ghost net, only a small area of the bottom is affected by the dredge as the activity it is focused just around that exact location. It is also efficient in ghost net host areas where the exact locations are not known, here a survey grid will be useful so that the area is covered in a structured way. The impacted bottom area will of course be larger, but the width of the track was by the use of “Havørreden’s” dredge only around 20 cm. Dredging is a cost-efficient way of recovering lost materials from most depths. In shallow areas up to around 10 meters it can be done by a small dinghy like “Havørreden” and in deep water areas like in Norway they used the method in depths from 50-1000 m (Ref #1).

Removal of nets by divers proved to be efficient if the exact position of the wreck was known, and prior knowledge of ghost nets on the wreck was available. Many wreck locations in the databases used for the survey proved to be wrong. Therefore, a lot of time was spent searching instead of diving even though a local diver participated in the survey and supplied local knowledge. This loss of time can be prevented by only conducting dives at wrecks with verified positions.

Removal by divers can be an effective and gentle way of retrieving ghost nets, as the nets potentially can be cut free carefully. This will off course increase the time spent on retrieval and potentially also the numbers of divers needed for the recovery. If large nets/trawls are observed and needs to be retrieved, it is important to be aware that there is a great risk that small parts from the wreck, that the nets are entangled with, also will be removed. Prior to initiating a removal, it is therefore important to consider whether the wreck is fragile or of historic interest.

Removal of ghost nets by divers should only be done by professional divers, as it can be a dangerous job with a risk of getting entangled in a net and e.g. pulled to the surface when the lifting bags are inflated.

A.8. Data Processing methods and data sources

Focus areas

Focus areas have been appointed using the data layer showing number of days with overlap between active and passive gears. In a few cases the areas have been appointed based on other knowledge.

Potential study areas

The potential study areas have been laid out within the focus areas where there is overlap between active and passive gears or other knowledge are available. Other work on Natura 2000 areas in the North Sea has shown Belgian beam trawlers at the stone reef in Gule Rev where there are Danish gillnetters. The data can't be used for this project, but the areas "Gule Rev 1" and "Gule Rev 2" at the stone reefs in the southern part of Gule Rev have been suggested as study areas.

Fishing intensity maps and overlap between fishing with passive and active gears

If there is fishery with passive (gillnets) and active (trawlers) gears there is a risk that the passive gears will be hit by a vessel or an active gear, and become a "ghost net".

A 1*1 km raster grid is defined.

From logbook data, the gear type is established for each vessel and date. This data is merged with VMS and AIS data and a speed filter applied to estimate fishing activity. The VMS and AIS data merged with logbook data are joined into one dataset. For foreign vessels, the same method is applied where VMS data are available from the Danish Fisheries Agency.

The data are split into fishery with active and with passive gears. To make fishing intensity maps for the years 2009-2018, the time difference between positions are summarized within the raster grid, so the unit in the resulting raster file is hours fished.

To make days with overlap between fishery with active and passive gears, for each day a raster is made for active and passive gears separately, checking if there is fishing activity within a 1*1 km raster cell. If they overlap, the resulting raster value is set to 1, and the raster layers with overlaps by day are summarized by year for the years 2014-2018.

VMS points

Within focus areas, VMS positions from Danish vessels are shown for the years 2018 and 2019, colored by active or passive gears. They are mapped to illustrate if the VMS positions are actually overlapping within the 1*1 km grid cells or if they are fishing in separate parts of the cell.

Shipwrecks with sum of fishing intensity

Source of ship wreck data: an excel-file with wreck data was sent from the Danish Agency for Culture and Palaces. The dataset contain data of different sources and quality. In some cases the information is accurate, in other cases, older data where the exact position is unknown have been assigned to a mid-point within an area, and therefore there can be overlapping wrecks in the dataset Moved or retrieved wrecks where also present in the dataset, but these were not relevant in this project, so we didn't use those. The ship wreck layer has been joined with the raster set showing sum of fishing intensity by active and passive gears during the years 2014-2018.

Another source of ship wreck position is the "Wreck guide" (https://www.vragguiden.dk/, u.d.). Positions with codes "Removed wreck", "Nature diving", "Archeological site" (Boplads) or "Fishing site" have been removed. Fishing intensity within 100 m from passive and active gears have been added to the positions.

EU Seamap

An EU-wide habitat map is available at the web-site EMODNET https://www.emodnet.eu/seabed-habitats. The geodatabase EUSM2019 EUNIS Broadscale Model has been downloaded colored by main sediment type from MSFD_BBHT (sand, mud, coarse sediment, mixed sediment, rock and biogenic reef). The habitat map has been modelled from available data sources, and therefore it is not completely overlapping with the stone-reefs mapped in the Natura 2000 areas, which is more precise.

Mapped stone reefs and bubbling reefs in Natura 2000 areas

Stone reefs and bubbling reefs have been mapped in detail by the Danish Environmental Agency within Natura 2000 areas.

Sea charts within focus areas

The Sea charts are from the Danish Maritime Agency, and are an updated version from 2013.

Bathymetry

A bathymetry layer from the Danish Maritime Agency covering the Danish EEZ is used for most areas. It was made before the Danish EEZ has been updated south of Bornholm. Therefore a bathymetry layer from the Dynocs project has been used in the area south-east of Bornholm.

AIS data

Aggregated AIS density maps are found from the Danish Maritime Agency website (https://www.soefartsstyrelsen.dk/SikkerhedTilSoes/Sejladsinformation/DownloadData/Sider/AIS-Density-Plot.aspx). There is an AIS density plot for all vessels from 2016, and AIS density plots for cargo vessels and passenger ships from 2014.

A.9. Dive descriptions

Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _1_/_9__, 2020 Dyk nr.__________1________ Aqua observatør: JEPOL/EMP____

Tidspunkt for neddykning kl. _19 : 31__ Tidspunkt for afslutning af dyk: kl. __20_:_17______

Navn på dykker/dykkere:__________Dana____

Vragnavn:______M/S Johnny________________________ Position: N_54°48,312_' E_12°16,614_'

Længde på vrag:_22____(m), Bredde på vrag____7_______(m), Højde på vrag:__________3______(m)

Dybde: Bund ____22__m Top _19____m

Omgivende budtype: _Silt de øverste ca 3 cm, sandet mudder_

Aktivitet (Husk målepind): Kortlægning X Oprensning □

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel X Andet: Lys monteret ved maske

Sidescan af vrag inden dyk? Ja X Nej □

Første dyk på dette vrag? Ja X Nej □, Hvis nej hvilket nummer dyk? __________________

Navn på første fil:_ REC_0008_1sep_MS_JOHNNY_dyk1_del1_________________

Redskaber observeret på vrag: Nej □ Ja X, hvis ja hvilken type: Trawl X, Garn X, Andet _Pilke og liner_____

Hvis redskaber bjerget: Estimeret mængde __________kg , Redskabstype(r)__________________________

Separat skema om fangst/begroning udfyldt Ja □ Nej X

Kommentarer fra dykker omkring observationer:

1 trawl observeret ved motor på ca 1m x 0,5m, ligger sammenrullet og der observeres ringe og reb, maskestr. ca 7x9 cm.
1 garn ca $2m^2$, maskestrørrelse på ca 2x2 cm
1 garn på ydersiden af vraget ca 1m x 0,2m

6-10 store pilke, nogle med line.

Andre noter:

Sidescan af vrag ses til højre.

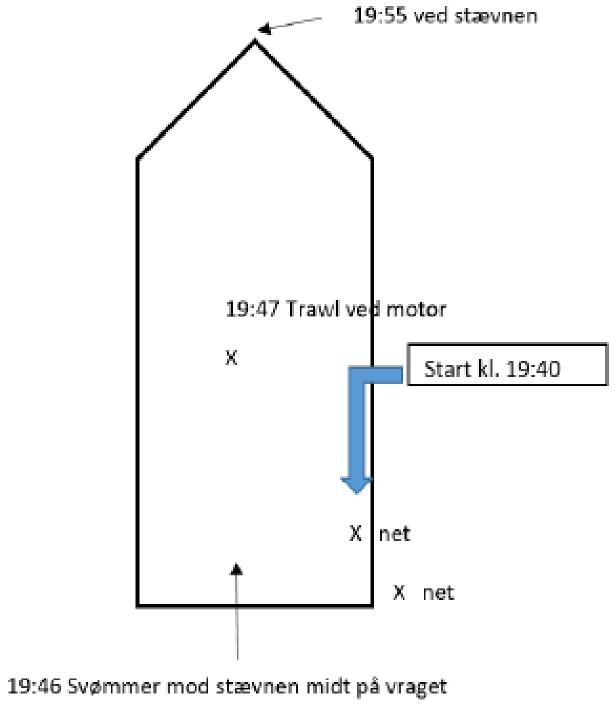
Sigt på 2-3 m på toppen af vraget, ved bunden 1,5-2 meters sigt

Krabbedød i forskellige steder sandsynligvis forårsaget at iltsvind.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

19:40	Start
19:41	Mange døde krabber, stor pilk
	Net på ca 2m2 med maskestørrelse på 2x2 cm
	Meget sportsfisker udstyr
19:44	2 små pilke på ca 10 cm.
	Mange døde krabber
19:45	Er ved agterenden af skibet
19:46	Svømmer mod stævnen midt over vraget
19:47	Er ved motor området hvor der observeres net+ kroge
19:48	Der observeres reb og net på ca 1m² med orange/røde ringe som i et løft. Er ca ved motorrummet ved styrbord side
19:50	Ved motoren
19:51	Trawl ned ringe (som i løft), mest krabber i nettet – ingen fisk
19:54	Fiskeline
19:55	Er ved stævnen
19:56	Svømmer på tværs og observerer fiskekroge/pirke
19:57	Fiskeline
19:58	Er ved motoren igen, det observerede trawl omdefineres til ca 1x0,5m
20:00	Styrbord yderside, agter. Net på ca 1x0,2m
20:02	Tjekker bundtypen
20:03	Svømmer mod ankeret
20:05	Er ved ankeret
20:06	Begynder opstigning



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _2_/_9__, 2020 Dyk nr.__________1_______ Aqua observatør:_JEPOL_____

Tidspunkt for neddykning kl. _14 : 37_ Tidspunkt for afslutning af dyk: kl. __15_:_21______

Navn på dykker/dykkere:_________Thomas____

Vragnavn:_____KANONVRAGET_________________ Position: N_54°05,58_' E_12°20,21_'

Længde på vrag:_40____(m), Bredde på vrag____12-14__(m), Højde på vrag:_1-2 (ror og anker)______(m)

Dybde: Bund ____22__m Top _20____m

Omgivende budtype: _Silt i det øverste lag, nedenunder hårdt grus_

Aktivitet (Husk målepind): Kortlægning X Oprensning ☐

Videooptager anvendt på dyk: Paralenz ☐ GoPro ☐ LH med kabel X Andet:_Lys monteret ved maske

Sidescan af vrag inden dyk? Ja X Nej ☐

Første dyk på dette vrag? Ja X Nej ☐, Hvis nej hvilket nummer dyk? _________________

Navn på første fil:__ REC_0013_2sep_kanonvraget_dyk1_del1___________________________________

Redskaber observeret på vrag: Nej ☐ Ja X, hvis ja hvilken type: Trawl X, Garn X, Andet _Pilke og liner_____

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)_______________________

Separat skema om fangst/begroning udfyldt Ja ☐ Nej X

Kommentarer fra dykker omkring observationer:

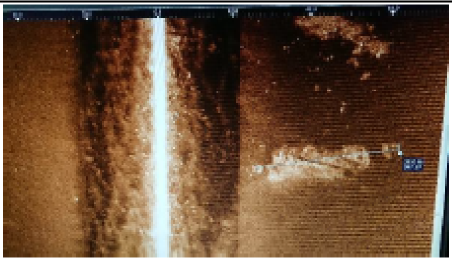
1 langt garn omkring ankeret ca. 3 m x 0.3 m (evt en trawlpose). Maskestr 1x1 cm. Syntetisk line. Tomt.

1 trawl rullet sammen ved anker. Ca. 1 m x 0.5 m. Maskestr 3x3 cm. Syntetisk line. Tomt.

3 pilke.

Andre noter:

Sidescan billede af vrag ses til højre.

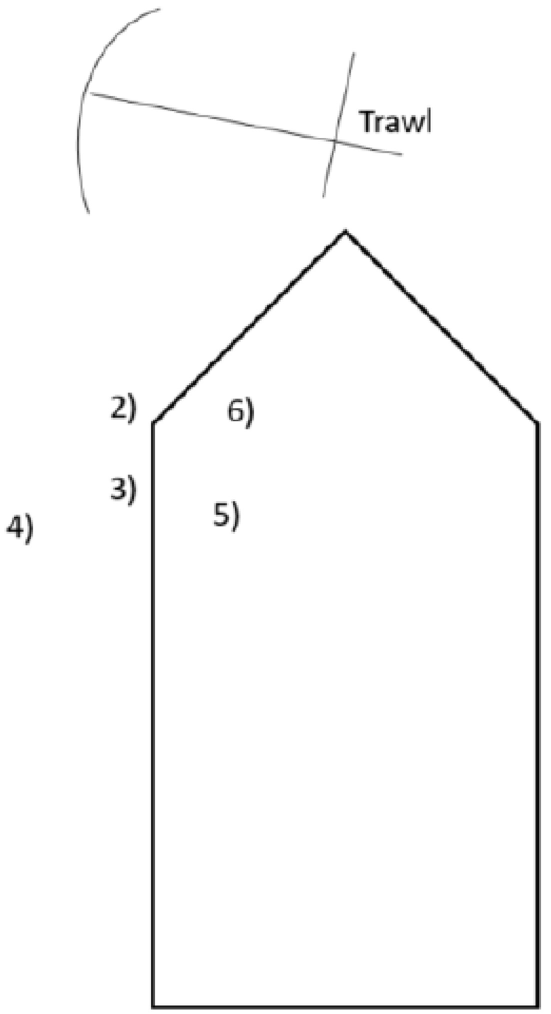


Kun kanoner samt vrag stikker 1-2 meter op. Ankeret stikker ca. 2 meter op. Resten af vraget er plant med bunden.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

14:36:30	Dykker i vandet
14:40	Dykker på bunden
14:41	1) Ved KANONVRAGETs anker (ca 3x3 meter – stikker ca. 2 meter op). Her ligger et trawl 1x0.5m rullet sammen.
14:47	2) Dykker er ved en kanon. Spekulerer over dateringen af vraget – måske omkring Napoleon.
14:50	Dykker svømmer langs vestlig skrogside.
14:51	3) Nogle pilke ligger her
14:55	4) Ekstra konstruktion
14:58	5) Flere pilke samt gammelt reb-rester
15:02	Flere pilke
15:16	Dykker på vej op igen.



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _2_/_9, 2020 Dyk nr.____2__________ Aqua observatør:______EMP______

Tidspunkt for neddykning kl. __16:01___ Tidspunkt for afslutning af dyk: kl. ___16:37________

Navn på dykker/dykkere:____________Staffan von Arbin____________________________________

Vragnavn:_________Kanonvraget__________________ Position: N__54°05,58' E__12°20,21'

Længde på vrag:_____40_(m), Bredde på vrag___12-14_____(m), Højde på vrag:____1-2________(m)

Dybde: Bund __22,5_m Top __20___m

Omgivende budtype: _____mudder med fast sand nedenunder_________________

Aktivitet (Husk målepind): Kortlægning X Oprensning □

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel X Andet_________________

Sidescan af vrag inden dyk? Ja X Nej □

Første dyk på dette vrag? Ja □ Nej x, Hvis nej hvilket nummer dyk? _____2__________

Navn på første fil:_ REC_0017_2sep_kanonvraget_dyk2_del1________________________________

Redskaber observeret på vrag: Nej X Ja □, hvis ja hvilken type: Trawl X, Garn □, Andet__________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)________________________

Separat skema om fangst/begroning udfyldt Ja □ Nej X

Kommentarer fra dykker omkring observationer:

Ca 5cm blødt silt på bunden med meget hård grus under.

Dette er 2. dyk på vraget. Formålet er at undersøge kanonerne på venstre side for redskaber samt midten af vraget.

Der blev ikke fundet yderliere redskaber under dette andet dyk.

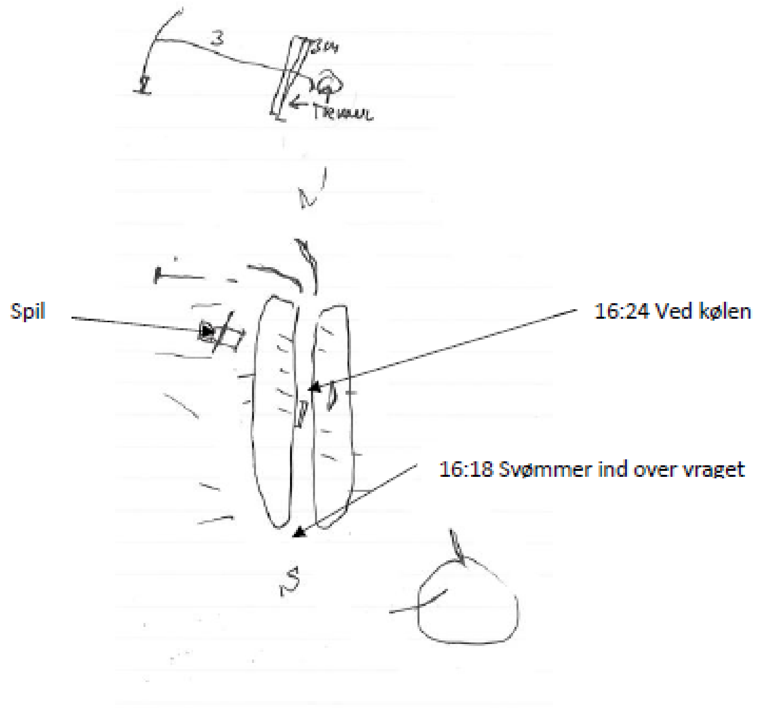
Andre noter:

Sigtbarheden er pga partikler i vandet ca 3m uden lampen og 30 cm med lampen tændt

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

16:05	Ca 5m nord for vraget omkring ankeret
16:07	Ved en kanon
16:10	Målepind sendes ned ad linen
16.15	Ved ankeret igen
16:18	Metal krogen
16:25	Svømmer på midten af vraget, observeret sten, jern og en plade
16:27	Kanon nord for vraget
16:30	Dykker går op



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: __3/9___, 2020 Dyk nr.________1__________ Aqua observatør:_____jepol_______

Tidspunkt for neddykning kl. _11_:_32__ Tidspunkt for afslutning af dyk: kl. __12_:_24_______

Navn på dykker/dykkere:______________Marie____

Vragnavn:______Jurbarkas_________________________ Position: N_54_°__43,068_' E_12_°__25,589_'

Længde på vrag:__100____(m), Bredde på vrag_____26____(m), Højde på vrag:_________3_______(m)

Dybde: Bund ___19___m Top ___16____m

Omgivende budtype: ____Soft bottom____________

Aktivitet (Husk målepind): Kortlægning x Oprensning ☐

Videooptager anvendt på dyk: Paralenz ☐ GoPro ☐ LH med kabel x Andet__________________

Sidescan af vrag inden dyk? Ja x Nej ☐

Første dyk på dette vrag? Ja x Nej ☐, Hvis nej hvilket nummer dyk? _________________

Navn på første fil:_____ REC_0003_3sep_JURBARKAS_dyk1_del1______________________________

Redskaber observeret på vrag: Nej ☐ Ja x, hvis ja hvilken type: Trawl ☐, Garn x, Andet__________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)_______________________

Separat skema om fangst/begroning udfyldt Ja ☐ Nej ☐

Kommentarer fra dykker omkring observationer:

1) Net: 8x8 cm maskestr. 80x20 cm er første estimat af størrelsen. Ved næste dyk viser det sig at nettet går 8 meter ind i skibet (bjergning)
2) Net: 8x8 cm maskestr. Rulle, 1,2 meter lang.
3) Flere net + fiskeline. 8x8 cm maskestr. 80x10 cm. To farver; grøn og anden farve.
4) Pilke + fiskeline

Andre noter:

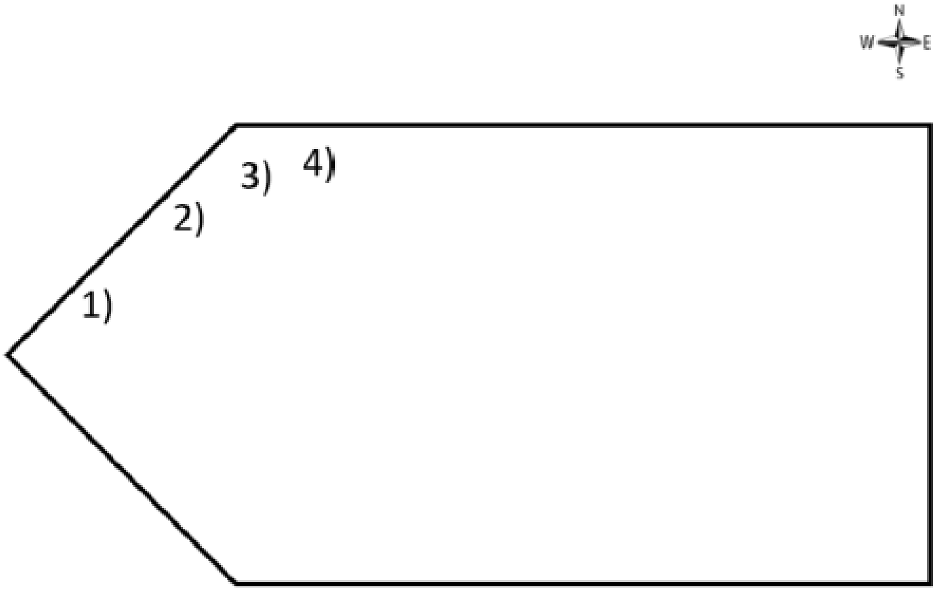
Kun ca. 70 x 5 meter afsøgt af den nordvestlige del af skibet afsøgt. Det vurderes at dette udgør ca. 15 % af det samlede areal. Vraget stikker ca. 4 meter op nogle steder.

Vraget er sprængt, derfor mange løsrevne dele. 3 – 4 meter sigtbarhed.

Til højre ses et sidescan billede af vraget.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: __3/9___, 2020 Dyk nr.________2__________ Aqua observatør:_____jepol________

Tidspunkt for neddykning kl. _13_:_30__ Tidspunkt for afslutning af dyk: kl. __14_:_40_______

Navn på dykker/dykkere:______________Marie____

Vragnavn:______Jurbarkas________________________ Position: N_54_°__43,068_' E_12_°__25,589_'

Længde på vrag:__100____(m), Bredde på vrag_____26____(m), Højde på vrag:_________3_______(m)

Dybde: Bund ___19___m Top ___16____m

Omgivende budtype: ____Soft bottom____________

Aktivitet (Husk målepind): Kortlægning □ Oprensning x

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel x Andet__________________

Sidescan af vrag inden dyk? Ja x Nej □

Første dyk på dette vrag? Ja □ Nej x, Hvis nej hvilket nummer dyk? ___2_______________

Navn på første fil:____ REC_0008_3sep_JURBARKAS_dyk2_del1_________________________________

Redskaber observeret på vrag: Nej □ Ja x, hvis ja hvilken type: Trawl □, Garn x, Andet___________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)________________________

Separat skema om fangst/begroning udfyldt Ja □ Nej □

Kommentarer fra dykker omkring observationer:

Bjergning af spøgelsesnet.

1) Trawl filteret ind i styrhuset og mast samt på bunden ved siden af vraget. Knap 100m2.
2) En mindre del var spredt ud således at det måske kunne fange fisk stadigvæk. Ca. 2 meter over bunden gående ud over siden af vraget.

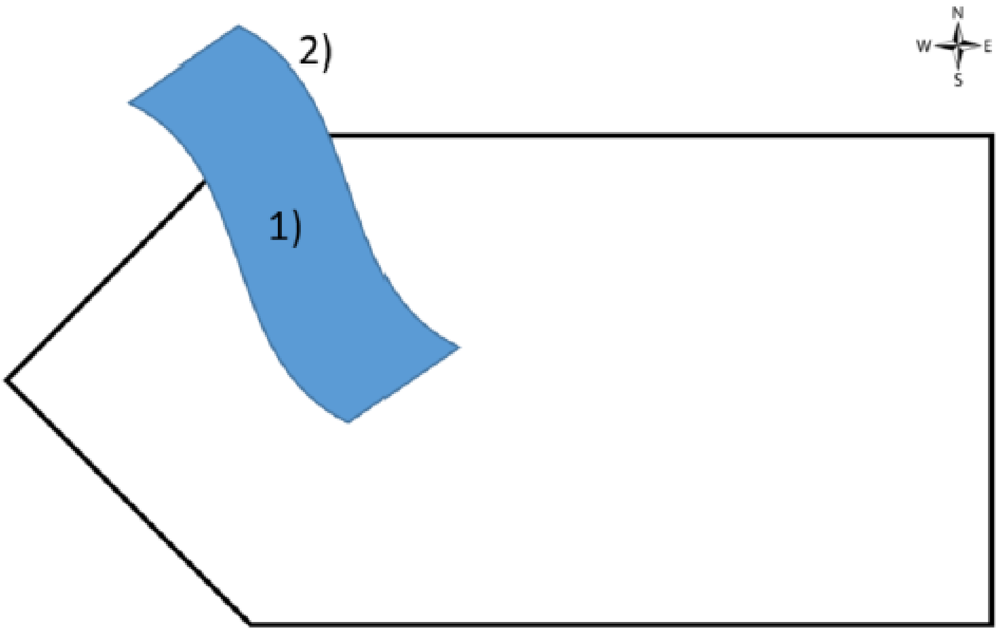
Andre noter:

Kun ca. 70 x 5 meter afsøgt af den nordvestlige del af skibet afsøgt. Det vurderes at dettte udgør ca. 15 % af det samlede areal.

Vraget er sprængt, derfor mange løsrevne dele. 3 – 4 meter sigtbarhed. Vraget stikker ca. 4 meter op nogle steder.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: __3/9___, 2020 Dyk nr._______3_________ Aqua observatør:_____jepol_______

Tidspunkt for neddykning kl. _15_:_13__ Tidspunkt for afslutning af dyk: kl. __15_:_18_______

Navn på dykker/dykkere:______________Thomas____

Vragnavn:_____Jurbarkas_______________________ Position: N_54_°__43,068_' E_12_°__25,589_'

Længde på vrag:__100____(m), Bredde på vrag_____26____(m), Højde på vrag:_________3_______(m)

Dybde: Bund ___19___m Top ___16____m

Omgivende budtype: ____Soft bottom____________

Aktivitet (Husk målepind): Kortlægning □ Oprensning x

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel x Andet__________________

Sidescan af vrag inden dyk? Ja x Nej □

Første dyk på dette vrag? Ja □ Nej x, Hvis nej hvilket nummer dyk? ___3______________

Navn på første fil:______ REC_0013_3sep_JURBARKAS_dyk3_del1________________________________

Redskaber observeret på vrag: Nej □ Ja x, hvis ja hvilken type: Trawl □, Garn x, Andet_________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)________________________

Separat skema om fangst/begroning udfyldt Ja □ Nej □

Kommentarer fra dykker omkring observationer:

Bjergning af et net. Blev tabt da det var sikret ved dykkerbåd. Nemt fundet igen da det bare var faldet direkte ned på bunden, da der ingen strøm var.

Andre noter:

Vraget er sprængt, derfor mange løsrevne dele. 3 – 4 meter sigtbarhed. Vraget stikker ca. 4 meter op nogle steder.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: __4/9___, 2020 Dyk nr._______1_________ Aqua observatør:_____jepol_______

Tidspunkt for neddykning kl. _10_:_18__ Tidspunkt for afslutning af dyk: kl. __10_:_52_______

Navn på dykker/dykkere:______________Thomas____

Vragnavn:_____Ebenezer_______________________ Position: N_54_°__52,267_' E_12_°__09,486_'

Længde på vrag:__20____(m), Bredde på vrag_____7____(m), Højde på vrag:_________2_______(m)

Dybde: Bund ___10___m Top ___5,9____m

Omgivende budtype: ____Fint sand____________

Aktivitet (Husk målepind): Kortlægning x Oprensning □

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel x Andet__________________

Sidescan af vrag inden dyk? Ja x Nej □

Første dyk på dette vrag? Ja x Nej □, Hvis nej hvilket nummer dyk? __________________

Navn på første fil:________ REC_0014_4sep_EBENEZER_dyk1_del1_____________________________

Redskaber observeret på vrag: Nej x Ja x, hvis ja hvilken type: Trawl □, Garn □, Andet___________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)________________________

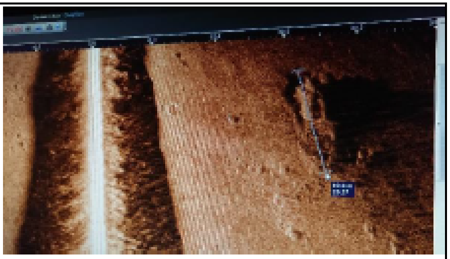
Separat skema om fangst/begroning udfyldt Ja □ Nej □

Kommentarer fra dykker omkring observationer:

Vrag stikker ca. 2 meter op mange steder – stor kompleksitet. Ligger på skråning i en rende, hvor der ofte er kraftig strøm. (Der spekuleres i om det er derfor der ikke bliver observeret fiskeredskaber på vraget). Meget grund eftersøgning. Sigt: 6-8 meter

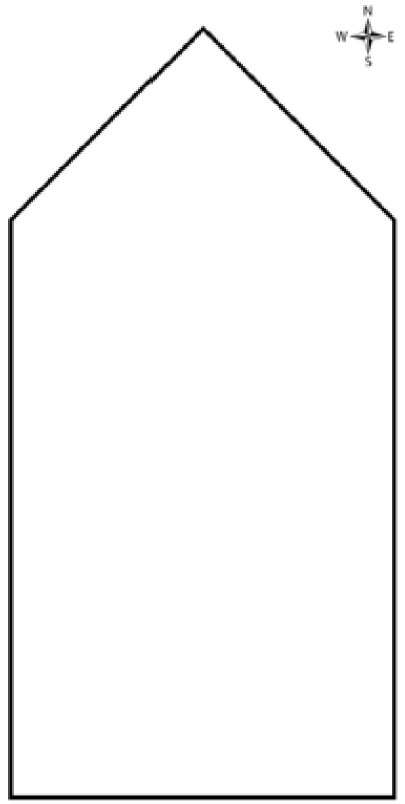
Andre noter:

Sidescan sonar billede af vrag ses til højre.



Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: __4/9___, 2020 Dyk nr.________1__________ Aqua observatør:_____jepol_______

Tidspunkt for neddykning kl. _14_:_34__ Tidspunkt for afslutning af dyk: kl. __15_:_05_______

Navn på dykker/dykkere:______________Marie ____

Vragnavn:_____Landgangsvraget_________________ Position: N_54_°__57,280_' E_11_°__54,990_'

Længde på vrag:__38____(m), Bredde på vrag_____8____(m), Højde på vrag:_________4_______(m)

Dybde: Bund ___10___m Top ___6____m

Omgivende budtype: ____Grus / sten med muslinger____________

Aktivitet (Husk målepind): Kortlægning x Oprensning ☐

Videooptager anvendt på dyk: Paralenz ☐ GoPro ☐ LH med kabel x Andet__________________

Sidescan af vrag inden dyk? Ja x Nej ☐

Første dyk på dette vrag? Ja x Nej ☐, Hvis nej hvilket nummer dyk? __________________

Navn på første fil:__ REC_0017_4sep_LANDGANGSVRAGET_dyk1_del1___________________________

Redskaber observeret på vrag: Nej x Ja x, hvis ja hvilken type: Trawl ☐, Garn ☐, Andet___________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)________________________

Separat skema om fangst/begroning udfyldt Ja ☐ Nej ☐

Kommentarer fra dykker omkring observationer:

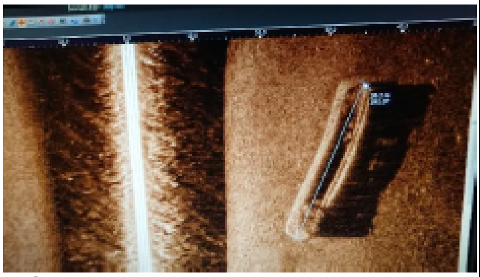
Ingen fiskenet observeret. Meget kraftig strøm, 2 – 2,5 meter sigt.

1) 2 fiskeline-stumper.
2) 2 Død fisk, ca. 15 cm lang.

Andre noter:

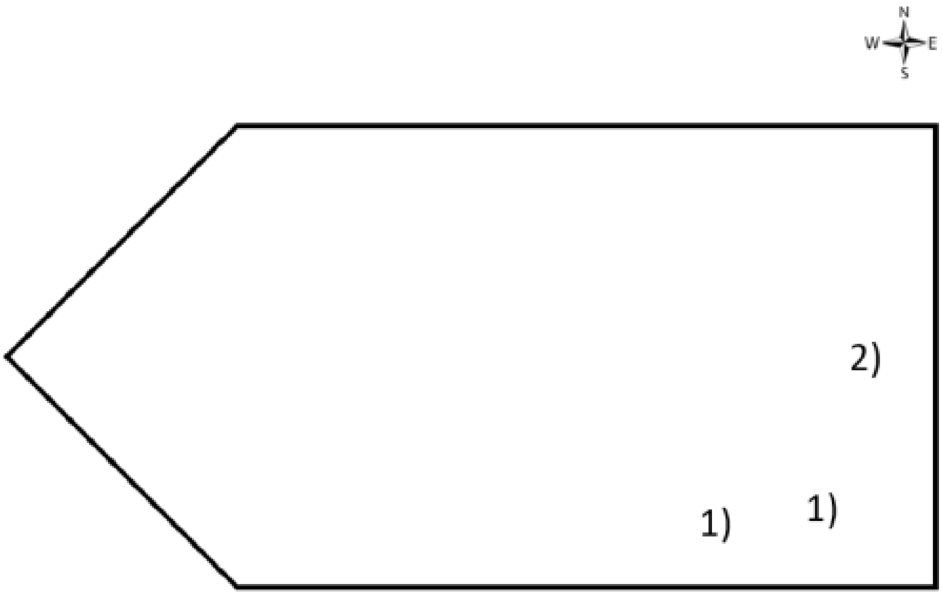
Intakt vrag. Stak ca. 4 meter op over bunden. 95 % gennemsøgt, manglede 2 meter i stævnen og lidt i midten af vraget.

Sidescan billede af vraget ses til højre.



Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):



Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _5/9__, 2020 Dyk nr.________2_______ Aqua observatør:__-___

Tidspunkt for neddykning kl. _19 : 31__ Tidspunkt for afslutning af dyk: kl. __20_:_17______

Navn på dykker/dykkere:_________Dana____

Vragnavn:_____M/S Johnny______________________ Position: N_54°48,312_' E_12°16,614_'

Længde på vrag:_22____(m), Bredde på vrag____7_______(m), Højde på vrag:_________3______(m)

Dybde: Bund ____22__m Top _19____m

Omgivende budtype: _Silt de øverste ca 3 cm, sandet mudder_

Aktivitet (Husk målepind): Kortlægning ☐ Oprensning X

Videooptager anvendt på dyk: Paralenz ☐ GoPro ☐ LH med kabel X Andet:_Lys monteret ved maske

Sidescan af vrag inden dyk? Ja X Nej ☐

Første dyk på dette vrag? Ja ☐ Nej X, Hvis nej hvilket nummer dyk? ______2___________

Navn på første fil:__ REC_0022_5sep_MS_JOHNNY_dyk1_del1_____________________________

Redskaber observeret på vrag: Nej ☐ Ja X, hvis ja hvilken type: Trawl X, Garn ☐ , Andet _Pilke og liner_____

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)_______Trawl________________

Separat skema om fangst/begroning udfyldt Ja ☐ Nej X

Kommentarer fra dykker omkring observationer:

Andre noter:

Sigt på 2-3 m på toppen af vraget, ved bunden 1,5-2 meters sigt

Krabbedød i forskellige steder sandsynligvis forårsaget at iltsvind.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _6/9__, 2020 Dyk nr.______1__________ Aqua observatør:_____EMP__________

Tidspunkt for neddykning kl. __15:12___ Tidspunkt for afslutning af dyk: kl. ___15:49_______

Navn på dykker/dykkere:____________Stafan____

Vragnavn:______Vibeke Høj_____________________ Position: N__55°01,71' E__12°35,78'

Længde på vrag:__60___(m), Bredde på vrag___8-9_______(m), Højde på vrag:_______4_________(m)

Dybde: Bund ___23___m Top __17___m

Omgivende budtype: ______siltholdigt sand________________

Aktivitet (Husk målepind): Kortlægning X Oprensning □

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel X Andet_________________

Sidescan af vrag inden dyk? Ja X Nej □

Første dyk på dette vrag? Ja X Nej □, Hvis nej hvilket nummer dyk? _________________

Navn på førte fil:___ REC_0028_6sep_VIBEKE_HØJ_dyk1_del1_______________________________

Redskaber observeret på vrag: Nej □ Ja X, hvis ja hvilken type: Trawl X, Garn □, Andet__________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)_______________________

Separat skema om fangst/begroning udfyldt Ja □ Nej □

Kommentarer fra dykker omkring observationer:

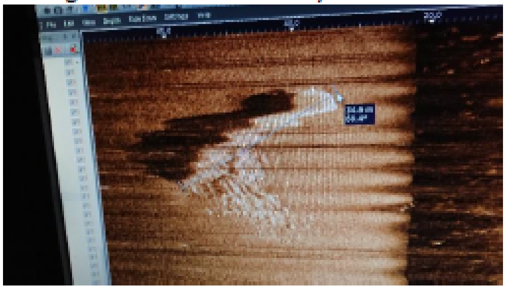
Trawlen ligger lige ved roret og hen over.

Vraget er mest begroet med muslinger og enkelte krabber

Andre noter:

Vraget er en stempram der ligger på bagbord side. Den er forlist i 1977 og der er 2 store lastrum fyldt med sten.

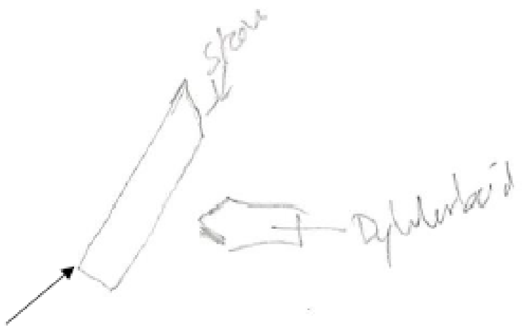
Til højre ses et sidescan sonar billede af vraget.



Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

15:15	Dykker på toppen af vraget og shootline bundet
15:19	Mange sten på bunden (boulders)
	Maste agtig ting observeret
15:22	Reb på spil
15:26	Ved propellen
15:27	Net observeret ved agterstavnen af vraget
15:28	Målepinden findes frem
15:29	Masker ca 5x5 cm
15:30	Reb ca 1-2cm i diameter og nettet går ned i sedimentet. Nettet går i retning mod N/NV
15:33	Bundtypen er silty (fint) sand
15:35	Net observeret, evt. samme net som tidligere, samme maske str som før ca 4-5x4-5 cm
15:38	Mere net inkl. reb og gummiringe
15:39	Kabel og reb ikke noget net.
15:41	Flytter shootline til området omkring agterstavnen af vraget
15:43	Dykker forlader bunden
15:49	Dykker i overfladen



15:27 Net observeret

Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _6/9__, 2020   Dyk nr.______2______   Aqua observatør:____EMP________

Tidspunkt for neddykning kl. __16:53___ Tidspunkt for afslutning af dyk: kl. ___17:38________

Navn på dykker/dykkere:________________________Marie______________________________________

Vragnavn:______Vibeke Høj___________________   Position: N__55°01,71'   E__12°35,78'

Længde på vrag:__60___(m), Bredde på vrag____8-9_____(m), Højde på vrag:______4_________(m)

Dybde: Bund ___23___m   Top __17___m

Omgivende budtype: ________siltholdigt sand __________

Aktivitet (Husk målepind):   Kortlægning ☐   Oprensning X

Videooptager anvendt på dyk: Paralenz ☐ GoPro ☐ LH med kabel X Andet________________

Sidescan af vrag inden dyk? Ja ☐   Nej ☐

Første dyk på dette vrag? Ja ☐   Nej X, Hvis nej hvilket nummer dyk? _______2_________

Navn på første fil:__ REC_0031_6sep_VIBEKE_HØJ_dyk2_del1_______________________________

Redskaber observeret på vrag: Nej ☐   Ja ☐, hvis ja hvilken type: Trawl X, Garn ☐, Andet_________________

Hvis redskaber bjerget: Estimeret mængde _________kg , Redskabstype(r)______________________

Separat skema om fangst/begroning udfyldt   Ja ☐   Nej ☐

Kommentarer fra dykker omkring observationer:

Medbringer 30L og 100L løftesække til hævning samt kniv

Andre noter:

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

16:53	Dykker i vandet med løftesække for at bjærge trawl
16:56	15 meter nede ad shootline
16:58	På bunden ved det observerede net
16:59	Svømmer mod nord fra vraget
17:00	Sætter løftesæk på trawl
17:03	Bundet 1 løftesæk på 100L på 2 reb, hvoraf det ene sidder sammen med nettet
17:07	Trawlen ligger ikke som en pølse men spredt ud over bunden
17:12	Sætter 100L sæk i stor bunke net og reb
17:18	Fylder mere luft i posen for at give den mere løft.
17:26	Nettet løfter
17:28	Sikrer nettet til shootline
17:32	Kigger på nettet langs roret
17:33	Dykker forlader bunden
17:38	Dykker på dæk

Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: _6/9__, 2020 Dyk nr.________3__________ Aqua observatør:_____EMP___________

Tidspunkt for neddykning kl. __18:10___ Tidspunkt for afslutning af dyk: kl. __19:00_________

Navn på dykker/dykkere:________________________Dana____________________________________

Vragnavn:______Vibeke Høj_______________________ Position: N__55°01,71' E__12°35,78'

Længde på vrag:__60___(m), Bredde på vrag___6______(m), Højde på vrag:______4_________(m)

Dybde: Bund ___23___m Top __17___m

Omgivende budtype: ______________________________

Aktivitet (Husk målepind): Kortlægning ☐ Oprensning X

Videooptager anvendt på dyk: Paralenz ☐ GoPro ☐ LH med kabel X Andet__________________

Sidescan af vrag inden dyk? Ja X Nej ☐

Første dyk på dette vrag? Ja ☐ Nej X, Hvis nej hvilket nummer dyk? ____3____________

Navn på første fil: REC_0035_6sep_VIBEKE_HØJ_dyk3_del1_______________________________

Redskaber observeret på vrag: Nej ☐ Ja ☐, hvis ja hvilken type: Trawl ☐, Garn ☐, Andet____________________

Hvis redskaber bjerget: Estimeret mængde ___70__kg , Redskabstype(r)____TRAWL, lystfisker udstyr__________

Separat skema om fangst/begroning udfyldt Ja ☐ Nej ☐

Kommentarer fra dykker omkring observationer:

Bjergningen ombord på fartøjet er filmet med GoPro, filer:

Kun et par meter trawl tilbage på havbunden, men mest rebrester.

Andre noter:

Nettet har løsnet sig yderligere fra bund og vrag siden dyk 2.

Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

18:10	Dykker i vandet
18:12	Påbegynder neddykning
18:14	Ved 17m dybde
18:16	At worksite
18:17	Afmonterer følgereb og sætter det på net
18:19	Flytter shootline fra net til vrag
18:22	Begynder at fjerne net
18:24	Hiver net fra vraget
18:25	Flytter shootline væk fra vrag
18:27	Cutter wire
18:29	Wire cuttet → bevægelse "pakken"
18:32	Venter på at sedimentet er setlet og cutter så endnu en wire
18:35	Cutter wire og "pakken" stiger mod overfladen
18:40	Ikke meget tilbage af nettet på vraget
18:48	Alt medbragt arbejdsudstyr er fundet
18:54	Dykker forlader bunden
19:00	Dykker i overfladen

Stationsskema dyk på vrag, spøgelsesnetprojektet.

Dato: 7/9 , 2020 Dyk nr. 1 Aqua observatør: EMP

Tidspunkt for neddykning kl. 14:57 Tidspunkt for afslutning af dyk: kl. 15:27

Navn på dykker/dykkere: Staffan

Vragnavn: M/S Vita Position: N 55°01,73' E 12°32,06'

Længde på vrag: 28 (m), Bredde på vrag ca 9 (m), Højde på vrag: 1- 1,5 (m)

Dybde: Bund 18,3 m Top 17,1 m

Omgivende budtype: fint sand

Aktivitet (Husk målepind): Kortlægning X Oprensning □

Videooptager anvendt på dyk: Paralenz □ GoPro □ LH med kabel X Andet

Sidescan af vrag inden dyk? Ja X Nej □

Første dyk på dette vrag? Ja X Nej □, Hvis nej hvilket nummer dyk?

Navn på første fil: REC_0040_7sep_MS_VITA_dyk1_del1

Redskaber observeret på vrag: Nej X Ja □, hvis ja hvilken type: Trawl □, Garn □, Andet

Hvis redskaber bjerget: Estimeret mængde ______ kg , Redskabstype(r)

Separat skema om fangst/begroning udfyldt Ja □ Nej □

Kommentarer fra dykker omkring observationer:

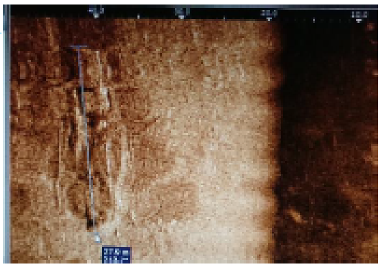
Ingen net eller andre mistede redskaber.

Sigt på 6-8 meter.

Andre noter:

Dykker kommentar: Vraget består mest af løse træbrædder, så hvis der kommer en trawler forbi kan man forestille sig at den bare kan trække over, eller evt. bare tager et bræt med i trawlen.

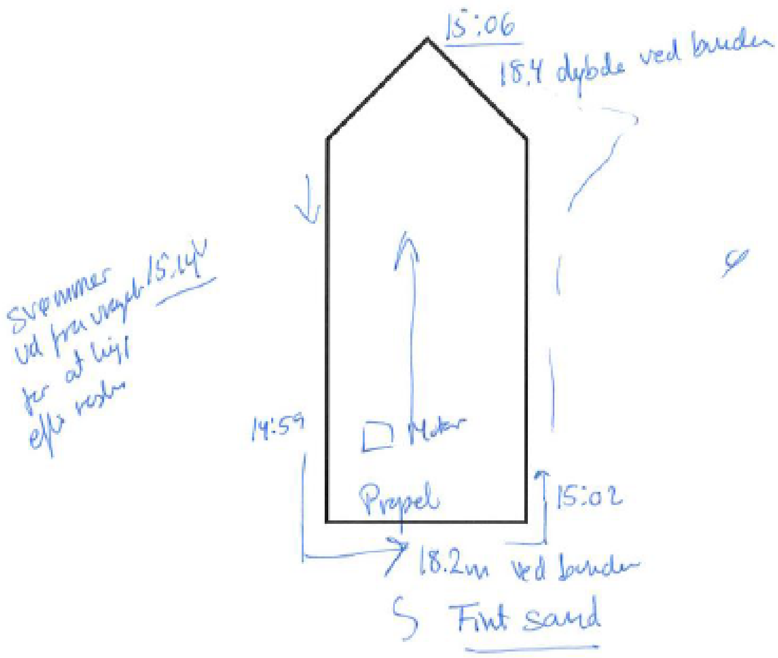
Sidescan sonar billede af vrag ses til højre.



Skematisk tegning af observationer angives på bagsiden → (VEND PAPIR)

Skematisk tegning af hvor på vraget redskaber er observeret (Angiv på tegningen i hvilken retning stævnen på skibet ligger):

14:57	Dykker i vandet
14:58	Dykker på 10 meters dybde, kan se at vraget er et fladt trævrag
14:59	Ved motor
15:00	Ved propellen
15:02	Ingen observationer af net
15:06	Der er ligesom et spor af brædder
15:07	Gummi slange
15:09	Endnu et anker
15:10	Træ er spredt ud over området
15:11	Bunke med ankerkæde
15:13	Videoen faldt ud!
15:14	Dykkeren svømmer ud fra vraget
15:15	Er ved motoren og det højeste punkt, dybde 17,1 meter
15:18	Gummi slange, svømmer mod strømme
15:21	Ved anker
15:23	Dykker forlader bunden



A.10. Dive video list

REC_0005_Redningsdyk

REC_0006_Redningsdyk

REC_0008_1sep_MS_JOHNNY_dyk1_del1

REC_0009_1sep_MS_JOHNNY_dyk1_del2

REC_0010_1sep_MS_JOHNNY_dyk1_del3

REC_0011_1sep_MS_JOHNNY_dyk1_del4

REC_0013_2sep_kanonvraget_dyk1_del1

REC_0014_2sep_kanonvraget_dyk1_del2

REC_0015_2sep_kanonvraget_dyk1_del3

REC_0016_2sep_kanonvraget_dyk1_del4

REC_0017_2sep_kanonvraget_dyk2_del1

REC_0018_2sep_kanonvraget_dyk2_del2

REC_0019_2sep_kanonvraget_dyk2_del3

REC_0003_3sep_JURBARKAS_dyk1_del1

REC_0004_3sep_JURBARKAS_dyk1_del2

REC_0005_3sep_JURBARKAS_dyk1_del3

REC_0006_3sep_JURBARKAS_dyk1_del4

REC_0007_3sep_JURBARKAS_dyk1_del5

REC_0008_3sep_JURBARKAS_dyk2_del1

REC_0009_3sep_JURBARKAS_dyk2_del2

REC_0010_3sep_JURBARKAS_dyk2_del3

REC_0011_3sep_JURBARKAS_dyk2_del4

REC_0012_3sep_JURBARKAS_dyk2_del5

REC_0013_3sep_JURBARKAS_dyk3_del1

REC_0014_4sep_EBENEZER_dyk1_del1

REC_0015_4sep_EBENEZER_dyk1_del2

REC_0016_4sep_EBENEZER_dyk1_del3

REC_0017_4sep_LANDGANGSVRAGET_dyk1_del1

REC_0018_4sep_LANDGANGSVRAGET_dyk1_del2

REC_0019_4sep_LANDGANGSVRAGET_dyk1_del3

REC_0022_5sep_MS_JOHNNY_dyk1_del1

REC_0023_5sep_MS_JOHNNY_dyk1_del2

REC_0024_5sep_MS_JOHNNY_dyk1_del3

REC_0025_5sep_MS_JOHNNY_dyk1_del4

REC_0026_5sep_MS_JOHNNY_dyk1_del5

REC_0028_6sep_VIBEKE_HØJ_dyk1_del1

REC_0029_6sep_VIBEKE_HØJ_dyk1_del2

REC_0030_6sep_VIBEKE_HØJ_dyk1_del3

REC_0031_6sep_VIBEKE_HØJ_dyk2_del1

REC_0032_6sep_VIBEKE_HØJ_dyk2_del2

REC_0033_6sep_VIBEKE_HØJ_dyk2_del3

REC_0034_6sep_VIBEKE_HØJ_dyk2_del4

REC_0035_6sep_VIBEKE_HØJ_dyk3_del1

REC_0036_6sep_VIBEKE_HØJ_dyk3_del2

REC_0037_6sep_VIBEKE_HØJ_dyk3_del3

REC_0038_6sep_VIBEKE_HØJ_dyk3_del4

REC_0040_7sep_MS_VITA_dyk1_del1

REC_0041_7sep_MS_VITA_dyk1_del2

REC_0042_7sep_MS_VITA_dyk1_del3

A.11. Activity log inner Danish waters

July 7th 2020: Day 1. Relocation of R/V Havfisken from its homeport Strandby to Korsør

July 8th 2020: Day 2. Sidescan survey in focus area 2. In the shallow area, the USBL system was bypassed and the position directly received from the DGPS. The affected files are marked with italic in App 4. In Nakskov harbor for the night.

July 9th 2020: Day 3. Start the sidescan survey in focus area 2. Ground truthing of target 51 using the BlueRov, mainly as at sea-trial test. Sidescan sonar mapping in focus area 3. In Nakskov harbor for the night.

July 10th 2020: Day 4. Sidescan sonar mapping all day in focus area 1. In Nakskov harbor for the night.

July 11th 2020: Day 5. Sidescan survey in focus area 3. Ground truthing of target 114-115 using the BlueRov, the current is too strong to navigate and the ROV gets flooded. Dragging past the target with no catch except from Laminaria. Sidescan activities was resumed in focus area 3. Ground truthing of target 135 using the CTD rigged with LH and Paralenz camera. In Nakskov harbor for the night.

July 12th 2020: Day 6. Ground truthing of target 114-115 using the CTD rigged with LH, Paralenz and GoPro cameras. Sidescan sonar mapping in focus area 3. Ground truthing of target 166-168 using the CTD rigged with LH, Paralenz and GoPro cameras. Moving to focus area 1 to ground truth target 104-108 using the CTD rigged with LH, Paralenz and GoPro cameras.

July 13th 2020: Day 7. Sidescan survey in focus area 4. Ground truthing of target 247-251 using the CTD rigged with LH, Paralenz and GoPro cameras. After this ground truthing of target 238-241 using the CTD rigged with LH, Paralenz and GoPro cameras. Harbor in Korsør.

July 14th 2020: Day 8. Relocation of R/V Havfisken from Korsør to its homeport Strandby

A.12. Video list inner Danish waters

Date	Target #	File name	Length of file	In water	On deck	Notes
09/7	test0858	2020-07-09_09.52.15	00:03:21	NA	00:22:53	Mediocre visibility
09/7	51	2020-07-09_14.01.59	00:42:53	00:03:00	NA	Poor visibility
09/7	51	MOV_0009	00:10:00	00:05:31	NA	Good visibility
09/7	51	MOV_0010	00:10:00	NA	NA	Mediocre visibility
09/7	51	MOV_0011	00:10:00	NA	NA	Good visibility
09/7	51	MOV_0013	00:09:40	NA	00:06:58	NA
11/7	114-115	2020-07-11_11.37.15	00:08:24	NA	NA	NA
11/7	114-115	2020-07-11_11.48.03	00:00:03	NA	NA	Good visibility
11/7	114-115	2020-07-11_11.48.17	00:08:25	NA	NA	Mediocre visibility
11/7	114-115	2020-07-11_12.02.21	00:08.22	NA	NA	Mediocre visibility
11/7	114-115	MOV_0001	00:10:00	00:00:27	NA	NA
11/7	114-115	MOV_0002	00.10:00	NA	NA	Mediocre visibility
11/7	114-115	MOV_0003	00:10:00	NA	NA	Mediocre visibility
11/7	114-115	MOV_0004	00:10:00	NA	00:06:51	Mediocre visibility
11/7	135	REC_0001	00:00:13	NA	NA	Good visibility
11/7	135	REC_0002	00:14:01	NA	00:05:38	Good visibility
11/7	135	MOV_0007	00:10:00	00_01:11	NA	Good visibility
11/7	135	MOV_0008	00:10:00	NA	NA	Mediocre visibility
11/7	135	MOV_0009	00:01:11	NA	00:00:31	NA
12/7	104-108	GOPR1755	00:19:53	00:05:55	NA	Poor visibility
12/7	104-105	GP011755	00:19:53	NA	NA	Poor visibility, Left the water at 00:02:41, reentered at 00:06:24
12/7	104-105	GP021755	00:04:40	NA	00:03:19	Poor visibility
12/7	104-105	GOPR1597	00:08:32	00:05:34	NA	Poor visibility
12/7	104-105	REC_009	00:15:01	00:00:38	NA	Mediocre visibility
12/7	104-105	REC_0010	00:15:01	NA	NA	Poor visibility, Left the water at 00:02:20, reentered at 00:06:02

Date	Target #	File name	Length of file	In water	On deck	Notes
12/7	104-105	REC_0011	00:08:09	NA	00:07:52	Mediocre visibility
12/7	104-105	MOV_0011	00:10:00	00:04:59	NA	Poor visibility
12/7	104-105	MOV_0012	00:10:00	NA	NA	Poor visibility
12/7	104-105	MOV_0013	00:10:00	NA	NA	Poor visibility, Left the water at 00:01:37, reentered at 00:05:21
12/7	104-105	MOV_0014	00:10:00	NA	NA	Mediocre visibility
12/7	104-105	MOV_0015	00:03:44	NA	00:02:08	NA
12/7	114-115	GOPR1595	00:19:55	00:09:28	NA	Poor visibility
12/7	114-115	GP011595	00:19:57	NA	NA	Mediocre visibility
12/7	114-115	GP021595	00:12:23	NA	00:04:28	Mediocre visibility
12/7	114-115	REC_0003	00:05:01	NA	NA	Mediocre visibility
12/7	114-115	REC_0004	00:09:05	NA	00:00:37	NA
12/7	114-115	MOV_0001	00:10:00	00:09:35	NA	NA
12/7	114-115	MOV_0002	00:10:00	NA	NA	Poor visibility, Camera is upside down, bottom is largely out of view
12/7	114-115	MOV_0003	00:10:00	NA	NA	Poor visibility
12/7	114-115	MOV_0004	00:10:00	NA	NA	Poor visibility
12/7	114-115	MOV_0005	00:10:00	NA	00:04:25	Poor visibility
12/7	166-168	GOPR1596	00:19:53	00:01:28	NA	Mediocre visibility
12/7	166-168	GP011596	00:09:45	NA	00:08:52	Mediocre visibility
12/7	166-168	REC_0006	00:15:01	00:00:37	NA	Mediocre visibility
12/7	166-168	REC_0007	00:12:56	NA	00:12:56	Mediocre visibility
12/7	166-168	MOV_0007	00:10:00	00:01:38	NA	Poor visibility, Camera is upside down
12/7	166-168	MOV_0008	00:10:00	NA	NA	Poor visibility
12/7	166-168	MOV_0009	00:10:00	NA	00:08:56	Mediocre visibility
12/7	166-168	MOV_0010	00:00:43	NA	NA	NA
13/7	omr4	MOV_0016	00:10:00	00:03:07	NA	Poor visibility
13/7	omr4	MOV_0017	00:10:00	NA	00:09:27	Poor visibility
13/7	omr4	REC_0013	00:15:01	00:02:40	NA	Mediocre visibility
13/7	omr4	REC_0014	00:04:39	NA	00:04:02	Mediocre visibility
13/7	238-241	GOPR1599	00:19:53	00:02:51	NA	Good visibility

Date	Target #	File name	Length of file	In water	On deck	Notes
13/7	238-241	GP011599	00:03:00	NA	00:00:58	NA
13/7	238-241	GOPR1757	00:16:51	00:02:19	NA	Mediocre visibility
13/7	238-241	REC_0019	00:15:01	00:01:11	NA	Good visibility
13/7	238-241	REC_0020	00:04:21	NA	00:04:11	Good visibility
13/7	238-241	MOV_0024	00:10.00	00:01	NA	Good visibility
13/7	238-241	MOV_0025	00:10:00	NA	00:09:35	Good visibility
13/7	238-241	MOV_0026	00:01:53	NA	NA	NA
13/7	247-251	GOPR1598	00:19:53	00:01:38	NA	Good visibility
13/7	247-251	GP011598	00:16:15	NA	00:15:17	Good visibility
13/7	247-251	GOPR1756	00:19:53	00:02:21	NA	Good visibility
13/7	247-251	GP011756	00:16:54	NA	00:16:00	Good visibility
13/7	247-251	REC_0016	00:15:01	00:00:42	NA	Good visibility
13/7	247-251	REC_0017	00:15:01	NA	NA	Good visibility
13/7	247-251	REC_0018	00:04:52	NA	00:04:17	Good visibility
13/7	247-251	MOV_0020	00:10:00	00:01:51	NA	Good visibility
13/7	247-251	MOV_0021	00:10:00	NA	NA	Good visibility
13/7	247-251	MOV_0022	00:10:00	NA	NA	Mediocre visibility
13/7	247-251	MOV_0023	00:06:13	NA	00:05:22	Mediocre visibility

A.13. Target list inner Danish waters

July 8th	Description	July 9th	Description
T.-1-50	Elongated object sticking up from the bottom	T.-1-49	Elongated structure
T.-1-51	Elongated object sticking up from the bottom	T.-1-50	Sand ribs
T.-1-52-54	Long narrow tracks in the bottom, could be tracks from trawl doors	T.-1-51	Object on the bottom between sand ribs – selected for ground truthing
T.-1-55	-	T.-1-52	-
T.-1-56	-	T.-1-53	Strange looking shadows across sand ribs
T.-1-57	Long narrow tracks in the bottom, could be tracks from trawl doors	T.-1-54	-
T.-1-58	Large sand rib	T.-1-55	Thing long structure around stones
T.-1-59	Long burrow in the sand close to sand rib	T.-1-56	-
T.-1-60	-	T.-1-57	Large stone or other round object
T.-1-61	Elongated structure, could be fish swimming	T.-1-58-63	Long thin structure along the bottom
T.-1-62	Large sand ribs	T.-1-64	Long thin structure along the bottom
T.-1-63	-	T.-1-65	-
T.-1-64	-	T.-1-66	Stone
T.-1-65	Stone between sand ribs	T.-1-67	Two long structure along the bottom
T.-1-66	-	T.-1-68	-
T.-1-67	-		

July 10th	Description	July 11th	Description
T.-1-55	Two long structure along the bottom close to a stone	T.-1-109	Thin structure across the bottom
T.-1-56	Dark long structure	T.-1-110	-
T.-1-57	Elongated structure	T.-1-111	-
T.-1-58	Dark areas	T.-1-112	Thin structure across the bottom
T.-1-59	Dark areas	T.-1-113	Elongated structures
T.-1-60	Thin structure around stones	T.-1-114-115	Structure across the bottom
T.-1-61	-	T.-1-116	Thin structure across the bottom
T.-1-62	Something round	T.-1-117	Very thin structure across the bottom
T.-1-63	-	T.-1-118	Long burrow in the bottom
T.-1-64	Thin line across the bottom	T.-1-119	-
T.-1-65	Stones	T.-1-120	Two hard elongated structures
T.-1-66	-	T.-1-121	-
T.-1-67	Thin line across the bottom	T.-1-122	Hard structure
T.-1-68	Thin line across the bottom	T.-1-123	Very thin structure across the bottom
T.-1-69	Dark line across the bottom	T.-1-124	-
T.-1-70	Burrows in the sediment	T.-1-125	Long structure
T.-1-71	Large stone or other structure	T.-1-126	-
T.-1-72	-	T.-1-127	Active gillnet
T.-1-73	Very thin line across the bottom	T.-1-128	Thin straight structure across the bottom
T.-1-74	Stones	T.-1-129	Thin straight structure across the bottom
T.-1-75	Stone like structure	T.-1-130	Thin straight structure across the bottom
T.-1-76	-	T.-1-131	-

July 10th	Description	July 11th	Description
T.-1-77	Stone like structure	T.-1-132	-
T.-1-78	Stones	T.-1-133	straight structure across the bottom
T.-1-79	-	T.-1-134	Structure across the bottom
T.-1-80	Stones	T.-1-135	Thin structures around stones
T.-1-81	-	T.-1-136	-
T.-1-82	Sand rib		
T.-1-83	Thin line across the bottom		
T.-1-84-87	Rope like line across the bottom		
T.-1-88	Thin structure across the bottom		
T.-1-89	-		
T.-1-90	Elongated structure		
T.-1-91	-		
T.-1-92	Thin structure across the bottom		
T.-1-93	Thin structure across the bottom		
T.-1-94	Hard bottom, pile of gravel or stone		
T.-1-95	Stone		
T.-1-96	Thin structure across the bottom		
T.-1-97	Thin structure across the bottom		
T.-1-98	Stone		
T.-1-99	Thin structure across the bottom		
T.-1-100	-		
T.-1-101	Sand ribs		
T.-1-102	Stone		
T.-1-103	Elongated structure around stone		
T.-1-104-108	Rope like line across the bottom		

July 12th	Description	July 13th	Description
T.-1-137	Long edge	T.-1-199	Test
T.-1-138	-	T.-1-200	-
T.-1-139	-	T.-1-201-202	Stones?
T.-1-140	Stone and sand ribs	T.-1-203-204	long structure
T.-1-141	Stone and sand ribs	T.-1-205-206	Thin long structure, rope?
T.-1-142	Thin structure across the bottom	T.-1-207-208	Rope?
T.-1-143	Straight structure across the bottom	T.-1-209-213	Long structure, a net?
T.-1-144-147	Active gill net	T.-1-214-215	Strange shadows
T.-1-148	-	T.-1-216-218	Lines across the bottom, rope?
T.-1-149	Thin structure across the bottom	T.-1-219-222	Edge of stones?
T.-1-150	Thin structure across the bottom	T.-1-223-224	Thin long structure, rope?
T.-1-151	Thin structure across the bottom	T.-1-225-226	Edge of stone
T.-1-152	-	T.-1-227	Buoy
T.-1-153	Thin structure across the bottom	T.-1-228	Stone and sand ribs
T.-1-154	-	T.-1-229	Lines
T.-1-155	Thin structure across the bottom	T.-1-230-231	Thin line, edge?
T.-1-156	-	T.-1-232-237	Long line of stones piled up?
T.-1-157	-	T.-1-238-241	Thin lines across the bottom, rope?
T.-1-158-159	Line like structure across bottom	T.-1-242	Stone, noted as hold on Havfiskens plotter
T.-1-160-161	Sand rib or net?	T.-1-243-244	Long structure
T.-1-162-163	Elongated structure close to sand rib	T.-1-245-246	Edge of stones

T.-1-164-165	Turning structure, rope?	T.-1-247-251	Thin long structure, rope?
T.-1-166-168	net like structure, however observed in a turn	T.-1-252-253	Thin long structure, rope?
T.-1-169	Structure across the bottom		
T.-1-190	Test		
T.-1-191	-		
T.-1-192-193	Structure around a stone		
T.-1-194-195	Lines across the bottom		
T.-1-196-197	long structure, but observed in a turn		
T.-1-198	-		

A.14. Sidescan sonar file list, inner Danish waters

The sonar files from each day is listed below. Due to survey in shallow areas, the filenames written in Italic received their position directly from the DGPS and not the USBL system.

July 8th	July 9th	July 10th	July11th	July 12th	July 13th
test08072020.jsf	*test.jsf*	Tv1.jsf	omr3_L2.jsf	20200712064300.jsf	Omr4_L1.jsf
tr1.jsf	*Omr2_L5.jsf*	Tv2.jsf	omr3_L2.001.jsf	20200712064800.jsf	Omr4_tv1.jsf
tr1.001.jsf	*Omr2_L5.001.jsf*	Tv3.jsf	omr3_L2.002.jsf	LSyd_midt.jsf	Omr4_tv1.001.jsf
tr1.002.jsf	*Omr2_L5.002.jsf*	Tv4.jsf	omr3_L3.jsf	LSyd_midt.001.jsf	Omr4_tv3.001.jsf
tr1.003.jsf	*Omr2_L5.003.jsf*	Tv5.jsf	omr3_L3.001.jsf	LSyd_midt.002.jsf	Omr4_tv3.002.jsf
tr1.004.jsf	*Omr2_L6.jsf*	venter.jsf	omr3_L3.002.jsf	LSyd_tv1.jsf	Omr4_tv3.jsf
tr1.005.jsf	*Omr2_L6.001.jsf*	Tv6.jsf	omr3_L3.003.jsf	LSyd_tv1.001.jsf	Omr4_L1_.jsf
tr1.006.jsf	*Omr2_tv9.jsf*	Tv6.001.jsf	*oMR3_L4.jsf*	LSyd_tv1.002.jsf	Omr4_L1_.001.jsf
tr1.007.jsf	*Omr2_tv10.jsf*	Tv6.002.jsf	*20200711113239.jsf*	Omr3_syd_tv4.jsf	Omr4_L1_.002.jsf
tr1.008.jsf	*Omr2_tv9_.jsf*	Tv5_.jsf	20200711115944.jsf	Omr3_syd_tv4.001.jsf	Omr4_L1_.003.jsf
tr1.009.jsf	*Omr2_tv11.jsf*	Tv7.jsf	20200711122649.jsf	Omr3_syd_tv4.002.jsf	Omr4_L4.jsf
tr1.010.jsf	*Omr2_tv12.jsf*	Tv8.jsf	Omr3_L5.jsf	Omr3_syd_tv4.003.jsf	Omr4_L4.001.jsf
tr3.jsf	Omr3_tr1.jsf	Tv9.jsf	Omr3_L5.001.jsf	Omr3_syd_tv7.jsf	
tr3.001.jsf	Omr3_tr1.001.jsf	Tv10.jsf	Omr3_L5.002.jsf	Omr3_syd_tv7.001.jsf	
tv1.jsf	Omr3_tr1.002.jsf	Tv11.jsf	Omr3_L5.003.jsf	Omr3_syd_tv9.jsf	
tv1.001.jsf	Omr3_tr1.003.jsf	Tv11.001.jsf		Omr3_syd_tv9.001.jsf	
tv1.002.jsf	Omr3_tr1.004.jsf	Tv12.jsf			
tv1.003.jsf	Omr3_tr1.005.jsf	Tv13.jsf			
tv1.004.jsf	Omr3_tr1.006.jsf	Tv13.001.jsf			
tv1.005.jsf	Omr3_tr1.007.jsf	Omr1_L1.jsf			
tv5.jsf	Omr3_tr1.008.jsf	Omr1_L1.001.jsf			
tv6.jsf		Omr1_L1.002.jsf			
tv7.jsf		Omr1_L1.003.jsf			
tv7.001.jsf		Omr1_L2.jsf			
tv7.002.jsf		Omr1_L2.001.jsf			
tv7.003.jsf		Omr1_L2.002.jsf			
tv8.jsf		Omr1_L3.jsf			
tv8.001.jsf		Omr1_L3.001.jsf			
L4.jsf		Omr1_L3.002.jsf			
L4.001.jsf		Omr1_L3.003.jsf			
L4.002.jsf					

A.15. Activity log, North Sea/Skagerrak

January 15th 2021:

Day 1. Relocation of R/V Havfisken from its homeport Strandby to the Hirtshals 1 area.
CTD profile and calibration of USBL system.
Sidescan survey in Hirtshals area 1. Two squares fully covered and three partly.
USBL pole broke in the middle of transect 2 and could not be fixed at sea.
Therefore, the position for the sidescan was transmitted directly from the DGPS.
The affected files are marked with italic in App 4.
In Hirtshals harbor for the night where the pole DGPS pole was repaired.

January 16th 2021:

Day 2. Sidescan survey in Store rev area 2. Ten squares covered but only in east-west direction.
CTD profile and calibration of USBL system.
Due to limited time in the area by the end of the survey, ground truthing with the BlueROV was skipped and a dragging attempt was made at target 334-336, where a small piece of rope was recovered.
In Hirtshals harbor for the night.

January 17th 2021:

Day 3.
CTD profile.
Ground truthing of target 281-283 in Hirtshals area 1 with BlueRov, a line got stock in one of the ROV propellers and the ROV had to be recovered – no serious injuries.
An attempt of dragging at target 281-283 was made and 240 m of net, 60 m of rope an anchor and a buoy was recovered (see detail in App. 5).
Sidescan survey in Hirtshals area 1. Two squares fully covered and three partly covered.
Ground truthing with ROV at target 301-304 in Hirtshals area 1. No ghost nets observed
In Hirtshals harbor for the night.

January 18th 2021:

Day 4. Sidescan sonar mapping in the Jammerbugt 2, 2 squares fully covered and 2 only in east-west direction.
Ground truthing of target 331-332 with BlueRov, ROV got stuck below the ship but everything except a float was recovered. No ghost nets observed
In Hirtshals harbor for the night.

January 19th 2021:

Day 5. Sidescan survey in Hirtshals area 2, 4 squares fully covered.
Ground truthing of target 411-414 with BlueRov. No ghost nets observed
Relocation of R/V Havfisken from Hirtshals to its homeport Strandby

A.16. Video list, North Sea/Skagerrak

Date	Target #	File name	Length of file	In water	On deck	Notes
17/01	281_283_net	GOPR1765	00:12:10	00:08:50	NA	Good visibility
17/01	281_283_net	GP011765	00:09:00	NA	00:05.35	Good visibility
17/01	301_304	GOPR1767	00:11:57	00:00:34	NA	Good visibility
17/01	301_304	GP011767	00:11:58	NA	NA	Mediocre visibility
17/01	301_304	GP021767	00:08:57	NA	NA	Mediocre visibility
17/01	281_283_garn	MOV_0001	00:02:11	NA	NA	NA
17/01	281_283_garn	MOV_0002	00:10:00	00:00:19	NA	Poor visibility
17/01	281_283_garn	MOV_0003	00:06:00	NA	00:04:45	Poor visibility
17/01	301_304	MOV_0004	00:00:32	NA	NA	NA
17/01	301_304	MOV_0005	00:10:00	00:00:45	NA	Mediocre visibility
17/01	301_304	MOV_0006	00:10:00	NA	NA	Poor visibility
17/01	301_304	MOV_0007	00:10:00	NA	NA	Mediocre visibility
17/01	301_304	MOV_0008	00:10:00	NA	NA	Mediocre visibility
17/01	301_304	MOV_0009	00:10:00	NA	NA	Mediocre visibility
17/01	301_304	MOV_0010	00:10:00	NA	NA	Poor visibility
17/01	301_304	MOV_0011	00:01:40	NA	00:01:04	NA
18/01	331_332	GOPR1786	00:12:04	00:00:56	NA	Good visibility
18/01	331_332	GP0011768	00:12:01	NA	NA	Good visibility

Date	Target #	File name	Length of file	In water	On deck	Notes
18/01	331_332	GP021768	00:12:15	NA	00:05:17	Mediocre visibility
18/01	331_332	GP031768	00:12:06	00:04:16	NA	NA
18/01	331_332	GP041768	00:12:04	NA	00.00:34	Mediocre visibility
18/01	331_332	GP051768	00:11:59	NA	NA	Good visibility
18/01	331_332	GP061768	00:11:59	NA	NA	NA
18/01	331_332	GP071768	00:12:09	NA	00:03:35	NA
18/01	331_332	MOV_0012	00:10:00	00:00:44	NA	Poor visibility
18/01	331_332	MOV_0013	00:10:00	NA	NA	Poor visibility
18/01	331_332	MOV_0014	00:10:00	NA	00:09:11	Mediocre visibility
18/01	331_332	MOV_0015	00:00:33	NA	NA	NA
18/01	331_332	MOV_0016	00:10:00	00:00:16	00:08:41	NA
18/01	331_332	MOV_0017	00:10:00	00:02:30	NA	Mediocre visibility
18/01	331_332	MOV_0018	00:10:00	NA	NA	Poor visibility
18/01	331_332	MOV_0019	00.10:00	NA	NA	NA
18/01	331_332	MOV_0020	00:10.00	NA	00:07:41	NA
18/01	331_332	MOV_0021	00:04:27	NA	NA	NA
19/01	411_414	GOPR1769	00:12:03	00:01:42	NA	Good visibility
19/01	411_414	GP011769	00:12:15	NA	00:06:33	Good visibility
19/01	411_414	GP021769	00:11:59	00:00:07	NA	Good visibility

Date	Target #	File name	Length of file	In water	On deck	Notes
19/01	411_414	GP031769	00:12:22	NA	00:07:30	Good visibility
19/01	411_414	GP041769	00:12:33	00:01:00	00:06:36	Poor visibility
19/01	411_414	GP051769	00:00:24	NA	NA	NA
19/01	411_414	MOV_0022	00:10:00	00:00:42	NA	Good visibility
19/01	411_414	MOV_0023	00:08:58	NA	00:07:45	Mediocre visibility
19/01	411_414	MOV_0024	00:10:00	00:02:16	NA	Good visibility
19/01	411_414	MOV_0025	00:10:00	NA	NA	Good visibility
19/01	411_414	MOV_0026	00:02:21	NA	00:01:34	NA
19/01	411_414	MOV_0027	00:10:00	00:00:15	00:05:51	Mediocre visibility
19/01	411_414	MOV_0028	00:02:02	NA	NA	NA

A.17. Target list, North Sea/Skagerrak

All anomalies marked as targets during the survey is listed below. The targets are sorted according to date and a short description of what the anomaly looks like. Due to a broken USBL pole the targets written in Italic received their position directly from the DGPS and not the USBL system and targets in **bold** were ground truthed.

January 15th	Description	January 16th	Description
T.-1-245-246	Test	T.-1-291-293	Trawl door track
T.-1-247	Line	T.-1-294-297	Trawl door track
T.-1-248-249	Bottlelike structure, probably a sand ripple	T.-1-298-300	Trawl door track
T.-1-250-252	Line along a sand ribs	T.-1-301-303	Curved line among stones, could be aligned stones
T.-1-253-254	Sand rib	T.-1-304-306	Wide track, anchor track?
T.-1-255-257	Line along a sand ripple	T.-1-307-308	Thin curved line
T.-1-258-260	Thin line among the stones	T.-1-309-313	Very long track probably from trawl door
T.-1-261	Thin line from san towards stone	T.-1-314-320	Trawl door track
T.-1-262-263	Thin line among the stones	T.-1-321-326	Trawl door track
T.-1-264-265	Thin line on sand could be interesting	T.-1-327-331	Line in stone reef area
T.-1-266-267	Blurry line	T.-1-332-333	-
T.-1-268	-	**T.-1-334-336**	Line with strong return signal - strange structure
T.-1-269-270	Line along a sand ribs	T.-1-337-338	Line
T.-1-271-273	Probably a sand rib line	T.-1-339-340	Line, could be a rope
T.-1-274-275	Line across the bottom	T.-1-341-342	Line among stones

T.-1-276-279	Trawl track?	T.-1-343	Large stone
T.-1-280	Line	T.-1-344-346	Structure in bottom around stone could be due to the current
T.-1-281-283	Curved line on sand – interesting	T.-1-347	-
T.-1-284-286	Could be the same as 281-283	T.-1-348-351	Line across gravel/stones
T.-1-287-288	Line on sand between stones		
T.-1-289-290	Sand ribs		

January 19th	**Description**
T.-1-348-350	Curved line among small stones
T.-1-351-352	Line along stony area
T.-1-353-355	Unusual structure, could be wave disturbance of the sonar
T.-1-356-357	Thin line
T.-1-358-362	Curved line in stony area
T.-1-363-364	Short thick line
T.-1-365-367	Line – active gillnet
T.-1-368-371	Line across stony area
T.-1-372-375	Long curved line around stone on sand – could be interesting
T.-1-376-377	Line across stony area
T.-1-378-383	Long curved line around stone on sand – could be interesting
T.-1-384-386	Line across stony area
T.-1-387-390	Line across stony area
T.-1-391-393	Line along the edge of a stony area
T.-1-394-399	Line across stony area
T.-1-400-405	Line across stony area. Could be net/rope
T.-1-406-407	Line across stony area
T.-1-408-410	Line across stony area

January 19th	Description
T.-1-411-414	Thin curved line on sand towards stone reef area. Could be net/rope

A.18. Sidescan sonar file list, North Sea/Skagerrak

January 15th	**January 16th**	**January 17th**	**January 18th**	**January 19th**
Test	tv1JAN16.001	2021-01-17_tr1	210118tr3.001	210119tr1
tr1.001	tv1JAN16.002	2021-01-17_tr2	210118tr3	210119tr2
tr1	tv1JAN16.003	2021-01-17_tr3.001	210118tr4.001	210119tr3.001
tr2.001	tv1JAN16.004	2021-01-17_tr3	210118tr4	210119tr3
tr2.002	tv1JAN16.005	2021-01-17_tr4	210118tv1.001	210119tr4
tr2	tv1JAN16.006	2021-01-17_tv1.001	210118tv1.002	210119tr5.001
tr3.001	tv1JAN16.007	2021-01-17_tv1	210118tv1	210119tr5
tr3.002	tv1JAN16.008	2021-01-17_tv2.001	*210118tv3*	210119tr6
tr3	tv1JAN16	2021-01-17_tv2	*210118tv4.001*	210119tv1.001
tv1	tv3JAN16.001		210118tv4	210119tv1
tv2	tv3JAN16.002		210118tv5	210119tv2.001
tv3	tv3JAN16.003		210118tv6.001	210119tv2
tv4	tv3JAN16		210118tv6	210119tv3
tv5.001			tr1.001	210119tv4.001
tv5			tr1	210119tv4
tv6			tr2.001	
tv1.002			tr2	
tv1.003				
tv1.004				
tv1.005				
tv5				
tv6				

A.19. Recovered materials

Oparbejdelse af bjerget materiale

Dato: _17_/_01_,2021 Position:__57.38.667N 009.48.564E_- 57.38.628N 009.48.604E______.

Materiale oparbejdet: På havet X, I land □.

Vægt opfisket materiale: ___50___kg. Vægt af net-materiale: _____3,3_____kg

Vægt af biologisk materiale: ______________ca 40 kg. Opgjort på separat skema: Ja □, Nej X

Vægt af metal: __Anker ca 5_________kg Andet: fiskebøje________ vægt af andet:_____ca 1,5__

Video af opfisket materiale: Ja X, Nej □ Navn på filer_GH017358 og GH017359_____________

Flere typer net: Nej X, Ja □ Hvis ja, hvor mange?_____________-_________________

Stykke(r) af net gemt i pose: Ja X, Nej □ Mærket med:_____________Hirtshals 1_______________

Type	Længde (m)	Vægt (kg)	Kommentarer
Krabbe garn m tæller, 7 masker på 22 cm	240 m	3,3	
Blå flagline	60 m		
70 stk. krabber		Ca 40	
1 stk. anker		Ca 5	
1 bambus bøje		Ca 1,5	
1 stk. gummihandske		0,09	
Løs plastik		0,01	
Metal		0,25	


1


2


3


4


5


6


7


8


9

1. The catch of the ghostnet on the drag, the blue flaggline can be seen. 2. The ghostnet including many of the crabs which could not be removed during the recoverey. 3. The net spread out on the dock in Hirtshals. 4. A closeup of part of the net. 5. A closeup of the rope (tælle) on the gillnet. 6. The plastic and metal catch in the net. 7. The bamboo fishing buoy 8. The Anchor attached to the net. 9. A bundle from the ghostnet

Oparbejdelse af bjerget materiale

Dato: _08_/_04_, 2021 Position:________ 55.6966N 12.6480E ___________________.

Materiale oparbejdet: På havet X, I land X.

Vægt opfisket materiale: ___40___kg. Vægt af net-materiale: __________kg

Vægt af biologisk materiale: _______________ca 30_kg. Opgjort på separat skema: Ja □, Nej X

Vægt af metal: _________kg Andet: Opdriftskugler og beton ankre__ vægt af andet:__ca 1,5__

Video af opfisket materiale: Ja X, Nej □ Navn på video filer_ GOPR1760, GP011760 ________

Flere typer net: Nej X, Ja □ Hvis ja, hvor mange?______________-_________________

Stykke(r) af net gemt i pose: Ja X, Nej □ Mærket med:____________Øreund_______________

Type	Længde (m)	Vægt (kg)	Kommentarer
Ca. 3 torsk/fladfisk garn m tæller, 70mm masker	Ca. 70 m	Ca. 4	sandsynligvis fritidsfisker redskab
Blåmuslinger		Ca 15	
2 stk. hjemmelavede ankere, beton i plastik rør		Ca 5	
3. stk. opdrifts kugler		Ca 1	
Laminaria (brunalge)		15	
Enkelte strandkrabber			
3 stk. pirke, og nogle forfang			
Blå flagline	5,25		

Oparbejdelse af bjerget materiale fra vrag.

Dato: 3/9, 2020 Vrag navn: Jurbarkas. Materiale fra dyk nr. 3

Materiale op arbejdet: På havet ◻, I land X. Vægt opfisket materiale: ca 15 kg. Vægt af net-materiale: 3,6 kg

Vægt af biologisk materiale: ca 10L=ca 5 kg kg. Opgjort på separat skema: Ja ◻, Nej X

Vægt af metal: 3,25 kg Andet: Lystfiskerudstyr vægt af andet:

Billeder af opfisket materiale: Ja X, Nej ◻ Navn på filer: samlet billede af materiale P1070422

Flere typer net: Nej ◻, Ja X Hvis ja, hvor mange? 3 forskellige

Stykke(r) af net gemt i pose: Ja X, Nej ◻ Mærket med Jurbarkas

Art	Længde (cm)	Vægt (kg)	Kommentarer
28 stk. lystfiskerudstyre, f.eks. blæksprutter og pirke		2,0	Foto P1070424
Sort net uden tæller	Filtret	0,5	Foto 1, prøver hjemtaget
Grønt/Brunt net uden tæller	Fitret	0,1	Ikke foto, prøver hjemtaget
Blyundertælle	1,7		
Blyundertælle (3 blyliner)	1,6		Foto P1070438
Blyundertælle	2m	3,5	Foto P1070433
Garn inkl. over og undertælle, ca 30 masker højt.	14m		Foto P1070432, prøve hjemtaget
Diverse jern		3,25	Foto P1070430
Ledning	3m	0,5	Foto P1070430
Diverse plastik		1	Foto P1070428, 2
Blåmuslinger		Ca 5 kg	Foto P1070436
1 stk søstjerne			
1 stk. levende krabbe			
2 stk halve krabber			


Foto: P1070422


Foto: P1070424


Foto: 1


Foto: P1070438


Foto: P1070433

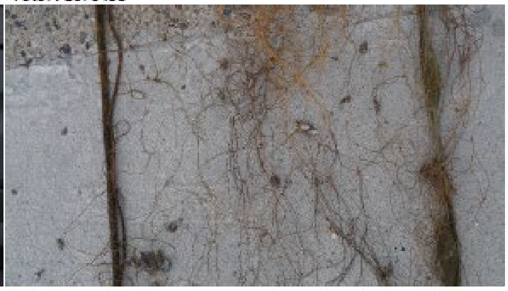


Foto: P1070433


Foto: P1070430


Foto: P1070428


Foto: 2


Foto: P107043

Oparbejdelse af bjerget materiale fra vrag.

Dato: 5/9, 2020 Vrag navn: M/S Johnny. Materiale fra dyk nr. 2

Materiale op arbejdet: På havet □, I land X. Vægt opfisket materiale: ca 18 kg. Vægt af net-materiale: ca 16 kg

Vægt af biologisk materiale: 0 kg. Opgjort på separat skema: Ja □, Nej X

Vægt af metal: 0,3 kg Andet: Tov vægt af andet: 0,7 kg

Billeder af opfisket materiale: Ja X, Nej □ Navn på filer P1070443, IMG 1544
Flere typer net: Nej □, Ja X Hvis ja, hvor mange? 2

Stykke(r) af net gemt i pose: Ja X, Nej □ Mærket med JOHNNY

Art	Længde (cm)	Vægt (kg)	Kommentarer
Trawl	670x170	12,25	Foto: 1, P1070451, P1070454, P1070457, prøve hjemtaget
Tovværk 15 mm	650	}	
Tovværk 15 mm	240	1,5	
Tovværk 15 mm	80	}	
Tovværk 10 mm	420	}	Del af trawl
Tovværk 10 mm	690	0,2	Del af trawl
5 stk. pirke/blæksprutter		0, 9	Foto: P1070457, prøve
Trawl	240x140	2,4	Foto: P1070448, P1070458, prøve
Kobber rør	0,5	0,3	


Foto: P1070443


Foto: P1070449


Foto: 1


Foto: P1070451


Foto: P1070454


Foto: P1070457


Foto: P1070448


Foto: P1070458

Oparbejdelse af bjerget materiale fra vrag.

Dato: 6/9, 2020 Vrag navn: Vibeke Høj. Materiale fra dyk nr. 3

Materiale op arbejdet: På havet □, I land X. Vægt opfisket materiale: 35-50 kg. Vægt af net-materiale: 30-40 kg

Vægt af biologisk materiale: 0 kg. Opgjort på separat skema: Ja □, Nej X

Vægt af metal: ca 10_inkl kæder på trawl_kg Andet:_____ vægt af andet:_____

Billeder af opfisket materiale: Ja X, Nej □ Navn på filer P1070460, P1070461

Flere typer net: Nej X, Ja □ Hvis ja, hvor mange?_____

Stykke(r) af net gemt i pose: Ja X, Nej □ Mærket med Vibeke Høj

Art	Længde (cm)	Vægt (kg)	Kommentarer
TRAWL, incl typhoon wire, kæder og vægtkloder på undertællen. 260 masker, 55	19m undertælle	30-40kg	Munding af trawl med metal-lod og kæder. Foto 1, P1070462, P1070463, P1070473, P1070474
Kobberrør	Ca 1,2	Ca 0,5	Foto: P1070472
Jernrør	Ca 1,5	Ca 5,0	
10 stk. Pirkegummidyr: 3 pirke, 3 blæksprutter, 2 gummifisk og 2 lange gummidyr + lidt line		0, 8	IMG_1620
1 ryghvirvel			P1070466


Foto: P1070460


Foto: P1070461


Foto: 1


Foto: P1070473


Foto: P1070463


Foto: P1070462


Foto: P1070474


Foto: P1070472


Foto: IMG_1620


Foto: P1070466

A.20. Detailed description of removal of nets by divers

When a ghost net is observed, it could be by a diver, an ROV or something similar and it is decided that a diver should retrieve the net, three steps are required. The first step is to document/describe the ghost net and how it is situated, so that a strategy for the cutting and release can be made and the appropriate equipment prepared. The second is to cut and release the net from the bottom or structure where it is stuck, and the third is to raise it to the surface and get it onboard the vessel. The three steps are described below.

1. Mapping of the net for retrieval.

The dive team consisted of three persons: a diver (diver #1), a dive leader and a rescue diver (diver #2). The diver, who was equipped with an intercom system and a live video link to the surface, searched the dive sites, in this case wrecks, and described and recorded any findings of fishing nets or other lost fishing gear so that the dive leader at the boat was familiar with the location, type, size etc. of the net found. In collaboration between diver #1, diver #2 and the dive leader, a recovery plan for the ghost net was made, based on these observations. The plan includes an equipment list, which is most cases is:

- a number og lift bags with different volume, capacity 30 - 100kg
- a hydraulic cable/wire/rope cutter
- an extra knife
- lines and rope to tie the ghost net together
- depending on the dive setup extra equipment could be scissors and extra air for the lift bags.

2. Releasing the net from the bottom/structure.

Diver #2 dives down to the site and depending on the net material and the placement of the net, the diver will most likely start to follow and free the net by hand or by cutting it free from the bottom structure or wreck. In case of gillnets, fykes or rope, the cutting can in most cases be done with a dive knife. In case of the presence of wires from e.g. a trawl, the hydraulic wire cutter is an essential tool. As the net is loosened, the material would in case it is gillnet be assembled into a pile or sausage-like structure that can be tied together with a rope to reduce the risk of entanglement. In case it is a trawl, lifting bags will often be attached to the net during the freeing process, as it can be a heavy structure to lift for the diver without some help from buoyancy.

3. Raise to the surface

When the net material is tied up, either in a pile or in a sausage with multiple lifting bags attached and hanging in mid-water, the aim is to have a controlled raising of the freed net material to the surface. Extra lifting bags might be attached to the net material or extra air could be inflated into the already attached lifting bags, prior to cutting the final line. When the final line is cut, the lifting bags will raise the collected net material to the surface, where a vessel can grab the lines with a boat hook and lift it onboard with a crane

A.21. Flyers from the industry; ‘Best practice’, ‘Gode råd’ & ‘Vejledning’

Affald fra fiskeriet er nemt at kende, når det skyller op på de danske strande. Og mistede reb og net er ikke just med til at styrke fiskeriets omdømme.

Med små ændringer i fokus og vaner kan vi faktisk relativt nemt bidrage til at nedbringe mængden af affald, der ender på de danske strande. Vi beder jer derfor læse denne folder, så vi i dansk fiskeri sikrer fokus på området og sammen kan bidrage til at minimere tab.

Best Practice til håndtering af netafskær – KIMO

Netafskær skyller op i store mængder langs kysterne i Danmark. Hvert år opsamles dette affald af kommuner og frivillige. Netafskær og rebstykker er desværre blandt de hyppigste former for affald, der bliver fundet på strandene. Det er nemt at forbinde til fiskeriaktiviteter, hvilket påvirker fiskeriets image.

Heldigvis kan dette problem løses relativt simpelt, ved at sikre gode arbejdsvaner og god affaldshåndtering ombord på fartøjer og i havnen. Men det kræver en fælles indsats.

Hvis dette skal lykkedes, kræver det, at skipper skal gå forrest og lave en plan for, hvordan affaldet håndteres ombord, så der skabes en fast rutine og gode vaner for håndtering af netafskær. Fokus skal rettes på aktiviteter og områder, hvor netafskær typisk foregår og derefter til, hvordan de kan opsamles mest effektivt. Bortskaffelse skal altid ske via havnens modtagelsessystem.

KIMO (leder af fishing for litter) har udarbejdet følgende best practice for håndtering af netafskær.

Materialet er udarbejdet med støtte fra

FISKEAFGIFTSFONDEN

ARBEJDE MED NET OG REB

OMBORD

Hvor fartøjets størrelse tillader det, kan reparationer foretages fra fartøjets skrog. Herfra er det næsten umuligt, at netafskær mistes til havs

Brug en affaldshåndteringsplan tilpasset skibets behov. Både skipper og medarbejdere bør bidrage med input til denne plan, så man sikrer, at alle arbejdsgange tages med i overvejelserne

Stil et tilstrækkeligt antal af affaldsbeholdere til rådighed, som er fæstnet til skibet. Beholderne skal være praktisk placeret i forhold til arbejdet og tilgængelige for medarbejderne

Besætningen instrueres om vigtigheden af opsamling af affald og korrekt brug af affaldsbeholdere

ARBEJDE MED NET OG REB

PÅ KAJEN

Brug områderne, som havnen stiller til rådighed, til reparation af net. De kan enten være indendørs i en hal eller udendørs på fast belægning uden afløb. Disse områder kan også være fejet mere hyppigt af havnemedarbejderne

Foretag reparationsarbejdet så langt fra vandkanten som muligt

Brug de redskaber og affaldsspande, som havnen stiller frem, og fej netafskær op efter reparationsarbejdet

Vær særlig opmærksom på, at netafskær kan hænge fast i nettet. Det er en god idé at ryste dem fri fra nettet, således at de kan opsamles, inden den rulles på plads

BEMÆRK!

Netafskær og reb kan ende i havet fra fartøjer til søs eller fra kajkanten, hvis de får lov til at ligge.

Det er i disse to situationer, hvor netafskær skal fjernes, inden det bliver til marint affald.

Under ingen omstændigheder bør netafskær skylles eller fejes overbord eller fra kajen ud i vandet.

Den bedste måde at håndtere netafskær på er at ændre arbejdsgangen således, at der er bedre muligheder for opsamling af affald ved arbejdsområdet eller skabe fysiske forhindringer som begrænser tab.

Nogle fiskere bruger kreative løsninger for at indsamle netafskær i forbindelse med deres reparationsarbejde og på den måde skåne havmiljøet mest effektivt.

Der er forsøg med at bruge en affaldslomme, hvor netafskær kan samles i takt med reparationsarbejdet. Det kan anvendes ombord eller i havnen. Andre lægger f.eks. en presenning o.l. på jorden på kajen, inden arbejdet begynder. Netafskær falder på presenningen, således at stykkerne er nemmere at indsamle ved fyraften.

Havet sletter ikke alle spor. Og det betyder desværre, at det affald, der ikke bliver samlet op, påvirker livet i havet og på sigt skyller op på stranden. I fiskeriet har vi også et ansvar for at bidrage til at løse denne udfordring.

I 2018 afholdt Miljø- og Fødevareministeriet kampagnen "Sammen om et hav uden affald". Her blev en række interviews med fiskere til 5 gode råd, der konkret kan medvirke til bedre affaldshåndtering ombord på fiskefartøjerne.

Disse er simple, ligetil og listet i denne folder.

Materialet er udarbejdet med støtte fra
FISKEAFGIFTSFONDEN

DANMARKS FISKERIFORENING Producent Organisation

Ministeriet for Fødevarer, Landbrug og Fiskeri

FØRST!
SKAB GODE AFFALDSVANER OMBORD
Nøglen til forandring findes i vanens magt. Det gælder også, når der skal indsamles affald. Kig derfor på arbejdsgangen med friske øjne. Lav en gennemgang af, hvordan I gør tingene i dag. Er alle ombord med på, hvordan tingene skal gøres – og er der noget, som kan gøres bedre?

5 GODE RÅD

1 TAG ALT JERES AFFALD MED IND
Den vigtigste og mest simple tommelfingerregel er, at ALT affald fra fartøjet skal med i land. Det gælder både brugte handsker, netafskær, og andet emballage fra fiskeriets drift. Det er affald, der meget tydeligt stammer fra fiskeriet. Hvis noget af dette affald ryger i havet fra jeres fartøj, så er det i alles interesse, at dette bliver samlet op, så der ikke bliver peget fingre ad fiskeriet.

2 FORTÆL OM TABT UDSTYR ELLER AFFALD I HAVET
Hvis I mister udstyr, som garn og trawl, så få det bjærget. Hvis I ikke kan få det tabte udstyr op, så husk at I skal melde det til FiskeriMoniteringsCenteret (FMC) på tlf. 72 18 56 09.

3 TAG ANDRES AFFALD MED IND
Husk, at når du støder på affald, enten fra land eller andre skibe, så forsvinder det ikke, medmindre det bliver taget med ind. I fiskeriet ved vi godt, hvor stort et problem marint affald er, men hvis resten af befolkningen også skal have indblik i, hvor meget affald danske fiskere tager med ind, så er det vigtigt at alt affald tages med i land.

4 SØRG FOR AT HAVE AFFALDSBEHOLDERE OMBORD
Sørg for, at I har beholdere til affald stående på de rigtige steder, så det er let at komme af med affaldet, når arbejdet udføres.

5 FÅ ANDRE MED
Sammen står vi stærkest! Det gælder også, når der skal indsamles affald. Hvis affald i fiskeriet skal minimeres, er det nødvendigt at inspirere til gode vaner. Del gerne oplevelser og gode erfaringer med dine fiskerikollegaer, så alle føler et medansvar for at holde havet og vores arbejdsplads rent.

De seneste år har mistede redskaber og såkaldte spøgelsesnet fået større og større fokus i EU.

Deres forekomst er dokumenteret i forskellig grad i danske farvande, og derfor er Danmarks Fiskeriforening PO, Dansk Amatørfiskerforening og Dansk Fritidsfiskerforbund gået sammen om at udarbejde gode råd og en simpel vejledning til sætning af særligt garn og tejner, så vi sammen kan arbejde for at minimere tab af fiskeredskaber.

Nogle punkter i denne folder er gældende lovgivning, mens andet er gode råd og oplysninger. Er noget uklart, kan man altid kontakte den ansvarlige styrelse.

VEJR

Det er vigtigt, at redskaber bjærges, hvis vejrmeldingen er meget dårlig. Der er en meget stor sandsynlighed for, at ens redskaber mistes, enten fordi de flytter sig eller ruller rundt og ødelægges i meget dårligt vejr. Redskaberne vil også være meget udsatte for at fyldes med drivende ålegræs eller tang i dårligt vejr.

GPS-KOORDINATERNE

Det er meget vigtigt, at man kan finde sine redskaber igen, og her er en GPS uundværlig. Husk at få afsat GPS-positioner på alle dine redskaber, så de kan findes igen. Det er også vigtigt at undgå at sætte sine redskaber i sejlruter, da der i disse områder vil være en meget stor risiko for, at ens bøjer bliver påsejlet af andre fartøjer.

Materialet er udarbejdet med støtte fra
FISKEAFGIFTSFONDEN

DANMARKS FISKERIFORENING Producent Organisation
Dansk Fritidsfiskerforbund

AFMÆRKNING AF REDSKABER

Garn, kasteruser, tejner i en lænke og krogliner skal, i den vestlige ende, afmærkes med en flagbøje med to flag og to reflekser. I den østlige ende skal redskaberne afmærkes med en flagbøje med et flag og en refleks. (Flagene må ikke være hvide) (For fritidsfiskere skal reflekserne være gule).

Enkeltstående tejner afmærkes med en flagbøje med et flag (ikke hvidt) og en refleks eller en fiskekugle med en diameter på mindst 15 cm.

AFMÆRKNING AF FLYDEGARN FOR SILD, MAKREL OG ØRRED

Det er ofte disse redskaber, der sejles ned og mistes pga. dårlig afmærkning. I områder med meget trafik bør disse typer af redskaber forsynes med blinklys. Garnet bør monteres med tydelige kugler på overtællen og en stor kugle eller garnbøje i forhånd for flagbøjen. Ankeret bør være på mindst 10 kg og være forsynet med min. 1 meter kæde.

Garnet kan sættes som svajgarn, kun ankret i den ene ende eller som stående mellem 2 ankre og flagbøjer som tidligere anført.

BØJELINEN

Bøjelinen skal som udgangspunkt være ca. 2 gange vanddybden for ikke at trække flagbøjen under i kraftig strøm. Det er meget vigtigt, at det sikres, at bøjelinen ikke flyder i overfladen, hvis der anvendes tov, der flyder. Dette vil øge risikoen for, at andre fartøjer i området sejler flagbøjerne af. Flydende tov til flagbøjen kan holdes under vandoverfladen ved at indflette synkeline ca. 1/3 nede af bøjelinen i forhold til lines længde (se figur nedenfor). En bøjeline har typisk en diameter på 6-8 mm.

Desuden skal du, når du sætter dit redskab, være opmærksom på, at linen ikke er viklet sammen eller er slidt, så risikoen for tab forøges.

ANKERET

Hvis der fiskes i områder med mange sten, vil redskaberne typisk stå relativt fast, men hvis der fiskes på en glat havbund, vil strøm og bølger kunne få redskaberne til at flytte sig. Det er derfor vigtigt, at man sikrer sig, at redskaberne står fast på den glatte havbund ved at anvende et anker i hver ende eller vægtklodser af beton eller jern. Vægten af ankret eller klodserne afhænger i høj grad af området, som der fiskes i, men typisk vil 2-3 kilo være tilstrækkeligt til et fritidsfiskergarn.

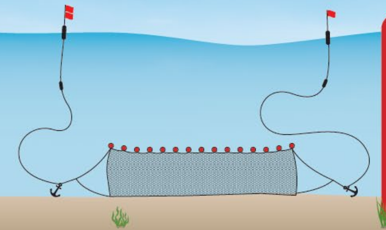
AFSTANDSREGLER

Vær opmærksom på, at der gælder visse afstandsregler for, hvor tæt man må sætte sine redskaber i forhold til andre redskaber, der allerede er sat. Der vil være en højere risiko for at få ødelagt eller miste sine redskaber, hvis redskaberne sættes for tæt. For garn, ruser og krogliner skal der være en afstand på 150 meter til pæleruser og erhvervsfisker-bundgarn. Indbyrdes skal de have en afstand på 50 meter. Garn skal holde en afstand på 100 meter til lavvandslinje og sejlrende.

Overtrædelse af reglerne om afstand mellem faststående fiskeredskaber er undergivet privat påtale.

BJÆRGNING AF REDSKABER

Hvis man skulle være så uheldigt at få begge sine flagbøjer sejlet ned, er det stadig muligt at bjærge sit redskab vha. et søgeanker, også kaldet et dræg. Det er vigtigt, at man holder bundkontakt samtidig med, at man sejler stille fremad. På sin GPS vil man kunne se, hvor redskabet står, og så vil en fremgangsmåde være at sejle vinkelret på redskabet og derved prøve at fange det igen, så det kan bjærges.



MELDEPLIGT VED MISTET REDSKAB

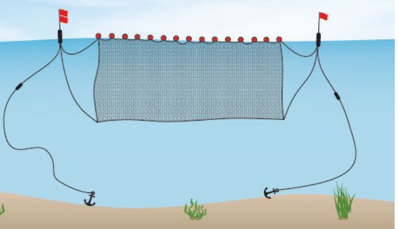
Hvis du som erhvervsfisker er så uheldig at miste dit redskab til havs, er det vigtigt, at du forsøger at bjærge dette, hvis vejret tillader det. Hvis det ikke lykkedes at bjærge redskabet, så skal dette meldes til FiskeriMoniteringsCenteret (FMC) på

72 18 56 09

Det forventes, at meldepligten vil blive udvidet til også at omfatte fritidsfiskere fra 1. juli 2021. Det betyder, at det også bliver lovpligtigt for fritidsfiskere at lave den nødvendige indberetning, hvis man taber et redskab. Dette lovforslag er dog endnu ikke vedtaget.

ANDEN LOVGIVNING

Der kan være lokale reguleringer om krav til pingere og sættetider. Er du i tvivl om reglerne herfor, kan du kontakte Fiskeristyrelsen.



A.22. Limfjorden clean-up – preliminary results

The ghost net problem in the Limfjord has been a reoccurring subject since Levende Hav and Limfjordsrådet have raised their concern about the extent of the ghost net problem here. This focus has resulted in a clean-up project in Limfjorden funded by the Danish Ministry for Food, Agriculture and Fisheries in June 2021. The project is a pilot project with the main aim of retrieving ghost nets in identified ghost net areas in Limfjorden and to estimate the type and age of the ghost gear and the ghost fishing in the area. The fishermen's organizations DFPO, FSKPO, DAFF & DFF and other stakeholders like Limfjordsrådet & Levende Hav have contributed with their knowledge about ghost net areas, identifying a large number of areas in the Western part of Limfjorden. The area with most ghost nets is believed to be Nissum bredning just east of Lemvig and in the northern part. All identified areas are lobster or brown crab fishing areas.

The first clean-up campaign ran from the middle of July to the end of August where the lobster fishery start. The first two fishermen started in week 28 in the area around Mors and Fur and in week 29 two more started in Kås bredning. In total 4 fishermen (SK20 Leo Andersen, T310 Flemming Johannesen, T99 Peter Pedersen & T329 Freddy Sandbæk) participated. In week 32 three of the fishermen and Foreningen Muslingeerhvervet (FME) vessel "Limfjorden" made a joint effort in Nissum bredning, retrieving a full container of nets in two days. Most retrieved nets were brought to The Danish Shellfish center at Nykøbing Mors were they were stored until the end of the campaign.

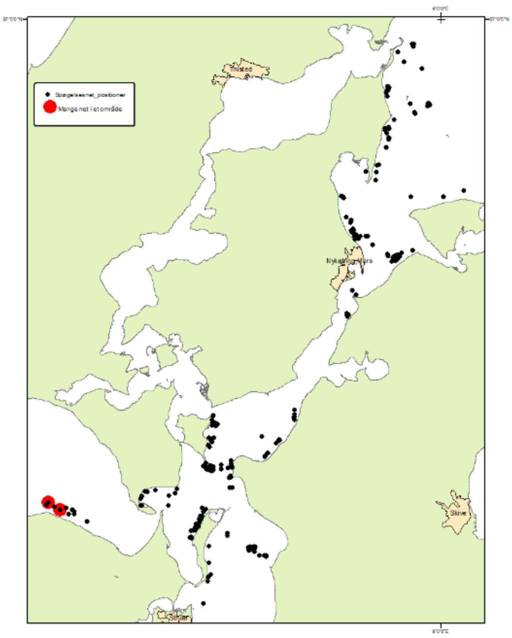


Figure 1. Map of Limfjorden showing all the positions from where ghost nets have been retrieved during a clean-up campaign in July-August 2021

In total more than 250 gillnets, china fykes, seine ropes and pots have been removed from the fjord in 26 survey days. A map showing the positions where ghost nets has been retrieved can be seen in figure 1. Two containers with ghost nets has been retrieved. Most net were old, some with no mesh left only top and bottom rope and some still had meshes but was overgrown by tunicates, algae and mussels. In these old nets bycatch of lobsters or brown crab was rarely observed. However a few newer nets were also retrieved one of these had 68 lobsters in the net and another net estimated to be around 1500 m long had 3-400 brown crabs.

Almost 17 ton of retrieved material was brought to Reno Nord in Aalborg for incineration, but prior to this the recycling potential of the material was evaluated by Plastix from Lemvig. Due to a combination of much biological material on the nets, the average age of the nets and the general mix of materials in the gear, like lead and polypropylen (PP) in the sinking ropes and multiple plastic types in the floating ropes, a lot of working hours would be required to separate the materials, it was therefore assessed that the effort did not measure up to the potential recycling result. In addition 26 bigbags were handled by the municipality of Morsø.

The result of the joint effort in Nissum bredning (Photo Flemming Johannesen & Knud-Erik Jacobsen)

Left and middle. Ghost fishing of lobster and brown crab by pots and gillnets respectively. (Photo Leo Andersen & Peter Pedersen). Right. Retrieval of a ghost net.

A.23. Andre datakilder; IBTS/BITS data, fiskernes rapporteringer om tab eller skader & diverse kortlægninger

IBTS/BITS marint affald

Siden 2011 har en række lande i forbindelse med IBTS, KASU og BITS togterne indsamlet affald der er bragt op i trawlet. Dette data bliver, lige som det biologiske data, sendt til ICES, hvor det efterfølgende bliver gjort offentligt tilgængeligt i DATRAS databasen.[1]

Spøgelsesnet bliver her registreres som *'Fishing net'* eller *''Plastic fishing net'* på den relevante tur og det relevante træk. Andre affaldstyper bliver registeret på samme måde, og vi har i denne rapport også valgt at medtage fiskeliner, der af ICES bliver kategoriseret som 'Plastic fishing line (entangled)' og 'Plastic fishing line (monofilament).

Området det enkelte træk dækker over bliver beregnet ud fra længden af trækket gange med afstanden mellem skovlene, som blandt andet afhænger af redskabstypen og dybden.

Det er derfor muligt at sammenligne træk med og uden spøgelsesnet i denne periode for at få et estimat af hvor mange spøgelsesnet der potentielt kunne fanges hvis hele dansk farvand blev trawlet igennem på denne måde.

Hvor stor en andel af spøgelsesnettene der rent faktisk bliver fisket op i forhold til hvor mange der ligger i det område der bliver trawlet er ikke undersøgt. Det vil blandt andet afhænge af størrelsen og udformningen af garnet, hvor dybt det ligger begravet, samt det områdets beskaffenhed. Antal net og liner opfisket pr. år kan ses i Tabel 1.

Det er ikke altid at vægten på et garn er opgivet pga. skiftende protokoller for indsamling af data, hvorfor der i denne forbindelse kun er brugt antal. Et spøgelsesgarn kan således både være en ganske lille stump på ganske få gram og et helt trawl.

Tabel 1. Antal net stykker og line stykker registeret under IBTS og BITS togter i perioden 2011-foråret 2021.

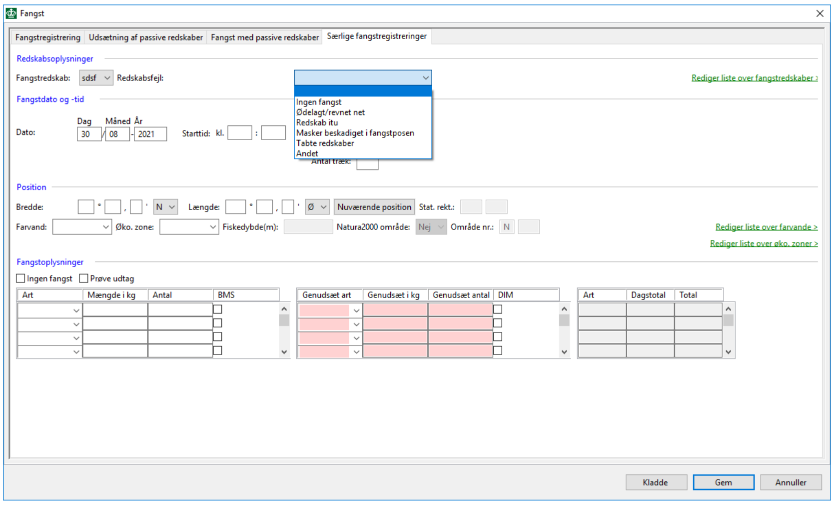
Net: 53 stk:		Liner: 688n stk:	
Year	LT_Items	Year	LT_Items
1: 2011	1	1: 2011	1
2: 2012	1	2: 2012	25
3: 2013	1	3: 2013	26
4: 2014	8	4: 2014	42
5: 2015	5	5: 2015	31
6: 2016	2	6: 2016	87
7: 2017	7	7: 2017	67
8: 2018	6	8: 2018	129
9: 2019	12	9: 2019	131
10: 2020	9	10: 2020	104
11: 2021	1	11: 2021	45

Eksempler på net stykker fanget under BITS/IBTS togter. Tv. En trawl. Th. et garn

[1] https://datras.ices.dk/Data_products/Download/Download_Data_public.aspx

Rapporteringer af mistede redskaber

I logbogen er det muligt at registrere hvis et redskab er blevet beskadiget eller tabt, se figur 1. Data med logbogsnumre pr hændelsestype er stillet til rådighed af Fiskerikontrolkontoret i Fiskeristyrelsen. Disse er koblet til de relevante logbøger som herefter kobles til positionsdata.



Figur 1. Logbogen hvor erhvervsfiskere kan rapportere tab af redskaber.

I perioden 2015-2019 er der indberettet i alt 2131 hændelser der kan kobles sammen med spøgelsesnet, fordelt på 'Masker beskadiget i fangstpose', 'Redskab itu', 'Tabte redskaber' samt 'Ødelangt/revnet net'. Af disse kan identificeres 1427 hvor der er positionsdata tilgængelig (VMS, AIS eller Blackbox), og af disse er 745 i dansk farvand (Tabel 2-4).

En hændelse er relateret til en logbog, som refererer til en fangsttur. Der er ofte mere end et træk på en fangsttur, men vi har valgt at gå ud fra at hændelsen finder sted på det sidste træk i en fangsttur, på baggrund af dette er der lavet oversigtskort over de indrapporterede hændelser figur 2 viser hvor forskellige fartøjskategorier har rapporteret om tab eller skader of figur 3 viser hvor de forskellige tab eller skader formentligt er sket.

Tabel 2. Logbogs indberetninger omkring skader på redskaber i perioden 2015-2019.

Beskrivelse	totale indberetninger	Positioner totalt	Positioner i Danmark
Masker beskadiget i fangstpose	327	248	131
Redskab itu	745	520	272
Tabte redskaber	131	82	40
Ødelagt/revnet net	928	577	302
I alt	**2131**	**1427**	**745**

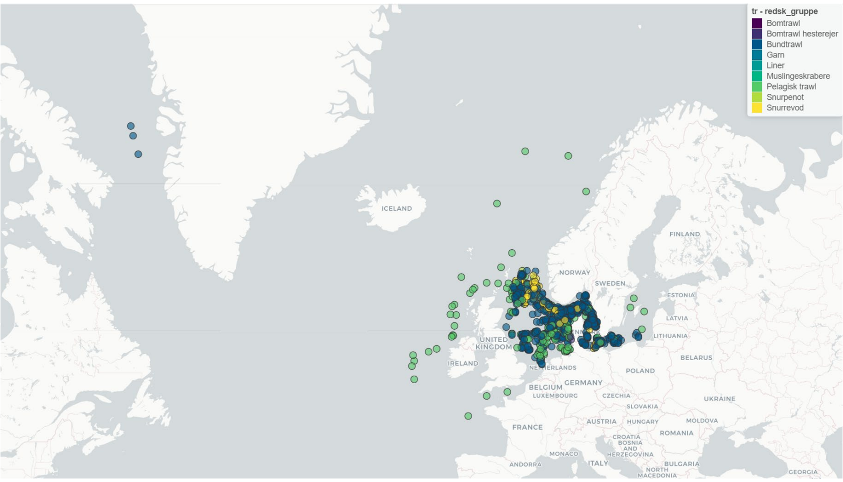
Positioner i dansk farvand, pr år.

Tabel 3. Logbogs indberetninger omkring skader på redskaber opdelt pr år for perioden 2015-2019.

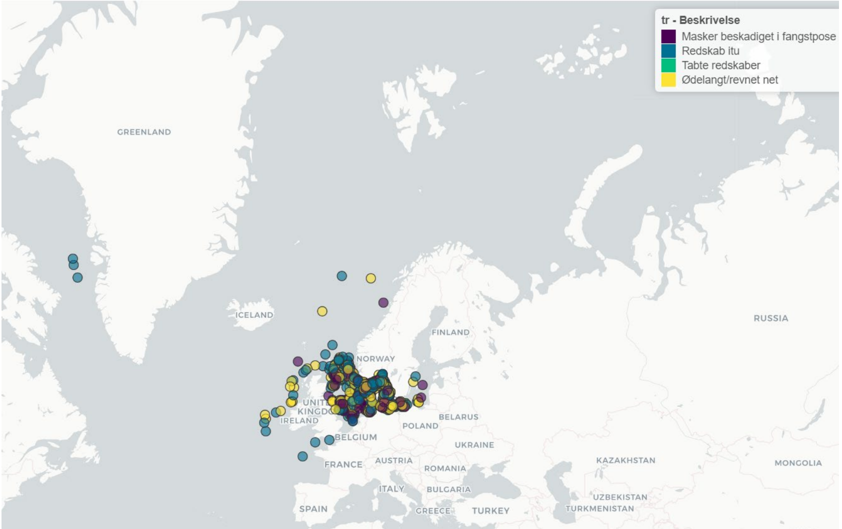
Beskrivelse	2015	2016	2017	2018	2019
Masker beskadiget i fangstpose	26	26	25	27	27
Redskab itu	70	58	52	44	48
Tabte redskaber	11	13	6	8	2
Ødelagt/revnet net	64	63	64	52	59

Tabel 4. Logbogs indberetninger af skader og tab fordelt på redskabsgruppe og år i perioden 2015-2019.

Beskrivelse	Redskabsgruppe	2015	2016	2017	2018	2019
Masker beskadiget i fangstpose	Bomtrawl	0	1	0	0	1
Masker beskadiget i fangstpose	Bundtrawl	21	20	22	19	23
Masker beskadiget i fangstpose	Pelagisk trawl	5	4	3	6	3
Masker beskadiget i fangstpose	Snurrevod	0	1	0	2	0
Redskab itu	Bomtrawl	1	0	0	0	0
Redskab itu	Bundtrawl	41	39	38	34	39
Redskab itu	Muslingeskrabere	1	0	0	0	0
Redskab itu	Pelagisk trawl	12	8	12	5	5
Redskab itu	Snurrevod	15	11	2	5	4
Tabte redskaber	Bundtrawl	8	7	3	7	2
Tabte redskaber	Pelagisk trawl	0	1	1	1	0
Tabte redskaber	Snurrevod	3	5	2	0	0
Ødelagt/revnet net	Bomtrawl	1	0	0	0	0
Ødelagt/revnet net	Bomtrawl hesterejer	0	2	1	1	1
Ødelagt/revnet net	Bundtrawl	41	49	54	40	55
Ødelagt/revnet net	Garn	1	0	0	0	0
Ødelagt/revnet net	Pelagisk trawl	15	2	7	6	3
Ødelagt/revnet net	Snurrevod	6	10	2	5	0



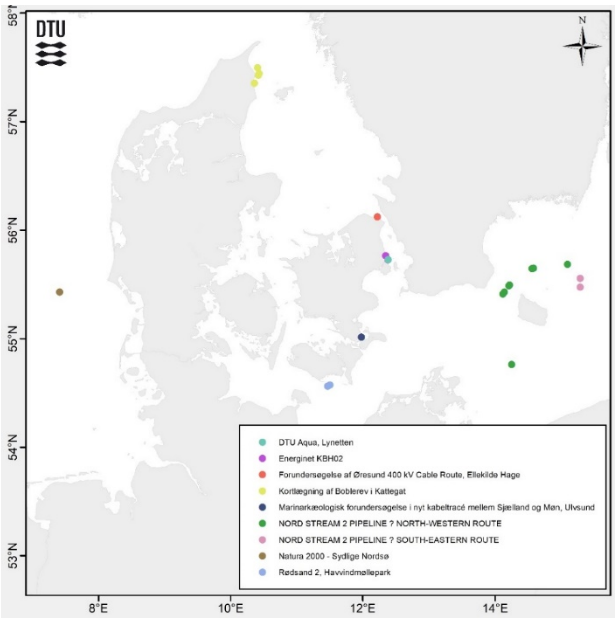
Figur 2. Kort der viser hvor forskellige fartøjskategorier har rapporteret om tab eller skader på redskaber i perioden 2015-2019.



Figur 3. Kort der viser hvor der er rapporteret om hhv. masker beskadiget i fangstpose, redskaber itu, tabte redskaber og ødelagt/revnet net i perioden 2015-2019.

Gennemgang af eksterne kilder for registreringer af Spøgelsesnet.

Et antal eksterne kilder som kortlægningsrapporter, arkæologiske undersøgelser, marine anlægs rapporter samt sidescan sonar optagelser er blevet screenet for observationer og notater om spøgelsesnet. Sidescan filerne fra Marta databasen blev hurtigt kasseret som kilde da distancen fra bunden i de fleste tilfælde var 10 m eller der over hvilket gør det meget usandsynligt at det er muligt at identificere spøgelsesnet da man til disse undersøgelser sigter mod en distance for bunden på 5 m. En liste over de gennemgåede rapporter og kilder kan ses nedenfor og et kort der angiver hvor der er registret fund af fiskeredskaber kan se på figur 4. Disse rapporteringer var ikke mulige at integrere i modellen til estimering af det samlede antal net i danske farvande da størrelsen på det afsøgte område i de fleste tilfælde ikke er kendt.



Figur 4. Kort med angivelse af, hvor der i tidligere kortlægninger eller andre marine undersøgelser er funder mistede fiskeredskaber.

Rapporter gennemgået:

Kortlægning af Natura 2000-områder. Marin habitatkortlægning i Skagerrak og Nordsøen 2017-2018

Marin habitatkortlægning i Skagerrak og Nordsøen 2015

Marin habitatkortlægning i de indre danske farvande 2014

Skov- og Naturstyrelsen, Kortlægning af Boblerev (1180) i Kattegat, 2007

Marin råstof- og naturtypekortlægning i Kattegat og vestlige Østersø 2011

Marin råstof- og naturtypekortlægning i Nordsøen 2010

Skov- og Naturstyrelsen Naturtypekortlægning i Nordsøen, Jyske Rev 2006

Marinarkæologisk forundersøgelse i nyt kabeltracé mellem Sjælland og Møn, Jørgen Dencker, MAJ j.nr. 2714

Marinarkæologisk forundersøgelse, Rødsand 2, Havvindmøllepark NMU j.nr. 2473, Jørgen Dencker 2007

SJÄLLANDSKABLARNA, Forundersøgelse af Øresund 400 kV Cable Route, Ellekilde Hage, VIR 2722, Andreas G. Binder & Morten Johansen 2019

NORD STREAM 2 PIPELINE – SOUTH-EASTERN ROUTE. Cultural heritage target assessment and exclusion zone recommendations. VIR 2740. Mikkel H. Thomsen. 2019

NORD STREAM 2 PIPELINE – NORTH-WESTERN ROUTE, Cultural heritage target assessment and exclusion zone recommendations, VIR 2740, Mikkel H. Thomsen 2019

NORD STREAM PIPELINE – ANKERKORRIDOR. Kontrolgennemgang af survey-data og kulturhistorisk vurdering. MAJ 2545 Mikkel H. Thomsen 2010

Marinarkæologisk forundersøgelse ved Københavns Nordhavn, MAJ j.nr. 2552. Morten Johansen 2009

FEMERN BÆLT FORBINDELSEN MARINARKÆOLOGISK RAPPORT Dykkerbesigtigelse af kystnære side scan sonar-, magnetometer- og luftfotoanomalier i dansk farvand MAJ j.nr. 2546. Mikkel H. Thomsen 2011

Energinet, Offshore Investigation for KBH02 2021.

Fotos af bjærgede net fra Energinet KBH02.

A.24. Recommendations and proposals from stakeholders

Proposals on prevention	Comments
Remotely readable ID-marking of fishing buoys allowing the fisheries inspection to scan areas with drones to ensure that no more than the allowed number of gears is used.	Could work but would carry extra costs to the fishermen.
An app that recreational fishermen should use to report the time, position and number of fishing gear set. This will make it impossible to fish with more gear than allowed and allow recovery if the gear is reported lost.	This is similar to the Norwegian system for commercial fishermen, which forms the basis for the annual retrieval surveys in Norwegian waters.
Collection and recycling of old fishing gear from fishing sheds and other storage.	No comments.
If recreational fishermen cannot retrieve their gear, they should arrange with a larger vessel to retrieve the gear.	This would reduce the needs for retrieval surveys.
Improved follow-up to reports about illegal fishing and unethical behaviour by fishermen.	No comments.
Complete prohibition of gillnet fishing in the lobster areas in the Limfjord during 1 July – 1 September. As it is now, some fishermen set their nets up to 2 weeks before 1 September and leave them unattended, which can lead to too heavy nets and dead lobsters.	Would limit the amount of gear that becomes too heavy to lift and avoid lobsters dying in such nets.
General proposals	**Comments**
Recreational fishermen catching ghost nets should be able to report it to the fisheries inspection and be allowed to land the ghost net without risk of fines.	No comment.
Website explaining what to do if a ghost net is caught or found on the beach.	Such a webpage is hosted by the Swedish Agency for Marine and Water Management. Spökgarn och andra förlorade redskap - Plast och konsekvenser av nedskräpning i haven - Havsmiljö - Miljöpåverkan - Havs- och vattenmyndigheten (havochvatten.se)
Support to local initiatives to create awareness of the consequences of ALDFG for the marine environment.	No comments.

A.25. Video list, Limfjorden

List of Videos Containing Targets

Name	**Date**	**Target/Position**	**Comments**
2021-07-14_11.33.00.mkv	2021-07-14 11:33:00	00:03:05 56°50.97931'N 08°50.64450'E	
2021-07-14_11.53.23.mkv	2021-07-14 11:53:23	00:02:38 56°50.89785'N 08°50.63461'E	
2021-07-15_11.17.47.mkv	2021-07-15 11:17:47	00:01:37 56°39.65950'N 08°46.34308'E	Foggy Lens
2021-07-15_11.26.50.mkv	2021-07-15 11:26:50	00:02:17 56°39.61601'N 08°46.31885'E	Lobster present in video.
2021-07-15_11.35.33.mkv	2021-07-15 11:35:33	00:02:38 56°39.61559'N 08°46.32745'E	

A.26. Target list, Limfjorden

Confirmed Targets

Name	SonarDateTime	ClickLat	ClickLon	CSFFile
Contact0001	2021-07-13T12:33:03.147	56.84966	8.844075	Day1_12_jsf-CH12.CSF
Contact0005	2021-07-13T12:31:26.417	56.8483	8.84391	Day1_12_jsf-CH12.CSF
Contact0006	2021-07-13T12:21:03.975	56.83988	8.845773	Day1_11.003_jsf-CH12.CSF
Contact0029	2021-07-15T07:23:28.044	56.66099	8.772385	Day3_10_jsf-CH12.CSF
Contact0031	2021-07-15T07:16:27.590	56.66027	8.771981	Day3_8_jsf-CH12.CSF
Contact0033	2021-07-15T07:16:21.653	56.66026	8.772124	Day3_8_jsf-CH12.CSF

Unconfirmed Targets

Name	SonarDateTime	ClickLat	ClickLon	CSFFile
Contact0000	2021-07-13T13:12:08.990	56.8284	8.8705	Day1_15.002_jsf-CH12.CSF
Contact0003	2021-07-13T12:32:25.385	56.84912	8.844027	Day1_12_jsf-CH12.CSF
Contact0007	2021-07-13T11:53:32.302	56.81565	8.867945	Day1_11.001_jsf-CH12.CSF
Contact0008	2021-07-13T11:57:20.766	56.81888	8.86453	Day1_11.001_jsf-CH12.CSF
Contact0009	2021-07-13T10:39:25.037	56.78121	8.914635	Day1_7.002_jsf-CH12.CSF
Contact0010	2021-07-13T10:33:35.833	56.78589	8.920742	Day1_7.001_jsf-CH12.CSF
Contact0011	2021-07-13T10:34:21.032	56.78524	8.919519	Day1_7.001_jsf-CH12.CSF
Contact0012	2021-07-13T10:31:09.296	56.78825	8.922008	Day1_7.001_jsf-CH12.CSF
Contact0013	2021-07-13T08:05:36.709	56.80425	8.961329	Day1_3.003_jsf-CH12.CSF
Contact0014	2021-07-13T07:55:54.556	56.80259	8.947128	Day1_3.001_jsf-CH12.CSF
Contact0015	2021-07-13T10:07:23.638	56.80252	8.947027	Day1_6.001_jsf-CH12.CSF
Contact0016	2021-07-13T07:54:46.141	56.80271	8.944975	Day1_3.001_jsf-CH12.CSF
Contact0017	2021-07-13T07:54:08.665	56.80257	8.944124	Day1_3.001_jsf-CH12.CSF
Contact0018	2021-07-14T07:40:45.361	56.94075	8.985614	Day2_6_jsf-CH12.CSF
Contact0019	2021-07-14T09:20:48.321	56.84757	8.849405	Day2_13_jsf-CH12.CSF
Contact0021	2021-07-13T12:48:22.167	56.84777	8.854226	Day1_14_jsf-CH12.CSF
Contact0022	2021-07-14T09:18:10.466	56.8477	8.853809	Day2_13_jsf-CH12.CSF
Contact0023	2021-07-14T09:06:16.048	56.84894	8.84727	Day2_11.001_jsf-CH12.CSF
Contact0025	2021-07-14T09:58:29.412	56.84518	8.848299	Day2_17_jsf-CH12.CSF
Contact0026	2021-07-14T09:05:14.739	56.84928	8.84931	Day2_11_jsf-CH12.CSF
Contact0027	2021-07-15T07:43:20.827	56.66312	8.773467	Day3_15_jsf-CH12.CSF
Contact0028	2021-07-15T07:45:22.373	56.66312	8.773467	Day3_16_jsf-CH12.CSF
Contact0030	2021-07-15T07:29:18.377	56.66088	8.772692	Day3_11_jsf-CH12.CSF
Contact0032	2021-07-15T07:21:53.837	56.66044	8.77207	Day3_9_jsf-CH12.CSF
Contact0035	2021-07-15T07:09:35.812	56.65937	8.770798	Day3_6_jsf-CH12.CSF
Contact0036	2021-07-15T07:14:21.905	56.65937	8.770798	Day3_7_jsf-CH12.CSF
Contact0037	2021-07-15T07:10:02.180	56.65951	8.770452	Day3_6_jsf-CH12.CSF
Contact0039	2021-07-15T06:52:06.066	56.65768	8.767621	Day3_1_jsf-CH12.CSF
Contact0040	2021-07-15T06:56:54.185	56.65773	8.767511	Day3_1.001_jsf-CH12.CSF

Contact0041	2021-07-16T07:47:48.240	56.69505	8.898132	Day4_5.001_jsf-CH12.CSF
Contact0042	2021-07-16T08:40:18.693	56.69505	8.898132	Day4_10_jsf-CH12.CSF
Contact0043	2021-07-16T07:42:14.459	56.69924	8.903447	Day4_5_jsf-CH12.CSF
Contact0044	2021-07-16T06:49:56.189	56.70322	8.899184	Day4_2_jsf-CH12.CSF
Contact0045	2021-07-16T08:17:42.084	56.69547	8.908323	Day4_8_jsf-CH12.CSF

A.27. Sidescan sonar file list, Limfjorden

13/07/2021	14/07/2021	15/07/2021	16/07/2021
Day1.001.jsf	Day2_1.jsf	Day3_1.001.jsf	Day4_1.jsf
Day1.002.jsf	Day2_10.001.jsf	Day3_1.jsf	Day4_10.jsf
Day1.003.jsf	Day2_10.jsf	Day3_10.jsf	Day4_11.jsf
Day1.004.jsf	Day2_11.001.jsf	Day3_11.jsf	Day4_12.001.jsf
Day1.005.jsf	Day2_11.jsf	Day3_12.jsf	Day4_12.jsf
Day1.jsf	Day2_12.001.jsf	Day3_13.jsf	Day4_13.001.jsf
Day1_10.001.jsf	Day2_12.jsf	Day3_14.jsf	Day4_13.jsf
Day1_10.002.jsf	Day2_13.001.jsf	Day3_15.jsf	Day4_14.001.jsf
Day1_10.003.jsf	Day2_13.jsf	Day3_16.jsf	Day4_14.jsf
Day1_10.jsf	Day2_14.001.jsf	Day3_17.jsf	Day4_15.jsf
Day1_11.001.jsf	Day2_14.jsf	Day3_18.jsf	Day4_16.jsf
Day1_11.002.jsf	Day2_15.001.jsf	Day3_19.jsf	Day4_2.001.jsf
Day1_11.003.jsf	Day2_15.jsf	Day3_20.jsf	Day4_2.002.jsf
Day1_11.jsf	Day2_16.001.jsf	Day3_21.jsf	Day4_2.jsf
Day1_12.jsf	Day2_16.002.jsf	Day3_22.jsf	Day4_3.001.jsf
Day1_13.001.jsf	Day2_16.003.jsf	Day3_23.jsf	Day4_3.jsf
Day1_13.jsf	Day2_16.004.jsf	Day3_24.jsf	Day4_4.001.jsf
Day1_14.jsf	Day2_16.jsf	Day3_25.jsf	Day4_4.jsf
Day1_15.001.jsf	Day2_17.001.jsf	Day3_26.jsf	Day4_5.001.jsf
Day1_15.002.jsf	Day2_17.jsf	Day3_27.001.jsf	Day4_5.jsf
Day1_15.003.jsf	Day2_18.001.jsf	Day3_27.jsf	Day4_6.jsf
Day1_15.jsf	Day2_18.jsf	Day3_29.jsf	Day4_7.jsf
Day1_2.001.jsf	Day2_19.001.jsf	Day3_3.jsf	Day4_8.001.jsf
Day1_2.002.jsf	Day2_19.jsf	Day3_30.jsf	Day4_8.jsf
Day1_2.jsf	Day2_2.jsf	Day3_31.jsf	Day4_9.jsf
Day1_3.001.jsf	Day2_3.jsf	Day3_32.jsf	

Day1_3.002.jsf	Day2_4.jsf	Day3_33.001.jsf	
Day1_3.003.jsf	Day2_5.jsf	Day3_33.jsf	
Day1_3.jsf	Day2_6.jsf	Day3_34.jsf	
Day1_4.001.jsf	Day2_7.jsf	Day3_35.jsf	
Day1_4.002.jsf	Day2_8.jsf	Day3_36.jsf	
Day1_4.003.jsf	Day2_9.jsf	Day3_37.jsf	
Day1_4.004.jsf		Day3_38.jsf	
Day1_4.005.jsf		Day3_39.jsf	
Day1_4.006.jsf		Day3_4.001.jsf	
Day1_4.007.jsf		Day3_4.jsf	
Day1_4.008.jsf		Day3_40.jsf	
Day1_4.jsf		Day3_41.jsf	
Day1_5.001.jsf		Day3_42.jsf	
Day1_5.002.jsf		Day3_43.jsf	
Day1_5.003.jsf		Day3_44.001.jsf	
Day1_5.004.jsf		Day3_44.jsf	
Day1_5.jsf		Day3_45.001.jsf	
Day1_6.001.jsf		Day3_45.jsf	
Day1_6.002.jsf		Day3_46.jsf	
Day1_6.jsf		Day3_47.jsf	
Day1_7.001.jsf		Day3_48.jsf	
Day1_7.002.jsf		Day3_49.jsf	
Day1_7.jsf		Day3_5.jsf	
Day1_8_p.001.jsf		Day3_50.jsf	
Day1_8_p.jsf		Day3_51.001.jsf	
Day1_9_p.001.jsf		Day3_51.jsf	
Day1_9_p.002.jsf		Day3_53.jsf	
Day1_9_p.003.jsf		Day3_54.jsf	
Day1_9_p.004.jsf		Day3_55.jsf	

Day1_9_p.jsf		Day3_56.jsf	
		Day3_57.jsf	
		Day3_58.jsf	
		Day3_59.jsf	
		Day3_6.jsf	
		Day3_60.jsf	
		Day3_61.jsf	
		Day3_62.jsf	
		Day3_63.jsf	
		Day3_64.jsf	
		Day3_65.jsf	
		Day3_66.jsf	
		Day3_67.jsf	
		Day3_68.jsf	
		Day3_7.jsf	
		Day3_8.jsf	
		Day3_9.jsf	

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