

SEPTEMBER 2014
BONN AGREEMENT

RESULTS FROM BE-AWARE II ENVIRONMENTAL AND SOCIOECONOMIC SENSITIVITY RANKING WORKSHOP

BRUSSELS 11-12 SEPTEMBER 2014

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PROJECT NO. A036390
DOCUMENT NO. 1.0
VERSION 1
DATE OF ISSUE 24. September 2014
PREPARED MORH, CRJ
CHECKED CRJ
APPROVED

CONTENTS

1	Introduction	7
1.1	Workshop approach and agenda	7
1.2	Participants	9
2	Ranking	9
2.1	Ranking scores and seasons	10
2.2	Ranking Matrix	11
2.3	Weighting of features	14
3	Discussions and rationales	15
3.1	Habitats	15
3.2	Species features	25
3.3	Protected areas	29
3.4	Socioeconomic features	29

1 Introduction

The Bonn Agreement and Belgium (DG Environment) invited members from contracting parties and COWI to attend the BE-AWARE II Environmental and Socioeconomic Sensitivity Ranking Workshop on 11 -12 September 2014.

The workshop is Action F.4 of the BE-AWARE II project. The aim of the workshop was to agree the ranking of the vulnerability / sensitivity of identified environmental and socioeconomic features (sandy beaches, fish spawning grounds, protected areas, sea grass meadows, tourism and recreations areas, ports etc.) according to the criteria developed in the BE-AWARE I project.

This report contains the final ranking matrix of the environmental and socio economic features as agreed by the workshop participants as well as the main discussion points raised in the proceedings.

1.1 Workshop approach and agenda

The Workshop was held in Brussels, Belgium, at the central offices of DG Environment Belgium over 2 days starting on Thursday, 11th September 2014, and finishing on Friday, 12th September 2014.

The workshop participants divided in to two subgroups with equal representation of contracting parties and participant expertise. Each group discussed and prepared ranking matrices on features within three main topics: Habitats, higher trophic species and socio-economic. After ranking of every topic was completed, the whole workshop finalised discussions and decisions in plenary, before starting discussions on rankings of the next topic.

At the end of the workshop, the participants agreed on an approach for weighting the four groups Habitat, higher trophic species, protected areas and socio-economy in the future model work in order to quantify the method robustness regarding different subjective choices.

Below is the program for the workshop:

Thursday September 11

Time	Activity
09:00 – 10:30	Introduction to Ranking Workshop, Experience from BRISK and Workshop aims
10:30 – 11:00	comfort break (coffee/tea)
11:00 – 12:30	Discuss ranking of habitat features in breakout groups
12:30 – 14:00	Lunch
14:00 – 15:30	Plenary session to compare habitat ranking scores Discuss ranking of species features in breakout groups
15:30 – 16:00	comfort break (coffee/tea)
16:00 – 17:30	Discuss ranking of species features in breakout groups Plenary session to compare species ranking scores
19:00 – 22:00	Dinner offered by host

Friday September 12

Time	Activity
09:00 – 10:30	Discuss ranking of socioeconomic features in breakout groups
10:30 – 11:00	comfort break (coffee/tea)
11:00 – 12:30	Discuss ranking of socioeconomic features in breakout groups Plenary session to compare socioeconomic ranking scores
12:30 – 14:00	Lunch
14:00 – 15:30	Finalisation of Ranking Matrix and next steps
Close of meeting	

1.2 Participants

The participants of the workshop represented all contracting parties, except for France and Ireland.

Table 1-1 List of participants

Name	Country	Institution
John Mouat	United Kingdom	Bonn Agreement Secretariat
Peter Søberg Poulsen	Denmark	Bonn Agreement Secretariat
Birgit Boehme	Germany	Havariekommando
Kevan Cook	United Kingdom	Natural England
Sjon Huisman	Netherlands	Rijkswaterstaat Zee en Delta
Michiel Visser	Netherlands	Rijkswaterstaat Zee en Delta
Alex Jensen	Denmark	Royal Danish Navy
Christer Larsson	Sweden	Hav och Vatten
Ingrid Lauvrak	Norway	Kystverket
Jon-Arve Royset	Norway	Kystverket
Ronny Schallier	Belgium	MUMM
Ward Van Roy	Belgium	MUMM
Morten Hjorth	Denmark	COWI
Carsten Jürgensen	Denmark	COWI

The meeting was organised and facilitated by Eric Donnay, Guido Fidlers and Peter Van Stijvendael from Ministry of Public Health, Belgium.

2 Ranking

2.1 Ranking scores and seasons

During BE -AWARE 1 it was agreed to rank the vulnerability to oil spill of each of the identified ecological and socioeconomic features using the scores and seasons applied in the BRISK project (Table 2-1).

Table 2-1 Scores and seasons that was applied in the vulnerability ranking

Scores	Seasons
Score 4 = Very high vulnerability	Winter: December, January and February
Score 3 = High vulnerability	Spring: March, April and May
Score 2 = Moderate/medium vulnerability	Summer: June, July and August
Score 1 = Low vulnerability	Fall: September, October and November.

The workshop gave vulnerability scores to each of the identified ecological and socioeconomic features and for each of the four seasons (winter, spring, summer or fall). Scores were defined for both a situation without using chemical dispersants to combat oils spill and one with dispersants application.

2.1.1 Criteria for ranking

Ecological features

The vulnerability scores for ecology are based on the following criteria, which were decided on during BE-AWARE 1:

- › Fate of oil (exposure; chemical recovery). The fate of oil in terms of oil weathering, natural degradation and removal in the particular ecosystem/ environment , the main factors being:

- › Onshore: Wave and tidal exposure, shoreline slope, substrate type (~ ESI index)
- › Open water (3D): Natural energy (waves, currents, winds), depth
- › Potential impact of oil/sensitivity of habitats and organisms and their recovery

Socioeconomic features

When oil impacts a sensitive socio-economic feature, the extent will depend not only on the fate of the oil in the environment, but also on the oil-sensitivity of the human activity and the potential for recovery of the activity once most of the oil has been removed. In other words, the same three aforementioned ‘vulnerability’ factors (exposure, sensitivity, recovery) also apply to define socio-economic vulnerability. As a result, any additional socio-economic ranking criterion should reflect one or more of these 3 vulnerability factors in its definition.

The BE AWARE I project examined a set of additional socio-economic ranking criteria and agreed upon adding the following two additional criteria:

- › Length of interruption of an activity or service
- › Compensation

Impacts in terms of length of interruption of an activity or service involve important factors such as the possibility (or not) of protecting an activity and the possibility (or not) of displacing an activity.

Compensation in terms of whether a damaged feature can be economically compensated for or not. This is important when comparing economic vs. ecological vulnerability.

2.2 Ranking Matrix

At the end of the workshop, the participants had made two matrices, one from each group. In addition, COWI had prepared a matrix for guidance and example (see Appendix A).

The workshop participants decided to use a final matrix created by taking the mean of the scores from each group.

Below is the final matrix of ranking scores for each selected feature as agreed upon on the workshop.

Table 2-2 Final ranking matrix of ecological and socioeconomic features for each season in cases of exposure to surface oil spills or chemical dispersed oil.

Ecological feature.	Surface oil spill				Chemical dispersed oil			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Shoreline and Coastal Habitats								
Exposed rocky shores and reefs < 20 m	3	3	2	2	3	3	2	2
Exposed rocky shores and reefs > 20 m	1	1	1	1	2	2	2	2
Sheltered rocky shores and reefs < 20 m	4	4	3	3	4	4	4	4
Sheltered rocky shores and reefs > 20 m	2	2	2	2	4	4	4	4
Littoral chalk communities	4	4	3	3	4	4	3	3
Sandy beaches	2	2	1	1	2	2	1	1
Shingle beaches	3	3	3	3	3	3	3	3
Tidal sand and mud flats	4	4	4	4	4	4	4	4
Salt marshes	4	4	4	4	4	4	4	4
Large shallow inlets and bays	3	3	3	3	3	3	3	3
Estuaries	4	4	4	4	4	4	4	4
Coastal lagoons	4	4	4	4	4	4	4	4
Underwater sandbanks < 20m	3	3	2	2	3	3	3	3
Underwater sandbanks > 20m	1	1	1	1	2	2	2	2
Biogenic reefs < 20 m	4	4	4	4	4	4	4	4
Biogenic reefs > 20 m	2	2	2	2	4	4	4	4
Maerl beds	4	4	3	3	4	4	4	4
Seagrass beds (<i>Zostera</i> sp., >5% (OSPAR))*	4	4	4	4	4	4	4	4
Kelp forests**	4	4	4	3	4	4	4	4
Open Sea Habitats								
Open water column (< 20 m)	2	2	1	1	2	2	2	2
Deep sea water column (> 20 m)	1	1	1	1	2	2	2	2
Deeper sea floor (>20 m)	1	1	1	1	2	2	2	2
Seamounts	1	1	1	1	2	2	2	2
Coral gardens and sponge aggregations	2	2	2	2	3	3	3	3
Carbonate mounds	2	2	2	2	3	3	3	3
<i>Lophelia pertusa</i> reefs	2	2	2	2	3	3	3	3
Sea-pen and burrowing megafauna	2	2	2	2	3	3	3	3
Species								
<i>Fish</i>								
Pelagic spawning areas for fish (e.g. other than herring)	2	2	1	2	3	3	2	3
Demersal spawning areas (e.g. herring)	3	3	4	4	3	3	4	4
Coastal nursery areas	4	4	4	3	4	4	4	4
<i>Birds</i>								
Areas for wintering birds	3	1	3	4	1	1	1	2
Areas for staging birds	4	2	4	2	2	1	2	1
Areas for breeding birds	4	4	3	1	3	3	2	1

Ecological feature.	Surface oil spill				Chemical dispersed oil			
Areas for moulting birds	2	4	2	2	1	2	1	1
<i>Mammals</i>								
Otters, coastal feeding grounds	4	4	4	4	3	3	3	4
Breeding, moulting and haul-out sites for seals	3	4	4	3	2	3	3	3
Protected areas								
Ramsar areas	4	4	4	4	4	4	4	4
Nature 2000 areas	4	4	4	4	4	4	4	4
National areas	4	4	4	4	4	4	4	4
World Heritage sites	4	4	4	4	4	4	4	4
Socioeconomic feature								
Offshore fisheries	2	2	2	2	2	2	2	2
Coastal fisheries (incl. fishing harbours)	3	3	3	3	3	3	3	3
Shellfish/seaweed (algae) harvesting	3	3	3	3	3	3	3	3
Fish farms	3	3	3	3	3	3	3	3
Shellfish cultures	3	3	3	3	3	3	3	3
Algae cultures	3	3	3	3	3	3	3	3
Amenity beaches	3	4	3	2	2	3	2	1
Marinas	2	3	3	1	1	1	1	1
Tourism activities	2	3	3	2	1	2	1	1
Densely populated town and communities	2	2	2	2	1	2	1	1
Surfing hot spots	3	4	3	3	1	2	1	1
Main recreational fishing locations	3	4	3	2	3	3	2	2
Cruise liner stops	1	2	1	1	1	1	1	1
Heritage sites	4	4	4	4	2	2	2	2
Ports	2	2	2	2	1	1	1	1
Mineral extraction sites	1	1	1	1	1	1	1	1
Renewable energy sites (OWF)	1	1	1	1	1	1	1	1
Water intakes	3	3	3	3	3	3	3	3

*) During the workshop it was decided to refine the definition of seagrass beds to be beds of *Zostera* sp. with an area cover of >5 % in accordance to OSPAR definitions.

**) Kelp forests were introduced as an additional ecological feature to distinguish this important habitat from "normal" marine vegetation and seagrass beds.

It has previously been agreed that whales (Cetaceans) should be excluded as a features since they appear widely, they are not highly sensitive to oil and they can move away from a slick. Therefore, they are not in the list above.

It was discussed to omit certain features, like moulting areas, surfing hotspots and cruise liner terminals. It was decided to evaluate the maps that would describe these features in order to include them or not.

2.3 Weighting of features

During the work shop there was a discussion on how to obtain a proper weighting of the feature scores in the future analyses.

Several weighting ratios were presented, which are listed in Table 2-3.

Table 2-3 Proposed weighting ratios of feature groups.

Groups	Weighting ratios (%)				
	1	2	3	4	Based on feature numbers
1 Habitats	25	35	15	50	48
2 Species	25	25	15	10	15
3 Protected areas	25	30	20	15	8
4 Socio-economy	25	10	50	25	28

The four first options in Table 2-3 were chosen and maps of total vulnerability will be made using each ration to observe variations due to weighting.

Maps for environmental features (group 1-3) as well as maps for socio-economy shall be produced.

3 Discussions and rationales

The following is a breakdown of the discussion and rationales behind the scoring of each feature.

3.1 Habitats

3.1.1 Shoreline and Coastal habitats

Exposed rocky shores and reefs < 20 m

Score surface oil spill: Spring: 3, Summer: 3, Fall: 2, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 2, Winter: 2

Arguments for scores:

- › Exposed rocky shores are typically a mix of steep rocks and rocks with low to moderate slope. The fate of oil differs somewhat on the two types of rocks:
 - › **Steep exposed** rocks are characterised by regular exposure to high wave energy and tidal currents. The waves are strongly reflected. The persistence of oil on steep exposed rock is low because they are exposed to large waves and wave reflection tends to keep oil offshore and waves promote rapid natural degradation of oil. In addition stranded oil remains on surface because the substrate is impermeable, resulting in quick removal of oil by natural degradation processes (within a few weeks). Clean-up operations are difficult and generally not required for oil stranded on exposed steep rocky coasts.
 - › **Exposed rock with low to moderate slope** is characterised by regular exposure to high wave energy and strong wave-reflection patterns. The lower slope result in a wider intertidal zone compared to vertical rocks. The intertidal zone can be up to hundreds of meters wide. The substrate is impermeable with no potential for subsurface penetration over much of the intertidal zone and the high wave energy tends to remove oil.

- › Organisms attached to rocks, stones are very sensitive to oil due to direct toxic effects, smothering, and indirect effects derived from the spill. Recovery of algal vegetation slow. Re-colonization by most species of epifauna is however quite rapid but the recovery of certain sensitive species may be prolonged (such as species of crustaceans and mussels).
- › Due to the less persistence of oil on exposed rocks compared to sheltered rocks , the score has been set to 3 and to 2 in fall and winter where the highest wave energy are expected to occur.

The scores and the arguments behind them are identical for surface oil spills and dispersed oil.

Exposed rocky shores and reefs > 20 m

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

The scores for surface oil spills have been lowered by one compared to “Exposed rocky shores and reefs < 20m, because the risk that spilled oil is reaching the reefs on deeper waters is less. For dispersed oil the score has been maintained as 2 in all seasons because in general the risk of dispersed oil reaching deeper water is higher.

Sheltered rocky shores and reefs < 20 m

Score surface oil spill: Spring: 4, Summer: 4, Fall: 3, Winter: 3

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › Important marine habitats with a high biodiversity. Spawning and nursery areas for fish and crustaceans, feeding areas for birds
- › Organisms attached to rocks and stones are very sensitive to oil due to direct toxic effects, smothering and indirect effects derived from the spill.
- › On shallow water < 20 m toxic concentrations may reach the organisms and affect them
- › Recovery of algal vegetation slow. Re-colonization by most species of epifauna is however quite rapid but the recovery of certain sensitive species may be prolonged (such as species of crustaceans and mussels).
- › Due to the general low energy regime of sheltered rocky shores spilled oil will have a high degree of persistence.

- › Higher scores for dispersed oil as it is less influenced by exposure and is more damaging than surface oil spills in general.

Sheltered rocky shores and reefs > 20 m

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

The scores for surface oil spills have been lowered by one compared to “Sheltered rocky shores and reefs < 20m, because the risk that spilled oil is reaching the reefs on deeper waters is less. The scores for dispersed oil remains the same as for shallower sheltered rocky shores and reefs due to the more damaging impact than surface oil spills in general.

Littoral chalk communities

Score surface oil spill: Spring: 4, Summer: 4, Fall: 3, Winter: 3

Score dispersed oil: Spring: 4, Summer: 4, Fall: 3, Winter: 3

Arguments for scores:

- › Littoral chalk communities are rare communities in Europe. The chalk formations house rich and unique communities of seaweed (particularly red algae)
- › Organisms on chalk communities on the shore are sensitive to oil spills
- › Chalk communities have therefore been allocated Score 4 during the growth season in spring and summer and score 3 during winter and fall outside the growth season
- › No difference between scores for surface oil spills and dispersed oil.

Sandy beaches

Score surface oil spill: Spring: 2, Summer: 2, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 1, Winter: 1

Arguments for scores:

- › The persistence of stranded oil is limited due to: 1) The compact nature of fine sand limits oil penetration to a few centimeters. 2) Fine grained sand beaches generally accrete slowly between storms reducing the potential for burial of oil by clean sand. 3) The low penetration and low potential for burial facilitates natural degradation processes and mechanical removal. 4) The beaches are generally highly exposed to waves facilitating the removal of oil from the shoreline

- › Sandy beaches above the high water mark generally have low species diversity and generally few organisms may be impacted following an oil spill.
- › The general low vulnerability score (of 1) has been increased to score 2 during spring and summer, when the biological productivity is highest.
- › No difference between scores for surface oil spills and dispersed oil.

Shingle beaches

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Shingle habitats are often home to many specialist plant species, which are unable to survive anywhere else. They are also extremely important to a range of other species that are sensitive to oil spills including ground nesting birds such as terns and the Ringed Plover and waders like the Oystercatcher and curlews.
- › Oil stranded on a shingle beach penetrates rapidly and deeply into the coarse sediments and may persist for years. A moderately to heavily oiled shingle beach is practically impossible to clean without removal of large amounts of pebbles and cobbles which may reduce the stability of the beach.
- › Due to the above, where the scores are mainly due to sensitive species, there is no difference between scores for surface oil spills and dispersed oil.

Tidal sand and mud flats

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › Tidal sand and mud flats are productive ecosystems. Mudflats are among the most productive ecosystems on Earth. Tidal sand and mud flats are characterized by very high density and biomass of organisms, but low diversity with few rare species. Fauna species that live on mudflats include invertebrates, birds and fish. The abundant invertebrate fauna provide food for a large number of wildfowl and are often feeding and resting areas for internationally important populations of migrant and wintering waterfowl. They are also important feeding and nursery areas for fish
- › Oil stranded on tidal flats in sheltered areas may persist for years due to low wave energy. On exposed flats the persistence is less.

- › Benthic invertebrate fauna and fish in the littoral zone are generally very sensitive to oil spill and elevated concentrations of toxic oil components in the water. However, benthic fauna has a high recovery potential. Recolonization by most species is quite rapid but the recovery of certain sensitive species may be prolonged (such as species of crustaceans and mussels). Birds on tidal flats are also very sensitive to oil spills (Birds are ranked separately).

Salt marshes

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › Salt marshes are extremely productive habitats. They serve as depositories for a large amount of organic matter, which feeds a broad food chain of organisms from microorganisms and invertebrates, which in turn become food for fish and birds.
- › Oil stranded in salt marshes may persist for years and is very difficult to clean-up

Salt-marsh organisms are sensitive to oil pollution.

Estuaries

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

If oil enters into estuaries, natural removal rates are very slow because there is little wave action to remove the oil. Toxic concentrations of oil may be encountered on the shallow water. In addition, there are often tidal flats and oil components tend to adhere to the flat, preventing removal by tides. Therefore, oil may persist for years on the flats.

The areas are highly productive and function as feeding grounds for a large number and species of birds.

The vulnerability has therefore been ranked a score of 4 during the whole season.

Large shallow inlets and bays

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Shallow inlets and bays are large indentations of the coast with a great diversity of sediments and substrates with a well-developed zonation of benthic communities.

- › The fate of oil in shallow inlets and bays is similar to estuaries and coastal lagoons and they more or less house the same type of organisms, although estuaries may contain species more adapted to salinity fluctuations compared to coastal lagoons, inlets and bays.
- › The vegetation and benthic fauna encountered in shallow inlets and bays are very vulnerable to oil spills. So are the birds and fish spawning and nursery areas encountered in shallow inlets and bays
- › Shallow inlets and bays has been allocated score 3 during the whole season for both types of oil exposure, which is one unit lower than estuaries.

Coastal lagoons

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

The fate of oil in coastal lagoons is similar to estuaries and shallow inlets and bays and they basically house the same organisms.

Coastal lagoons are in general less exposed to wave energy and the vulnerability has therefore been ranked with a score of 4 during the whole season and for both types of oil exposure.

Underwater sandbanks < 20m

Score surface oil spill: Spring: 3, Summer: 3, Fall: 2, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Benthic invertebrate fauna organisms typically encountered on underwater sandbanks are generally very sensitive to oil spill and elevated concentrations of toxic oil components in the water. There are numerous examples of severe impacts on benthic fauna following oil spills. However, impacts have only been observed on shallow water along the coasts where toxic concentrations may reach the seabed.
- › In general, benthic fauna has a high recovery potential. Recolonisation by most species is quite rapid but the recovery of certain sensitive species may be prolonged (such as species of crustaceans and mussels).

Therefore underwater sandbanks on shallow water (less than 20 m depth) has been allocated score 2) during fall and winter when the productivity is low and score 3) during spring and summer when productivity is highest concerning surface oil spills. The ranking score for dispersed oil is 3) for the whole season as a reflection of a higher availability for the oil to be taken up by organisms,

Underwater sandbanks > 20m

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

- › Underwater sandbanks on deeper waters (more than 20 m depth) has been allocated score 1 for all seasons concerning surface oil spills, because there is only a small risk that oil spilled at the surface will reach the seabed and affect the organisms.
- › Underwater sandbanks on deeper waters (more than 20 m depth) has been allocated score 2 for all seasons concerning dispersed oil, as there is a higher risk of the oil reaching the seabed.

Biogenic reefs < 20 m

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › Same arguments as for underwater sandbanks < 20 m in regard to fate of oil.
- › High sensitivity all year round as the reefs constitute hot spots of diversity and production.
- › Same ranking for surface oil spills and dispersed oil.

Biogenic reefs > 20 m

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › Scores for surface oil spills are set lower as it is less likely that surface oil will reach deeper biogenic reefs.
- › Same arguments as for underwater sandbanks > 20 m in regard to sensitivity

Maerl beds

Score surface oil spill: Spring: 4, Summer: 4, Fall: 3, Winter: 3

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › European maerl (which consist of nodular coralline algae) is ecologically fragile due to very slow growth. Maerl is considered to be of significant conservation importance due to its rarity and valuable role as a highly bio-

diverse habitat. Maerl beds are important nursery areas for the juvenile stages of commercial species such as juvenile cod, saithe, pollack and juvenile scallops

- › Most commonly encountered from 20 m depth to the low tide mark, where toxic concentrations of oil may be encountered

Maerl beds are highly sensitive to oil and oil smothering and their recovery will be extremely slow, due to slow growth. The scores of 3) in fall and winter for surface oil spills, reflects an anticipated higher wave energy exposure.

Seagrass beds (Zostera sp. with >5 % coverage)

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for scores:

- › Eelgrass beds are important habitats with a high biodiversity. Eelgrass beds have an associated fauna of benthic invertebrates. They stabilise the sediment, is food for some seabirds and eelgrass beds are important feeding, spawning and nursery grounds for fish.
- › Eelgrass favours areas sheltered from wave action, so spilled oil may persist for quite a while in areas with eelgrass
- › Severe adverse impacts on seagrass have been observed following oil spills including the Amoco Cadis spill in 1978 and The Exxon Valdez oil spill in 1989

Seagrass meadows have therefore been allocated Score 4 during the entire season for both surface oil spills and dispersed oil.

Kelp forests

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 3

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Kelp forests are dense populations of fast growing brown macroalgae. They provide food and shelter for many marine animals, including commercial species such as spider crabs, the European lobster and juvenile finfish including Pollack. In addition they recycle nutrients and provide energy for coastal food webs and act as defenses of the coastline by absorbing wave energy.

Arguments for scores:

- › Kelps grow to the sea surface and together with the associated fauna, they are highly vulnerable to surface oil spills, with a slightly lower score in winter where wave actions are highest.

- › In relation to dispersed oil, a high ranking score was selected for the whole season.

3.1.2 Open water habitats

Open water column (< 20 m)

Score surface oil spill: Spring: 2, Summer: 2, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

- › **Plankton** The sensitivity of plankton to oil pollution has been demonstrated in the laboratory, but serious effects have not been observed in the field. There are probably two main reasons for plankton populations not being seriously affected in the open sea following an oil spill. Firstly, the oil and its soluble components are rapidly diluted to non-toxic concentrations. Secondly, high reproductive rates of plankton organisms and immigration from outside the affected area counteract short-term reductions in numbers caused by the oil.
- › **Adult pelagic fish.** During an oil spill, toxic concentrations to adult fish are not normally encountered in the water column beneath the oil slick. In addition, adults are highly mobile and are capable of actively avoiding oil-impacted areas.
- › Pelagic fish eggs and larvae and birds that are also encountered in open waters are ranked separately and not included in the ranking of open waters.

Open sea habitats have therefore been allocated a score of 2 in the productive periods of spring and summer and 1 for fall and winter. For dispersed oil, a ranking score of 2 has been given for all seasons.

Deep sea water column (> 20 m)

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

Deep-sea water column is not vulnerable to surface oil spills as oil will not reach the deep sea. This cannot be stated for dispersed, which has been ranked a score of 2.

Deeper sea floor (> 20 m)

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

- › Same arguments as for deep sea water column.

Seamounts

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

- › Seamounts are defined as undersea mountains of volcanic origin. The majority of seamounts occur along the Mid- Atlantic ridge between Iceland and the Hayes fracture zone.
- › Three seamounts are registered within the Bonn Agreement area.
- › They are not vulnerable to surface oil spills as oil will not reach the deep sea where they are encountered. They have been given a slightly higher score for dispersed oil, which may penetrate deeper in the water column.

Coral gardens and sponge aggregations

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Coral gardens are a relatively dense aggregation of coral species with high biological diversity. Coral gardens can be found from 30 m depth (in Norwegian fjords) and down to several thousand meters on open ocean seamounts. Deep-sea Sponge Communities occur in water depths of 250-1300 m.
- › Coral gardens and sponge aggregations are not as vulnerable to surface oil spills as to dispersed oil. In general, they are scored as being vulnerable to their high biodiversity and slow-growing characteristics.

Carbonate mounds

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Carbonate mounds are very steep-sided mounds of variety of shapes. They occur mainly offshore in water depths of 500-1100 m.
- › Arguments are similar as for coral gardens and sponge aggregations.

Lophelia pertusa reefs

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › *Lophelia pertusa* is a reef building, deep water coral. The biodiversity of Lophelia reefs are high. They are most commonly encountered on the continental slope at depths of 200 – > 2,000 meters . Lophelia is sensitive to oil and has extremely low growth rates.
- › Their sensitivity to oil is high, but it is very unlikely that they will be exposed to surface oil spills.
- › The ranking score for dispersed oil is higher, due to a higher risk of dispersed oil reaching the reefs.

Sea-pen and burrowing megafauna

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › This biotope occurs in areas of fine mud that is heavily bioturbated by burrowing megafauna at water depths ranging from 15- 200 m or more.
- › Impacts on this habitat on the shallower waters cannot be excluded, but not very likely. Habitats on deeper waters will not be affected as spilled oil on the surface will not reach the seabed.
- › The ranking score for dispersed oil is higher, due to a higher risk of dispersed oil reaching the habitat.

3.2 Species features

3.2.1 Fish

Pelagic spawning areas for fish

Score surface oil spill: Spring: 2, Summer: 2, Fall: 1, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 2, Winter: 3

Arguments for scores:

- › Fish eggs and larvae are quite sensitive to oil, as demonstrated in numerous laboratory toxicity tests. However, in several studies effects on pelagic fish eggs and larvae were not observed in the field following oil spills. One reason for this may be that toxic concentrations of oil components are generally confined to the uppermost parts of the water column immediately beneath an oil slick and that fish eggs and larvae are encountered below the toxic water layers.

- › There is no evidence to date that even very large oil spill has affected stocks of species with pelagic eggs even in cases where massive kills of eggs and larvae was observed. The lack of effects on numbers in subsequent adult populations following massive kills of eggs and larvae is probably because the fish produce extremely large numbers of eggs and larvae and because most species have extensive spawning grounds
- › Based on this pelagic spawning areas for fish (other than herring-Cf arguments for herring below) have been allocated score 2 for winter, spring and summer when spawning occurs and score 1 for autumn when spawning does not take place.
- › The same arguments apply to the scoring for dispersed oil, but the value is increased by one, as dispersed oil is more bioavailable.

Demersal spawning areas (e.g. herring)

Score surface oil spill: Spring: 3, Summer: 3, Fall: 4, Winter: 4

Score dispersed oil: Spring: 3, Summer: 3, Fall: 4, Winter: 4

- › Herring is a species with demersal spawning (i.e. it deposits its eggs on the seabed in shallow water). It is documented from the Exxon Valdes oil spill that a herring stock collapsed and had not recovered 20 years following the spill. The mechanism for the collapse is not known
- › Sensitivity of spawning areas on shallow water to surface oil spills and dispersed oil has therefore been allocated score 4 during the spawning seasons (fall and winter). For spring and summer the score is lowered to score 3 because on the one hand it is outside the spawning season and on the other persisting oil spilled during spring and summer may still affect spawning during autumn and winter due to destruction of spawning substrate

Coastal nursery areas for fish

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 3

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Arguments for score:

- › Juvenile fish sensitive to oil
- › Nursery areas are in shallow water, therefore toxic concentrations of oil may be encountered from surface to seabed
- › Nursery season is spring and summer, which therefore have been allocated a score of 4 in regard to surface oil spills. Fall have also been allocated 4, as juveniles may still be in the areas. In Winter, they have been allocated a score of 3 as oil spilled may persist and affect juveniles during the following nursery season.
- › Scores in regard to dispersed oil have been given a value of 4 in all seasons.

3.2.2 Birds

Wintering areas for birds

Score surface oil spill: Spring: 3, Summer: 1, Fall: 3, Winter: 4

Score dispersed oil: Spring: 1, Summer: 1, Fall: 1, Winter: 2

Arguments for scores:

- › Seabirds are perhaps the most prominent victims of oil spills at sea. Harmful effects of oils are well documented and severe bird mortality often occurs if spilled oil enters areas where seabirds are concentrated. The reason for seabirds being easily harmed by floating oil is the fact that in case oil sticks to the plumage feathers may collapse destroying the insulating properties of the plumage.
- › Wintering birds at sea spend most of the time on the sea-surface and are therefore particularly vulnerable. Sensitivity of wintering areas for birds to surface oil spills have been allocated score 4 during winter. For spring the score is lowered to score 3, because there may still be some "wintering" birds in the areas. During summer there are none and the score is set to 1. During fall some individuals have started to arrive, and fall has been allocated the score 2
- › Effects of dispersed oil on birds are much less severe compared to surface oil spills. There are no major effects on the plumage, although increased dietary uptake of oil may occur. The scores for dispersed oil follow the same seasonal pattern as surface oil, but has been decreased by two units.

Staging areas for birds

Score surface oil spill: Spring: 4, Summer: 2, Fall: 4, Winter: 2

Score dispersed oil: Spring: 2, Summer: 1, Fall: 2, Winter: 1

Arguments for scores:

- › The bulk of birds in staging areas are shorebirds and waterfowl that are often concentrated on tidal flats and are very vulnerable to oil spills. Apart from the impacts on plumage waterfowl and shorebirds may be affected as a result of toxic effects.
- › The sensitivity of staging areas for migrating birds to surface oil spills have been allocated the score 4 in spring and fall when the peak numbers are encountered. For winter and summer the score has been lowered to 2 as there still may be some birds left early summer and early winter.
- › Effects of dispersed oil on birds are much less severe compared to surface oil spills. There are no major effects on the plumage, although increased dietary uptake of oil may occur. The scores for dispersed oil follow the same seasonal pattern as surface oil, but has been decreased by two units.

Breeding birds

Score surface oil spill: Spring: 4, Summer: 4, Fall: 3, Winter: 1

Score dispersed oil: Spring: 3, Summer: 3, Fall: 2, Winter: 1

Arguments for scores:

- › The open waters and tidal flats off breeding areas are important feeding areas for breeding birds and large numbers of birds are concentrated here. Surface oil spills in such areas may therefore cause massive kills of birds, whereas dispersed oil may have a lesser impact.
- › Sensitivity of breeding areas for sea and shore birds to surface oil spills have been allocated score 4 for spring and summer when breeding is at its peak. Score 3 and score 1 have been allocated for winter and fall, respectively as oil spills during the seasons may persist and affect birds during the breeding season.
- › Effects of dispersed oil on birds are much less severe compared to surface oil spills. There are no major effects on the plumage, although increased dietary uptake of oil may occur. The scores for dispersed oil follow the same seasonal pattern as surface oil, but has been decreased by one unit.

Moulting birds

Score surface oil spill: Spring: 2, Summer: 4, Fall: 2, Winter: 2

Score dispersed oil: Spring: 1, Summer: 2, Fall: 1, Winter: 1

Arguments for scores:

- › Moulting birds cannot fly and stay on the sea-surface. They are therefore particularly sensitive to surface oil spills
- › Concerning surface oil spills moulting areas for seabirds have been allocated score 4 for the summer period when moulting takes place and score 2 for others seasons, when birds are not moulting. For dispersed oil, the scores follow the same seasonal pattern, but are lowered.

3.2.3 Mammals

Coastal feeding ground for otters

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 4, Summer: 4, Fall: 4, Winter: 3

Arguments for scores:

- › The European otter may inhabit any unpolluted body of fresh water, including lakes, streams, rivers, and ponds as long as the food supply (primarily fish), is adequate. European otters may also live along the coast, in salt water, but require regular access to fresh water to clean their fur.

- › Otters are more vulnerable to the effects of a surface oil spill than any other marine mammal. This results from the small size, high metabolic rate, complete reliance on fur for thermo-insulation and prolonged periods of time floating or swimming and the sea surface where oil concentrates. Their sensitivity to dispersed oil is equally ranked high as it may also affect the quality of their prey.

Breeding, shedding and haul-out sites for seals

Score surface oil spill: Spring: 3, Summer: 4, Fall: 4, Winter: 3

Score dispersed oil: Spring: 2, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Seals and especially their pups are very vulnerable to oil spills when they are concentrated on their breeding, moulting and haul-out sites on undisturbed islands, islets sandy beaches, reefs, skerries and sandbanks.
- › Concerning surface oil spills, fall has been allocated score 4 and winter score 3 because Grey seal breed during the period September – January and shedding for both seal species takes place in August – September. Summer has been allocated score 4 because Harbour seals breeds during summer especially from the beginning of June to the beginning of July on undisturbed breeding sites on land. Spring has been allocated score 3, because some seals may still be at haul out sites.
- › Similar arguments are used for dispersed oil, but the scores have been decreased by one, as dispersed oil may not impose a severe effect on the fur as surface oil spills.

3.3 Protected areas

The protected areas include Ramsar sites for birds, Nature 2000 areas, nationally selected protected areas and World Heritage sites. Together they house many of the sensitive species and habitats described above. As they are protected, they have been allocated an extra vulnerability score, i.e. score 4 for all seasons for both surface oil spills and dispersed oil.

3.4 Socioeconomic features

3.4.1 Offshore fisheries

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

- › Offshore fisheries may be impacted from both surface oil spills and dispersed oil, which can lead to fishing bans in affected areas. The length of the interruption was assessed to be short.
- › Financial compensation may be available to some extent, and fishermen may allocate to other areas during interruptions.
- › The same scoring applies to both surface oil spills and dispersed oil

3.4.2 Coastal fisheries

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › The same arguments apply as for offshore fisheries. However, it was assessed that coastal fisheries do not have the same range and mobility as offshore fisheries. This may affect their allocation ability and therefore was the ranking scores increased by one unit.
- › The same scoring applies to both surface oil spills and dispersed oil

3.4.3 Shellfish/seaweed (algae) harvesting

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › The length of interruption of harvesting shellfish or seaweed after an oil spill may be relatively long. Shellfish will not be suitable for consumption and seaweeds will be covered in oil or tainted with droplets.
- › Compensation is unlikely, but it might be possible to allocate to other unaffected areas.
- › The same scoring applies to both surface oil spills and dispersed oil

3.4.4 Fish farms

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › The length of interruption of cultivating fish farms after an oil spill may be relatively long. Fish may die if they are covered in oil or they will not be suitable for consumption for prolonged periods after exposure.
- › Some compensation may be possible, and it might be possible to allocate some fish farms to other unaffected areas before a spill reaches the area.
- › The same scoring applies to both surface oil spills and dispersed oil

3.4.5 Shellfish cultures

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › The length of interruption of cultivating shellfish after an oil spill may be relatively long. Individuals may die if they are covered in oil or they will not be suitable for consumption for prolonged periods after exposure.
- › Some compensation may be possible.
- › The same scoring applies to both surface oil spills and dispersed oil

3.4.6 Algae cultures

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Same arguments for scores as for shellfish cultures.

3.4.7 Amenity beaches

Score surface oil spill: Spring: 3, Summer: 4, Fall: 3, Winter: 2

Score dispersed oil: Spring: 2, Summer: 3, Fall: 2, Winter: 1

Arguments for scores:

- › Amenity beaches represent the highest value in the tourist season, which is culminating in summer, but also with some activity in spring and fall. Beaches are to some degree also used in winter has some recreational value.
- › Length of interruption can be long, even after a clean-up has taken place. To some degree a spill event can stay in people perception of a place.
- › No compensation is likely to be available
- › For surface oil spills, amenity beaches are given a score of 4 in summer and 3 in spring and fall. Winter has been given a score of 2.

- › The score values for dispersed oil follow the same seasonal pattern, but with lower values as dispersed oil is less obvious compared to oil slicks.

3.4.8 Marinas

Score surface oil spill: Spring: 2, Summer: 3, Fall: 3, Winter: 1

Score dispersed oil: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Arguments for scores:

- › Marinas are most active in the leisure sailing season from spring to fall.
- › Surface oil spills are most likely to affect marinas more than dispersed oil.
- › Length of interruption will be short and oil may be stopped from entering marinas, but on the other hand, marinas may be closed temporarily during clean-up operations.
- › Compensation possibilities are considered to be absent
- › Scores for surface oil spills are 3 for summer and fall and 2 for spring. Winter is not considered to be an active time for marinas and the score given is 1.
- › The scores for dispersed oil are 1 throughout the season, as it was assessed the marinas would not be affected by dispersed oil.

3.4.9 Tourism activities

Score surface oil spill: Spring: 2, Summer: 3, Fall: 3, Winter: 2

Score dispersed oil: Spring: 1, Summer: 2, Fall: 1, Winter: 1

Arguments for scores:

- › Tourism activities are general activities associated to coastal areas, and perceived as number of overnight stays in these areas.
- › Tourism activities peaks from spring to fall, but there are also activities during winter.
- › Length of interruption can be long, even after a clean-up has taken place. To some degree a spill event can stay in people perception of a place.
- › Compensation possibilities are considered to be absent
- › Scores for surface oil spills are 3 for summer and fall and 2 for spring and winter.
- › The scores for dispersed oil are 1 throughout the season, except for summer.

3.4.10 Densely populated towns and communities

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 1, Summer: 2, Fall: 1, Winter: 1

Arguments for scores:

- › This feature is perceived as effects on the local residents of coastal communities and how they are affected by oil spills and dispersed oil.
- › Length of interruption may be short, dependent on the activities the local residents carry out.
- › Compensation possibilities are considered to be absent
- › The value of the score was set to be 2 all season for surface oil spills and for summer of dispersed oil. Spring, fall and winter were given a score of 1 for dispersed oil.

3.4.11 Surfing hot spots

Score surface oil spill: Spring: 3, Summer: 4, Fall: 3, Winter: 3

Score dispersed oil: Spring: 1, Summer: 2, Fall: 1, Winter: 1

There was a discussion at the workshop, which this feature should go out, as it is just one of many coastal water activities and should not be emphasised.

Arguments for scores:

- › Surfing hot-spots are thought to be very local areas with surfing as the main activity.
- › In general, they are scored high as length of interruption can be prolonged and no compensation is likely to be available.
- › Surface oil spill scores are set to be higher than dispersed oil.

3.4.12 Main recreational fishing locations

Score surface oil spill: Spring: 3, Summer: 4, Fall: 3, Winter: 2

Score dispersed oil: Spring: 3, Summer: 3, Fall: 2, Winter: 2

Arguments for scores:

- › Main recreational fishing locations are small areas, often reefs or banks where fish congregate and recreational fishing is good.
- › The associated economy can be important for local communities

- › Length of interruption may be prolonged and can be affected by public perception of an area after a spill.
- › Compensation is unlikely
- › Recreational fishing is seasonal dependent, which is reflected in the score.

3.4.13 Cruise liner stops

Score surface oil spill: Spring: 1, Summer: 2, Fall: 1, Winter: 1

Score dispersed oil: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Arguments for scores:

- › Length of interruption is estimated to be short
- › Impacts on cruise liner stops are difficult to compensate
- › Scores reflect seasonal variations with highest intensities may-september.

3.4.14 Heritage sites

Score surface oil spill: Spring: 4, Summer: 4, Fall: 4, Winter: 4

Score dispersed oil: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Arguments for scores:

- › Heritage sites and their socio-economic value are estimated to be very sensitive to oil spills, e.g. (Dover Cliffs or Mont St. Michel covered in oil)
- › Dispersed oil may not have the same effect, and are ranked with a lower score

3.4.15 Ports

Score surface oil spill: Spring: 2, Summer: 2, Fall: 2, Winter: 2

Score dispersed oil: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Arguments for scores:

- › Length of interruption is estimated to be short
- › Impacts on ports are relatively easy to compensate
- › Scores reflect no seasonal variation.

3.4.16 Mineral extraction sites

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Arguments for scores:

- › Length of interruption is estimated to be short
- › Impacts on extraction sites are relatively small and easy to compensate
- › Scores reflect no seasonal variation.

3.4.17 Renewable energy sites (OWF)

Score surface oil spill: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Score dispersed oil: Spring: 1, Summer: 1, Fall: 1, Winter: 1

Arguments for scores:

- › Length of interruption is estimated to be short
- › Impacts on renewable energy sites are relatively small and easy to compensate (if necessary at all)
- › Scores reflect no seasonal variation.

3.4.18 Water intakes

Score surface oil spill: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Score dispersed oil: Spring: 3, Summer: 3, Fall: 3, Winter: 3

Arguments for scores:

- › Impacts on water intakes are potentially severe, difficult to compensate
- › Scores reflect no seasonal variation

4 Task Force

It was decided to use a task force to clarify outstanding environmental and socio-economic questions. The task force will be steered by the Bonn Agreement Secretariat.

- › Kevan Cook (UK) proposed to clarify outstanding questions regarding chalk communities
- › MUMM (BE) is willing to participate
- › RWS (NL) is willing to draw upon experts if requested