Interreg
Baltic Sea Region

EUROPEAN REGIONAL DEVELOPMENT FUND
EUROPEAN UNION

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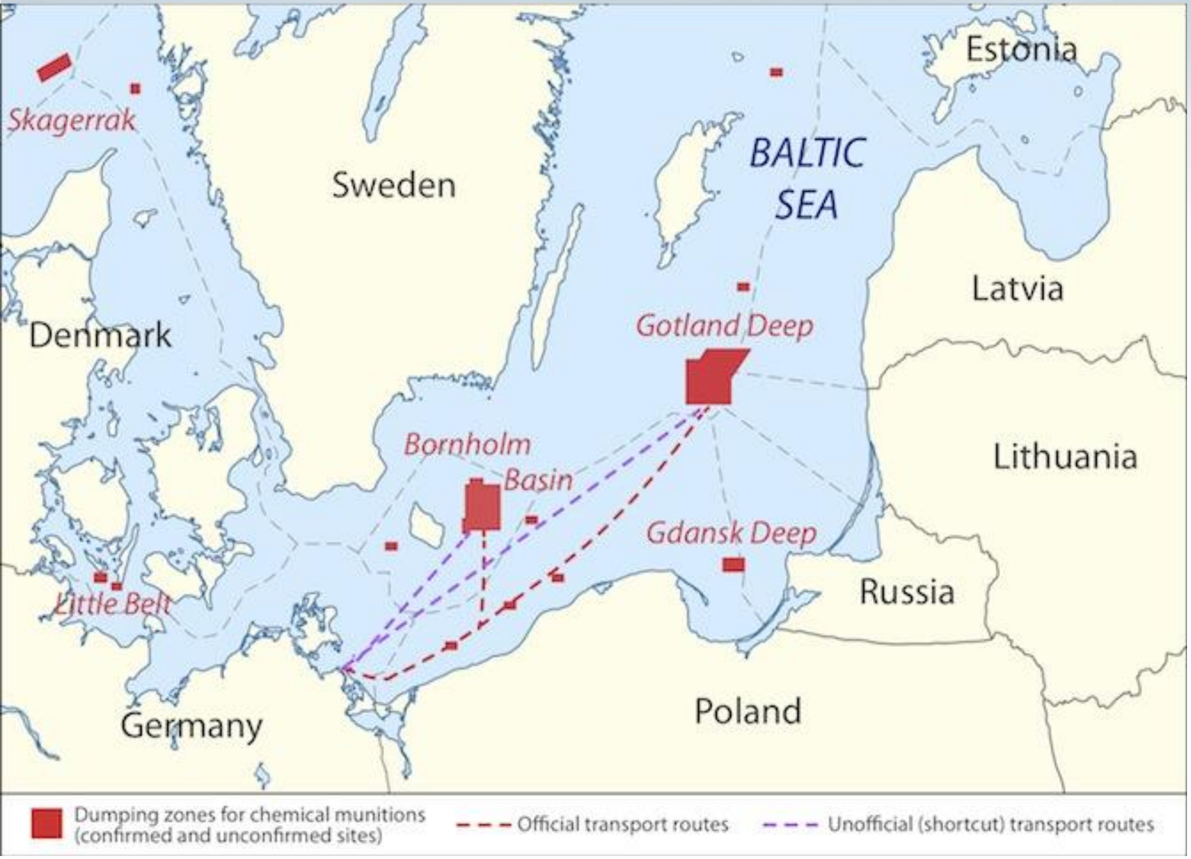
EU STRATEGY FOR THE BALTIC SEA REGION
FLAGSHIP

Decision Aid for Munitions Management

Daimon final conference

Situation of Baltic Sea dumped munitions


Skagerrak
Sweden
Estonia
BALTIC SEA
Latvia
Denmark
Gotland Deep
Lithuania
Bornholm Basin
Gdansk Deep
Little Belt
Russia
Poland
Germany
🟥 Dumping zones for chemical munitions (confirmed and unconfirmed sites)
Official transport routes
Unofficial (shortcut) transport routes

CHEMSEA
CHEMICAL MUNITIONS SEARCH & ASSESSMENT

MODUM
TOWARDS THE MONITORING OF DUMPED MUNITIONS THREAT

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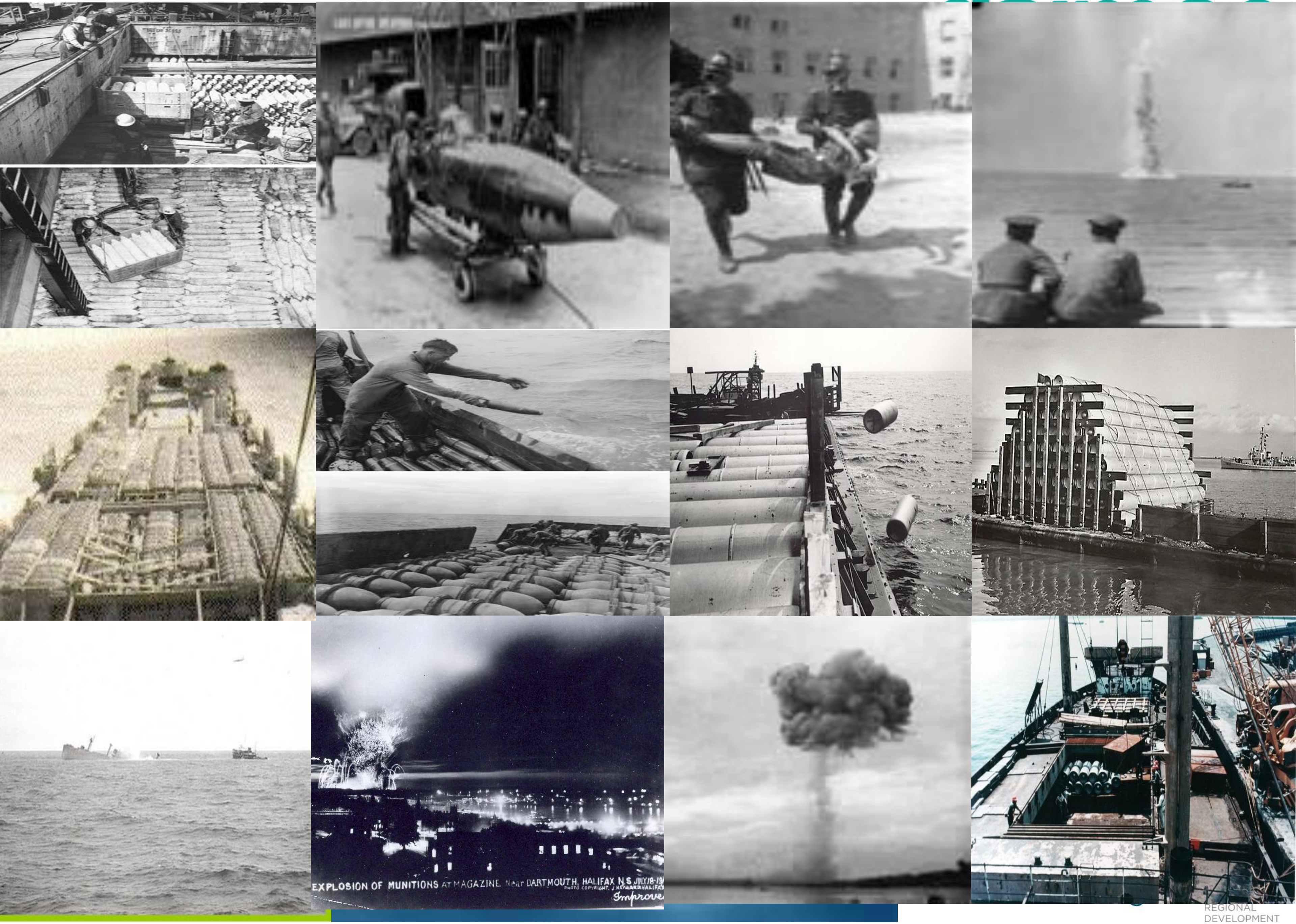
Chemical munitions sunk at sea

- **40 000 tonnes sunk in Baltic proper, 150 000 tonnes in Skagerrak**
- **Natural processes plus enhancing human pressure put environment at risk**


EXPLOSION OF MUNITIONS AT MAGAZINE Near DARTMOUTH, HALIFAX N.S JULY 18-19
PHOTO COPYRIGHT, J. HAYWARD HALIFAX
Improved

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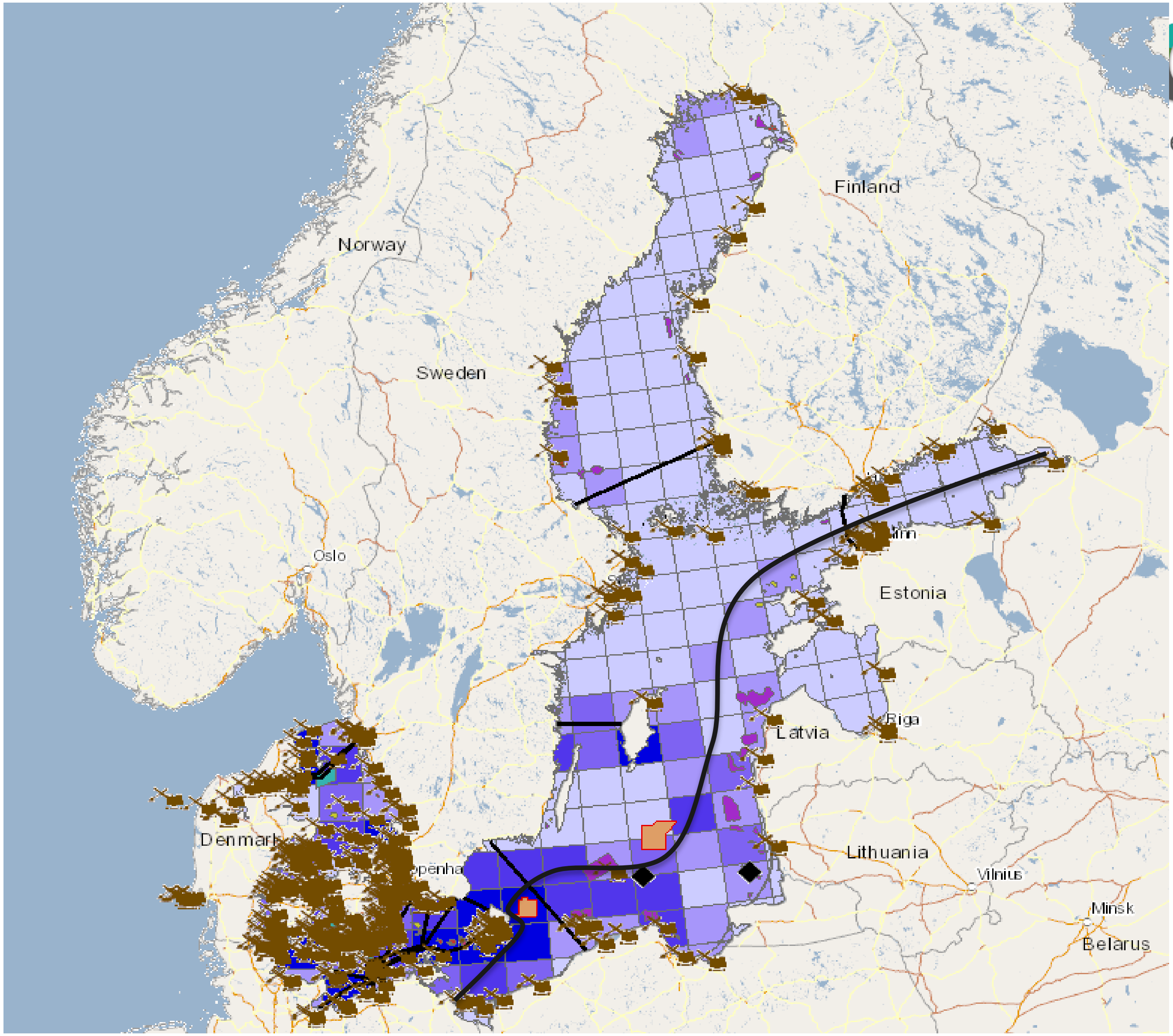
Finland
Norway
Sweden
Oslo
Estonia
Latvia
Riga
Denmar
Lithuania
Vilnius
Minsk
Belarus

Legend:

- 🟨 CWA Dumps
- 🟫 Dredge sites
- 🟪 Offshore wind farms (planned)
- ▨ Bottom Trawling intensity
- — Pipelines and Cables

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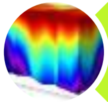
DAIMON Outline

Methods

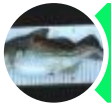
Risk Assessment Tool

Decision support

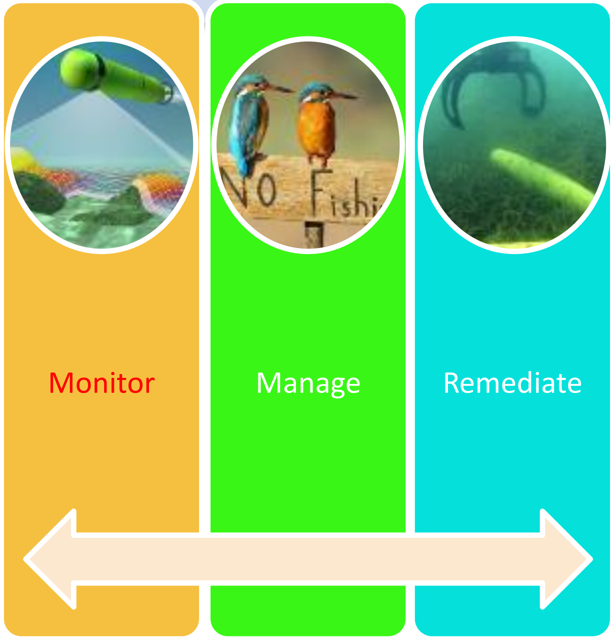
Munition Status Examination


Modelling of possible release

Pollution of sediments and water


Impact on biota assessment

Risk categorization procedure



Monitor

Manage

Remediate

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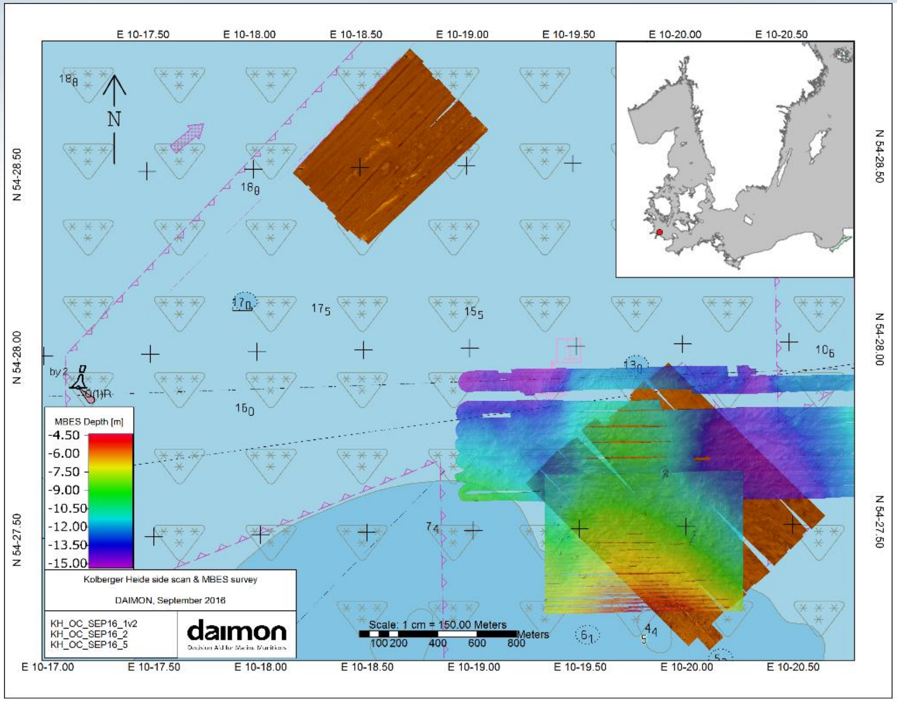
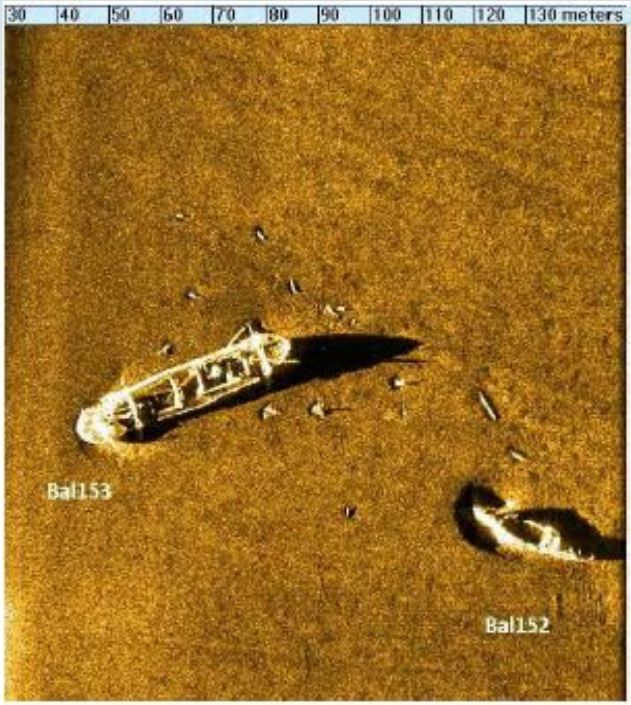
Detection


E 10-17.50
E 10-18.00
E 10-18.50
E 10-19.00
E 10-19.50
E 10-20.00
E 10-20.50
N 54-28.50
N 54-28.00
N 54-27.50
N
MBES Depth [m]
-4.50
-6.00
-7.50
-9.00
-10.50
-12.00
-13.50
-15.00
Kolberger Heide side scan & MBES survey
DAIMON, September 2016
KH_OC_SEP16_1v2
KH_OC_SEP16_2
KH_OC_SEP16_5
daimon
Scale: 1 cm = 150.00 Meters
100 200 400 600 800
Meters
E 10-17.00

Kiel Bay


30
40
50
60
70
80
90
100
110
120
130 meters
Bal153
Bal152

Skagerrak

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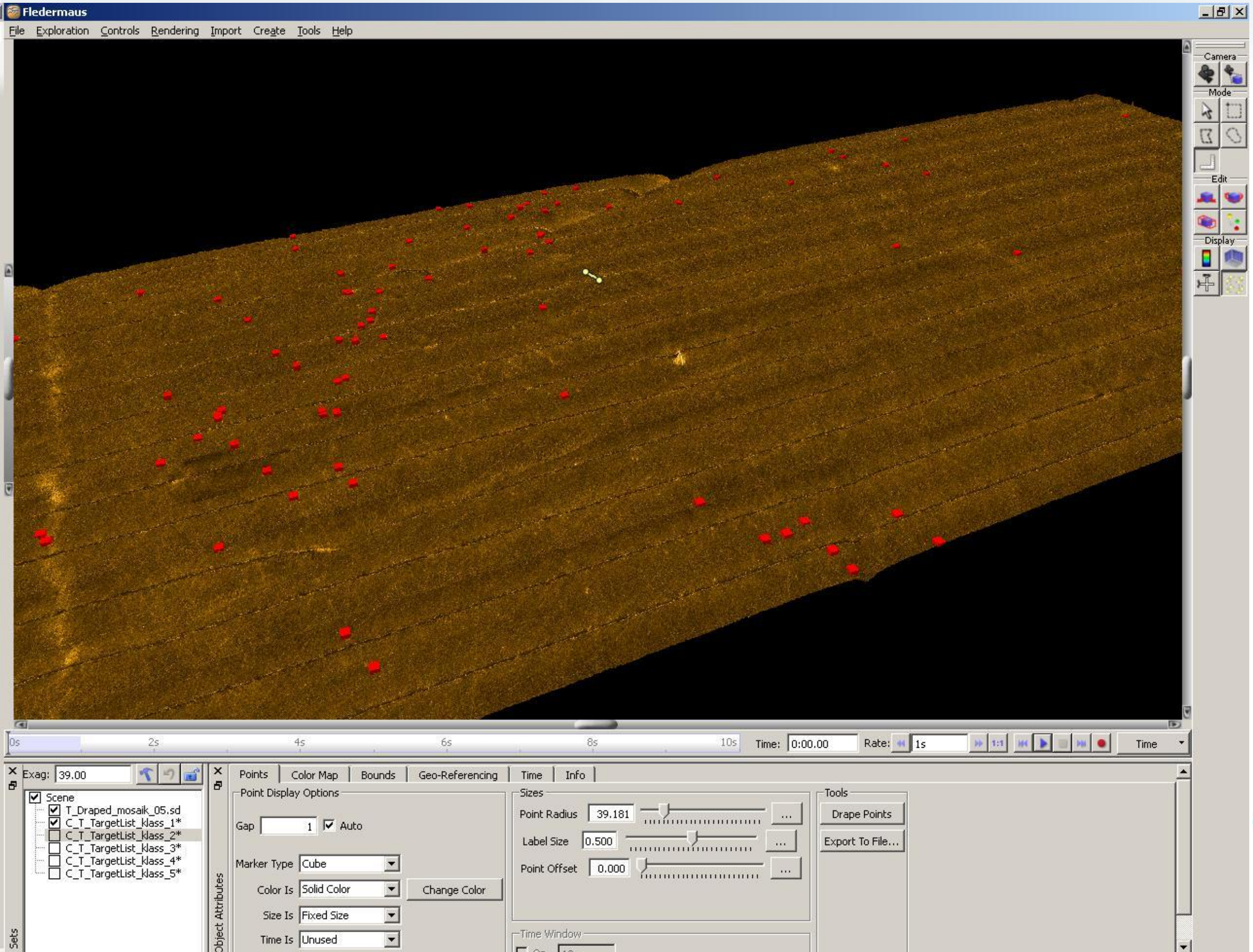
Classification


Fledermaus
File Exploration Controls Rendering Import Create Tools Help
Camera
Mode
Edit
Display
0s 2s 4s 6s 8s 10s
Points Color Map Bounds Geo-Referencing Time Info
Point Display Options
Sizes
Tools
Change Color
Drape Points
Export To File...
Time Window
Sets
Object Attributes

Time: 0:00.00
Rate: 1s
Time

Exag: 39.00

☑ Scene
☑ T_Draped_mosaik_05.sd
☑ C_T_TargetList_klass_1*
☐ C_T_TargetList_klass_2*
☐ C_T_TargetList_klass_3*
☐ C_T_TargetList_klass_4*
☐ C_T_TargetList_klass_5*

Gap 1 ☑ Auto
Marker Type Cube
Color Is Solid Color
Size Is Fixed Size
Time Is Unused

Point Radius 39.181
Label Size 0.500
Point Offset 0.000

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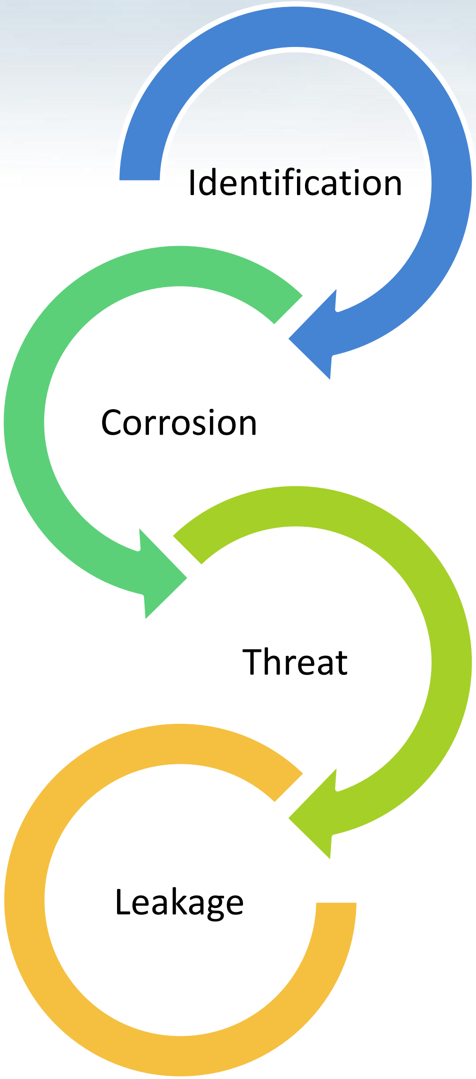
Munition Status



Identification

Corrosion

Threat

Leakage

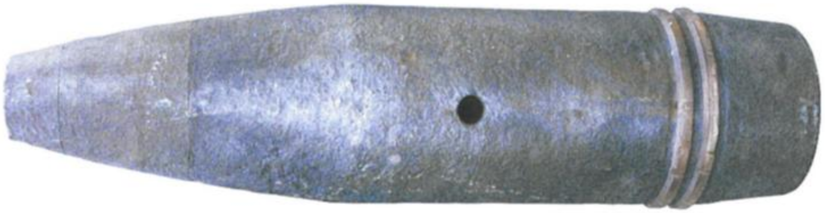


Figure 1

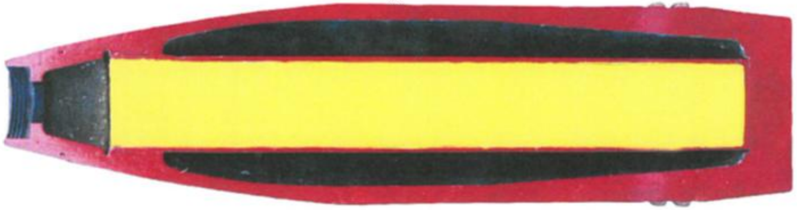


Figure 2

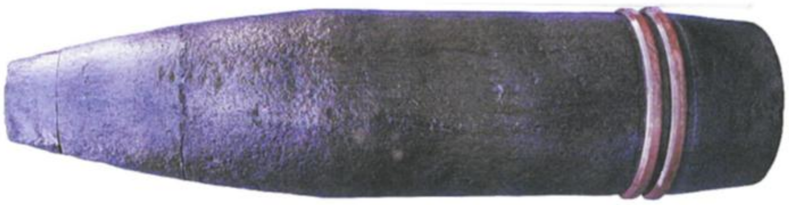


Figure 3

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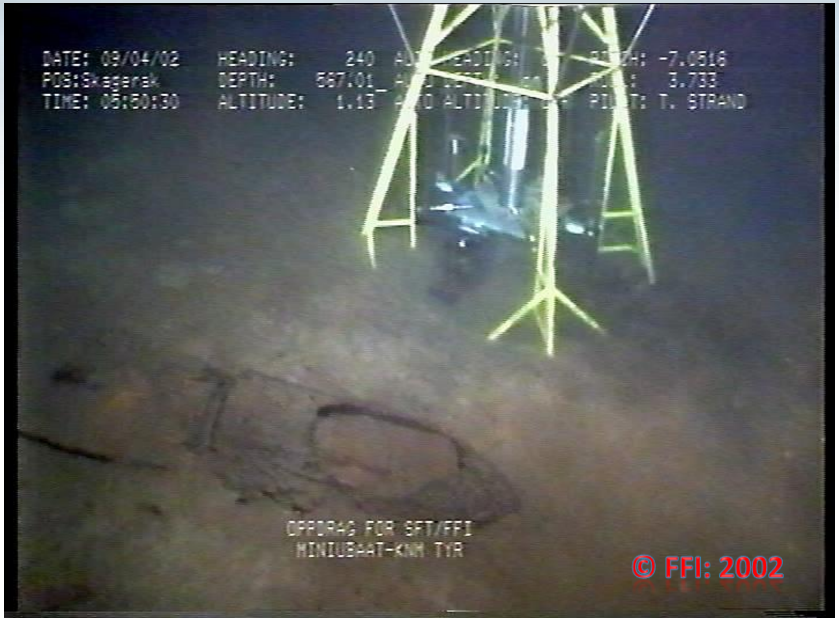
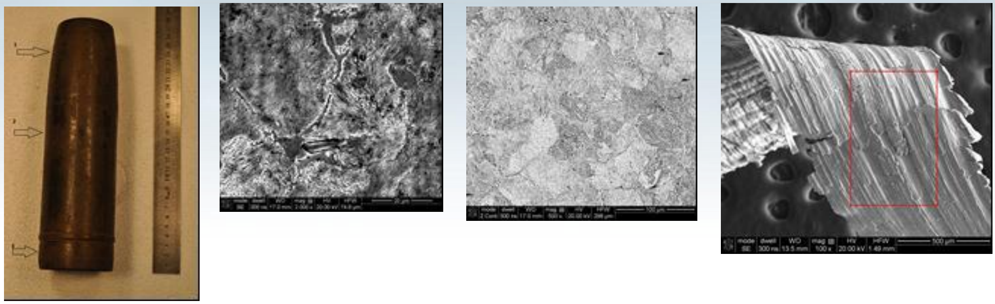
Modelling release


DATE: 03/04/02
POS:Skagerak
TIME: 08:50:30
HEADING: 240
DEPTH: 567.01
ALTITUDE: 1.13
PITCH: -7.0516
3.733
PILOT: T. STRAND
OPPDRAG FOR SFT/FFI
MINIUBAAT-KNM TYR
© FFI: 2002

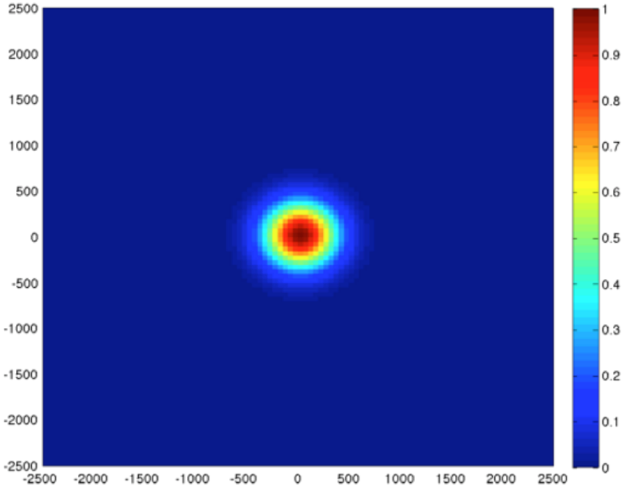


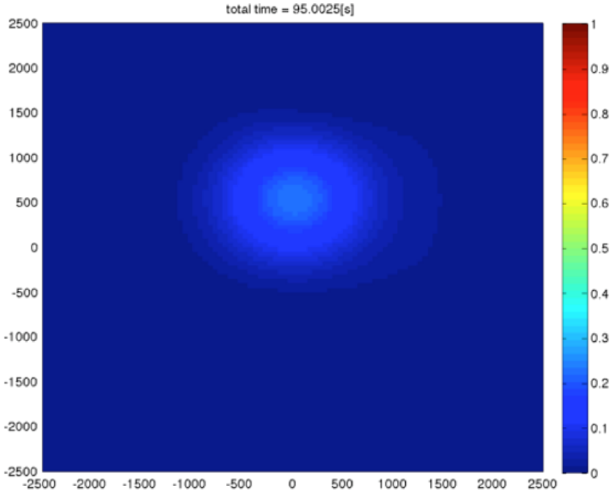
Corrosion:

X-ray Energy Dispersive Spectroscopy

Release:

High Resolution Model, NEMO, Leakage model





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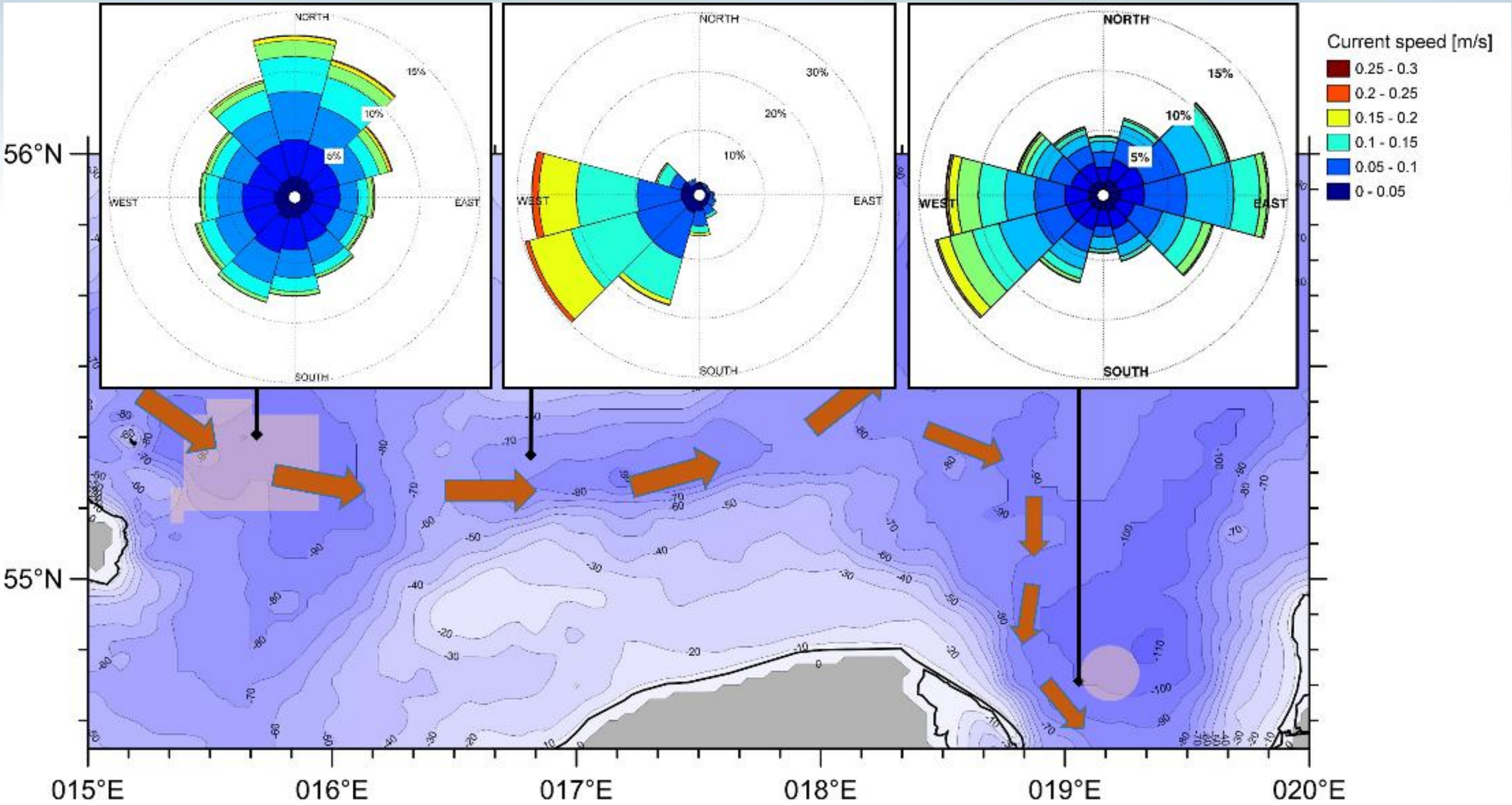
Transport with currents


NORTH
SOUTH
WEST
EAST
5%
10%
15%
20%
30%
Current speed [m/s]
0.25 - 0.3
0.2 - 0.25
0.15 - 0.2
0.1 - 0.15
0.05 - 0.1
0 - 0.05
56°N
55°N
015°E
016°E
017°E
018°E
019°E
020°E

Bottom Currents

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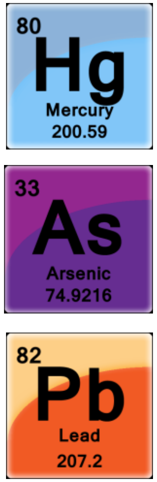
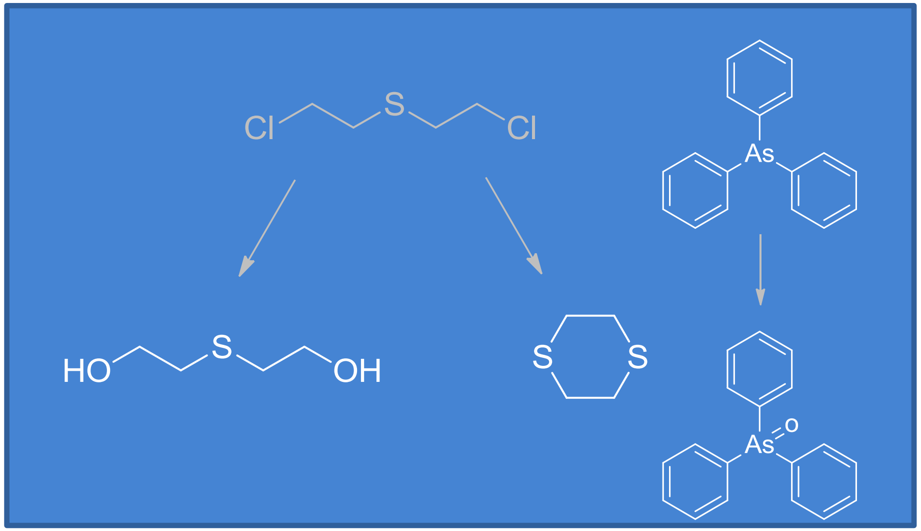
Pollution of sediments and water

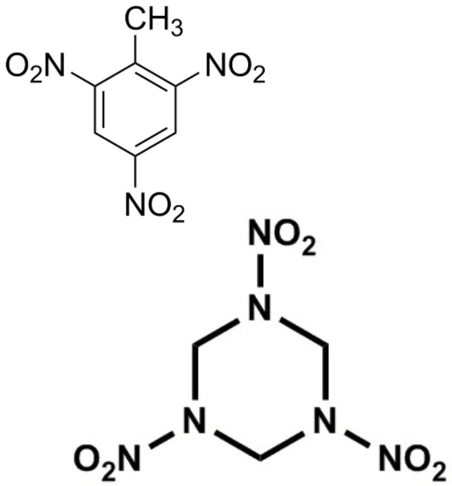
Metals


80
Hg
Mercury
200.59
33
As
Arsenic
74.9216
82
Pb
Lead
207.2

Chemical Warfare Agents


Cl
S
Cl
HO
S
OH
S
S
As
As
O

Explosives


CH3
O2N
NO2
NO2
NO2
N
N
N
O2N
NO2

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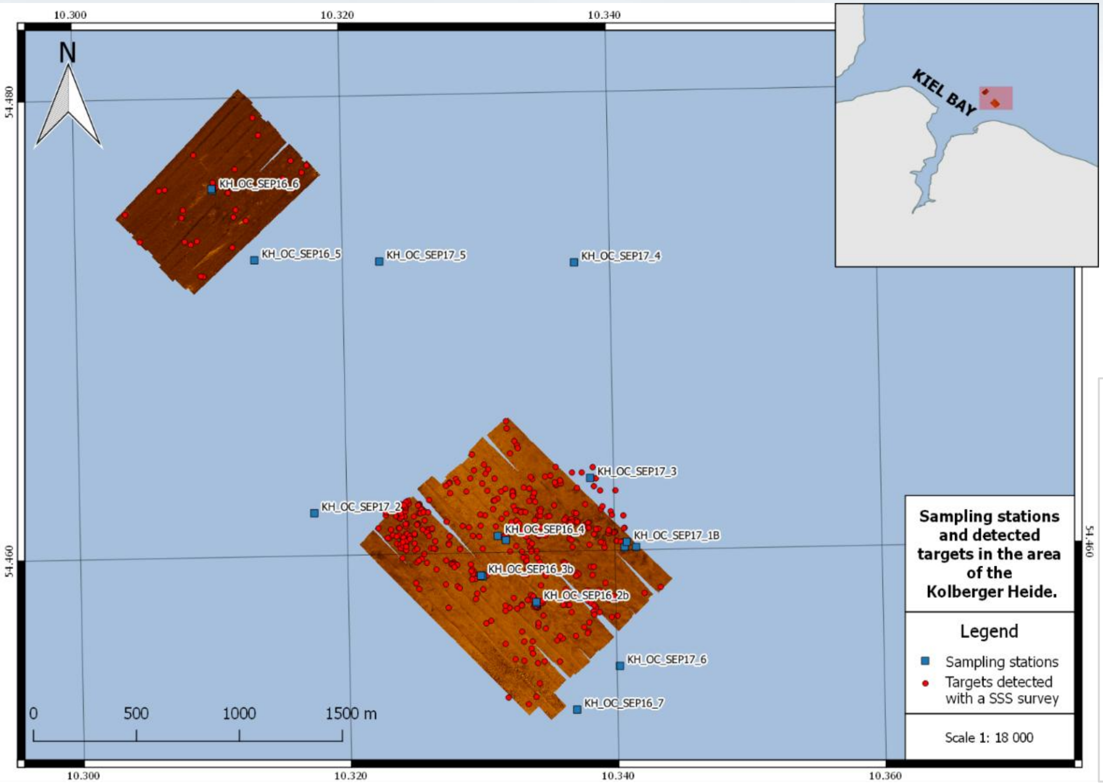
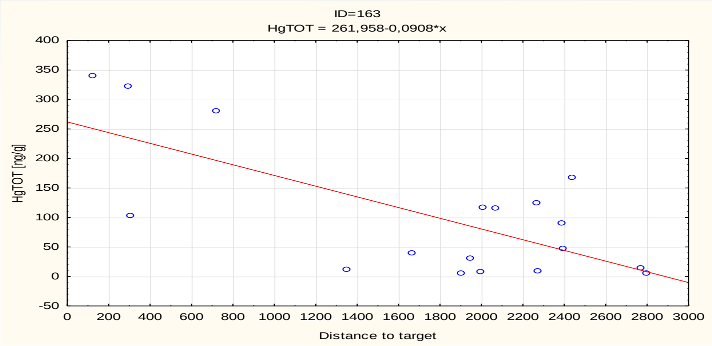
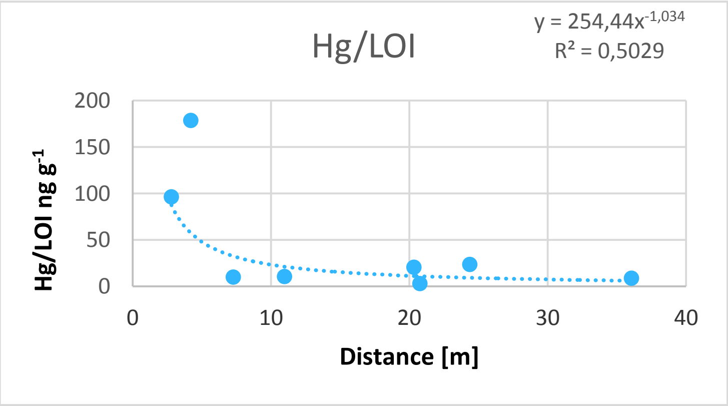
Overal concentrations


10.300
10.320
10.340
10.360
54.480
54.460
N
KIEL BAY
KH_OC_SEP16_6
KH_OC_SEP16_5
KH_OC_SEP17_5
KH_OC_SEP17_4
KH_OC_SEP17_3
KH_OC_SEP17_2
KH_OC_SEP16_4
KH_OC_SEP17_1B
KH_OC_SEP16_3b
KH_OC_SEP16_2b
KH_OC_SEP17_6
KH_OC_SEP16_7
0
500
1000
1500 m
Sampling stations and detected targets in the area of the Kolberger Heide.
Legend
Sampling stations
Targets detected with a SSS survey
Scale 1: 18 000





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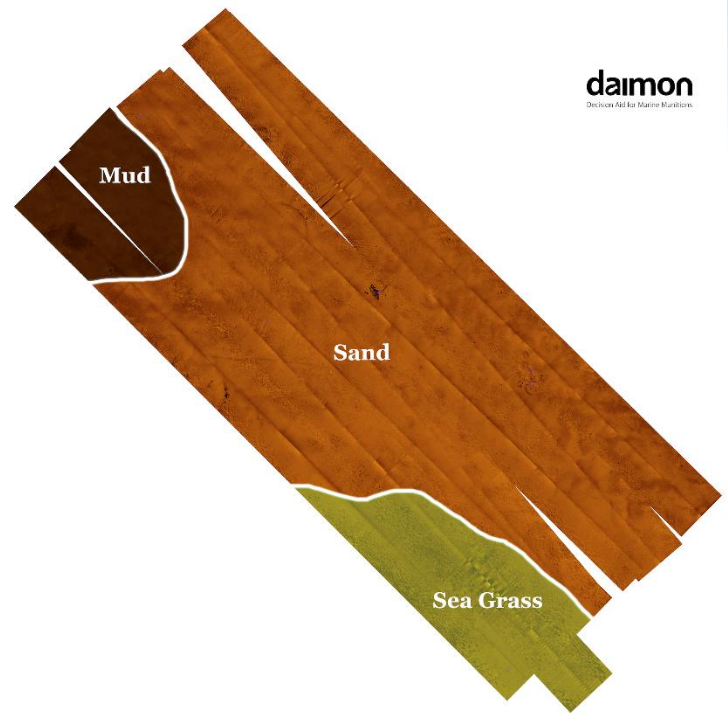
Impact on biota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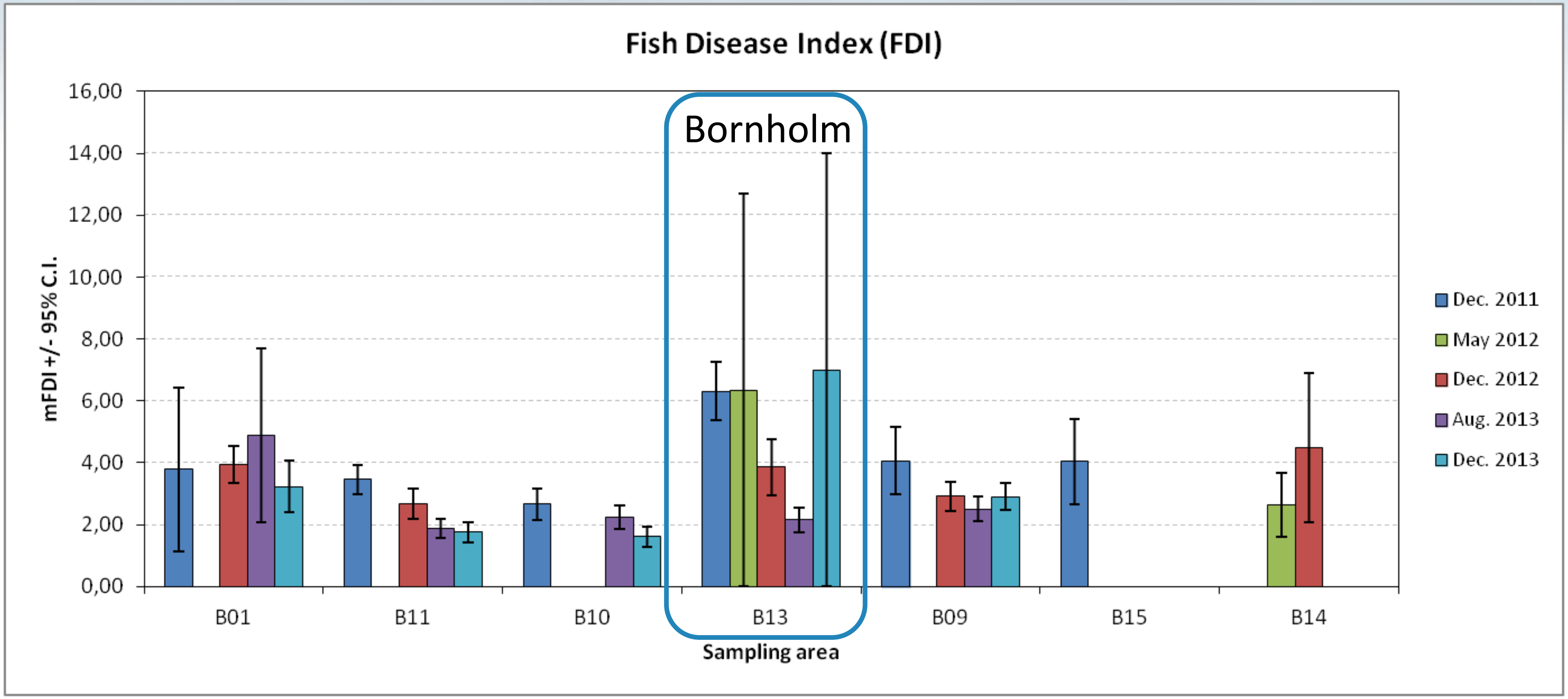
Mud
Sand
Sea Grass

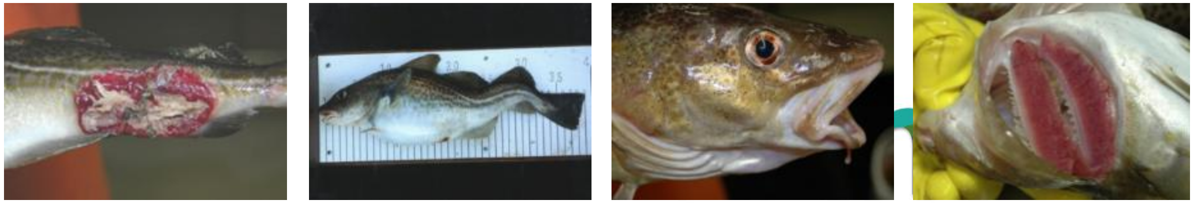
- Habitat damage
- Biomarkers
- Toxicity
- Accumulation

Types of habitats

A5.2 - **Sublitoral Sands**
A5.4 - **Sublittoral Mixed Sediments**
A5.5 - **Sublittoral Macrophyte-Dominated Sediment**

Biomarkers





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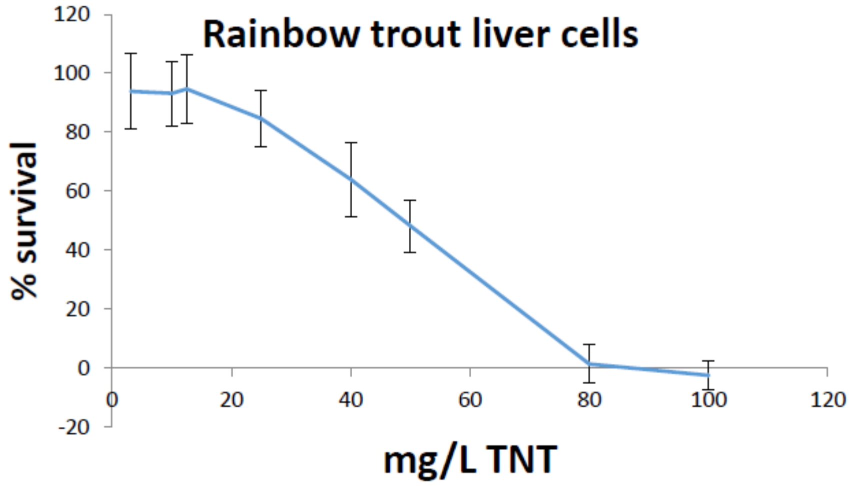
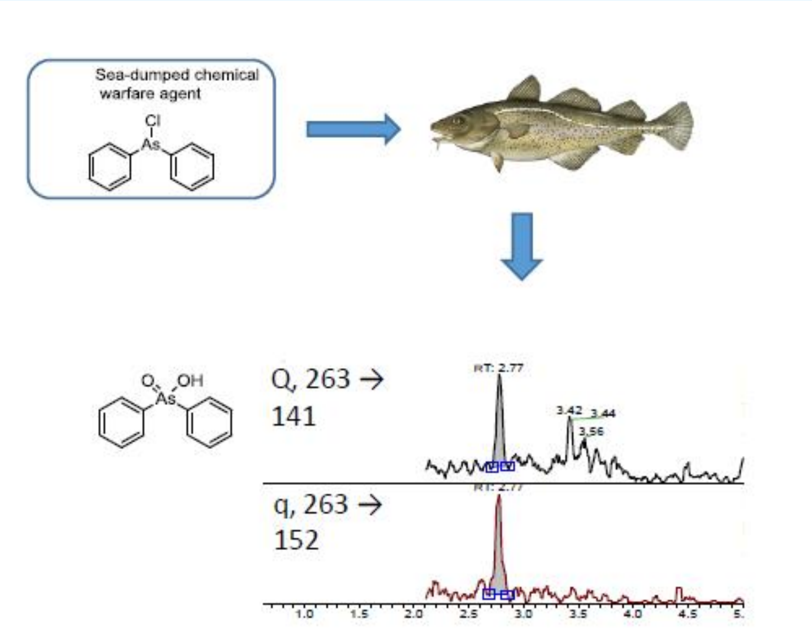
Biota Impact

Toxicity



Bio accumulation


Sea-dumped chemical warfare agent
Cl
As
O
OH
As
Q, 263 → 141
q, 263 → 152
RT: 2.77
3.42
3.44
3.56
RT: 2.77
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.

DSS – Decision Support Sysytem

Location	Objects	Chemistry	Biota	Impact
Habitat	Type	CWA	Toxicity	Risk algorithm
hydrography	number	Explosives	Accumulation	Weighing
oxygen	density	Release	Biomarkers	Cummulative impact
bottom	corrosion	Spreading	Bioindicators	Weight of Evidence model
				Confidence level

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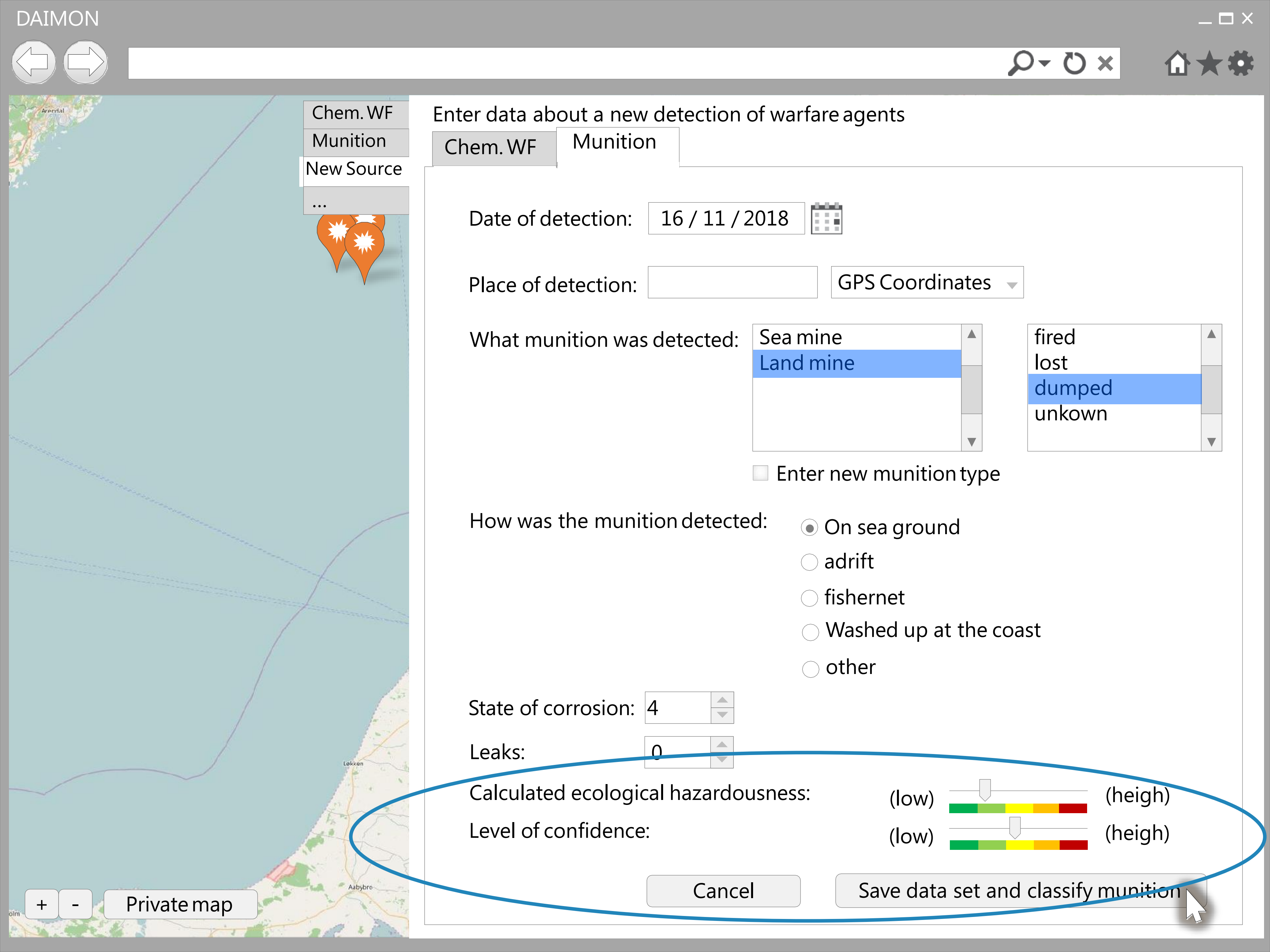
DAIMON
Chem. WF
Munition
New Source
...
Arendal
Løkken
Aabybro
+
-
Private map
Chem. WF
Munition
Cancel
Save data set and classify munition

Enter data about a new detection of warfare agents

Date of detection: 16 / 11 / 2018

Place of detection: GPS Coordinates

What munition was detected:
Sea mine
[✓ Land mine]

fired
lost
[✓ dumped]
unkown

☐ Enter new munition type

How was the munition detected:
● On sea ground
○ adrift
○ fishernet
○ Washed up at the coast
○ other

State of corrosion: 4

Leaks: 0

Calculated ecological hazardousness: (low) (heigh)

Level of confidence: (low) (heigh)

Thank You for attention

1) 'The research work was fund by the European Union (European Regional Development Fund) under the Interreg Baltic Sea Region Programme 2014-2020, project #R013 DAIMON'

2) 'The research work was financed by the Ministry of Science and Higher Education from the 216-2019 science funding allocated for the implementation of international co-financed project'

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