Report of the

Second
TMAP Blue Mussel Workshop
Ameland, 8 – 10 April 2002

Draft Version (June 2002)

Common Wadden Sea Secretariat
Trilateral Monitoring and Assessment Group

Contents

1. Introduction

Protection of blue mussels in the Wadden Sea

Blue Mussels beds are important structures in the Wadden Sea ecosystem in many ways, e.g. as habitat and important food source for a number of species. Mussel beds also cause the deposition of a great amount of suspended matter which give them an important role in the sediment budget of the Wadden Sea.
Because a serious decrease in numbers and size of mature mussel beds occurred in the last decade, several national and trilateral regulations have been established to protect this important habitat.
A trilateral Target has been formulated with regard to the tidal area and, in specific, for blue mussel beds:

- A natural dynamic situation in the Tidal Area.
- An increased area of geomorphologically and biologically undisturbed tidal flats and subtidal areas.
- An increased area of, and a more natural distribution and development of natural mussel beds, Sabellaria reefs and Zostera fields.

At the Trilateral Governmental Conference in Esbjerg 2001, the ministers agreed:
§ 9. To acknowledge the efforts that have been made with regard to the policy on the mussel fishery and to stress that the implementation of the Targets on geomorphology, eelgrass beds and mussel beds still deserves attention and, therefore, to evaluate before the end of 2004 the mussel fishery with special attention to stable mussel beds.
§ 10. To base the conservation and management of mussel beds on the protection of sites where stable beds occur and areas with a high potential for the development of stable mussel beds.

Blue mussel fisheries

Since the last workshop in 2000, the status of commercial blue mussel fisheries in the Wadden Sea has not changed. In all countries, fisheries regulations are established, e.g. concerning number of licenses, fishing and non-fishing areas, or size of culture lots.
A recent overview of the national shellfish fisheries was prepared in the beginning of 2002 (CWSS 2002).

Blue mussel monitoring

Monitoring of blue mussels – undertaken regularly in all countries, improved/intensified during the last 10 years
(see workshop 2000)

- national programs
- contribution to TMAP

Monitoring of blue mussel beds is carried out in each country applying own monitoring strategies and techniques depending on the specific objectives and aims of the national mussel management plans.
This has lead to a heterogeneous data basis, which is not harmonized and, in most cases, cannot be compared directly.
As a consequence, the results are difficult to assess on the trilateral level. The QSR 1999 has revealed this problem, especially with regard to an assessment of the long-term development of intertidal mussel beds

Monitoring of Blue Mussels in the TMAP

In the TMAP Common Package, the monitoring of blue mussel beds is carried out to document changes and trends in locations and areas of blue mussel beds in the whole intertidal area. This basic information together with data about species and community parameters will be used to assess changes in species and on the community level of blue mussel beds and the influence of human activities, namely pollution, fishery and climate change (sea level rise).

The monitoring is also carried out to assess the progress made in implementation of the trilateral Targets (Wadden Sea Plan, 1997). The Targets of “An increased area and a more natural distribution and development of natural mussel beds” has been adopted by the three countries and common policy and management measures have been agreed to implement this Target.

Results of the first TMAP blue mussel workshop

The first TMAP blue mussel workshop was held in Tönning on 11-12 October 2000. It had the aim to develop a common monitoring strategy for blue mussels to be able to compare the results of the different monitoring programs and to make them available for trilateral assessment.

The workshop resulted in

- an inventory of the national blue mussel monitoring programs,
- a common definition of a blue mussel bed,
- an overview concerning the comparability of single monitoring parameters,
- a proposal for revised TMAP guidelines for blue mussel monitoring,
- recommendations for several follow-up activities within the TMAP.

The workshop also identified several issues, which should be dealt with within the TMAP in a second blue mussel workshop in 2002. It should include field work and joint efforts of field trials to check methods, definitions, and the role of experiences, as well as data handling, reporting, quality assurance, and development of monitoring strategies for new issues:

The Trilateral Monitoring and Assessment Group (TMAG) acknowledged the workshop report and adopted the revised blue mussel monitoring guidelines (CWSS 2001). The TMAG also decided on the Terms of Reference of the second TMAP blue mussel workshop (see Annex 1).

2. Objectives of the second TMAP Blue Mussel Workshop

The workshop had the task

a. to compare the existing remote sensing techniques

Identification and quantification of mussel beds by aerial photographs requires experiences in field surveys and good knowledge of remote sensing techniques. A detailed analysis of the used techniques (aerial photographs) should identify the advantages but also the limitations of the different approaches and should contribute to an improvement of the monitoring and a better comparison of the results.

b. to carry out intercalibration of field sampling methods

The workshop should evaluate the different monitoring strategies, sampling techniques, calculations and statistical methods of blue mussel monitoring in detail and make sure that the results of the different monitoring programs would be comparable and can be used for a trilateral assessment. An intercalibration exercise was to reveal the comparability of the different methods and whether the results could be combined. An optimized monitoring approach for the TMAP should be developed based on the results of these experiments.

c. to review and refine the common data handling model and reporting procedure

The common data model based on an inventory of available data and the TMAP database should be discussed by the blue mussel experts regarding further requirements for trilateral reporting and assessment procedures.

d. to prepare proposals for quality assurance procedures

Common standards for quality assurance should be developed as a result of the intercalibration exercise. A standard operation procedure for comparing remote sensing, field sampling methods as well as data analysis should be prepared to become part of the TMAP guidelines.

e. to explore the possibilities of the integration of field surveys in the TMAP

The workshop should select parameter from existing field surveys (including monitoring of subtidal mussel beds) which could be included into the TMAP Common Package (“location and area of blue mussel beds”) in accordance with § 81 Esbjerg Declaration.

f. to prepare a proposal for developing a monitoring strategy to measure recruitment

A research project should be initiated to gain more knowledge about recruitment and settlement of spat with the aim to develop a common monitoring strategy. Because only limited knowledge is available about the factors affecting the recruitment of blue mussel and therefore, it is currently not possible to monitor this important process.

3. Present Status

The workshop participants presented recent results of the ongoing blue mussel monitoring programs in the three countries.

An overview of the development of blue mussel beds and total biomass is given in Table 1.

A detailed description of the national programs was compiled in 2000 and can be found in the report of the first workshop (CWSS 2001).

Most of the national monitoring programs were designed as part of the national blue mussel fisheries management, e.g. to decide on fishing permissions, areas to be fished or quotas. This fact has to be considered in the discussion of a better harmonization of the blue mussel monitoring and in the comparison of the different methods in use.

Table 1: Development of blue mussel beds (ha) and total biomass of blue mussels (tons fresh weight).
*[1)] Surface area and biomass data based on spring measurements.
*[2)] Data from the period 1989-1991

Area (ha)	NL*[1)]	LS	S-H	DK
Before 1980	4120	5000		4000
1987			1250	
1988			3000	
1989		2700*[2)]	3000	
1990			2000	
1991			1800	1100
1992			1900	
1993			1900	950
1994		1300	2000	
1995	1100			1020
1996	400	170		1000
1997	700	1280		
1998	200		600	
1999	300	2895	1000	1050
2000	1000	2342	800	
2001	800	1918		

Biomass (tons fresh weight)	NL*[1)]	LS	S-H	DK
Before 1980	100000		60000	23500
1987				
1988			53000	
1989			60000	
1990			25000	
1991		46000	20000	27300
1992			35000	62000
1993			35000	90000
1994		9000		117000
1995				66400
1996		1000		47600
1997		25000		11800
1998			26850	66200
1999	11600	100000	39530	44000
2000	17600	70000		49000
2001	15500	55000		

Sources
QSR 1999, TMAP Blue Mussel Workshop 2000; NL: RIVO, 2001, DK: DFU Report no. 87-01, June 2001, Blåmuslingebestanden i det danske Vadehav efteråret 2000, by Per Sand Kristensen & Niels Jørgen Pihl; SH: Yearly reports, G. Nehls, LS: data submitted by G. Millat

3.1 The Netherlands

A policy target of 2000 – 4000 ha stable intertidal mussel beds has been defined in the Netherlands (Beleidsbesluit Schelpdiervisserij Kustwateren 1999 – 2003, LNV 1999) for which currently an assessment method is being developed. An overall evaluation of the shellfish fisheries in the Wadden Sea and the Eastern Scheldt will be carried out in 2003 (Min. LNV & MinV&W, 1999).

Monitoring of blue mussels (intertidal and subtidal) is carried out by RIVO in connection with the yearly cockle surveys in spring. Several methods (stratified sampling, aerial photographs, reconnaissance flights, ground truth) are used to determine the distribution of beds and biomass of mussels, and to gain sufficient information for the fisheries management, e.g. food reservation for birds. This information has to be available in the beginning of June each year and forms the basis for fisheries permissions. Since 1991, there has been no mussel fisheries on intertidal beds with the exception of minor fisheries in autumn 1994.

Regular field surveys on selected mussel beds are carried out by Alterra to document the development of mussel beds in detail. Since 1995, four intertidal mussel beds have been regularly monitored by Alterra during the period April to July: Balgzand, Ameland (two beds) and Schiermonnikoog. Because

of financial constraints, this detailed monitoring has been ceased. It is unclear if it can be continued in the future.

3.2 Germany

Lower Saxony

In Lower Saxony, the blue mussel monitoring is carried out in the framework of the blue mussel management plan. Aerial photographs have been taken in May/June to determine size and location of blue mussel beds in the whole area since 1994. Additional field surveys are carried out on selected beds to determine i.a. biomass, coverage, proportion, length distribution, and other mussel bed characteristics.

In 2001, the number of mussel beds remained the same. In general, a decline of total area and biomass was observed (see Table 1). The mussel stock is still dominated by spatfall of 1996. Because these mussels are at the end of their life cycle and only few spat has been established since then, it can be expected that the decline of beds will continue in the future.

Schleswig-Holstein

In Schleswig-Holstein, blue mussel monitoring has been carried out since 1988. A new monitoring program started in 1998 with detailed field surveys of selected intertidal beds in connection with aerial photographs.

In the period 1998 – 2000, the total coverage of mussel beds decreased with about 30%. The biomass of single beds slightly decreased or remained stable whereas the biomass in patches remained almost constant (about 12 kg/m²).

Locations of subtidal mussel beds are monitored by analyzing black box fishery data by month. The application of underwater videoing to identify subtidal mussel beds has successfully been tested on culture lots; best results were obtained during high tide and in July and August, because of less water turbidity.

3.3 Denmark

In Denmark, blue mussel surveys are carried out in autumn every two to three years (dredge sampling) as part of the fisheries management. Aerial photographs were taken for the whole intertidal area in May 1999. The most recent survey data are from 2001 (Kristensen & Pihl 2001). The next survey will be carried out in September 2002.

For several years, the location and size of the intertidal mussel beds have not changed significantly, whereas the total biomass has undergone some fluctuations (Table 1). From 1998 to 2000, the total biomass decreased with about 26%

In 2001, the TAC of 5000 tons was given, which was fished by 5 fishermen in 3 months.

3.4 Conclusions

The monitoring of blue mussel beds has been further improved in all countries, e.g. by standardization of methods, the use of remote sensing techniques (aerial photographs), GPS and GIS. A large amount of data has been made available especially for the last 10 years, which can be used for trilateral assessment.

However, there are still methodological difficulties to exactly determine the borders of a mussel bed because of the highly variable and complex structure of a bed, which can change dramatically within a few months. This concerns also the determination of biomass, coverage and other important mussel bed characteristics. Especially borders of a seed bed are high variable. Furthermore, the area of a bed and coverage may decrease (smaller patches or less patches) but within the patches the mussel density (proportion, “Besatz”) can remain constant.

Because of practical limitations (resources and time frame) monitoring of these parameters can give only a rough indication of the mussel bed development for the whole Wadden Sea, whereas for single sub-areas or mussel beds, very detailed information is available.

The existing monitoring strategies and the chosen methodology also reflect the different approaches in blue mussel management in the three countries (see CWSS 2002) Therefore, a complete harmonization of mussel monitoring in the TMAP was not been regarded as a realistic option. Instead, the existing programs should be adapted in order to make the results better comparable for trilateral assessment.

The workshop concluded that the determination of the location and area of single mussel beds (mandatory TMAP parameter) can be regarded as comparable for trilateral purposes although some methodological differences exist between the countries. These have to be considered when carrying out trilateral assessments.

The data on biomass and coverage area are also comparable but only on a larger scale, e.g. as average value per country or region. It is not possible to zoom in and to compare biomass and coverage for individual beds because

- biomass and coverage of beds may change within one year,
- biomass determination per bed requires more samples than obtained now in order to detect changes in biomass less than 50% with a significance of 95%,
- methodological difficulties exist to determine coverage of single beds.

4. Remote sensing techniques

The TMAG guidelines recommended aerial photographs to get a synchronized and complete overview of all intertidal mussel beds. This has been implemented in all national programs. However, the surveys sometimes differ with regard to the applied methods, the frequency of the surveys, and the importance of these surveys within the overall mussel monitoring and management (CWSS 2001).

In the Netherlands and Schleswig-Holstein, the aerial photographs (NL: color 1:40,000, SH: black and white 1:15,000) were regarded as not sufficient by the Dutch and Schleswig-Holstein experts to map all mussel beds completely. Because of false negative (and false positive) identification it was estimated that only 80 – 90% of the beds could be identified. Consequently, the monitoring activities in the Netherlands and Schleswig-Holstein give a high focus on field surveys.

In Lower Saxony, the aerial surveys are the central activities to determine location and area of the beds. Ground truth is carried out to analyze the biological characteristics and to estimate total biomass and coverage. Experiences from the past showed that more than 95% of all mussel beds could be identified on aerial photographs (black and white, scale of 1:15,000) by using a stereoscopic interpretation equipment.

In Denmark, aerial color photographs (1:25,000) are used to identify intertidal beds for field surveys and to determine the total biomass of beds. The 1993, 1996 and May 1999 surveys are the only complete set of aerial photographs.

Conclusions

The workshop stressed that different experiences with aerial photographs of intertidal beds have been gained during the last years. Beside the technical aspects this is also because of the different frameworks in which the mussel monitoring is carried out (setting the time frame and the required accuracy): as part of the fisheries management (as in NL and DK), as a status description (as in SH) or to deliver information for policy (mussel management plan in LS).

The workshop compared aerial photographs with different spatial scales and from different parts of the Wadden Sea and concluded that most of the mussel beds could be identified with good accuracy. However, there is always the possibility that some beds may be overlooked (covered with sediment, scattered occurrence of beds, young beds) or that beds may be wrongly identified.

The workshop concluded that it is necessary to check the reliability of aerial photographs in detail and to quantify false negative/false positive interpretations in order to optimize the interpretation procedure.

It was agreed to cross check aerial photographs from Lower Saxony and Schleswig-Holstein (also regarding interpretation of problematic beds) and to carry out a special training workshop on aerial photographs in spring 2003.

5. Assessment Criteria

Beside comparable monitoring results, common criteria for a trilateral assessment should be available. With regard to mussel monitoring this concerns

- a common definition of a mussel bed,
- a common classification of beds or sites (stable beds / stable sites).

The common definition of stable beds/stable sites will provide the basis for the follow-up work of the 2001 Esbjerg Conference. The Esbjerg Conference decided “that the implementation of the Targets on geomorphology, eelgrass beds and mussel beds still deserves attention and, therefore, to evaluate before the end of 2004 the mussel fishery with special attention to stable mussel beds” (§ 9 ED) and “to base the conservation and management of mussel beds on the protection of sites where stable beds occur and areas with a high potential for the development of stable mussel beds” (§ 10 ED).

In the Netherlands, a policy target of 2000 – 4000 ha stable intertidal mussel beds has been defined for which currently an assessment method is developed. It was proposed to classify the beds concerning their degree of stability. A scoring system was set up to rank specific characteristics of individual beds (age of bed, proportion of patches, type of underlying sediment, location of bed in a habitat model). The scoring system has the advantage that it gives room for policy decisions by describing a relative stability (not a yes-or-no classification) and makes the classification for each bed understandable. The main practical problem is that not always (especially in years with many beds) enough data will be available for all beds to apply the scoring system.

The Dutch habitat model has been developed as an important tool to identify suitable sites for mussel beds in the Dutch Wadden Sea. The model has been validated with several data sets and was able to describe the development of mussel beds during the last decades quite well (see presentation Brinkman). The model will be further developed by including additional variables.
The workshop recommended testing the application of the model also in other Wadden Sea areas. A suitable area would be the Lister Deep for which the required basic data were probably available and sufficient to run the model.

In Lower Saxony, the management scheme is related to stable mussel bed sites because single beds are highly variable (or even may disappear within one year). A site may be defined as stable if mature mussel beds (one or more) have been present over several years.
A stable site is defined as “a suitable site where mussel beds can develop to a mature stage”. The main criteria is the repeated prove of mussel beds over a longer time period in the past. Additional criteria may be included in this definition later, which would be type of location, age and sediment structure of beds.
The definition of a mussel bed site is based on the occurrence of a mussel bed. The concrete delimitation of a site is determined by the borders of former and recent mussel beds. Spatial fluctuation of the bed within the site or, in some years, also outside the borders of the site is possible.

In Schleswig-Holstein, the location of a mussel bed is regarded to have a higher importance than single bed characteristics when describing the probability of a bed to persist. Areas with high and low dynamics can be distinguished.
In principle, the classification of mussel beds into stable beds is always retrospective. No prediction can be made that a bed will persist or not. In case of Schleswig-Holstein, the mussel beds, which are present now, can be regarded as stable because they have persisted over several years without any major spatfall since 1996.

The workshop stressed that mussel beds showed a high variability and complex development in the field, which is difficult to follow by monitoring with a reasonable effort. This makes it also difficult to set quantitative values to single bed characteristics (e.g. contours of a bed, demarcation between beds, minimum size of beds).

Characterization of mussel beds depends on the specific management objectives, which also defines the selected scale of observation (time and space). This concerns practical questions, e.g. how to define a minimum size of bed or whether neighboring beds should be treated separately.

As a practical approach, the “25-m-rule” has been chosen in the Netherlands and is more or less also applied in the other countries. However, firm guidelines cannot be set because they will not cover all possibilities and may not be applicable in all cases.

With regard to fisheries management, Schleswig-Holstein criticized the approach to select “unstable” beds for fisheries instead of managing larger areas (tidal flats, tidal basins).

Conclusions

The workshop concluded that the definition of stable mussel beds (or stable sites) is not a purely scientific classification but depends on the selected scale of observation which is defined by national mussel fisheries policy and management. Therefore, a trilateral classification scheme can only be defined after common objectives have been developed

Several criteria can be applied to characterize a mussel bed concerning its persistence over several years:
- the age of a bed,
- the type of location,
- the sediment structure of the mussel bed basis.
Relative importance of these criteria depends on the specific management objectives.

More experience with the proposed monitoring protocol and scoring system should be gained in the Netherlands before a trilateral discussion on this issue is continued.

It has to be stressed that it was the issue of “stable beds/sites” was discussed at a trilateral workshop for the first time. The discussion on the national level has also not yet been finished. Because of several management implications, the workshop was not able to reach a final conclusion. The discussion on this issue has therefore to be continued.

6. TMAP Guidelines

Mussel bed definition

The workshop agreed on small amendments of the former definition (CWSS 2001) to ensure that all types of mussel beds (seed beds, young beds and mature beds) are covered by the definition:

“Definition:
‘A mussel bed is a benthic community ~~dominated~~ structured by blue mussels. ~~and~~ It may consist~~s~~ of a spatially well defined irregular collection of more or less protruding smaller beds, which may be called patches, separated by open spaces.’

This description entails also young beds with a high abundance of small mussels. ~~However~~, The described structure may not be so distinct in young beds or just settled beds (spatfall).“

Location and area of intertidal mussel beds

The workshop concluded that the contours of a mussel bed could be identified in a comparable way in all countries using a set of different techniques (aerial photographs, ground truth GPS measurement, dredge sampling). As far as possible, results from the spring survey (May/June) should be used for a trilateral mapping. However, because not all beds are synchronously monitored in all parts of the Wadden Sea in spring, data from beds monitored later in the year should also be included.

Minimum size of beds for mapping in the TMAP

In principle, a minimum size of a mussel bed cannot be defined (see previous chapter). For practical reasons, the workshop decided to map only beds with a size of 0.1 ha (30 m in diameter) in the TMAP.

The scale of the TMAP map was defined in the previous workshop (scale 1: 50,000: 0.1 ha). In any case, information about smaller beds is necessary.

Coverage

The average value for a larger area is comparable between the countries and can be used trilaterally. A detailed analysis between single beds cannot be carried out because of the high variance.

Biomass

Biomass values are trilaterally comparable for larger areas but not for single beds because of the high variance within a bed (e.g. a biomass range of 5 – 23 kg/m²).
The present sampling design has been selected for pragmatic reasons and allows only an indication of the biomass development. For example, 12 samples per bed allows to document a 50 % change of biomass (95% significance), whereas 50 samples are necessary to document a 25% change with the same accuracy. Furthermore, a high amount of mussel biomass may occur outside of mussel beds.

Primary Settlement

At present, there is no monitoring strategy available concerning monitoring of larvae abundance in the water column, primary settlement and spatfall. The workshop considered it useful to gain more knowledge about these processes and to include them into monitoring at a later stage.

Therefore, this topic should not be excluded from TMAP guidelines but addressed by research activities concomitant to the monitoring program.

7. Field Excursion

[chapter to be finalized]

Two beds on the tidal flats near Ameland were visited: a mature bed (differentiated structure) and a young bed (more uniform structure, seed from last year) (see aerial photograph):

Borders of bed

4 parallel GPS measurements. Differences mostly with regard to inclusion or exclusion of neighboring areas with mussels (one or two beds) and small patches within a bay.

Analysis by GIS under preparation (by Gerald Millat).

Coverage:

Estimation by steps methods (“stiefelmethode”), two methods
- 36% coverage (8 series of 100 steps and 1 of 60)
- 27% coverage (402 steps on mussels, 1478 steps on open spaces)

Biomass:

No testing, only a few samples taken.

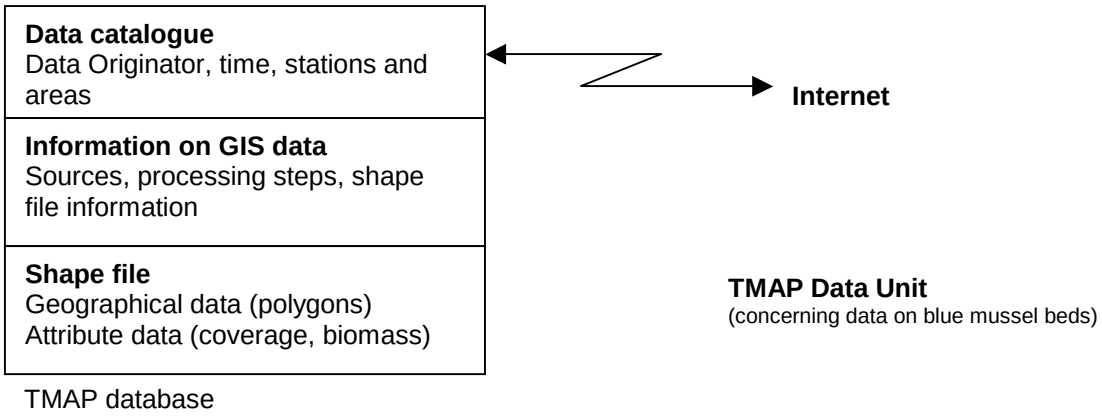
Preliminary conclusion

Mussel bed identification and contours no problem in the field, although monitoring protocol was difficult to apply. Difference in coverage higher.

[to be completed during follow-up work]

8. Data Handling

Technical overview
The TMAP data handling system serves as a tool to make monitoring data available for trilateral experts. The system consists of autonomous but identically structured data units, which can mainly be seen as databases with an Internet access. The data of each country or federal state is related to one data unit. Data units are located in Roskilde (Denmark), Tönning (Schleswig-Holstein/Hamburg), Wilhelmshaven (Lower Saxony) and Haren (the Netherlands).
The blue mussel data is stored in a trilateral harmonized data model, which is divided into three parts. Data on originators, time, stations and areas is needed to identify and select data in the database and is stored in the data catalogue of the TMAP database. The blue mussel data itself will be stored in ArcView shape files, which allows to store area and location of blue mussel beds within a GIS. Additional information on the shape files, like information on background data (e.g., aerial pictures), processing steps and how the GIS data is produced is also stored in the database. Beside the geographical data the shape files will also contain attribute data about the mussel beds, like coverage and biomass.



TMAP database

Planned data management
The blue mussel data has to be collected on national level. To harmonize and to check the quality of data on the trilateral level, the data will be sent to the secretariat and compiled to a trilateral GIS ArcView shape file. The shape file will again be separated per country and send back for national quality check before finally stored in the TMAP data units.

Discussion points:

a. Access to data (administrational procedure)
The use of national blue mussel data will be controlled by the national data units and the national TMAG members. For trilateral purposes and access on all available data units the TMAG will be responsible. In data access and usage modalities of the data, owners will be involved.

b. Data ownership
The data ownership and data management has to be organized on the national level. This has to be especially clarified in NL, because administrational agreements for delivery data owned by RIVO and Alterra on the trilateral level have not been reached.

c. Update of morphological data
The morphological background data, which will be part of the shape file, can be updated by the CWSS in cooperation with national authorities (RIKZ, NL; BSH, G), which will be done in practice every 5 to 10 years.

d. QSR Preparation
The whole process of blue mussel data collection, harmonization and usage can be tested during the production of the next QSR to show whether the trilateral data handling supports experts in an effective assessment of blue mussel beds.

Conclusions:

Data management:

a. GIS data on size (contours) and location of mussel beds can be delivered and are mandatory for the trilateral TMAP data management.
b. Attribute data on coverage, biomass and age of beds should be delivered if possible; also if only available for selected beds. From a trilateral view delivery of these data is optional.
c. The process of data management and data storage for blue mussel beds will start with data of 1999, because they are complete and available in all countries.

Follow up:

For a first run blue mussel data of 1999 will be delivered to the CWSS for further compilation until August 2002 by all participants of the workshop. Nevertheless, in the Netherlands, the trilateral usage of mussel data has to be discussed between RIVO and LNV.

a. The national data packages will contain GIS data (ArcView shape files or ArcInfo import files) on location and contours of all blue mussel beds identified during monitoring in 1999.
b. The biomass and coverage of selected beds should be added.
c. Additionally, the calculated total biomass and average coverage per country should be delivered. Also the age of selected beds (if available).
d. For the trilateral data units also information on data sources (aerial photographs, ground truths, etc.), shape file processing and about originators are necessary and should be delivered.

9. Follow-up Activities

The workshop agreed on several follow-up activities to be carried out in 2002/2003. Because of the heavy workload during the period spring – autumn, several activities cannot be carried out before November 2002.

1. Preparation of Workshop Report

Workshop presentations by participants to be delivered to CWSS by 1 May, draft version by CWSS by 15 May, comments by participants by 1 June, delivery of draft version to TMAG in June.

2. Data delivery

Delivery of 1999 data by August 2002 (all participants) (NL data delivery on biomass on contours to be discussed between RIVO and LNV):

- contours (all beds),
- biomass and coverage of selected beds (to be delivered by Alterra),
- total biomass per country,
- average coverage per country,
- age of selected beds (if available).

3. Aerial Photographs

- Cross check of photographs from LS and SH (also regarding problematic conditions): November 2002
- Interpretation of DK photos of 1999 and transfer to GIS (by Gerald Millat and CWSS): November 2002
- Workshop on aerial photographs in Wilhelmshaven in Feb./March 2003

4. Scale

- Test different scales (25 m, 50 m, 100 m) in mapping mussel beds (aerial photographs) by Gerald Millat by spring 2003 (preparatory work of aerial photograph workshop)

5. QSR Preparation

Planning of mussel project in QSR preparation (pending decisions TWG, TMAG) by mussel experts and CWSS

- outline in June
- preparation of project description by fall 2002 (work steps, time schedule, effort, finances, product),
- work period 2003 - 2004

6. Habitat Model

Explore possibilities to apply habitat model in Lister Deep by Bert Brinkman

- check data availability with Jan Backhaus (Uni HH), Georg Nehls and GKSS

7. Information exchange

- Listing of available mussel reports by CWSS (homepage),
-
- Regular exchange of national reports between mussel experts,
- Inclusion of an English summary in the national reports.

10. References

Brinkman et al., Habitat Model

CWSS 2001. TMAP Blue Mussel Workshop, October 2000. Final version May 2001, 35 pages.

CWSS 2002: Final Draft Mussel Fisheries Report, document TWG 02/1/-3.2, version 18 April 2002

Kristensen, Per Sand & Niels Jörgen Pihl, 2001. Blamuslinge-bestanden i de danske Vadehavet efteraret 2000. DFU rapport nr. 87-01, pp. 23.

Annex 1 Terms of Reference

TMAP Blue Mussel Expert Workshop
Terms of Reference
11.03.2002

1. Introduction

The first Blue Mussel workshop was held in Tönning on 11-12 October 2000. It had the aim to develop a common monitoring strategy for blue mussels to be able to compare the results of the different monitoring programs and to make them available for trilateral assessment. The workshop prepared proposals to up-date the TMAP guidelines and to extend the TMAP with the ongoing national blue mussel monitoring programs.

The workshop also identified several issues which should be dealt with within the TMAP in a second blue mussel workshop in 2001. It would include field work and joint efforts of field trials to check methods, definitions and the role of experiences, as well as data handling, reporting, quality assurance and development of monitoring strategies for new issues:

With regard to the assessment of the progress made in implementation of the trilateral Target for blue mussels ("An increased area and a more natural distribution and development of natural mussel beds"), common criteria for the assessment procedure should be developed.

2. Tasks

The workshop has the task

a. to compare the existing remote sensing techniques

Identification and quantification of mussel beds by aerial photographs requires experiences in field surveys and good knowledge of remote sensing techniques. A detailed analysis of the used techniques (aerial photographs) will identify the advantages but also the limitations of the different approaches and will contribute to an improvement of the monitoring and a better comparison of the results.

b. to carry out intercalibration of field sampling methods

The workshop should evaluate the different monitoring strategies, sampling techniques, calculations and statistical methods of blue mussel monitoring in detail and make sure that the results of the different monitoring programs are comparable and can be used for a trilateral assessment. An intercalibration exercise will reveal the comparability of the different methods and whether the results can be combined. An optimized monitoring approach for the TMAP should be developed based on the results of these experiments.

c. to review and refine the common data handling model and reporting procedure

The common data model based on an inventory of available data and the TMAP database should be discussed by the blue mussel experts regarding further requirements for trilateral reporting and assessment procedures.

d. to prepare proposals for quality assurance procedures

Common standards for quality assurance should be developed as a result of the intercalibration exercise. A standard operation procedure for comparing remote sensing, field sampling methods as well as data analysis should be prepared to become part of the TMAP guidelines.

e. to explore the possibilities of the integration of field surveys in the TMAP

The workshop should select parameters from existing field surveys (including monitoring of subtidal mussel beds) which could be included into the TMAP Common Package ("location and area of blue mussel beds") in accordance with § 81 Esbjerg Declaration.

f. to prepare a proposal for developing a monitoring strategy to measure recruitment

A research project should be initiated to gain more knowledge about recruitment and settlement of spat with the aim to develop a common monitoring strategy. Because only limited knowledge is available about the factors affecting the recruitment of blue mussel and therefore, it is currently not possible to monitor this important process.

3. Participation

The workshop will be attended by persons who are in charge of the national blue mussel monitoring in organizational and technical aspects. The TMAG will nominate participants of the workshop and appoint a chairman. The CWSS will be responsible for the secretarial work.

4. Mandate

The workshop will be held as a TMAP expert workshop under the responsibility of the TMAG to carry out the tasks given above. The workshop will report on the results to the TMAG meeting in June 2002.

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