

Monitoring Specifications

Date: 2010-01-28

Macrophytes





ARGE BLMP - Working Group for the North Sea and Baltic Sea Monitoring Programme

At the 34th North German Environmental Ministerial Meeting held on 17 April 1997, the competent departments of the German Federal Government and of the federal states of Hamburg, Mecklenburg-Vorpommern, Lower Saxony and Schleswig-Holstein agreed to establish a joint working group co-ordinating the monitoring of the marine environment of the North and Baltic Seas (ARGE BLMP Nord- und Ostsee).

Members of ARGE BLMP are:

- Federal Ministry of Food, Agriculture and Consumer Protection
- Federal Ministry of Transport, Building and Urban Development
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- Federal Ministry of Education and Research
- Authority for Urban Development and Environment of the Free and Hanseatic City of Hamburg
- Mecklenburg-Vorpommern Ministry for Agriculture, the Environment and Consumer Protection
- Lower Saxony Ministry for the Environment and Climate Protection
- Schleswig-Holstein Ministry for Agriculture, the Environment and Rural Areas

The Monitoring Manual describes the current measuring programme implemented under BLMP. The monitoring requirements of the different EC Directives (Marine Strategy Framework Directive, Water Framework Directive, FFH, Birds Directive), marine protection conventions (OSPAR, HELCOM, Trilateral Monitoring and Assessment Program) and other bodies of regulations have been taken into account in the Manual. The Monitoring Manual is available free of charge on the BLMP website at www.blmp-online.de/Seiten/Monitoringhandbuch.htm

Editorial information

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1 General

1.1 Subject area

Biological Monitoring - Flora - Macrophytes

1.2 Definition

For the purposes of these specifications, macrophytes are subdivided into:

- Eulittoral and sublittoral macroalgae
- Eulittoral and sublittoral seagrass meadows
- *Salicornia* und *Spartina* swards
- Salt meadows and reedbeds from the eulittoral zone to the supralittoral zone

1.3 Competent authority/ies

Federal Government:	UBA , BfN , BSH
Hamburg:	BSU
Mecklenburg-Vorpommern:	LUNG
Lower Saxony:	NLWKN , NLPV NI
Schleswig-Holstein:	LLUR , LKN-SH

1.4 Working group

Ad Hoc Working Group on Benthos and Benthic Habitats
TMAP ad hoc group on seagrass

2 Monitoring requirements

2.1 Necessity

[MSFD \[1\]](#)

Article 11 [2]

Comments

According to Annex III, Table 1, monitoring programmes must be drawn up that encompass the following parameters for angiosperms and macroalgae:

- species composition,
- biomass and
- annual/seasonal variability.

Article 8(1) [3]

Comments

The results of macrophyte monitoring are required for the initial assessment of marine waters. This must incorporate the following parameters for angiosperms and macroalgae:

- species composition,
- biomass and
- annual/seasonal variability.

See MSFD, Annex III, Table 1.

[HD \[4\]](#)

Article 11 [5]

Comments

Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2 with particular regard to priority natural habitat types and priority species.

The "conservation status" of a natural habitat is defined by, among other things, the conservation status of the species that are characteristic of it. Macrophytes represent some of the species typical of many HD habitat types:

- Sandbanks (Natura 2000 Code 1110)
- Estuaries (Natura 2000 Code 1130)
- Lagoons (Natura 2000 Code 1150)
- Large shallow inlets and bays (Natura 2000 Code 1160)
- Reefs (Natura 2000 Code 1170)
- Driftlines (Natura 2000 Code 1210)
- Stony banks (Natura 2000 Code 1220)
- Sea cliffs (Natura 2000 Code 1230)
- *Salicornia* and other annuals colonising mud and sand (Natura 2000 Code 1310)
- *Spartina* swards (Natura 2000 Code 1320)
- Salt meadows (Natura 2000 Code 1330)

[WFD \[6\]](#)

Article 8(1)

Comments

According to the WFD, macrophytes must be investigated as a quality element in transitional and coastal waters at least every three years in the context of surveillance monitoring (see Annex V, 1.3.3 and 1.3.4: monitoring of macroalgae and angiosperms in coastal and transitional waters). In the context of operative monitoring, macrophytes represent an important indicator for eutrophication effects.

[HELCOM](#)

Baltic Sea Action Plan [7]

Comments

A range of EcoQOs have been described by HELCOM for all four segments of the Baltic Sea Action Plan, in which respect macrophytobenthos have hitherto played a merely subordinate role (main variable) after phytoplankton and macrozoobenthos (core variables). An assessment should be carried out on the basis of the influence eutrophication exerts on depth range and species composition through nutrient concentrations and the light climate. In future, the significance of macrophytes under the WFD will also be reflected within HELCOM by means of the establishment of a Macrophytobenthos Expert Group.

COMBINE

Comments

The [COMBINE-Manual](#) lists phytobenthos as a "main variable". Monitoring is focussed on the "response of the different biological compartments" to eutrophication. In this respect, eutrophication effects stand to the fore: the influence of light conditions and the nutrient situation on depth range and species composition. See also COMBINE, Part C: Guidelines for monitoring of phytobenthic plant and animal communities in the Baltic Sea

A procedure for the assessment of eutrophication is currently being developed as part of the Eutrophication Assessment project. This will involve the specification of appropriate metrics, which will have to be monitored in future.

Macrophytes must be monitored once a year in summer (July-September, preferably August-September).

OSPAR

JAMP (see Theme B: Biological diversity and ecosystems)

Comments

- Monitoring of the distribution of species and habitats.
- Assessment of the ecosystem status in order to determine the range of anthropogenic impacts.

JAMP Common Procedure

Comments

Procedure for the determination of the eutrophication status of the OSPAR marine region.

Macrophytes must be monitored in order to record primary eutrophication effects.

Monitoring frequencies for the purposes of assessment under the OSPAR [Common Procedure](#):

Problem areas und potential problem areas:	Annually
Non problem areas:	Every three years

TMAP [8]

Wadden Sea Plan (Stade Declaration, 1997)

Comments

The Common Package in Annex 2 describes the monitoring of seagrass and macroalgae (biological parameters), and salt meadows (habitat parameters).

Annual estimation of macrophyte coverage (macroalgae and seagrass, remote sensing and parallel in situ measurements), as well as monthly investigation of selected areas of high variability during the vegetation period.

Technical necessity

	WFD - surveillance	WFD - operative	HD	MSFD	OSPAR	HELCOM	TMAP
Frequency	At least every three years	At least annually	At least every six years	At least annually and seasonally	At least annually	At least annually	At least annually

Minimum requirements concerning the monitoring frequencies for macrophyte monitoring imposed by the directives.

As a rule, annual monitoring (once a year in summer) is necessary on account of macrophytes' high natural variability. A number of the species examined are annual and, in addition to this, display strong seasonality.

2.2 Environmental targets

MSFD

'On the basis of the initial assessment made pursuant to Article 8(1), Member States shall, in respect of each marine region or subregion, establish a comprehensive set of environmental targets and associated indicators for their marine waters [...], taking into account the indicative lists of pressures and impacts set out in [...] Annex III.'

HD

This directive is intended to contribute towards ensuring biodiversity through the conservation of natural habitats and wild fauna and flora in the European territory of the Member States to which the Treaty applies (Article 2(1)). Macrophytes are included in the species inventories for various habitat types.

WFD

Good ecological status. This is described as follows:

- Transitional waters: 'There are slight changes in the composition and abundance of macroalgal taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of phytobenthos or higher forms of plant life resulting in undesirable disturbance to the balance of organisms present in the water body or to the physico-chemical quality of the water'; and
- Coastal waters: 'Most disturbance-sensitive macroalgal and angiosperm taxa associated with undisturbed conditions are present. The level of macroalgal cover and angiosperm abundance show slight signs of disturbance.'

(See WFD, Annex V, 1.3.3 and 1.3.4)

HELCOM

The aims of COMBINE are to:

- determine the extent and the effects of anthropogenic inputs of nutrients on marine biota ([Combine Manual-Eutrophication Programme](#)) and
- identify environmentally relevant alterations, in particular the influence of eutrophication ([Guidelines for monitoring of phytobenthic plants](#)).

OSPAR

[Eutrophication strategy](#) and [Common procedure](#)

Assessment of the eutrophication status of the marine environment:

'The overall objective is the achievement in 2010 of a healthy marine environment where eutrophication does not occur.'

Eutrophication status of the North Sea

'All parts of the North Sea should have by 2010 the status of non-problem areas with regard to eutrophication, as assessed under the OSPAR Common Procedure for the Identification of the Eutrophication Status of the Ospam Maritime Area.'

Quality objectives for nutrients and eutrophication effects

- Chlorophyll a - maximum and mean chlorophyll a concentrations during the growing season should remain below a justified area-specific % deviation from the background not exceeding 50 %;
- Eutrophication indicator species - specification of maximum permissible abundances for nuisance and toxic species (area-specific). See also the [revised list of EcoQOs](#) (Annex 2).

TMAP

'The monitoring of macroalgae is carried out to assess their changes [...] due to changes in input of nutrients.' Further objectives: 'an increased area of, and a more natural distribution and development of [...] Zostera fields' (draft TMAP Guidelines), the enhancement of 'carrying capacity', an 'increased area of natural salt marshes' and 'increased natural morphology and dynamics, including natural drainage patterns of artificial salt marshes, under the condition that the present surface area is not reduced' and an 'improved natural vegetation structure, including the pioneer zone, of artificial salt marshes' (targets set in the [Trilateral Wadden Sea Plan](#)).

2.3 Threats

The distribution and abundance of macrophytes are influenced very heavily by eutrophication. Further threats are attributable to:

- Historic rock extraction (Baltic Sea)
- Water engineering measures and other built structures

The threats to salt meadows are described in HD Habitat Type: Atlantic Salt Meadows (1330).

2.4 Spatial allocation

	EEZ	12- nm zone	Coastal waters 1)	Transitional waters
MSFD	x	x	x	-
HD	-	x	x	x
WFD	-	-	x	x
HELCOM	x	x	x	-
OSPAR	-	x	x	x
TMAP	-	-	x	x

1) Under the WFD: baseline plus one nautical mile

3 Monitoring concept

3.1 Description of monitoring network

Only monitoring procedures that are already being implemented are described below. In this respect, the precise method by which the values measured are combined to arrive at an overall assessment is, in some cases, only specified definitively after the tests. Nevertheless, these procedures are mentioned here if the monitoring procedure is well established. Deficiencies are described in section 6.

North Sea

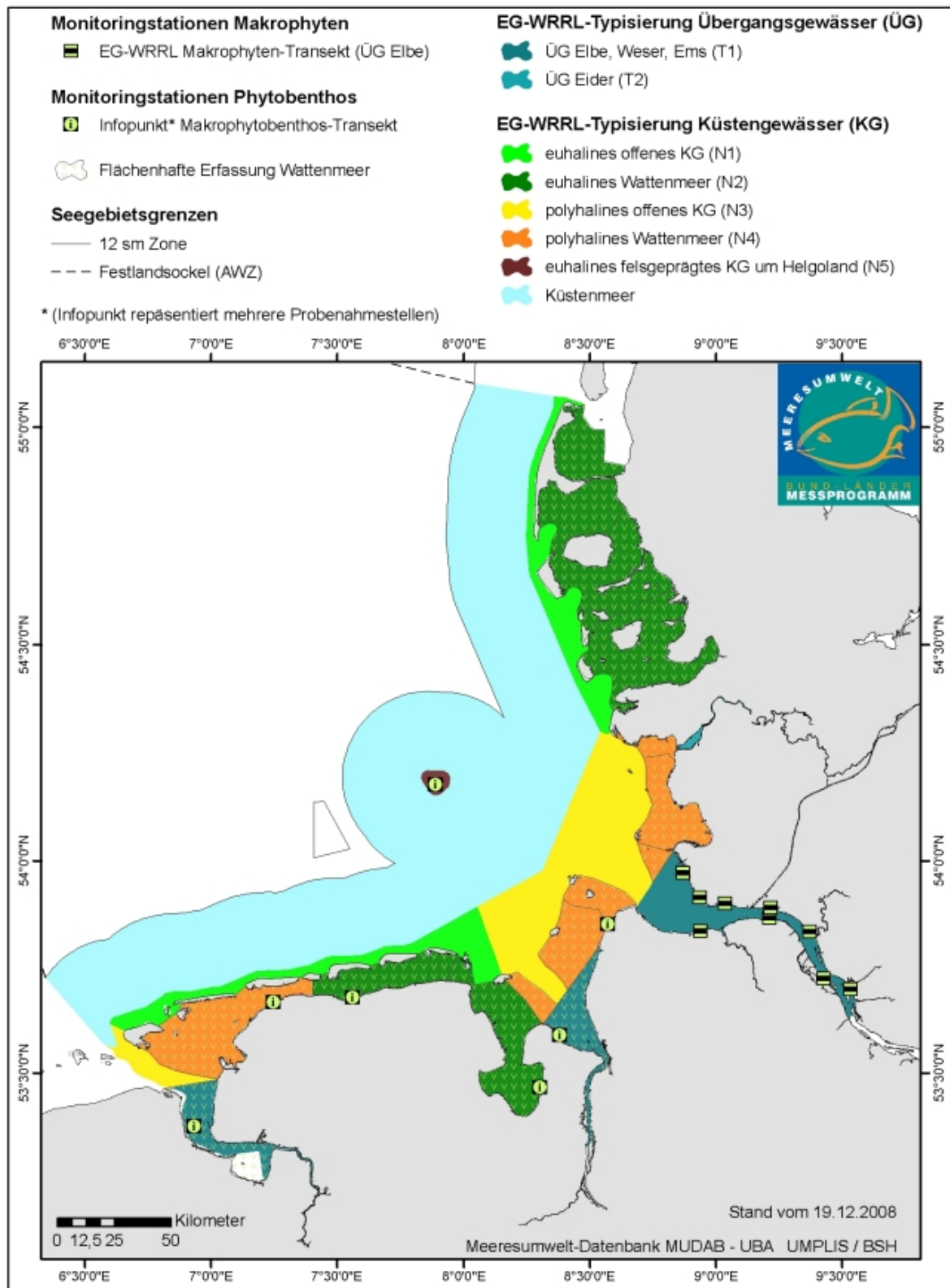


Figure 1: Map showing the stations intended for macrophyte monitoring in the North Sea.

[Figure 1 as PDF-Dokument](#)

Table 1: Occurrence of macrophytes in various water types

	Macroalgae	Sea grass	<i>Salicornia</i> and <i>Spartina</i> swards	Salt meadows and reedbeds
North Sea EEZ	-	-	-	-
North Sea 12-nm zone	X	-	-	-
North Sea sublittoral coastal waters	X	X 1	-	-
North Sea eulittoral coastal waters	X	X	X	X
North Sea transitional waters	X	X	X	X
Heligoland	X	-	-	-

1 Does not occur at present

Macroalgae

- 12-nm zone in the North Sea
 - Where reefs occur, it is to be examined whether they are located at a depth that permits the growth of macrophytes, which should then be used for assessments.
- Coastal waters
 - Eulittoral: areal surveying of green algae mats by means of remote sensing in the eulittoral zone. Lower Saxony: additional in situ transects with surveying of the species inventory and the abundance of red, brown and green algae in representative areas, covering all relevant habitats in the sublittoral and eulittoral zones
- Heligoland (rocky coast)
 - Eulittoral:
 - One qualitative transect and permanent quantitative squares (Schubert, 2006)
 - Spatial-quantitative surveying of the populations of all macrophyte species by means of georeferenced grid mapping
 - Additional spatial surveying of the dense *Fucus* population by means of polygon mapping
 - Species inventory by means of one inspection on foot using the RSL (Reduced Species List) index put forward in Wells et al. (2006) (Kuhlenkamp und Bartsch 2007)
 - Sublittoral:
 - Dive transects replicated three times to survey the depth boundaries of *Laminaria hyperborea* and four red algae species
- Transitional waters
 - Macroalgae not relevant in these areas

Seagrass

- Coastal waters
 - Eulittoral:
 - Areal surveying by means of remote sensing + in situ surveying of (current and potential) seagrass meadows at selected permanent monitoring fields + staged comprehensive in situ mapping on foot, one-sixth of the area of tidal flats (off Schleswig-Holstein) covered each year
 - Sublittoral:
 - Macrozoobenthos samples (see Macrozoobenthos) are also checked for the occurrence of seagrass in order to obtain evidence about any reemergence of sublittoral seagrass.
- Transitional waters
 - See information on coastal waters (mesohaline and polyhaline zones only)

Salt meadows and reedbeds

- Coastal waters
 - Area-wide surveys: surveying of vegetation on the basis of CIR aerial images (analogue or digital) and ground truthing
 - Area-wide surveys: surveying seaward of the main dyke and on the islands together with monitoring of habitat types 1150, 1310, 1320 and 1330 every six years
 - Point surveys: permanent monitoring stations at selected locations

- Transitional waters
 - Elbe: site survey below MHT at nine stations (WFD) (Stiller, 2005, 2008). Eider: site survey below MHT at three stations (WFD) (currently being revised in accordance with Stiller, 2005, 2008)
 - Surveying of salt meadows follows that of coastal waters (see information on coastal waters)
 - Weser and Ems: foreshore areas, the proportion of near-natural biotopes and reedbed width are surveyed in accordance with Adolf et al. (2007), and the vegetation structure surveyed in accordance with Stiller (2005, oligohaline zone). In addition to this, there are salt meadows in the polyhaline zone, the extent and zoning of which are surveyed.
 - Work is currently ongoing on the application of this method and the definition of stations in the Ems, Weser, Eider, Krückau, Pinnau and Stör.

See also HD Habitat Type: Atlantic Salt Meadows (Natura 2000 Code 1330).

Baltic Sea

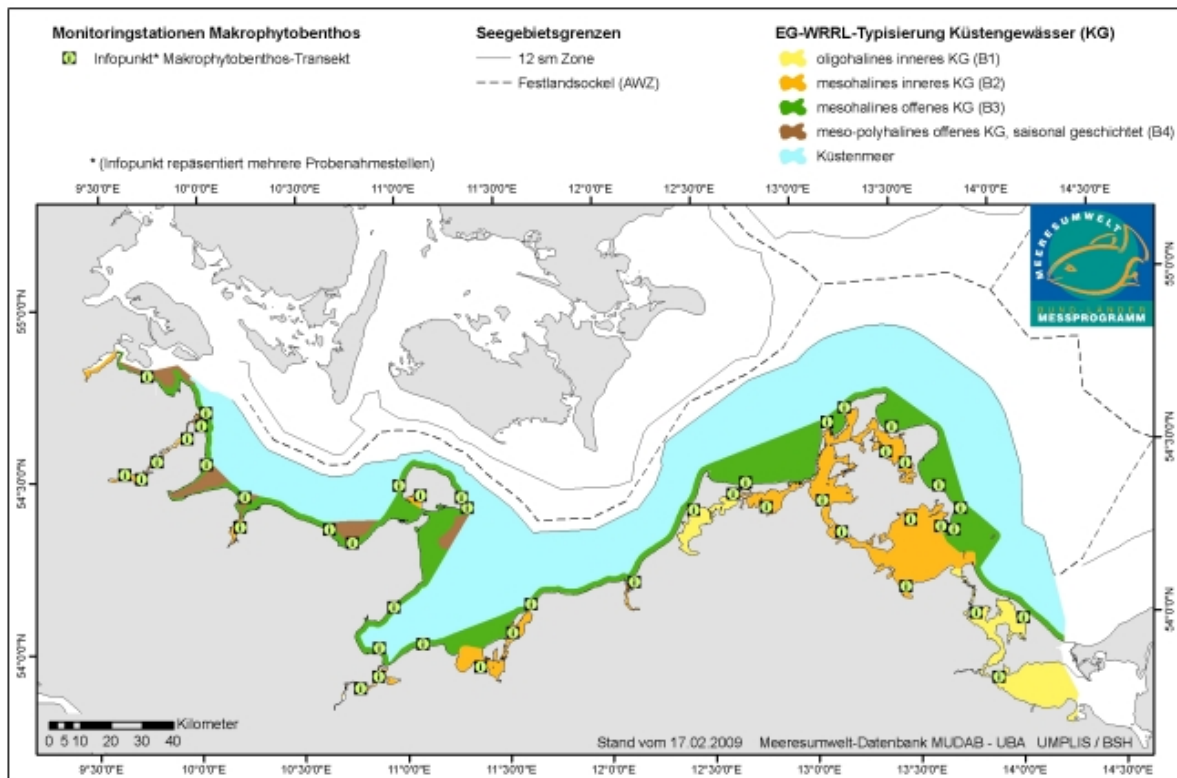


Figure 2: Map showing the stations intended for macrophyte monitoring in the Baltic Sea.

[Figure 2 as PDF document](#)

EEZ

Macrophytes on the habitat type reefs, e.g. Kadettrinne, Kriegers Flag, Adlergrund: area-wide surveying with underwater camera and frame sampling

12-nm zone

Extension of measurements in outer coastal waters to the 12-nm zone, since it is necessary to survey the lower distribution limit, which does not necessarily end with the one-nm zone (for methods etc., see information on coastal waters)

Inner coastal waters

- Schleswig-Holstein: nine transects
- Mecklenburg-Vorpommern: 16 transects

Outer coastal waters

- Schleswig-Holstein: 20 transects
- Mecklenburg-Vorpommern: nine transects

Note:

The investigations of macrophytes have to be carried out in accordance with the sample standard operating procedure for laboratories involved in the German Marine Monitoring Programme (BLMP), which is coordinated in accordance with the BLMP: Testing Procedure SOP: Macrophytobenthos Investigations on Marine Substrates of the Littoral Zone, as most recently amended. Reference is made below to the corresponding sections of this SOP.

3.2 Monitoring activities

North Sea

Macrophytes - Sandy Eulittoral - Salt Meadows and Reedbeds

Methods:

General remarks

In Lower Saxony and Schleswig-Holstein, salt meadows are currently surveyed periodically and assessed in the light of the Habitats Directive. During the first management cycle, they are only being used for WFD assessment in Lower Saxony.

The survey method is described in the Marine Monitoring Manual specifications for the various habitat types.

Zone:

Eulittoral

Macrophytes - Sandy Sublittoral - Macroalgae

Methods:

A method for the surveying and assessment of sublittoral macroalgae is still being developed in Lower Saxony at present. In Schleswig-Holstein, the intention is to examine whether such a method is feasible and necessary during the first management cycle.

(See on this topic SOP: Macrophytobenthos, section X)

Parameter:

- Biomass
- Coverage
- Depth range
- Extent (species)
- Position
- Species composition

Zone:

Sublittoral

Macrophytes - Sandy Sublittoral - Seagrass

Methods:

General remarks

Sublittoral seagrasses no longer, or hardly, occur today in the German North Sea because they were killed off by a slime mould infection at the beginning of the 1930s. They have not been able to reestablish themselves to the present day, evidently on account of hydrodynamic factors, possibly also due to the reduced amount of light available. However, they constituted part of the original status of the Wadden Sea. It is for this reason that their absence is assessed negatively. However, confirming their absence across the whole area is methodologically very, and indeed disproportionately, laborious. The 'monitoring of the absence of sublittoral seagrass' is therefore based only on point surveys. During the first WFD management periods, the intention is to determine whether a systematic search (e.g. using underwater video) is required and will be possible in future.

Monitoring methods (see on this topic SOP: Macrophytobenthos, section X)

The occurrence of sublittoral seagrass populations is investigated using random samples as part of macrozoobenthos monitoring. It is currently regarded as unlikely that sublittoral seagrass populations will establish themselves again. In consequence, no monitoring method has yet been developed.

Frequency:

Annual, given that to date the schedule has followed that for macrozoobenthos monitoring (see Macrozoobenthos)

Parameter:

- Depth range
- Position

Zone:

Sublittoral

Macrophytes - Sandy Eulittoral - Seagrass - Schleswig-Holstein

Methods:

General remarks

The seagrass populations in the eulittoral zone are very different in Schleswig-Holstein and Lower Saxony, which makes the application of different methodologies necessary. In general, a combination of remote sensing and in situ methods is applied. In this respect, the different proportions of the total seagrass population found in the Wadden Sea off Schleswig-Holstein and Lower Saxony are taken into consideration methodologically.

At present, as part of OFEW, a method is being trialled in which remote sensing data from satellites and aircraft are combined with in situ measurements. The core of the method is the objective classification of remote sensing data, which is advantageous with regard to the comparability of results (spatial and temporal). This development should be observed and the results adopted where applicable. This is also recommended by the TMAP ad hoc working group on seagrass, see [Final Report](#) (28 August 2006).

Schleswig-Holstein (see on this topic SOP: Macrophytobenthos, section X)

This work is carried out in accordance with a method put forward by K. Reise (see Dolch et al., 2009). This involves overflights for spatial mapping and the determination of the total area of seagrass (and macroalgae populations). The aircraft flies at an altitude of 300 to 500 m. During the flight, three independent observers enter the corresponding populations on Wadden Sea maps. A distinction is made between 20 - 60 % and > 60 % seagrass coverage of the bed of the Wadden Sea in the areas mapped. These flights are carried out three times a year in summer (if possible in June, July and August) in order to ensure that the maximum seagrass coverage is surveyed in the course of the year to be used for assessment (see Dolch and Reise, 2008).

In addition to this, fixed monitoring units are surveyed on the seabed and one-sixth of the Schleswig-Holstein Wadden Sea is mapped for seagrass meadows each year so that the entire seagrass population is surveyed in the course of one WFD management cycle. All these investigations on the seabed involve estimating the extent of meadows (defined as 20 % plus seabed coverage; in addition to this, areas with 5 % plus coverage are currently surveyed for the purposes of comparison with Lower Saxony) using inspections on foot and GPS points. Transects are walked through meadows in order to survey their mean density and composition in terms of the two *Zostera* species.

Frequency:

Flights three times a year during the vegetation period (June-September)

Annual inspection of permanent monitoring fields on foot and mapping of one-sixth of the total population (six-sixths in six years)

These frequencies are necessary because the occurrence and distribution of macrophytes (seagrass and macroalgae) are subject to major annual fluctuations. At least three overflights are necessary in order to be able to survey the maximum coverage during a year. Annual measurements are necessary because, apart from nutrients, the formation of eutrophication-indicative epiphyte and green algae populations is also dependant on local weather conditions and therefore does not happen every year. Comprehensive surveying has had to be spread out over six years on account of the great deal of effort involved.

Parameter:

- Coverage
- Epiphytes on *Zostera*
- Extent
- Position
- Species composition

Zone:

Eulittoral

Macrophytes - Sandy Eulittoral - Macroalgae - Schleswig-Holstein

Methods:

General remarks

At present, as part of the OFEW project, a method is being trialled in which satellite and aerial remote sensing data are combined with in situ measurements. The core of the method is the objective classification of remote sensing data, which is advantageous with regard to the comparability of results (spatial and temporal). This development should be observed and the results adopted as appropriate. This is also recommended by the TMAP ad hoc working group on seagrass (see [Final Report](#), 28 August 2006).

Schleswig-Holstein (see on this topic SOP: Macrophytobenthos, section X)

Hitherto, this work has been carried out in accordance with a method put forward by K. Reise. This involves overflights for spatial mapping and the determination of the total area of green algae populations (and seagrass) with => 20 % algae coverage of the bed of the Wadden Sea in the areas mapped. The aircraft flies at an altitude of 300 to 500 m. During the flight, three independent observers enter the corresponding populations on maps of the tidal flats. In this respect, a distinction is made between 20 - 60 % and >60 % algae coverage of the examined bed of the Wadden Sea in the areas mapped. These flights take place three times a year in summer (if possible in June, July and August). This ensures that the maximum coverage of opportunistic algae is surveyed in the course of the year to be used for assessment.

The biomass of green macroalgae is surveyed monthly at two bights with tidal flats in the Königshafen on Sylt. Ten representative samples (stratified random sampling design), each of 100 cm³, are taken from marked permanent plots, each measuring 50 x 50 m. The samples are analysed by genus (in this case, foliaceous thalli such as *Ulva*, tubular thalli such as *Enteromorpha* or *Chaetomorpha* and *Cladophora*).

Additional surveying of *Fucus* coverage and biomass on shellfish banks ('Stiefelmethode' step method), determination of biomass. Coordination with macrozoobenthos monitoring expedient. At present, preliminary investigations are still being carried out into the surveying of the neophyte *Gracilaria vermiculophylla* (red algae).

Frequency:

Overflights for the surveying of opportunistic algae mats: three times a year (see above). This frequency is necessary because, apart from a need for large quantities of nutrients, the formation of algae mats is also dependent on weather conditions (temperature and insolation). In addition to this, these algae mats are highly mobile, so that they are easily dispersed and could consequently be missed by one-off monitoring. This approach ensures algae mats that appear are also identified and their dimensions surveyed. Since the algae monitoring is carried out concurrently with the monitoring of seagrass (see information on seagrass), only modest additional effort is involved.

Parameter:

- Biomass
- Coverage
- Extent
- Position

Zone:

Eulittoral

Macrophytes - Sandy Eulittoral - Macroalgae - Lower Saxony

Methods:

General remarks

See Macrophytes - Sandy Eulittoral - Macroalgae - Schleswig-Holstein

Lower Saxony (see on this topic SOP: Macrophytobenthos, section X)

Overflights for the surveying of the spatial extent of green algae populations; samples are taken from each of the relevant habitats in four station areas in order to determine the species composition and abundance of red, brown and green algae.

Frequency:

As a rule, annual monitoring is necessary on account of macrophytes' high natural variability.

Green algae overflight at least three times a year during the vegetation period; species composition surveyed in the four above-mentioned station areas every three years

Parameter:

- Biomass
- Coverage
- Extent (species)
- Position
- Species composition

Zone:

Eulittoral

Macrophytes - Sandy Eulittoral - Seagrass - Lower Saxony

Methods:

General remarks

See Macrophytes - Sandy Eulittoral - Seagrass - Schleswig-Holstein

Lower Saxony (see on this topic SOP: Macrophytobenthos, section X)

Comprehensive surveying by means of overflights (aerial survey) in combination with field mapping (every six years). Annual sampling of selected seagrass meadows (permanent monitoring units) to validate aerial data, and survey the annual variability of the seagrass within the six-year period and characteristic supporting parameters (including species composition, density, quantity of epiphytic algae, biomass).

For methods, see: [TMAP Seagrass-Report](#), pp. 16ff.

Frequency:

Comprehensive surveying (area-wide): once in six years. Selected seagrass meadows (permanent monitoring units): annually.

Grounds: As a rule, annual monitoring is necessary on account of macrophytes' high natural variability. The frequencies chosen represent a compromise that reflects the requirements imposed by the WFD - monitoring once every three years. The area-wide surveying may be carried out at a lower frequency, but annual monitoring at selected stations supplies information about developments during the intervening period.

Parameter:

- Coverage
- Epiphytes on *Zostera*
- Extent (species)
- Position
- Species composition

Zone:

Eulittoral

Macrophytes - Rocky Eulittoral (Heligoland)

Methods:

Monitoring methods (see on this topic SOP: Macrophytobenthos, section X)

- Transect and fixed georeferenced square plots: quantitative: all macroalgae species (% coverage of all macroalgae plus macrozoobenthos in 50 x 50 cm frame; photographs of all squares)
- Quantitative grid mapping: approx. 150 georeferenced points; located using sub-metre DGPS (% coverage of all macrophytes plus macrozoobenthos in 50 x 50 cm frame; photographs of all squares)
- Polygon mapping (sub-metre DGPS) of dense *Fucus* and *Ulva* populations
- Inspection of defined habitats on foot at low water to draw up a Reduced Species List of the kind discussed by Wells et al. (2006)

Frequency:

As a rule, annual monitoring is necessary on account of macrophytes' high natural variability.

- Twice in three years in summer: transects; every two to three years: areal surveying. Grounds: Compromise that reflects the development of perennial components, which do not fluctuate heavily as a rule, and ephemeral components, which are indicative of nutrient loading and are affected more heavily by climatic factors. However, more recent findings show that perennial species such as *Fucus serratus* may also be subject to large fluctuations. In so far as this is the case, it is necessary to carry out grid mapping and polygon mapping annually, ideally twice a year (summer and winter aspects) to assess climatic influences (Kuhlenkamp et al., 2009a, b). A lower frequency holds the danger of an erroneous bad assessment if the *Fucus* population temporarily collapses dramatically due to natural storm events (that were not registered at the time) and this cannot be distinguished from an anthropogenic stress effect.
- Wells Index once a year (less time-consuming) (Kuhlenkamp and Bartsch, 2007; Kuhlenkamp et al., 2009a, b)

Parameter:

- Coverage
- Extent (species)
- Position
- Species composition

Zone:

Eulittoral

Macrophytes - Rocky Sublittoral (Heligoland)**Methods:**

General remarks

The sublittoral zone of Heligoland constitutes a species-rich habitat unique in Germany that, however, can only be monitored with difficulty on account of its location on the high seas and the diving operations required.

Monitoring methods (see on this topic SOP: Macrophytobenthos, section X)

- Depth boundary transects: quantitative recording of dominant brown seaweeds and red algae in 0.5 m depth sections; carried out along three suitable, permanently marked transects

Frequency:

Depth boundary transects: every three years in summer; however, as the method is very weather-susceptible, this should be undertaken in the first and fourth years of each management cycle so that, where necessary, it is possible to reschedule the work in question for the following year. 1st management cycle: in principle, surveyed annually if possible in order to rapidly obtain a test data set.

Surveying of the total *Laminaria* population once in six years. Given that *Laminaria* live for several years, major changes are not to be expected from one year to the next.

Parameter:

- Coverage
- Depth range
- Extent (species)
- Position
- Species composition

Zone:

Sublittoral

Macrophytes - Transitional Waters**Methods:**

General remarks

The transitional waters of the North Sea (Eider, Elbe, Weser, Ems) differ in terms of the macrophyte components that occur in them. In these transitional waters, salt meadows and reedbeds are also to be observed in accordance with the method for coastal waters because otherwise the areas above MHT would not be covered by the site survey for transitional waters in the Elbe. This is carried out in accordance with the methods for coastal waters (see information on coastal waters).

Monitoring methods (see on this topic SOP: Macrophytobenthos, section X)

Registration of vegetation at selected monitoring units in submerged reedbeds, classification using the Site Typology Index for Macrophytes (STIm) (see the assessment procedure proposed by Stiller, 2005). Salt meadows are surveyed following the procedure for coastal waters.

Furthermore, foreshore areas, reedbed widths and the proportion of near-natural biotopes in the Weser and Ems are to be surveyed (after Adolph et al., 2007), as well as, in accordance with the methods for coastal waters, seagrass meadows.

Frequency:

As a rule, annual monitoring is necessary on account of macrophytes' high natural variability.

Once a year in summer: spring mapping is also recommended for the surveying of the complete species spectrum and joint monitoring of macrophytes. Grounds: 'In contrast to the frequency prescribed in the WFD, annual sampling of macrophytes is recommended.' (Stiller, 2005)

Parameter:

- Area
- Biomass
- Coverage
- Depth range
- Epiphytes on *Zostera*
- Extent (species)
- Position
- Species composition
- Vegetation types (TMAP)

Baltic Sea**Macrophytes - Inner Coastal Waters****Methods:**

General remarks

The monitoring described here is carried out in the more enclosed fjords (Schlei, Inner Flensburg Fjord,¹ Trave, Inner Orth Bight) as well as the Bodden. There are considerable differences in salinity between these areas, which means that the macrophyte species differ greatly.

Surveys of salt grasslands (created by grazing) and brackish water reedbeds are undertaken under the Habitats Directive but, in accordance with the consensus of the states around the Baltic Sea and a BLMP decision, are not used for assessments under the WFD.

1) Despite the physical allocation of the Inner Flensburg Fjord to type B2, the BALCOSIS procedure for outer coastal waters in the Baltic Sea is applied (see information on outer coastal waters) on account of the composition of the macrophyte growth.

Monitoring methods (see on this topic SOP: Macrophytobenthos, section X)

Surveying of species and their coverage using frame sampling (divers) along a depth transect ζ surveying of species' lower distribution limit, definition of plant communities (Schubert et al., 2003, Selig et al., 2006, 2008).

The investigations are carried out following the ELBO approach: sampling of vegetation and sediment along transects by divers as far as the lower distribution limit, frame sampling in defined depth sections (0.25; 0.5; 0.75; 1; 1.5; 2; continued at 1 m levels). Five mapping areas (1 m²), which are located at distances of 5 - 10 m apart, are surveyed at each depth level.

An overview of the method is given by 'Vorläufige Handlungsanweisung zur Erfassung der Angiospermen- und Makroalgenbestände in den inneren Küstengewässern der Deutschen Ostseeküste - Bewertung entsprechend den Vorgaben der EU-Wasserrahmenrichtlinie' (Selig et al., 2008, 2nd edition) and the English summary in [Steinhardt et al. \(2009\)](#).

Frequency:

Frequency: once a year in summer, period: 15 June to 15 August. In waters where the charophyte species *Tolypella nidifica* is one of the characteristic species of the plant community, the sampling must be carried out before 15 July. Annual sampling is required because the charophyte species to be used for the assessment display very great variability, i.e. in some years individual species are not found on account of the natural dynamics of seed fall and germination, which could result in an erroneous poor assessment.

Parameter:

- Coverage
- Depth range
- Extent (species)
- Position
- Species composition

Macrophytes - Outer Coastal Waters**Methods:**

General remarks

The permanently water-covered macrophytes of the Baltic Sea can only be surveyed at selected monitoring units. Macroalgae (on rocks) and seagrasses (on soft seabed) are surveyed in these areas. Salt grasslands (created by grazing) and brackish water reedbeds are surveyed under the Habitats Directive but, in accordance with the consensus of the states around the Baltic Sea and a BLMP decision, are not used for assessments under the WFD.

Monitoring methods (see on this topic SOP: Macrophytobenthos, section X)

Underwater video for surveying the depth range of *Zostera marina* and *Fucus* spp. (five video transects/station or section of the coast)

Dive investigations in various depth zones (dense seagrass population, 0 - 2 m, 5 - 7 m) for species identification, determination of coverage and biomass. The assessment is carried out following the BALCOSIS procedure.

An overview of the methods for surveying various parameters is given in `Handlungsanweisung zum Monitoring in den äußeren Küstengewässern; (Fürhaupter and Meyer, 2008).

Following unsuccessful tests, no macrophyte investigations are carried out for the WFD in water type B4 (Schleswig-Holstein) because the quality of the historical data is too poor and depth boundaries cannot be determined with any certainty on account of the lack of hard substrates in deep water. The BALCOSIS procedure (Fürhaupter and Meyer, 2008) is used to assess this quality element in each of the B4 water bodies in Schleswig-Holstein in conjunction with a neighbouring B3 water body.

Habitat type reefs in the EEZ: underwater video for surveying status, frame sampling (by divers) for the estimation of density and determination of species populations. See also HD Habitat Type: Reefs.

For salt grasslands, see also HD Habitat Type: Atlantic Salt Meadows.

Frequency:

On account of the high interannual variability of, in particular, opportunistic macroalgae, the monitoring is carried out annually in summer. This also corresponds to the requirements imposed by HELCOM (once a year in summer: July-September, preferably August-September)

Parameter:

- Biomass
- Coverage
- Depth range
- Position
- Species composition

3.3 Additional parameters

The following parameters are required additionally for the assessments::

- Acidity
- Appraisal of anthropogenic influences (boat traffic, tourism, fishing, etc.)
- Bathymetry
- Climatic conditions
- Ice situation
- Light conditions
- Nutrients
- Salinity
- Sediment exposure
- Sediment properties
- Sedimentation rate
- Sight depth
- Temperature

4 Assessment

4.1 Assessment procedures

North Sea

Title


Coastal Waters - Sandy Eulittoral - Macroalgae and Seagrass

Authors

Assessment procedure and operating procedure

Schleswig-Holstein:

- Dolch and Reise (2008a): 'Seegrass-Monitoring im Schleswig-Holsteinischen Wattenmeer 2007'; report for LLUR-SH.

- Dolch, Buschbaum and Reise (2009), in preparation  : 'Seegrass-Monitoring im Schleswig-Holsteinischen Wattenmeer 2008 inklusive "endgültige Handlungsanweisung plus Bewertungs-Verfahren über 6 Jahre"'.
Lower Saxony:

- Jaklin et al. (2007): Aufbau einer Bewertungsmatrix für die Gewässertypen nach EG-WRRL im Küstengebiet der Nordsee, Schwerpunkt Flussgebietseinheiten Weser und Ems: Teil A: Nährstoffe, Fische, Phytoplankton, Makrophyten (Makroalgen und Seegrass); Berichte des NLWKN.

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Description of the assessment procedure

Schleswig-Holstein:

The eulittoral seagrass meadows here are assessed to ascertain their extent, their density and their composition in terms of the two *Zostera* species. In addition to this, the extent and density of opportunistic algae (green macroalgae) are also assessed. These metrics are combined together using their individual standardised EQRs.

The euhaline (North Friesland) and the polyhaline (Dithmarschen) areas of tidal flats off Schleswig-Holstein are assessed separately, but there is no differentiation within these areas because (a) large numbers of macroalgae thalli and, in the autumn, seed-bearing seagrass shoots are constantly being exchanged with the tidal current between the tidal basins, i.e. within the areas tidal flats off under discussion; and (b) green algae mats and seagrass meadows occur particularly frequently at the watersheds between tidal basins in the flats (often the boundaries between water bodies).

[Assessment matrix for the North Friesland Macrophytobenthos Index in PDF format](#)

[Assessment matrix for the Dithmarschen Macrophytobenthos Index in PDF format](#)

Lower Saxony:

The eulittoral seagrass meadows here are assessed to ascertain their extent, their density and their composition in terms of the two *Zostera* species. In addition to this, the extent and density of opportunistic algae, as well as the species composition of brown and red algae are also assessed. These metrics are combined together using their individual EQRs

Metrics, class boundaries, EQRs

Schleswig-Holstein:



Table with limit values, EQRs that will be completed at the end of 2008

Lower Saxony:

Seagrass and green algae coverage: See Jaklin et al., 2007; apart from this, current class boundaries and EQRs for the parameters green algae coverage and area of seagrass meadows. See Kolbe (2007): 'Intercalibration Report (NEA GIG) - Assessment of German Coastal Waters (NEA1/26, NEA3/4) and Transitional Waters (NEA11) by Macroalgae and Angiosperms:

Macroalgae Species Spectrum (Red and Brown Algae)': in preparation.

Pressures
Eutrophication

North Sea

Title

Coastal Waters - Sandy Eulittoral - Salt Meadows and Reedbeds - Lower Saxony

Authors

Assessment procedure and operating procedure

Lower Saxony:

- Adolph et al. (2007): Aufbau einer Bewertungsmatrix für die Gewässertypen nach EG-WRRL im Küstengebiet der Nordsee, Schwerpunkt Flussgebietseinheiten Weser und Elbe: Abschlussbericht Teil B: Makrophyten (Röhrichte, Brack- und Salzmarschen), Makrozoobenthos, Schadstoffe; Berichte des NLWKN.

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Assessment procedure in Lower Saxony provisional until a procedure harmonised between the Länder is available.

Description of the assessment procedure

See Adolph et al., 2007

Metrics, class boundaries, EQRs

Lower Saxony:

See Adolph et al., 2007

Pressures

Eutrophication, morphological changes

North Sea

Title

Coastal Waters - Sandy Eulittoral - Salt Meadows and Reedbeds - Schleswig-Holstein and Hamburg

Authors

N/a

The assessment procedure is described in the Marine Monitoring Manual specifications for the various habitat types.

Guideline:

HD

Stretch of Water:

Coastal waters

North Sea

Title

Coastal Waters - Sandy Sublittoral

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Description of the assessment procedure

Lower Saxony:

The occurrence of sublittoral seagrass and the species composition of brown and red algae are assessed. These metrics are combined together using their individual EQRs.

Metrics, class boundaries, EQRs

Lower Saxony:

Seagrass: see Jaklin et al., 2007

Macroalgae species spectrum (red and brown algae): in development.

Pressures

Eutrophication, hydromorphological alterations

North Sea

Title

Coastal Waters - Rocky Eulittoral (Heligoland)

Authors

Assessment procedure and operating procedure

- [Kuhlenkamp & Bartsch \(2007\)](#): 'Benthosbewertung Helgoland: Teil I: Phytobenthos'; report for LLUR-SH.
- [Kuhlenkamp & Bartsch \(2008\)](#): 'Marines Monitoring Helgoland: Benthosuntersuchungen gemäß Wasserrahmenrichtlinie: Handlungsanweisung Makrophytobenthos'; report for LLUR-SH.

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Description of the assessment procedure

Initially, the various modules of the assessment procedure are assessed. They are then combined using their EQRs and a weighting (given in percent, see below) to arrive at an overall assessment by the quality element macroalgae. The following modules are used:

- Reduced Species List (RSL, after Wells et al. 2006): species richness, proportion of green algae, proportion of red algae, ESG* ratio, proportion of opportunists: (50 %)
- Green algae: abundance of *Ulva lactuca* in the eulittoral zone (10 %)
- Fucetum: coverage of the eulittoral zone with *Fucus serratus* (20 %)
- Depth boundaries of sublittoral algae: three red algae species and *Laminaria hyperborea* (20 %)

*ESG = Ecological Status Group, adapted in accordance with Orfanidis et al (2001)

Metrics, class boundaries, EQRs

Table 1: [Assessment matrix](#) for the Heligoland Phytobenthic Index (HPI) in PDF format (364 kB)

North Sea

Title

Coastal Waters - Rocky Sublittoral (Heligoland)

Authors

Assessment procedure and operating procedure

- [Kuhlenkamp & Bartsch \(2007\) Benthosbewertung Helgoland](#): 'Benthosbewertung Helgoland: Teil I: Phytobenthos'; report for LLUR-SH.
- [Kuhlenkamp & Bartsch \(2008\) Marines Monitoring Helgoland](#): 'Marines Monitoring Helgoland: Benthosuntersuchungen gemäß Wasserrahmenrichtlinie: Handlungsanweisung Makrophytobenthos'; report for LLUR-SH.

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Description of the assessment procedure

See Rocky Eulittoral (Heligoland)

Metrics, class boundaries, EQRs

See Rocky Eulittoral (Heligoland)

Pressures

Eutrophication

North Sea

Title

Transitional Waters

Authors

Assessment procedure and operating procedure

Elbe and Eider:

- Stiller (2005): 'Bewertungsverfahren für die Qualitätskomponenten Makrophyten und Angiospermen in der Tideelbe gemäß EG-WRRL'; report for ARGE Elbe.
- Stiller (2008): 'Überblicksweise Überwachung der Qualitätskomponenten Makrophyten und Angiospermen in der Tideelbe gemäß EG-Wasserrahmenrichtlinie'; report for ARGE Elbe.

Weser and Ems:

- Adolph et al. (2007): *Aufbau einer Bewertungsmatrix für die Gewässertypen nach EG-WRRL im Küstengebiet der Nordsee, Schwerpunkt Flussgebietseinheiten Weser und Elbe: Abschlussbericht Teil B: Makrophyten (Röhrichte, Brack- und Salzmarschen), Makrozoobenthos, Schadstoffe*; Berichte des NLWKN (incorporates parameters discussed by Stiller (2005, 2008), see above).
- Seagrass in the polyhaline and mesohaline zones, see information on coastal waters.

Guideline:

WFD

Stretch of Water:

Transitional waters

Comments:

Description of the assessment procedure

Eider and Elbe:

In the procedure based on Stiller (2005, 2008), the submerged reedbeds are assessed by means of the calculation of a Site Typology Index for Macrophytes (STIm), which takes account of the species present, their extent, vegetation zoning and vigour.

Weser and Ems:

In the procedure for oligohaline foreshore areas based on Adolph et al. (2007), the proportion of near-natural biotopes and reedbed width are surveyed, supplemented by parameters drawn from the Site Typology Index for Macrophytes (STIm) put forward by Stiller (2005, 2008). In addition to this, salt meadows and seagrass meadows in the mesohaline to polyhaline zones are surveyed using the relevant procedure for coastal waters.

Metrics, class boundaries, EQRs

Eider and Elbe:

Allocation of EQR value to ecological status and potential classes for the procedure based on Stiller (2008).

Status classes	High	Good	Moderate/strong>	Poor	Bad
STI for Macrophytes	>10,0	<=10,0 >7,5	<=7,5 >5,0	<=5,0 >3,0	<= 3,0
EQR	>0,833	<=0,833 >0,625	<=0,625 >0,417	<=0,417 >0,25	<=0,25

Potential classes	Good and better	Moderate	Poor	Bad
STI for Macrophytes	>7,5	<=7,5 >5,0	<=5,0 >3,0	<=3,0
EQR	>0,625	<=0,625 >0,417	<=0,417 >0,25	<=0,25

Weser and Ems:

See Adolph et al., 2007

Pressures

Eutrophication, hydromorphological changes

Baltic Sea

Title

Inner Coastal Waters

Authors

Assessment procedure and operating procedure

- Selig et al., 2007 (1st edition) and 2008 (2nd edition): 'Vorläufige Handlungsanweisung zur Erfassung der Angiospermen- und Makroalgenbestände in den inneren Küstengewässern der deutschen Ostseeküste ; Bewertung entsprechend den Vorgaben der EU-Wasserrahmenrichtlinie'.

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Description of the assessment procedure

The ELBO procedure is used to assess the regression of the lower distribution limit and the disappearance of particular plant communities specified for each water body in accordance with defined levels of degradation.

The assessment parameters are:

- Definition of plant community (17)
- Charophyte depth limit
- Spermatophyte depth limit

Comments: The final method used to combine the figures and convert them into EQRs will be included in the revised operating procedure by the end of 2008.

Metrics, class boundaries, EQRs



Please forward tables for use in assessment to the University of Rostock/LUNG/LLUR once completed
Pressures

Baltic Sea

Title

Outer Coastal Waters

Authors

Assessment procedure and operating procedure

- Fürhaupter and Meyer (2008): Handlungsanweisung zum Monitoring in den äußeren Küstengewässern der Ostsee nach den Vorgaben der EU-Wasserrahmenrichtlinie, Qualitätskomponente Makrophyten, BALCOSIS-Verfahren; report for LLUR-SH and LUNG-MV.

Guideline:

WFD

Stretch of Water:

Coastal waters

Comments:

Description of the assessment procedure

Seven individual metrics, which encompass soft and hard seabed vegetation, are assessed here. Of these metrics, the depth boundaries of *Zostera marina* and *Fucus* spp. are weighted more heavily because good historical data and models are available for them in Schories et al. (2006). The seven metrics are combined using a weighted median to reach an overall assessment based on macroalgae and angiosperms. The metrics are, in particular:

- *Zostera marina* depth limit
- Proportion of opportunists in *Zostera meadows*
- *Fucus* spp. depth limit
- Dominance of *Fucus* at depths of 0 - 2 m (compared to opportunistic species)
- Proportion of biomass comprising opportunists on hard substrate at depths of 5-7 m
- Reduction in number of species of important perennial macroalgae on hard substrate at 5 - 7 m
- Proportion of biomass comprising *Furcellaria lumbricalis* on hard substrate at 6 - 7 m

Metrics, class boundaries, EQRs

Metric	Ref.	High	Good	Mod	Poor	Bad	EQR _{HG}	EGR _{GM}	Inter-cal?
EQR _{norm} ¹	1.0	1,0 - 0,8	0,8 - 0,6	0,6 - 0,4	0,4 - 0,2	0,2 - 0,0			
<i>Zostera</i> depth [m]	9,4	[9,4-8,5]	(8,5-7,0]	(7,0-4,5]	(4,5-0,5]	(0,5-0,0]	0,9	0,74	Yes
Opportunists in <i>Zostera</i> [% mass]	0,5	[0,5-1]	(1-10]	(10-30]	(30-75]	(75-100]	0,5 ⁴	0,02 ⁴	No
<i>Fucus</i> depth [m]	9,4	[9,4-8,5]	(8,5-7,0]	(7,0-4,5]	(4,5-0,5]	(0,5-0,0]	0,9	0,74	No
<i>Fucus</i> dominance [% coverage]	80	[80-75]	(75-50]	(50-10]	(10-0,5]	(0,5-0]	0,94	0,63	No
Opportunists in 5-7 m [% mass]	0,5	[0,5-1]	(1-10]	(10-30]	(30-75]	(75-100]	0,5 ⁴	0,02 ⁴	No
<i>Furcellaria</i> in 5-7 m [% biomass]	40	[40-30]	(30-20]	(20-5]	(5-0,5]	(0,5-0]	0,75 ⁴	0,5 ⁴	No
Species reduction, B3a-water body ² [Number of species]	7	7	5-6	3-4	1-2	0	0,93 ⁴	0,64 ⁴	No
Species reduction, B3b-water body ³ [Number of species]	10	10-9	8-7	6-4	3-2	1-0	0,85 ⁴	0,65 ⁴	No

Notes:

*1: The intervals are to be understood as open or closed in line with those of the corresponding metrics

*2: B3 water body east of the Darß Sill

*3: B3 water body west of the Darß Sill

*4: Still needs to be specified uniformly because an EQR has to be calculated in this case

Pressures

Eutrophication

5 Quality assurance

- Quality Assurance Panel (workshops, intercalibration exercises, first draft of a species list, standardisation with DIN, CEN and ISO, support for the establishment of QM systems, drafting of sample SOPs, performance of audits)

Comments

The Quality Assurance Panel at the Federal Environment Agency is responsible for the coordination of quality assurance under the BLMP. Each of the monitoring institutions bears responsibility for establishing and administering its own DIN EN ISO/IEC 17025 quality management systems. The institutions involved in the BLMP coordinate their activities within the framework of the Working Group on Quality Assurance and its sub-working groups, as well as the Ad Hoc Working Group on Benthos.

5.1 Monitoring institutions

- [LimnoMar](#)
- [LLUR](#)
- [MariLim](#)
- [Uni-Rostock](#)
- [BfN](#)
- [NLWKN](#)
- [NPV SH](#)
- [NLPV NI](#)
- Stiller
- [AWI](#)

5.2 Guidance documents

- BLMP Quality Assurance Panel at the UBA, 2008: *Muster-Qualitätsmanagementhandbuch für Laboratorien des Bund/Länder-Messprogramms nach DIN EN ISO/IEC 17025 (BLMP Sample Quality Management Manual)*; Version: 01 of 1 February 2008; Federal Environment Agency.
- BLMP Quality Assurance Panel at the UBA, 2009: *Prüfverfahren-SOP Makrophytobenthos-Untersuchungen auf marinen Substraten: Rahmenbeprobung im Eulitoral (P-SOP-BLMP-MPB_RB-EUL_v01) (Testing Procedure SOP: Macrophytobenthos Investigations on Marine Substrates: Frame Sampling in the Eulittoral Zone)*; Federal Environment Agency (Version: 01 of 15 October 2009 in [Members' Area](#)).
- BLMP Quality Assurance Panel at the UBA, 2009: *Prüfverfahren-SOP Makrophytobenthos-Untersuchungen auf marinen Substraten: Rahmenbeprobung im Sublitoral (P-SOP-BLMP-MPB_RB-SUB_v01) (Testing Procedure SOP: Macrophytobenthos Investigations on Marine Substrates: Frame Sampling in the Sublittoral Zone)*; Federal Environment Agency (Version: 01 of 15 October 2009 in [Members' Area](#)).
- HELCOM, COMBINE Manual, Annex C-9: [Guidelines for monitoring of phytobenthic plant and animal communities in the Baltic Sea](#).
- JAMP, 2004: [Guidelines on quality assurance for biological monitoring in the OSPAR area](#); ICES Techniques in Marine Environment Sciences; 32; 2004.
- JAMP, ASMO, 1997: *Eutrophication monitoring guidelines - benthos*: 'Technical Annex 1: [Hard bottom macrophytobenthos, soft-bottom macrophytobenthos and hard-bottom macrozoobenthos](#)'.

5.3 Standards

- DIN EN ISO/IEC 17025, 2005: General requirements for the competence of testing and calibration laboratories.
- DIN EN 14996, 2006: Water quality - Guidance on assuring the quality of biological and ecological assessments in the aquatic environment.
- DIN EN ISO 19493, 2007: Water quality - Guidance on marine biological surveys of hard-substrate communities.
- DIN EN ISO 16665: Water quality - Guidance for quantitative sampling and sample processing of marine soft-bottom macrofauna.

5.4 Current status

A BLMP Study Group decision (2006) obliged the BLMP laboratories to establish DIN EN ISO/IEC 17025 quality management systems. For this purpose, a Sample Quality Management Manual was drawn up in 2006/2007 by the Quality Assurance Panel in cooperation with the Quality Assurance Sub-Working Group on Quality Management. This manual has been available for subscription from the Quality Assurance Panel at the UBA since mid-2008 and is to be used as the basis for internal QM documentation at laboratories. The manual is designed as a loose-leaf collection, so that regular updates can be added as required. The intention is for it to be gradually supplemented with sample SOPs coordinated within the BLMP. As far as macrophytes are concerned, the following testing procedure SOPs are currently available: Macrophytobenthos Investigations on Marine Substrates: Frame Sampling in the Eulittoral Zone and Macrophytobenthos Investigations on Marine Substrates: Frame Sampling in the Sublittoral Zone, Version 01 of 15 October 2009. The testing procedure SOPs Transect Mapping in the Sublittoral Zone and Vegetation Mapping of Coasts and Estuaries are currently in preparation.

Intercalibration exercises

Not yet available, planned as of 2011.

Workshops

- UBA/BLMP-WS: Methods of Macrophyte Monitoring under the BLMP and the EC WFD including Exercises in the Identification of Marine Macrophytes: Part 1: Hard Seabed Monitoring (2005)
- UBA/BLMP-RV: Methods of Macrophyte Monitoring under the BLMP and the EC WFD including Exercises in the Identification of Marine Macrophytes: Part 2: Soft Seabed Monitoring (2005)
- UBA/BLMP-WS: Taxonomy of Marine Macrophytes and their Significance for Monitoring under the International Conventions on the Protection of the Seas (2001)

6 Literature

- Dolch, T. and K. Reise, 2008: *Seegrass-Monitoring im Schleswig-Holsteinischen Wattenmeer, 2007*; report of the State Agency for Agriculture, Environment and Rural Areas of the Land Schleswig-Holstein (LLUR), Flintbek.
- Dolch, T., 2008: *High-resolution spatial analysis of morphodynamics and habitat changes in the Wadden Sea (SE North Sea)*; dissertation; University of Kiel.
- Dolch, T., Buschbaum, C. and K. Reise, 2009: *Seegrass-Monitoring im Schleswig-Holsteinischen Wattenmeer 2008*; interim report of the State Agency for Agriculture, Environment and Rural Areas of the Land Schleswig-Holstein (LLUR), Flintbek
- Grimm, V., Strasser, M. and K. Reise, 2003: 'Marine metapopulations: a useful concept?'; *Helgol. Mar. Res.*; 56; pp. 222 - 228.
- Hanski, I., 1999: *Metapopulation Ecology*; Oxford Univ. Press.
- Hauxwell, J., Cebrián, J. and I. Valiela, 2003: 'Eelgrass *Zostera marina* loss in temperate estuaries: relationship to land-derived nitrogen loads and effect of light limitation imposed by algae'; *Mar. Ecol. Prog. Ser.*; 247; pp. 59 - 73.
- Nienburg, W., 1927: 'Zur Ökologie der Flora des Wattenmeeres: I: Der Königshafen bei List auf Sylt'; *Wiss. Meeresunters. (Abt. Kiel)*; 20; pp. 146 - 196.
- Raabe, E.-W., Dierßen, K. and U. Mierwald, 1987: *Atlas der Flora Schleswig-Holsteins und Hamburgs*; Wachholtz-Verlag, Neumünster.
- Reise, K. and I. Siebert, 1994: 'Mass occurrence of green algae in the German Wadden Sea'; *Deutsche Hydrogr. Z Suppl.*; 1; pp. 171 - 188.

7 Activities required to implement the concept

7.1 Changes to the current monitoring programme

Some of the monitoring activities outside the BLMP are suitable for compliance with monitoring requirements under the Habitats Directive and the WFD. For this reason, it is important for these activities to be taken into consideration in future in the context of German marine monitoring.

7.2 Working steps required

Priorities

Once the assessment schemes for the HD habitat types have been completed, the current network for macrophyte monitoring is to be adapted or extended as necessary.

Monitoring frequencies should be standardised between Schleswig-Holstein and Lower Saxony.

Methodological harmonisation

The aspiration should be to harmonise remote sensing applications between Schleswig-Holstein and Lower Saxony. However, this is only possible to a certain extent on account of area-specific differences (e.g. occurrence of seagrass) and the different methodologies these differences imply.

The concept in Schleswig-Holstein involves one overflight of the salt meadows every five years; the concept in Lower Saxony involves one overflight every six years. Hitherto, both Länder have used aircraft equipped with different technologies (CIR aerial imaging - analogue and digital - in Schleswig-Holstein and conversion to aerial scanning in Lower Saxony). The frequencies and technologies should be harmonised. The time intervals also need to be harmonised - above all in view of the mandatory reporting obligations.

Apart from this, salt meadows are currently surveyed at sample plots/permanent monitoring stations each year in Schleswig-Holstein, while 25 % are covered each year in Lower Saxony. Steps to harmonise these activities should be discussed and implemented, if possible.

Quality assurance

The establishment of DIN EN ISO/IEC 17025 quality management systems under the BLMP should be concluded by 1 January 2012.

In this context, apart from the development of uniform quality standards (QM system), efforts should also be made to ensure the participating institutions work largely in accordance with shared guidelines when the SOPs are being drafted. To this end, the Sample Quality Management Manual is to be amended and the following SOPs drawn up for investigations of macrophytes and macroalgae:

- SOP: Transect Mapping in the Sublittoral Zone
- SOP: Vegetation Mapping of Coasts and Estuaries

The DIN EN ISO/IEC 17025 quality management system includes the following elements:

- documented validation/verification of the investigation methods deployed for the determination of performance characteristics,
- storage of reference and comparative collections
- the qualification and regular training of personnel for the procedures deployed,
- the regular performance of internal and external audits,
- regular participation in national and international interlaboratory comparisons, intercalibration exercises, training courses and workshops, and their evaluation.

The laboratories must guarantee the prompt and complete communication of the investigation results to MUDAB on the basis of the MUDAB data formats, including the QA data that have been defined as a minimum, which meet international standards (ICES).

Further steps to be taken as of 2010:

- Provision of the uniform species list including synonyms via the QA information system
- Drawing up of agreements on taxa that cannot be identified to species level
- List of independent experts for cases where identification is problematic
- Alternating workshops on taxonomic questions, methodology and evaluation procedures (to guarantee uniform minimum quality standards at all laboratories) and intercalibration exercises to ensure that, if possible, some form of external QA can be offered once a year (in this connection, of course, international workshops and intercalibration exercises that allow the UBA Quality Assurance Panel to hold events less frequently have to be taken into consideration). These activities are to be documented adequately and promptly.
- Continuation of the Environmental Research Plan project to draw up identification keys (*Ulva/Enteromorpha*)
- Establishment of a data management system for all participating institutions within the framework of the work of the Working Group on Data Management

Since workshops and intercalibration exercises cannot be offered annually by the Quality Assurance Panel (Biology Section), regular interlaboratory comparison analyses should be organised bilaterally and independently between the laboratories, the results of which should be presented and discussed in the Working Group on Quality Assurance. As a matter of principle, attention is to be paid to continuity among

the staff involved in the processing of long-term monitoring series, as well as steps to ensure they are appropriately qualified.

Supporting parameters

Information on sediment exposure and sedimentation rates are required as supporting parameters. To this end, appropriate investigations are necessary.

In so far as technically possible, it should be routine for seagrass areas to be surveyed when echo-sounding measurements and side-scan sonar investigations are undertaken for hydromorphological purposes in order to further develop the relevant methodology.

Assessment procedures

Transitional waters:

Under the ARGE Elbe concept, the intention is for macrophytes to be monitored at nine stations in the Elbe in future. These stations are required in order to extrapolate from the individual transects investigated to the whole section of the river and have already been investigated in 2005 as part of a field test (Stiller, 2005).

In principle, this procedure may also be used for the Ems and Weser. However, the applicability of a procedure from the Netherlands to German transitional waters and the options for its further development are currently being examined.

The salt meadow monitoring methods for coastal waters are to be applied in transitional waters (for grounds: see above).

HD

Where applicable, the assessment schemes for the HD habitat types are to be incorporated into the current monitoring concepts.

OSPAR

An appropriate monitoring concept that includes macrophytes is required for the assessment of the eutrophication status of the North Sea under the Comprehensive Procedure (see also [Phytoplankton](#), [Macrozoobenthos](#) und [Zooplankton](#)).

Footnotes

(1) Marine Strategy Framework Directive; Directive 2008/56/EC of 17 June 2008. This also applies to transitional waters and coastal waters covered by Directive 2000/60/EC, where pertinent aspects of the protection of the marine environment not dealt with in Directive 2000/60/EC are at issue.

(2) Version: proposal of the Secretariat-General of 13 November 2006.

This also applies to transitional waters and coastal waters covered by Directive 2000/60/EC, where pertinent aspects of the protection of the marine environment not dealt with in Directive 2000/60/EC are at issue.

(3) Version: proposal of the General-Secretariat of 13 November 2006.

This also applies to transitional waters and coastal waters covered by Directive 2000/60/EC, where pertinent aspects of the protection of the marine environment not dealt with in Directive 2000/60/EC are at issue.

(4) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

(5) Article 11 (monitoring of habitats and all species listed in Annexes II, IV and V) imposes the obligation to monitor the conservation status of all habitats (listed in Annex I) of Community interest. In consequence, this provision is not limited to NATURA 2000 areas, but habitat types outside the Habitat Directive areas are also to be included in the monitoring as appropriate.

(6) EC Water Framework Directive; Directive 2000/60/EC. The coastal waters subject to ecological assessment under the WFD extend 1 nautical mile beyond the baseline.

(7) Baltic Sea Action Plan, HELCOM 2007

(8) The monitoring requirements under TMAP were specified in the Wadden Sea Plan ([Sylt, 2010](#)) (see also [TMAP Manual, section 2](#)).