ENCORA Theme 7 - MARBEF Theme 3
Workshop on Marine Biological Valuation
6-8 December 2006
Ghent, Belgium

WORKSHOP REPORT

Joint workshop in the framework of:

ENCORA Theme 7
MARBEF Theme 3

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Introduction

This report gives an overview of the discussions held during the workshop on marine biological valuation that was held from 6 to 8 December 2006 at Ghent (Belgium). The workshop was a joint venture of the EU CA ENCORA (www.encora.org) and the EU NoE MARBEF (www.marbef.org). Both Theme 7 within ENCORA and Theme 3 within MARBEF deal with marine/coastal biological valuation and by organizing a common workshop for both themes it was hoped to reach a consensus on this topic which is agreed upon by a large scientific community.

Marine biological valuation encompasses the determination of the value of the marine environment from a nature conservation perspective. As such, marine biological valuation aims at providing an integrated view on nature's intrinsic value (i.e. without any reference to anthropogenic use), as opposed to socio-economic valuation aiming at the quantification of the goods and services.

Because there is an ever increasing use of the marine environment, practitioners, stakeholders and policy makers request clear and simple baseline maps in order to allow them make well-deliberated choices: e.g. usage maps may be used to detect conflicts in spatial distribution of human activities, whereas sedimentology maps allow to deliberately identify suitable aggregate extraction zones. These maps are indispensable within the process of spatial planning. However, a protocol to develop baseline biological valuation maps, differentiating between the intrinsic values within an area, does not exist. Consequently, when such maps are needed, one is often obliged to trust on the available best expert judgement.

Taking the success of the terrestrial biological valuation maps of Flanders (Belgium) as an example, the MARBEF Theme III and ENCORA Theme 7 teams set the development of a widely applicable and scientifically acceptable valuation protocol for the marine and coastal environment as one of their major goals. Doing so, a prototype protocol was developed, making optimal use of (1) the lessons learned from the terrestrial valuation experts, (2) existing national initiatives and (3) existing international directives (e.g. Habitat Directive and European Marine Strategy).

During this workshop we wanted to make use of the expertise and thoughts on this subject of the participants. Only such wide and interactive cooperation might lead to a protocol that is widely accepted and applicable.

The **main objectives of the workshop** were therefore:

- To have a general discussion on the prototype valuation protocol, with emphasis on the applicability in marine/coastal habitats
- To come to a preliminary consensus on the biological valuation protocol
- To agree on the project outline and timing for the coming years
- To select case study areas for protocol testing and to make practical arrangements on these tests.

The ENCORA community mainly consists of coastal scientists, practitioners and policy makers and the main topic of Theme 7 is the restoration and preservation of coastal biodiversity. To be able to conserve and restore coastal biodiversity, biological valuation maps depicting the most valuable sites should be made available to policy makers. Therefore ENCORA Theme 7 organized this first workshop to define a concept and protocol for marine biological valuation.

By inviting members of the MARBEF Theme 3 community, which also deals with marine biological valuation (next to the goods and services valuation of marine biodiversity), the expertise present during the workshop was drastically increased. MARBEF also doesn't focus only on the coastal area, but enlarges the field of study to the entire marine system. Cooperation between ENCORA and MARBEF in this initial phase of the development of a biological valuation methodology will lead to a methodology which is acceptable for a broader marine/coastal community. As ENCORA focuses on end-users, participation from this network could bring in the indispensable input of practitioners and stake holders as well as their experience with decision support systems in the coastal area.

Workshop agenda

Day 1 ***Wednesday 6th December 2006***
To get all on the same track…

MORNING SESSION
Chair: Steven Degraer
Rapporteur: Ine Moulaert

- 8h45 – 9h00: Registration

- 9h00 – 9h10: Welcome (Magda Vincx)
  - The liaison between MARBEF Theme III and ENCORA Theme 7

- 9h10 – 9h30: Introduction (Steven Degraer)
  - Aims of the workshop
  - Workshop strategy
  - Agenda overview
  - Adoption of the agenda

- 9h30 – 10h10: Presentation of the concept of marine biological valuation (Sofie Derous)
  - Definition of biological value
  - Why?
  - Where do we come from?
  - Time line of projects leading to the concept
  - Questions and discussion

- 10h10 – 10h40: Break

- 10h40 – 11h20: Presentation of the marine biological valuation concept (John Roff)
  - Outline of the December 2004 workshop
  - Outcome of the December 2004 workshop
    - Criteria
    - Application: Organisational levels of biodiversity
  - Questions and discussion

- 11h20 – 12h10: Presentation of the marine biological valuation protocol (Sofie Derous)
  - Assessment questions and algorithms
  - Scoring system
  - Results of a test application of the protocol
    - Case study area: Belgian part of the North Sea
  - User-friendly web interface
  - Questions and discussion

- 12h10 – 13h30: Lunch break

AFTERNOON SESSION

Chair: John Roff

Rapporteur: Marijn Rabaut

- 13h30 – 15h00: Comments on and suggestions for improvement of the proposed valuation concept and protocol (all participants: ± 5 min./attendee)
    - Comments of each attendee on the concept and protocol
        - General opinion on strengths, weaknesses, opportunities and threats of the proposed concept and protocol (cf. SWOT analysis)
        - Suggestions for adaptation of the concept/protocol
        - Possible new discussion items (for Day 2)

- 15h00 – 15h30: Break

- 15h30 – 16h00: Comments on and suggestions for improvement of the proposed valuation concept and protocol: Continued. (Sofie Derous)
        - Summary of SWOT analyses

- 16h00 – 16h30: Conclusion: Preparation of next day's discussion (John Roff)
    - Updating list of discussion items
    - Definition of the discussion items

- 16h30: Closure of the first day

Day 2 ***Thursday 7th December 2006***

To agree upon a marine biological valuation protocol…

MORNING SESSION

Chair: Steven Degraer

Rapporteur: Sofie Derous

- 9h15 – 9h20: Introduction of the day programme (Steven Degraer)
    - Outline of second day's objectives

- 9h20 – 9h50: A testimony from a terrestrial biological valuation expert (Desiré Paelinckx)
    - Biological valuation in Flanders (Belgium)
    - Natura 2000 criteria and biological valuation: A conflict?

- 9h50 – 10h10: Introduction to break-up discussion sessions (Steven Degraer)
    - Summary of the first day's conclusions
    - Introduction to break-up discussion session
        - Practicalities
        - Discussion items presentation for Session I.

- 10h10 – 11h30: Break-up discussion session I on valuation concept discussion items (with reservation)
    - Appointment of rapporteur
    - Discussion on selected discussion items: e.g. need for improvement?

- 10h40 – 11h00: Break

- 11h00 – 12h00: Break-up discussion session I on valuation concept discussion items (with reservation): Continued
    - Discussion on selected discussion items: e.g. need for improvement?
    - Preparation of a presentation of the main outcomes (e.g. suggestions for improvement) for the meet back session

- 12h00 – 13h00: Meet back session I on valuation concept discussion items (with reservation).
    - Presentations of break-up discussion outcomes
    - Plenary discussion of outcomes, focusing on suggestions for improvement.
    - Consensus on an adapted valuation concept.

- 13h00 – 14h00: Lunch

AFTERNOON SESSION

Chair: John Roff
Rapporteur: Sofie Derous

- 14h00 – 14h20: Introduction to break-up session II.
    - Discussion items presentation for Session II.

- 14h20 – 15h40: Break-up discussion session II on valuation protocol discussion items (with reservation).
    - Appointment of rapporteur
    - Discussion on selected discussion items: e.g. need for improvement?
    - Preparation of a presentation of the main outcomes (e.g. suggestions for improvement) for the meet back session

- 15h40 – 16h00: Break

- 16h00 – 17h00: Meet back session II. Valuation protocol discussion items (with reservation).
    - Presentations of break-up discussion outcomes
    - Plenary discussion of outcomes, focusing on suggestions for improvement.
    - Consensus on an adapted valuation concept.

- 17h00: Closure of the second day

Day 3 ***Friday 8th December 2006***
To agree on future cooperative protocol testing…

MORNING SESSION
Chair: Magda Vincx
Rapporteur: Jeroen Speybroeck

- 9h15 – 9h30: Introduction of the day programme (Magda Vincx)
  - Outline of third day's objectives

- 9h30 – 10h45: Where to go from here?: Testing the protocol. (Sofie Derous)
  - Selected MARBEF Theme III Case-study areas
    - Presentation
    - MSc student involvement
  - Invitation for ENCORA Theme 7 Case-study areas
  - Agreements on responsibilities for each case-study area (who will do what?)
    - Data gathering
    - Data management

- 10h45 – 11h15: Break

- 11h15 – 12h30: Wrap-up: conclusions of the workshop (all attendees)
  - Drafting outline of workshop report
  - Drafting content of workshop report

  - 12h30 – 14h00: Lunch break

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Presentations

A. Welcome

At the start of the workshop Magda Vincx welcomed the participants of the workshop and gave a short presentation of the structure of the ENCORA and MARBEF networks and the contents of ENCORA Theme 7 and MARBEF Theme 3. As both themes deal with the development of a generally applicable marine/coastal biological valuation protocol a joint workshop for both theme members was organized, aiming at a protocol consensus reached by a broader scientific audience.

B. Introduction

Then Steven Degraer gave an overview of the main aims of the workshop, namely to agree on the concept of marine biological valuation, to agree on the protocol to be followed when doing a marine biological valuation of a certain area and to make arrangements on testing the protocol on different case study areas within ENCORA Theme 7 and MARBEF Theme 3. Finally, he presented the outline of the workshop and the agenda.

All participants received two working documents before the workshop. These documents (one on the concept of marine biological valuation – Derous et al. (submitted) and one on the protocol of valuation – Derous et al. (in prep.)) were the basis of the discussions during this workshop.

C. The concept of marine biological valuation

The concept of marine biological valuation was presented by Sofie Derous. First a clear definition of the term “biological value” (i.e. the intrinsic value of marine biodiversity, without reference to anthropogenic use) was given and it was explained why such marine biological valuation can be useful for marine policy. Several previous initiatives on this topic were also presented. The slides of this presentation can be found on the ENCORA (www.encora.org) and MARBEF (www.marbef.org) websites.

The concept of marine biological valuation was further explained by John Roff. In December 2004 a first international workshop on marine biological valuation was held and during this workshop the valuation criteria were selected from all criteria circulating in literature. John Roff was one of the participants of this first workshop and was therefore invited to this new ENCORA - MARBEF workshop to present the outcomes of the first workshop.

The criteria that were selected during the first workshop are given in the table below (with their definitions). He also explained how these criteria could be applied to the different organizational levels of biodiversity. Some discussion topics that were highlighted during this presentation were:

- Are there any valuation criteria that should be added to the list?

- Are there any redundant valuation criteria (e.g. overlap between 'aggregation' and 'fitness consequences')
- What are we over- or underemphasizing with this concept?
- Importance of scale (for both study area as when applying the 'proportional importance' criterion)
- Difficulties with applying the criterion 'naturalness'

The slides of this presentation can also be found on the ENCORA and MARBEF websites.

1st order criteria	
Rarity	Degree to which an area is characterized by unique, rare or distinct features (landscapes/habitats/ communities/species/ecological functions/ geomorphological and/or hydrological characteristics) for which no alternatives exist.
Aggregation	Degree to which an area is a site where most individuals of a species are aggregated for some part of the year or a site which most individuals use for some important function in their life history or a site where some structural property or ecological process occurs with exceptionally high density.
Fitness consequences	Degree to which an area is a site where the activity(ies) undertaken make a vital contribution to the fitness (= increased survival or reproduction) of the population or species present.
Modifying criteria	
Naturalness	The degree to which an area is pristine and characterized by native species (i.e. absence of perturbation by human activities and absence of introduced or cultured species).
Proportional importance	Global importance: proportion of the global extent of a feature (habitat/seascape) or proportion of the global population of a species occurring in a certain subarea within the study area. Regional importance: proportion of the regional (f.i. NE Atlantic region) extent of a feature (habitat/seascape) or proportion of the regional population of a species occurring in a certain subarea within the study area. National importance: proportion of the national extent of a feature (habitat/seascape) or proportion of the national population of a species occurring in a certain subarea within territorial waters.

D. The marine biological valuation protocol: experiences from the Belgian part of the North Sea.

Building on this concept, a marine biological valuation protocol was developed in the framework of the Belgian BWZee project ("A biological valuation map for the Belgian Continental Shelf", project financed by the Belgian Federal Science Policy Office, 2004-2006). Sofie Derous explained how the valuation criteria were linked to the different organizational levels of biodiversity (from the genetic to the ecosystem level, including both structures and processes) by constructing a table with assessment questions. These assessment questions were then further analyzed to construct practical algorithms which can be used for querying a biological database. The Belgian part of the North Sea (BPNS) was divided into grid cells (subzones) that are relevant for the different ecosystem components (250x250 m for benthos and 3x3 km for seabirds). Then a scoring system was chosen where all first-order criteria get

the same weight and the subscores are summed. This sum can then be adjusted when subzones score high for one or more modifying criteria.

The application of this protocol to the available biological data of the BPNS was shown, resulting in a first marine biological valuation map (BVM) of the BPNS. This map and all underlying data maps can be consulted on the user-friendly website (www.vliz.be/projects/bwzee/atlas.php). The slides of this presentation can also be found on the MARBEF and ENCORA websites.

E. A testimony from a terrestrial biological valuation expert

The development of a concept for marine biological valuation was based partly on the biological valuation maps that exist already for the terrestrial part of Belgium. During the second day of the workshop Desiré Paelinckx proposed the methodology used to develop these BVMs and explained the relationship between these maps and the aims of the EU HABITAT Directive. The terrestrial method combines the inventory of the different vegetation types with a valuation estimate of these different types by using a set of valuation criteria. To implement the HABITAT Directive the BVMs are now translated to habitat maps that give an overview of the percentage of each habitat within the different complexes. The quality of the habitat is also assessed by looking at the habitat structure, the vegetation development and the level of disturbance in each habitat. Dunes are also included in the terrestrial valuation so no separate valuation protocol has to be designed for them. Beaches however are not incorporated and it should be tested whether the marine valuation protocol can also be used for beach areas.

F. Dissimination of results through coastal WIKI

Simon Claus gave a presentation of the coastal WIKI, which is a tool that is developed in the ENCORA network to disseminate information of the different themes to managers and other scientists. This tool, which is similar to WIKIPEDIA, could also be used to spread information on marine biological valuation. The difference of the coastal WIKI with WIKIPEDIA is the fact that the system is not open for everybody. WIKI is linked to a contact database and only registered members can upload documents or make changes to the existing information. It is a dynamic tool that can make progress in projects visible to the project partners. It should not be seen as a discussion forum, but rather as an information platform.

Comments on the presentations

The comments on the proposed concept and protocol of marine biological valuation were clustered into a selected list of discussion questions/topics that were dealt with during the remainder of the workshop. These questions could be separated in three broad categories: questions dealing with the concept, others dealing with the protocol and a third category of questions dealing with the use of the biological valuation maps.

Questions dealing with the concept of marine biological valuation:

1. Do we need an independent assessment process for biological/ecological valuation?
2. If not – what do we do/use if we do not have such a framework?
    a. What are the alternatives?
    b. Do we need instead/in addition/ an "ecosystem-based" approach to valuation that spreads across national boundaries? How would we achieve this? What would it consist of?
3. What about each of the first-order criteria?
    a. Rarity – agreed?
    b. Aggregation – agreed?
    c. Fitness consequences – agreed?
    d. Additions and/or redundancies?
4. What about each of the modifying criteria?
    a. Naturalness – agreed? How to define/apply?
    b. Proportional importance – agreed? How to define/apply across studies?
    c. Additions and/or redundancies?
5. Do we need to include resilience in the concept (as a criterion)? Is it adding to intrinsic biological value? ('resilience' was omitted during the previous workshop as it is related to a stressor)
6. Biodiversity elements (~ table Zacharias & Roff (2000))
    a. List of elements – what should be in or out?
7. What is the relationship between the concept of intrinsic value and the concept of "goods & services"?
8. What is missing in the concept in terms of the process to determine value? (~ flow chart paper)
9. How to include temporal scale in concept? Shifting baseline concept? How to deal with seasonality? How to deal with global change?
10. Can beaches also be valuated with the same concept?

Questions dealing with the protocol for marine biological valuation:

1. Who needs these valuation maps? What is the scale (regional, national,…) of these maps?
2. How would we "apply/test" the valuation protocol? Is an independent assessment of the outcome possible? How do we assure quality of the product? How confident are we with the results?
3. How do we standardize the assessment questions and algorithms? Do we need to standardize the algorithms to achieve consistency or can they be designed for each case study separately? Minimum number of assessment questions needed to be able to valuate area?
4. How do we decide whether some element/data should be added or not to the protocol? Which criteria can be used to include or exclude them? Minimum requirement for data availability and reliability? How to deal with data taken along transects (e.g. trawling)?
5. How many 'value' classes do we need (3/5/10)? How to rationalize the number of categories?

6. How to decide on the scale/size of subareas? Definition of subareas? Size of study area? Arbitrary? Recommendations? How to decide on geographic boundaries of areas? Can the grid cells be different for various ecosystem components?
7. Can we add "apples and pears" to achieve estimates of value? Equivalence of data (genetic → ecosystem level)? How are these combined values weighted: summed, averaged, take the maximum,…?
8. How are the modifying criteria included in the protocol? How do they change the values of the first-order criteria?
9. How do we modify the values with 'expert opinion/data interpretation'? (One should not just use raw data without expert interpretation)

Questions dealing with the use of the marine biological valuation maps (BVMs):

1. Are there conflicts between value estimates and existing or proposed MPAs? What happens if we have established MPAs in areas of low value?
2. Dissimination of information to other agencies/groups? Updating of maps needed.
3. Does the production of BVMs give us a false sense of security?
4. What 'caveats' do we need to caution HOW the valuation protocol should be used/applied?
5. What is the relationship between the protocol and the concepts of "goods & services" protocols?
6. What is the relationship between the valuation protocol and HABITAT Directive, Water Framework Directive, NATURA 2000, Marine Strategy, Maritime Policy,…?
7. When to involve managers? Do they need to be involved?

The first 2 questions dealing with the concept were discussed plenary, while all other questions were discussed in break-up groups during the first and second day of the workshop.

Plenary discussion

Only question 1 and 2 concerning the biological valuation **concept** were discussed plenary as an agreement on these issues was needed before proceeding to the next questions.

A. Do we need an independent assessment process for biological valuation?

- All participants eventually agreed that biological valuation could be a useful tool for marine management. Participants also mentioned the value of underlying maps (from simply mapping the geographical distribution of samples up to making valuation maps for the different ecosystem components), next to the usefulness of the end-product of the valuation process (integrated biological valuation map). We need a comprehensive

framework to valuate areas so we don't have to base our judgements on expert knowledge each time a question is asked by policy makers.
- Inclusion of socio-economic value is not possible, as only the intrinsic biological value is investigated (first step).
- "Independency" of the process difficult to ensure → should be analyzed during quality control of the end products.
- Problems with the term "valuation": politically loaded term, implies a judgement of the scientists, people tend to perceive the meaning of the term in their own way ➔ we need a better definition of "valuation" or we need another "term" (suggestions: characterization, categorization, …).

B. If not – what do we do/use if we do not have such a framework?

- As all participants agreed that we need a biological valuation we didn't have to look for alternative frameworks.
- One possible alternative for the concept could be to produce different data layers but no final valuation map. These data layers could then be combined to answer specific management questions. However, the terrestrial expertise on BVMs has shown that managers need a final valuation map as such maps are easy to read. Policy makers are usually not able to interpret the separate data layers and will come back to the scientists to combine them into valuation maps.
- Also, some alternatives of the term "biological valuation" were proposed: biological characterization, categorization, evaluation, biodiversity valuation, ecological valuation, … → As we apply the criteria to all organizational levels of biodiversity it would be more logical to call it 'biodiversity valuation' or 'ecological valuation' (when physical elements are included in the assessment).
- An ecosystem based approach is used in some places (e.g. Canada) but never in the context of only intrinsic biological value. The term is also poorly defined and boundaries are very arbitrary in the marine environment. Such an approach should also include the mapping of energy fluxes. With biological/biodiversity valuation we don't include such fluxes; we only want to produce something new with existing available data.
- Although an ecosystem based approach is not possible in this framework, biodiversity valuation should be done across national boundaries where possible.

Group discussions

The other questions mentioned above were discussed in four break-up groups. Afterwards the results were presented to the group and discussed plenary. Below you can find the outcome of each of the discussion topics.

A. Other questions on the concept of marine biological valuation

1. What about each of the first-order criteria?

a) Rarity – agreed?

- All groups agree that 'rarity' should be kept as a first-order criterion.
- Clear definitions are needed!
- Most groups would only assess rarity at the physical/habitat level and not on the genetic or species level.

b) Aggregation – agreed?

- Most groups thought that 'aggregation' and 'fitness consequences' are linked to each other in many cases and suggest merging them into one criterion.
- 'Aggregation' and 'fitness consequences' should be combined EITHER/OR because they do not always fully overlap.

c) Fitness consequences – agreed?

- See 'aggregation'.
- Difficult to find practical algorithms to assess this.

d) Additions and/or redundancies?

- All groups agreed that no additional criteria should be added to the list of first-order criteria.

2. What about each of the modifying criteria?

a) Naturalness – agreed? How to define/apply?

- This criterion can be included as a modifier if we can provide a clear definition and algorithms to assess it.
- See further below.

b) Proportional importance – agreed? How to define/apply across studies?

- Instead of keeping 'proportional importance' as a modifying criterion, the group agreed to do the valuation on two different levels.

- First the valuation should be done at the local level of the study area and afterwards the valuation can be done on a broader (ecoregional) level.
- Such exercise would be very useful to compare the values of the subareas on both levels (are the subareas with high value on a national scale also valued high on an ecoregional scale?).

c) Additions and/or redundancies?

- No additional modifiers are needed.

3. Do we need to include resilience in the concept?

- All groups agreed to exclude 'resilience' from the concept as a criterion as it is too closely linked to human impact.
- However, certain habitats are known to be more resilient to natural impacts than others and could get a higher value for that. But such kind of resilience is already treated within the 'goods & services' valuation as defined by MARBEF theme 3 and should therefore not be treated here. The future decision support system that will be built around the socio-economic and biological valuation should integrate both values.

4. Which biodiversity elements should be included in the concept?

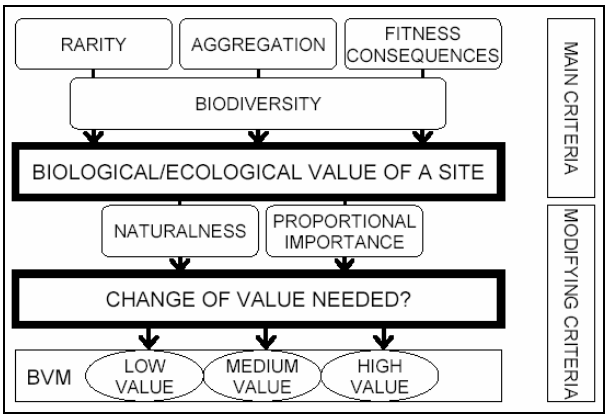
- This comprehensive item was discussed separately and the outcome of this discussion can be found in the paragraph 'Biodiversity elements' below.

5. What is the relationship between the concept of intrinsic value and the concept of "goods & services"?

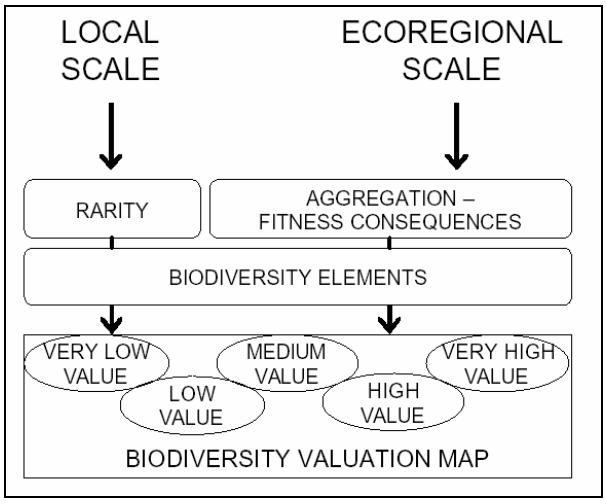
- Although techniques to attribute monetary units to intrinsic value have been developed, mapping both the intrinsic biological value and the Goods & Services value and comparing them is preferred.
- This question is also discussed further below (question U).

6. What is missing in the concept in terms of the process to determine value?

- This question analyzes the flow chart from the working document:



- This flowchart should be changed as some criteria are excluded from the concept or lumped together.
- Also the term 'biological valuation' should be changed into 'biodiversity valuation' as we apply the valuation criteria to different biodiversity elements.
- The new flowchart could be adapted as follows (the indication of 'local scale' and 'ecoregional scale' means that the valuation of a study area should be done first on a local scale (i.e. value subareas within the study area relatively to each other) and in a next step the same subareas should be valuated on a broader (ecoregional) scale to see if changes in value occur):



7. How to include temporal scale in concept?

- Because the marine environment is a highly dynamic and open system and because different ecosystem components show a high variation (e.g. benthic communities) valuation maps have to be updated after a certain period of time to reflect the most recent status of the study area.
- However, due to the high sampling intensity needed to update the BVMs these maps cannot be updated frequently enough to reflect real interseasonal or interannual differences in value.

8. Can beaches also be valuated with the same concept?

- Most participants agreed that the developed valuation methodology should be tested on beach case study areas to see whether it can also be used in these habitats.
- If not the methodology should be adapted to the specific needs of beach environments.

B. Questions on the protocol of marine biological valuation

1. Who needs these valuation maps? What is the scale of these maps?

- These maps will be used by the administration, enterprises and scientists.
- Maps should be used as guidelines which can be valuable for several stakeholders (both private and public).
- Each organization that needs spatial planning needs to use these maps.
- Maps should be available in the administration and will save a lot of money in implementing new activities.
- Maps should be produced based on a 'logical minimum' scale with the division in subareas on an ecological basis (not just square grid cells which are not so useful for management).

2. How would we "apply/test" the valuation protocol?

- Only the subjectivity of the protocol can be tested by letting different groups of people create maps with the same data.
- It is necessary to produce a quality assurance package with the maps taking into account the number of assessment questions which can be answered, the percentage of coverage of the available data, the amount of available data,… . Preferably the quality of the valuation indicated on the maps should be given with 1 (integrated) label.
- We need standing operating procedures for using the valuation protocol and the production of the BVMs to provide better uniformity among valuation results.
- The BVMs should only be produced by experts, because the protocol itself cannot be applied by 'non-experts'.
- The reliability of the valuation results, plotted on the maps, depends on the management questions for which the maps will be used. A document should be provided next to the maps to clearly indicate for which purposes the maps can be used and for which purposes they are not able to give answers.

3. How do we standardize the assessment questions and algorithms?

- Experts on each ecosystem component (e.g. fish, birds, benthos,…) from different study areas should come up with a protocol per component.

- Due to large variations in the available data in the study areas, the algorithms cannot be standardized but should be designed for each study area separately.
- During a valuation of an area, within a component, all parts should be addressed with the same protocol.
- The minimum number of assessment questions, which are needed for a reliable valuation, can not be determined.

4. How do we decide whether some element/data should be added or not to the protocol?

- Every ecosystem component map should be provided with a reliability estimate (e.g. achieved by multivariate analysis and Principle Components Analyses). On the basis of these reliability labels one can decide whether the map should be used to produce the final valuation map.
- In the ideal world, all component maps provide full spatial coverage of the study area. However, in the real world there are often gaps, which might or might not be filled by interpolation. It could be useful that when different component maps are combined, only the subareas that have overlap in coverage are shown (while the other subareas become 'blanc').
- The grids (subareas) of the separate components do not need to be of the same size, but do need to overlap (e.g. 4 in 1).
- There should be at least one component map to give an idea of the value of the subareas, but off course the integration of more maps will increase the confidence level of the valuation.
- Data taken along transects (e.g. beam trawls) can easily be extrapolated to grids.

5. How many 'value' classes do we need?

- During the assessments it is up to the experts to decide the number of intermediate score classes, ranging from 0/1 (e.g. yes/no or presence/absence) to a continuum of scores.
- However, the 'end' values for a component and for the final BVMs should be classified, preferably around 5 but this is dependent on the scale of the subareas within the study area (to be able to show patterns in the map).

6. How to decide on the scale/size of subareas?

- Two maps should be made, one at the scale of the case study area and on at the ecoregional scale.
- The scale of the subareas will be different for the different case studies and flexibility of scale should be included in the protocol.

7. Equivalence of data and weighting?

- At this point, we are only able to produce maps on the community level (i.e. biological valuation maps) and on the ecosystem level (i.e. habitat maps). The biological valuation map is obtained by adding separate component maps (e.g. fish, benthos, birds, etc.).
- One way to add these component maps could be to plot only the subareas with a 'high' value for a certain component and to give a 'higher' value where 'high' values for different components overlap. In this way the final BVM shows all subareas which are of value for one or more component.
- The separate component maps should always be attached, so the user can see for which components a subarea is of relevance.
- The habitat maps are considered to be characterization maps and they should not be combined with the BVM. However they should be used next to each other to supply relevant additional information.

8. How are the modifying criteria included in the protocol?

- It was agreed to exclude both modifying criteria from the concept, although 'proportional importance' is still present in some way as the valuation protocol should be applied on two different scales (local and ecoregional scale).
- As naturalness is too closely linked to human impacts, a map showing the (un)naturalness of the subareas could be produced as a second step after the valuation.

9. How do we modify the values with 'expert opinion/data interpretation'?

- The output of the valuation should certainly not be modified, but judged and provided with 'expert explanation'.
- The quality of the raw data available for the assessment should also be judged by the experts and, if needed, the experts can make the data suitable for assessment (e.g. by filling temporal or spatial gaps by interpolation).

C. Questions on the use of the marine biological valuation maps

1. Are there conflicts between value estimates and existing or proposed MPAs?

- Value estimates don't have to compare with selected/proposed MPAs as they are produced by a different methodology and by using different data.
- Comparison of both results could be a nice signal to policy makers.
- Repetitions of the valuation of a study area when the MPA is implemented since a certain period could give an idea of the effects of the conservation measures on the value.

2. Dissemination of information to other agencies/groups?

- We should make use of online tools like the coastal WIKI, which have an open access philosophy but with registration obligations for data providers and data users, to disseminate the valuation results.
- Training courses and/or workshops could be organized for potential users of the BVMs.
- We should invest in dynamic databases and database structures to allow the continuous updating of the maps and for new data input. The reliability criteria should be improvement when this is possible.
- The valuation protocol should be reviewed on a periodic basis and the validity of the maps should be documented. A periodic update of the maps (e.g. every 5 years) seems necessary to provide the latest status of the value of the subareas.

3. Does the production of BVMs give us a false sense of security?

- Yes, but we can address that by increasing the transparency of the protocol by establishing guidelines, accessible to a wider public, and/or by referring to the experts who made the maps and/or by describing the protocol clearly and by communicating about the reliability and accuracy of the maps.
- As a communication strategy it is suggested to present the biological valuation maps and the reliability maps together.

4. What 'caveats' do we need to caution HOW the valuation protocol should be used/applied?

- There needs to be a clear communication about the purpose and the scale of the maps.
- There needs to be consistency in the terms/definitions in order to relate with other disciplinary valuations (e.g. socio-economic or cultural valuations).
- The selection of (and division in) subareas needs to be done carefully.
- The protocol for making BVMs should not be used for *ex post* evaluations or Environmental Impact Assessments.

5. What is the relationship between the protocol and the concepts of "G&S" protocols?

- There's no single G&S protocol that is accepted by all environmental economists, so it is still difficult to know how the G&S protocol, which will be chosen for MARBEF Theme III RMP, could be combined with the biological/biodiversity valuation protocol in the future. A decision support

system (DSS), combining the results of both valuations, will be developed in the same RMP.
- The future DSS could be composed out of 3 different layers: one layer being the G&S valuation map, another layer being the biological valuation map and a third 'impact' layer showing the costs/damage of human activities on biodiversity.
- Caution should be exercised so that no elements are double counted by both protocols.

6. What is the relationship between the valuation protocol and international regulation?

- The valuation protocol should be able to give answers to legislative questions.
- Therefore, the data selection (type of data/amount of data) for valuation should be done carefully.
- The valuation exercise could be useful to give advice on monitoring issues required by EU legislation.
- A problem that arises from EU legislation is the fact that each member state needs to implement the legislation while they have no control on transboundary issues. BVMs on a EU scale could help to solve this problem and could lead to a better implementation of the legislation and to the establishment of more efficient monitoring networks.

7. When to involve managers?

- Managers should be involved from the start of the valuation process as they could be potential data providers. They could also give input on the required format of the results and could establish an agreed communication strategy.
- At the end of the valuation process the results should be presented to the managers so they know that the information exists.
- The managers should be given a sense of involvement and cooperation, but they should not be involved in the technical and methodological aspects.
- A direct link between the managers and the scientific experts should be established.

Definitions of the selected criteria

A. Rarity

- The definition mentioned in the working document: ***"Degree to which an area is characterized by unique, rare or distinct features (landscapes/habitats/ communities/species/ecological functions/ geomorphological and/or hydrological characteristics) for which no alternatives exist"*** can be kept as long as it is mentioned that it is a relative measure

- Rarity is assessed for each subzone relative to the others. It is not an absolute measure.
- Accidental recordings/vagrants should not be considered under 'rarity' and this should be made clear in the description of the protocol.

B. Aggregation/Fitness consequences

- The definitions of both criteria, as mentioned in the working document, should be merged to cover this lumped criterion: ***"Degree to which an area is a site where most individuals of a species are aggregated for some part of the year or a site which most individuals use for some important function in their life history or a site where some structural property or ecological process occurs with exceptionally high density either/or the degree to which an area is a site where the activity(ies) undertaken make a vital contribution to the fitness (= increased survival or reproduction) of the population or species present"***.
- Lumping both criteria should avoid that certain subzones are scored twice for the same reason (e.g. reproductive areas where species aggregate).

C. Naturalness

- As it is very difficult to define and apply this criterion without reference to human impact and as we mostly do not know what the natural state of most waters is, the participants agree to exclude 'naturalness' from the list of modifying criteria.
- Naturalness is something that should be assessed as a second step after a biological valuation is done. Naturalness can then be linked to different impact sources, leading to different maps. Integration of this kind of information in a biological valuation map is not useful to managers.
- So, there are no modifying criteria anymore, only two first-order criteria which are applied on all biodiversity elements and on two different scales (at the scale of the study area and on a broader ecoregional scale).

Biodiversity elements

The following table is adapted from Zacharias & Roff (2000) and was used to produce the assessment questions that are described in the working document. During the workshop these elements of biodiversity were closely analyzed to see whether some assessment questions were missing or redundant.

Genetic		**Species/population**		**Community**		**Ecosystem**	
Structure	**Process**	**Structure**	**Process**	**Structure**	**Process**	**Structure**	**Process**
Structure	Mutation	Structure	Migration	Structure	Succession	Watermass	Currents
Genotypes	Differentiat.	Abundance	Dispersion	S.Diversity	Predation	Temp.	Tides
Fitness	Drift	Distribut.	Retention	S.Richness	Competit.	Salinity	Disturban.

Haplotype D	Flow	Focal spp	Mig/Drift	S.Eveness	Parasitism	Properties	Gyres
Stocks	Nat.Select.	Keystone	Growth	Abundance	Mutualism	Boundaries	Retention
	Inbreeding	Ind.Cond.	Reprod.	Represent.	Disease	Depth/Press.	P-B couple
	Mating	Ind.Comp.	Recruit.	Distinctive	Production	Light	Entrain.
	Dir.Select.	Umbrella		Biomes	Decomp.	Stratificat.	B-G cycles
	Stab.Select.	Phenotypes		Biocoenos.		Topography	Seasonal.
	Dis.select.	Fragments		S-A relns.		Substrate	Product.
	Micro.Evol.	Meta-pops.		Transitions		Represent.	H-A equil.
	Erosion			Fun.groups		Distinctive	H-L equil.
	Speciation			Heterog.		Anomalies	Turbulence
	Macro.Evol.			Endemism		Exposure	Mixing
				Alt.S.stats.		Patchiness	Upwelling
				Symbioses		Nutrients	Divergence
				Biomass		Diss. Gases	Ecol.Integ.
						Anoxia	Erosion
							Desiccation

These are the results of the 'biodiversity' discussion:

- If all elements from the table are considered in the valuation process we are rather valuating 'biodiversity' than 'biology' and the term should be changed in 'marine biodiversity valuation'.
- As much elements from the table as possible should be added to the protocol in the form of assessment questions, depending on the confidence level of the available data to assess them.
- As there are still only very fragmentary data available for the genetic level it is suggested to exclude these elements (for the moment) from the protocol.
- Subareas within the study area can have different levels of available data and not all biodiversity assessment questions can be assessed for each subarea. This could give difficulties when we want to compare the values of the subareas (as they are based on different amounts of assessment questions). Some solutions could be:
    - Only compare the subareas with the same amount of information
    - If extrapolation to neighboring subareas is possible, comparison of subareas can be done, indicating that the confidence level diminishes for each subsequent extrapolation.
    - Include all the information for each subarea and, depending on the degree of confidence on the scores of the subarea for each assessment question, decide whether to add the scores or not. This could lead to subareas without an indication of the total value (= subareas with a low degree of confidence).
    - The table of Zacharias and Roff (2000) was screened and only the relevant elements for valuation were selected:

Species/population		**Community**		**Ecosystem**	
Structure	**Process**	**Structure**	**Process**	**Structure**	**Process**
Abundance	Dispersion	S.Diversity	Mutualism	Temp.	Tides
Distribut.	Retention	S.Richness	Production	Salinity	Disturban.
Focal spp	Growth	Abundance		Boundaries	Gyres
Keystone	Reprod.	Distinctive		Stratificat.	Retention
Ind.Cond.	Recruit.	Biomes		Topography	Entrain.
Ind.Comp.		Heterog.		Substrate	Upwelling
Umbrella		Endemism		Anomalies	Erosion
		Symbioses		Exposure	

		Biomass		Anoxia	

Testing the protocol on case study areas

For the MARBEF Theme III RMP 6 case study areas were selected:

- Flamborough Head Area (NE UK)
- Isles of Scilly (SW UK)
- Pico-Faial Channel (Azores, Portugal)
- Belgian-Dutch coast (Belgium – the Netherlands)
- Sylt-Romo area (Denmark)
- Gulf of Gdansk (Poland)

There's no even distribution of the case study areas over European marine waters as no case study areas are located in the Mediterranean Sea, along the Atlantic coast of France and Portugal and in the northern Scandinavian area. It would be nice if these areas could be covered as well by selecting new case study areas there in the framework of ENCORA Theme 7. There are also no beach areas analyzed in the current case study areas, so maybe these environments could be covered as well. An open invitation to all ENCORA members will be send out in January to propose new case study areas to test the protocol on.

For each case study area within MARBEF Theme III arrangements were made concerning supervision and coordination of the MSc. Students (see table below). The same areas will also be valuated socio-economically and culturally and the valid legislation will be investigated. All this information, together with the results of the biodiversity valuation, should then be clustered in a decision support system for that area.

		Methods				
Case study areas	Local co-ordinator: Including co-ordination of MSc students supervision	Economic valuation	Cultural valuation	Legislation (Regulation)	Ecological 'Biological valuation'	Decision support system
Flamborough Head	David Starkey	MSc	MSc	Elizabeth	MSc	MSc*
Gulf of Gdansk	Tomasz Zarzycki	Tomasz	Tomasz	Tomasz	Tomasz	Tomasz
Sylt-Romo	Poul Holm	MSc	PhD	MSc*	MSc	MSc*
Belgian/Dutch coast	Steven Degrear/Ekko van Ierland	MSc	MSc	MSc*	Sofie	Martijn
Pico-Faial channel	Tomaz Dentinho	Andriana	MSc	MSc*	MSc	MSc*
Isles of Scilly	Mel, Mike Kaiser, Nicky, Mangi	MSc	MSc	MSc*	MSc	MSc*
Co-ordinating PhD student		Andriana	PhD (to be appointed)	Elizabeth	Sofie Derous	Martijn

Several MSc. students are already interested in taking on the biodiversity valuation of a case study area (Belgian/Dutch coast, Isles of Scilly and probably also Flamborough Head area and Pico-Faial Channel) and Tomasz Zarzycki will take on the biodiversity valuation of the Gulf of Gdansk in the framework of his PhD. However, we still need a MSc. student for the Danish study area. At the training

course in Faro (11-14 April 2007) the MSc. students will get more detailed information on the methodology to do such valuation.

These case study areas will be used to test the biodiversity valuation protocol. Several tests can be done:

- Giving the same dataset to different people and comparing the resulting biodiversity valuation maps to test the consistency of the protocol.
- Valuate neighboring countries first separately and then together to see whether you get conflicts at the borders and if changes in value occur in the different subareas when the scale is broadened. This test could be done in the Belgian-Dutch coast study area.
- Next to creating biodiversity maps one could also create habitat maps (using the biodiversity elements at the ecosystem level) and overlay these habitat maps with biological valuation maps (using the biodiversity elements at the species/population and community level) to see whether these combination maps differ from the biodiversity valuation maps.

General conclusions of the workshop

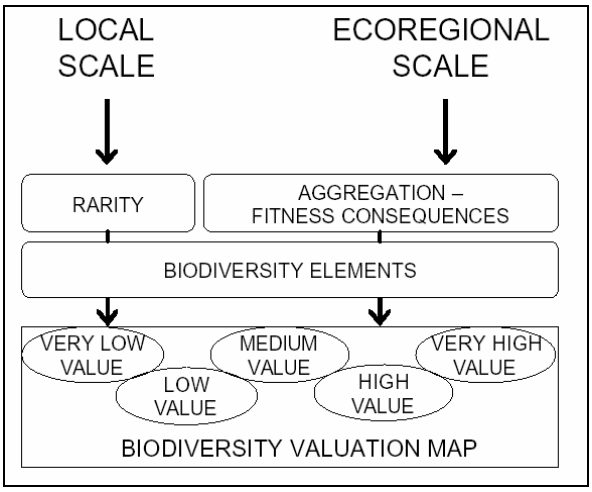
As we are assessing the value of biodiversity elements in a study area, the general term ‘marine biological valuation’ should be changed into ‘marine biodiversity valuation’ or ‘marine ecological valuation’.

The concept of marine biodiversity valuation, as described in the first working document (Derous et al., submitted), was changed as one criterion was excluded (naturalness) from the framework and other criteria were lumped together (aggregation-fitness consequences) or used in a different way (proportional importance).

Only two valuation criteria are remaining (rarity and aggregation/fitness consequences) and these criteria are applied on the elements of biodiversity.

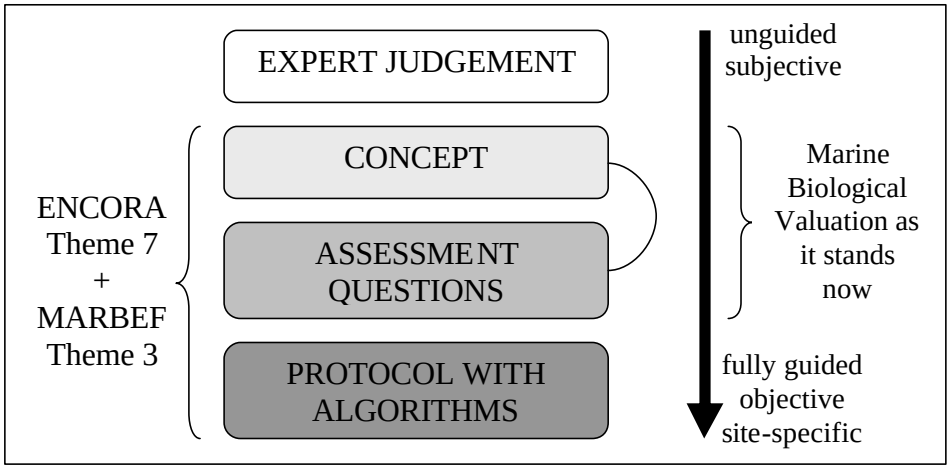
The former “modifying” criterion ‘proportional importance’, which is related with the scale of the study area, is excluded as a criterion, but the scale issue is still present in the concept as the valuation of a study area should be done at two scale: first on a local scale (= scale of the study area) and afterwards on a broader (ecoregional) scale. This will allow evaluating the subareas’ values in a broader perspective.

The following flowchart illustrates the revised concept for marine biodiversity valuation:



The protocol for marine biodiversity valuation should be as transparent as possible and should determine clear assessment questions around the selected valuation criteria and elements of biodiversity. Marine biological valuation should not be done solely by using expert judgement, as consulting a team of experts cannot guarantee the inclusion of subjectivity in the process. Expert judgement could also obscure the valuation process which would make it unrepeatable in the future.

The marine biological valuation protocol that will be determined and used in ENCORA Theme 7 and MARBEF Theme 3 will move beyond the use of expert judgement, but will define appropriate assessment questions around the developed concept and test these on real case study areas. Using the assessment questions for valuation could reveal new problems with the concept which demand adaptations. When good assessment questions are determined these can be translated into practical algorithms. However, no mathematical algorithms to apply these assessment questions on databases can be described by the protocol as these algorithms will be different for different study areas as they depend strongly on the available data. So, it is utopic to think that all subjectivity can be banned from the protocol as experts will be asked to determine these algorithms. The ultimate goal of marine biodiversity valuation is to determine well-defined algorithms that produce the same maps independently of the person who applies them to a certain database. But this situation is still far from reality. The following figure gives an overview of different approaches for marine biological valuation.



Although the protocol is not perfect yet (cannot exclude all subjectivity as expert judgment is still involved), it should be tested as it stands now on case study areas. The results of the valuation of these case study areas will give an idea on the degree of subjectivity involved in the selection of the algorithms by the experts of the different study areas.