



GRACE grant no 679266

## Baseline monitoring report

Protocol for environmental baseline study in the tidal zone for pilot scale study on coastal in situ burning impacts

D4.11

WP4: Combat of oil spill in costal arctic waters  
– effectiveness and environmental effects



Prepared under contract from the European Commission  
Contract n° 679266  
Research and Innovation Action  
Innovation and Networks Executive Agency  
Horizon 2020 BG-2014-2015/BG2015-2

Project acronym: GRACE  
Project full title: Integrated oil spill response actions and environmental effects

Start of the project: 01 March 2016  
Duration: 42 months  
Project coordinator: Finnish Environment Institute (SYKE)  
Project website: <http://www.grace-oil-project.eu>

Deliverable title: Preliminary screening of design and data requirement  
Deliverable n°: D4.11  
Nature of the deliverable: Report  
Dissemination level: Public

WP responsible: WP4  
Lead beneficiary: AU

Due date of deliverable: 31. August 2017  
Actual submission date: 31. August 2017

Deliverable status:

Version	Status	Date	Author	Approved by
1.0	draft	25.8.2017	Susse Wegeberg, Janne Fritt-Rasmussen, Kim Gustavson, AU	Commented by JFR and KG, AU
1.1	final	30.8.2017	Authors as above	Steering group 30.0.2017

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## Executive Summary

A coastal in situ burning test was performed in vicinity of Færingehavn, south of Nuuk, Greenland, in a selected bay (Bay 1) with suitable coastline. A reference bay was also included (Bay 2).

For monitoring environmental effects of the coastal in situ burning test, a baseline study of the tidal community was performed in the area for the coastal in situ burning test and in the reference area.

The baseline was established by sampling of all tidal community organisms (e.g., *Ascophyllum nodosum*, *Fucus distichus*, *F. vesiculosus*, *Littorina* spp, and *Gammarus oceanicus*), within a square of 25 × 25 cm; an area of 0.0625 m<sup>2</sup>. *Semibalanus balanoides* was not sampled but estimated in the field. Biomass and abundance, as well as coverage of fucoids and barnacles in the squares were estimated.

9 and 5 squares with 2.25 and 1.5 m in between were sampled in three tidal levels in Bay 1 and Bay 2, respectively, and along horizontal transects on the coast established by ropes fastened with screws in the cliff. A total of 27 samples were taken in Bay 1, the test site, and 15 samples in Bay 2, the reference site.

All the samples were frozen and will be shipped to Denmark to be analysed regarding species; biomass and abundance.

Impact as well as potential recovery will be monitored in 2018.



## 1. Introduction

For operational and environmental research pilot scale oil spill experiments were conducted in vicinity of Færingehavn, south of Nuuk, Greenland, in two selected bays with suitable coastlines. The study investigated the efficiency and environmental impacts of combating oil spill at a shoreline by in situ burning.

A thorough baseline study was performed to make the basis for the assessment of the impacts /effects on and potential recovery of the coastal ecosystems and key organisms when affected by burning oil.

The in situ burning operation was initiated when tide was going down and reaching the level of the mid tidal zone to ensure direct effect on the tidal community organisms. Thereby optimal effect on the coastal tidal community organisms within the limited selected burning area was obtained for later assessment of the impact.

## 2. Locations

Two limited shoreline areas of 13 and 9 m, respectively, were selected in two adjacent bays which were considered to be comparable regarding substratum and wind exposure (Figs 1-3).

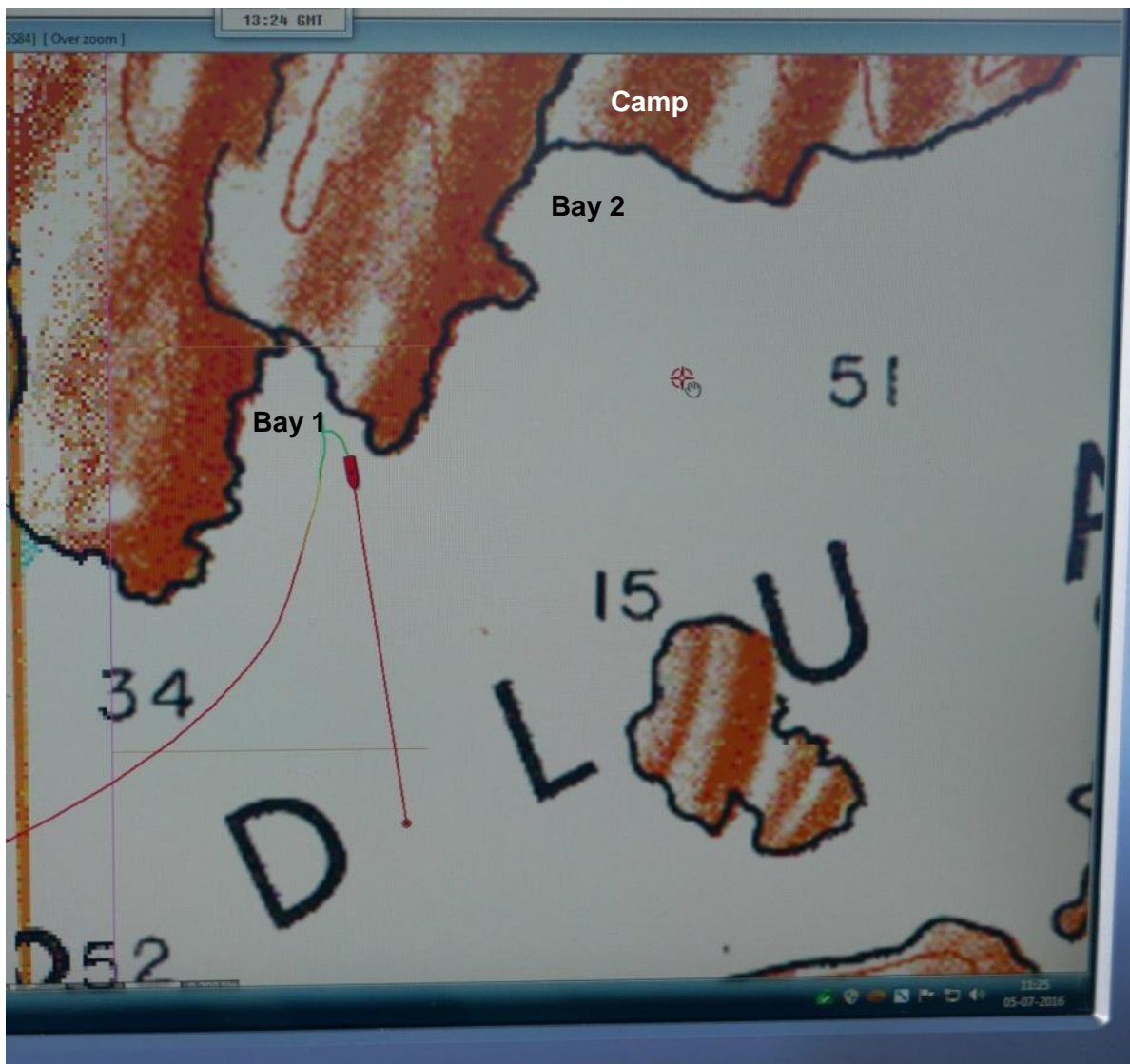


Fig.1. Location of Bay 1 and 2; test and reference bay, respectively, in relation to each other.



Fig. 2. Coastal in situ burning test location - Bay 1, area marked with red ring.



Fig. 3. Reference location - Bay 2, area marked with yellow ring.

### 3. Sampling

#### 3.1 Sampling method

Sample size: 25 × 25 cm

Sample photos: 1) Pre-sampling: coverage of fucoids (*Ascophyllum nodulosum*, *Fucus distichus*, *F. vesiculosus*)

2) Post-sampling: coverage of *Semibalanus balanoides*

Sampling: In each sample square all organisms (fucoids + e.g., snails, amphipods from seaweed and rock) excl. *S. balanoides* (Fig. 4).



Fig. 4. Estimating coverage of seaweeds (*Ascophyllum nodosum*, *Fucus distichus* and *F. vesiculosus*) and barnacles (*Semibalanus balanoides*), and sampling the organisms from 25 × 25 cm squares placed with a distance of 2,25 m along ropes at three different levels in the tidal zone.

### 3.2 Sample sorting

Samples were placed in zip bags, weighed and frozen for shipping to Denmark for later sorting for analyses of specific biomass and abundance.

	Fucoids	Snails	<i>Gammarus</i>	Other
Wet weight	X	X	X	X
Numbers		X	X	(X)

### 3.3 Sampling levels

At each bay, three sampling levels were marked. Tidal levels were found on coast from tide table and using levelling staff. The levels are defined as:

Highest seaweed vegetation level: 2.25 m

Mid, between highest and lowest sampling levels, assessed as most biomass rich: 1.6 m

Lowest (possible) tide level for sampling: 1.0 m

### 3.4 Sampling strategy

#### 3.4.1 Coastal in situ burning test location - Bay 1

Coastal test area: 13 m for each tide level.

Ropes were placed along the coastal test area according to height levels by use of screws (Fig. 5), and each screw were numbered (I-VIII) and the distance were measured between them in order to be able to relocate the monitoring transects in 2018:

Vegetation level:

I – 3.80 m - II – 4.40 m - III – 3.00 m - IV – 3.20 m - V – 3.30 m - VI – 2.40 m – VII – 3.20 m - VIII

Mid tidal zone:

I – 5.90 m - II – 7,10 m - III – 4,85 m - IV – 4,35 m - V

Low tidal zone:

I – 5.15 m - II – 3,25 m - III – 3,50 m - IV – 4,30 m - V – 2,90 m - VI – 4,70 m – VII



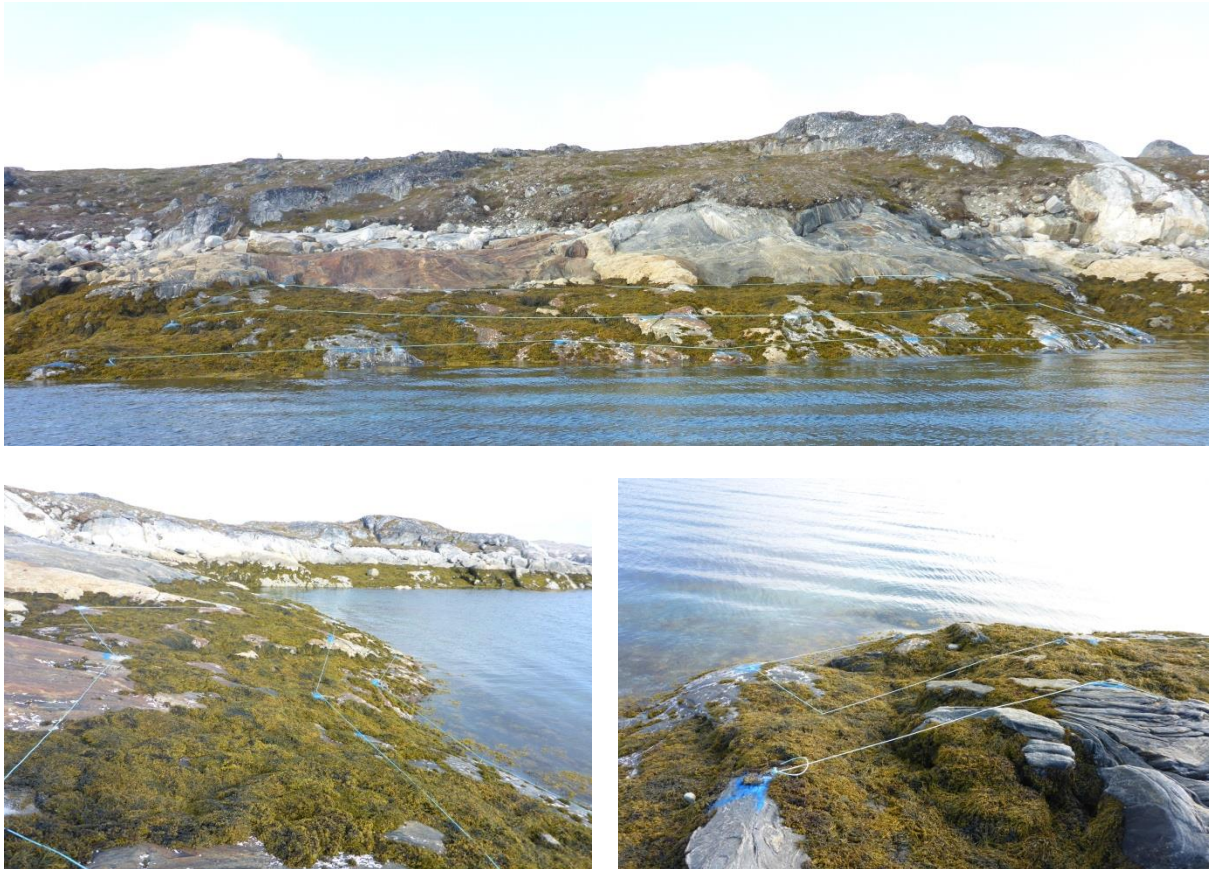
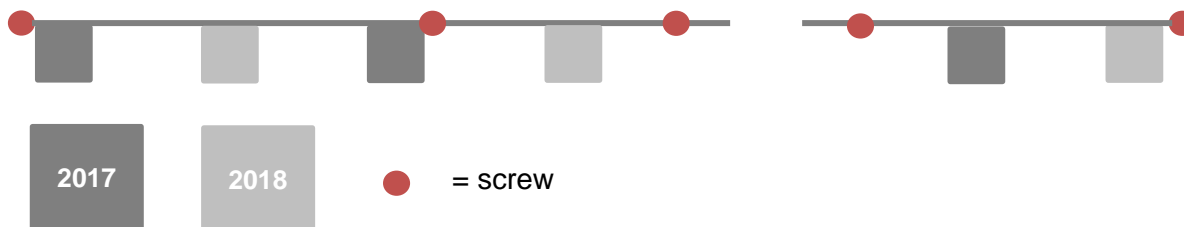
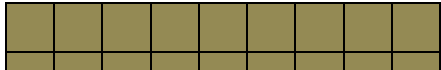
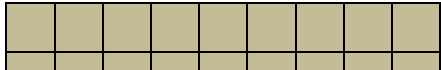
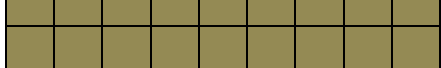
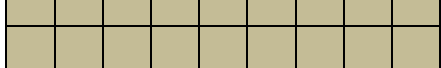
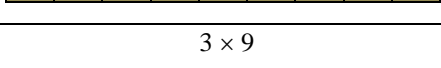
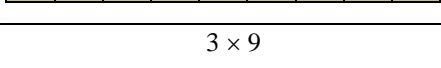


Fig. 5. Area for coastal in situ burning test with preparation for baseline sampling. Ropes were placed at three levels over lowest water mark in a sufficient large area considered homogeneous with respect to seaweed cover. The ropes were kept in place by placing 5-7 nails at each level. The nails persist for establishing the same sampling grid for next year's monitoring.

Nine samples were taken horizontally along the rope with 2.25 m distance as shown in the below illustration for each of the three tidal levels. The illustration also indicates where the expected long term monitoring will take place next year (2018).



Overview of sampling for 2017 and 2018:

Tidal level	Test area		Total	
	2017	2018	2017	2018
High				
Mid				
Low				
No.	3 × 9	3 × 9	27	27

### 3.4.2 Reference location

Coastal control area: 7.5 m for each tide level.

Ropes were placed along the coastal reference area according to height levels by use of screws (Fig. 6).

Five sample squares are placed horizontally along the ropes with 1.50 m distance:

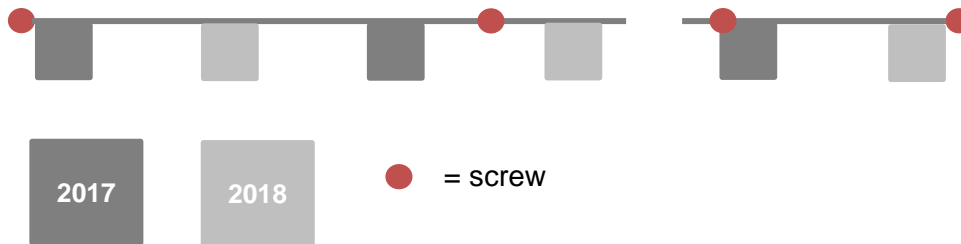
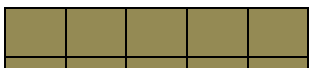
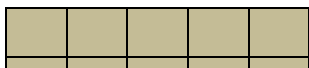
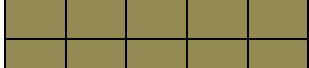
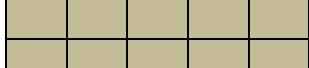
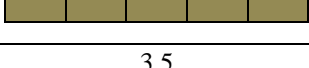
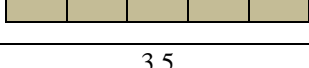


Fig. 6. Sampling and coverage estimation of organisms within 25 × 25 cm squares at three tidal levels along horizontal transects established with ropes at the reference site.

Overview of sampling for 2017 and 2018:

Tidal level	Control		Total	
	2017	2018	2017	2018
High				
Mid				
Low				
No.	3 5	3 5	15	15

#### 4. Preliminary results

Dominant species were considered to be as expected; key species from the tidal zone as observed during an investigation along Greenland's west coast, which are:

*Ascophyllum nodosum*

*Fucus distichus*

*Fucus vesiculosus*

*Gammarus oceanicus*

*Littorina* spp.

*Semibalanus balanoides*

Total biomass per sample (0.0625 m<sup>2</sup>) were of similar weight as found in corresponding samples from the Nuuk area and

Baseline results will be analysed together with the 2018 monitoring and presented hereafter.

