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Background paper

Session 3a: Spatial units

Summary and issues for discussion

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SEEA EEA Revision, Expert Consultation, WG1: Spatial units

Summary and issues for discussion

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In this document we summarise the main issues brought forward by experts that have reviewed the three discussion papers prepared by working group 1 on spatial units for the SEEA EEA revision.. The issues are presented and discussed in the same order as the questionnaire, namely issues with respect to:

- The design criteria and the review of classifications (section 1)
- The five options (section 2)
- The atmosphere (section 3)
- The marine environment (section 4)
- Urban areas (section 5)
- Other issues (section 6)

1. Issues with respect to the design criteria and the review of existing classifications

Relevant questions:

- Question 1: Do you agree with the design criteria for an ecosystem type classification as described in section 3 of Discussion paper 1.1?
- Question 2: Do you have comments on the findings from the review of existing classifications, in particular on the summary of the review (Discussion paper 1.1 section 4)?

Discussion paper 1.1 identifies six design criteria that an ecosystem type classification that is to be used for SEEA ecosystem accounting must meet. The design criteria are:

- Criterion 1: The classification typology should represent ecosystems
- Criterion 2: The classification units can be spatially delineated
- Criterion 3: The classification units are geographically and conceptually exhaustive, and comprehensive across all environmental domains
- Criterion 4: The classification types are mutually exclusive, both conceptually and geographically.
- Criterion 5: The classification should be practicable
- Criterion 6: The classification should be linkable to other established classification systems

1.1 Summary of main issues brought forward by experts

- Issue 1: Reviewers doubt the feasibility of developing an ecosystem type classification that meets all six design criteria.
- Issue 2: Is it necessary in the SEEA to restate or perhaps reinforce the value of having an ecosystem type classification?
- Issue 3: The requirement that it should be possible to spatially delineate – i.e. map – classification units needs clarification.
- Issue 4: Is it always possible to assign discrete spatial units to discrete ecosystem types? Reviewers remark that mutual exclusivity is difficult to achieve.
- Issue 5: How should the classification deal with the spatial scale of the ecosystem type classification (or the mapping resolution) and the homogeneity of ecosystem units identified on a map?
- Issue 6: In what way should the ecosystem type classification accommodate repeated measurements over time?
- Issue 7: Should land ownership and management be used to classify ecosystem types?

1.2 General comments on the design criteria

The reviewers generally support the design criteria formulated in the discussion paper. They do have issues with particular criteria and with the way in which criteria interplay within a classification.

Issue 1: Reviewers doubt the feasibility of developing an ecosystem type classification that meets all six design criteria.

It was noted that there currently are no ecosystem classifications that comply with all the design criteria. Some reviewers doubt the feasibility of developing a classification that meets all or most design criteria. Their reasons relate to the diversity of ecosystems, to conceptual clashes between design criteria, and to the possibility of assigning a spatial unit to one and only one ecosystem type.

On the diversity of ecosystems, one reviewer does not agree "with the need to satisfy at least four criteria at the same time [which] will be very difficult as we have many different types of ecosystems and environmental domains: terrestrial, coastal and marine."

On conceptual clashes between design criteria, one reviewer remarks that geographical exhaustiveness may clash with the requirement that types represent ecosystems. Take for example "a parking lot – required to be spatially exhaustive, but is it an ecosystem?" Another reviewer see conceptual clashes between criteria 5 (practicable) and 6 (linkable) on the one hand and criteria 2 (spatially delineated) and 4 (mutually exclusive) on the other.

> *"Mapping between existing frameworks will be vital to the system being practicable (6 and 5). However the mapping of more granular frameworks from more coarse frameworks often prevents us from being able to perfectly delineate areas spatially (2) and, more often, lead to definitions which are not mutually exclusive (4). [...] To my mind criteria 5 and 6 override all other criteria since without them the system cannot be used. [...] Rather than starting with a set of principles and choosing a system based upon that I would start with one criteria, 6, and set up a process by which all extant systems of any significance are mapped against each other."*

On the possibility of assigning a spatial unit to one and only one ecosystem type, one reviewer raises concerns with respect to the requirement for mutually exclusive types. It "will be very difficult to satisfy as ecosystem types often overlap with each other." And "is it swamp and peatland forest or is it wetland? And I'm not sure how the 3D tranche of ocean will be mappable if we go with the option 2 of paper 1.3." Another reviewer questions whether concerns raised with respect to the combination of design criteria may be dependent on the scale of application: "I am not sure how all the criteria will intersect and how they will be met in practice. Potential issues here may be scale dependent – of concern when you get down to sub-types, but possibly OK at high levels of the hierarchy".

1.3 Comments with respect to design criterion 1: The classification typology should represent ecosystems

Issue 2: Is is necessary in the SEEA to restate or perhaps reinforce the value of having an ecosystem type classification?

Few reviewers comment on criterion 1. A number of reviewers confirm the notion that in the context of SEEA ecosystem accounting an ecosystem type classification refers to ecosystems:

> *"criterion 1 is key – not only because of the need to think about ecosystems [...], but also because the units need to consider ecological processes and functions, as these are what support the provision of benefits."*
>
> *"for accounting purposes, ecosystem classifications are most useful when they represent ecosystems, which provide a distinct set of ecosystem services, this could potentially be used as a criterion for classification, especially at the more refined scale."*
>
> *"Because the intent of the SEEA ecosystem accounting is to develop a set of area-based statistical accounts [...] associated with ecosystems, it stands to reason that the units under consideration should indeed represent ecosystems."*

However, one reviewer suggests that an ecosystem type classification is not necessary. This reviewer notes that "*the emerging practice is for ecosystem services to be assessed differently depending on the type of*

service, not the type of ecosystem" and "*the assessment [...] must be made starting with specific ecosystem services rather than starting from ecosystem types*" even though "*the results of ecosystem service assessments can, where appropriate, be allocated to ecosystem types post hoc.*" When taking an "asset view" researchers "*focus on a particular, relevant aspect of the ecosystem (say, soil) while retaining an underlying ecosystem (wholistic) perspective. In this case, no ecosystem type classes are necessary, yet the approach is still a form of ecosystem thinking and accounting (boundaries, stocks, flows).*" In these and other applications "*ecosystem thinking is being used with a variety of ecosystem classifications used depending on the needs of the work*".

1.4 Comments with respect to design criterion 2: The classification units can be spatially delineated

Issue 3: The requirement that it should be possible to spatially delineate – i.e. map – classification units needs clarification.

For some reviewers it is unclear what criterion 2 precisely means. Does it mean potentially 'mappable' or currently mapped? What level of detail in thematic and geographic accuracy is required and at what scale (local, regional, national, global)? Does this criterion imply that the WG prefers a map-based typology rather than a conceptual typology?

The ecosystem type classification will be applied to geographic areas. Ecosystem units must be mapped in such a way that each unit is assigned to no more than one ecosystem type. "For SEEA ecosystem accounting purposes, a mapped classification is essential, wherein the ecosystem entities are mapped as geographic occurrences and these occurrences are attributed with geometric (e.g. area), ecological, and other (e.g. economic value) properties." (Discussion paper 1.1, p. 12)

The WG does not favour a conceptual or a map-based approach. We note that either approach can be used to develop an ecosystem type classification. Yet, in either case mapping is essential: "If a conceptual classification is to be used for ecosystem accounting, a map will have to be developed showing the spatial occurrences of the ecosystem type."

1.5 Comments with respect to design criterion 4: The classification types are mutually exclusive, both conceptually and geographically.

The reviewers have raised two issues with regard to the possibility of achieving a classification with *mutually exclusive* ecosystem types.

Issue 4: Is it always possible to assign discrete spatial units to discrete ecosystem types?

Reviewers remark that the mutual exclusivity criterion is difficult to achieve because "ecosystem types often overlap with each other", because there are overlapping layers of properties that could be part of a classification ("For instance, a mountain layer – we might not want to have a clear mountain versus non-mountain classification, so there is a need to define what the classification will cover versus what can be an overlay"), and because some spatial areas might be classified as one ecosystem type or the other depending on the season ("*how much of the year does there need to be water for us to call it water-related?*") or the perspective ("*Does this not imply that there needs to be at least one level of hierarchy where ecotones are considered? For example, some areas of wetland may be considered as characteristic of certain agricultural fields in the main but will take on more wetland ecosystem characteristics under certain hydro events.*").

Issue 5: How should the classification deal with the spatial scale of the ecosystem type classification (or the mapping resolution) and the homogeneity of ecosystem units identified on a map?

Mutual exclusivity may be a matter of scale: "for example, an estuary is often considered an ecosystem type, but so are its component elements such as seagrass, saltmarsh and mangroves. Similarly, small wetlands in a forest could be considered as separate ecosystems or ecological communities, or part of the natural

variability/heterogeneity of the ecosystem, depending on the scale of classification and mapping of the ecosystems."

The issue of spatial scale and homogeneity "*has implications for how ecosystems are defined, and for how the classifications are applied practically in mapping and accounting activities. In reality, many ecosystems will not be spatially homogeneous, so the resolution at which the unit is defined will affect how different spatial areas are classified. […] Largely heterogeneous landscapes may only appear so in relatively refined scales, more granular spatial units may gloss over such variability.*" Another reviewer notes that at higher hierarchical levels, most classification systems have similar main types. This is where mapping resolution comes into play: "*the criteria that a classification should be able to differentiate ecosystems rather than habitats or land cover seems to be crucial especially when looking at fine thematic and geographic mapping.*"

One reviewer proposes that a hierarchical structure is necessary to tackle the issue of scale and homogeneity of ecosystem types. "The definition of an ecosystem type may be somewhat arbitrary, depending on how much variation will be allowed within a type, the scale of the processes to be represented, and the components of the system that are relevant to the ecosystem types." A hierarchical structure "*will help frame the alignment of the scale and the level of detail [and] will give more flexibility to the classification system, that can then be used at different scales and at different levels of detail, allowing cross-reference of local and regional maps with continental and global maps without loss of information [which] is required for the linkage with other classification systems.*"

Another reviewer suggests an additional design criterion, namely that the typology should be reasonably proportionate, meaning that the overall extent of classes at some level of the hierarchy should be comparable. "For example, if 50% of the world is: T7 Intensive anthropogenic terrestrial systems […] should this really be only one ecosystem class? This does not seem very helpful for national scale landscape planning and having groupings that vary hugely in size will limit some statistical analyses."

1.6 Comments with respect to design criterion 5: The classification should be practicable

The reviewers present two issues with respect to practicability of an ecosystem type classification. The first issue concerns the need for rigorous testing. We consider the need for rigorous testing self-evident, even though this will probably not be done by the WG on Spatial Units. The second issues concerns dealing with changes in the landscape with repeated measurements using the ecosystem type classification.

Issue 6: In what way should the ecosystem type classification accommodate repeated measurements over time?

We can safely assume that repeated measurements over time are a given. It is only by mapping and statistically measuring ecosystems that (spatially specific) trends in the extent, condition, production of ecosystem services, and value of services and assets can be identified.

One reviewer is concerned that the classification may be too complicated for regularly repeated mapping. "With complex classification system, it may be possible to map one time, but difficult to monitor at regular time periods due to limitation of resources (financial, human and infrastructure related) and suitable tools." For ecosystems accounting, it must be possible to repeat (update) and replicate (for a region of interest) a map based on the ecosystem type classification.

> *"Moreover since ecosystems are dynamic, in order to facilitate the repeatability, the characteristics describing the ecosystem that are 'stable' such as climate, soil type and topography, could be integrated and labeled as "context" and the land cover, which is more dynamic, could then be updated on a regular basis. Therefore a classification system based on land cover in opposition to ecosystem (criteria 1) should not be rejected."*

One question with regard to repeated measurements relates to degradation:

> *"at what point is an ecosystem classification subject to change as an ecosystem moves along a spectrum from highly 'natural' to highly 'degraded', or vice versa (such as through processes of human alteration, desertification, etc.), and might these potentially represent distinct ecosystem types. A 'condition'-type characteristic may help to classify ecosystems along this spectrum (and be valuable in terms of ecosystem accounting). Perhaps condition is a separate issue in itself, but there may be some argument that ecosystems in 'extreme' conditions may be different enough to warrant different classifications"*

Is this a question for the WG on spatial units, for the WG on ecosystem condition, or for both? One reviewer suggests that "it would be good if […] 'ecosystem types and condition' should be looked at in synergy".

1.7 Comments with respect to design criterion 6: The classification should be linkable to other established classification systems

Issue 7: Should land ownership and management be used to classify ecosystem types?

There are sound conceptual reason for excluding land ownership and management as well as other non-ecological criteria from the classification. Such information does, however, raise the usefulness of ecosystem accounts for policy and management.

A number of reviewers suggest this should not be done for conceptual reasons (*"Non-ecological criteria […] are not consistent with an ecological or an ecosystem-based approach")*.

One reviewer links land ownership and management to physical changes to ecosystems:

> *"While we agree that land ownership and management provide important links to the national accounts and are important and necessary analytical accounting themes we do not think they should be included as defining ecosystem characteristics and may be inconsistent with general classification principles and other variables/criteria presented. [...] ownership and management are implied or indirect measures that in many instances do not provide information about the biophysical characteristics or functioning of the ecosystem. [...] In many areas land management and ownership has not translated into a recognizable change on the ground and could be very confusing and difficult to try to translate into real measures of the biophysical characteristics. This includes parks and protected areas where there is a high degree of variability in how this status translates to change on the ground."*

Other reviewers suggest it should be done to make the classification more useful as well as to link the SEEA ecosystem type classification to the SNA:

> *"the next phase of development of this classification should include linking the classification to legal/administrative/economic dimensions, as this will be key if we want the accounts to be used for policy and management purposes."* and *"One benefit of the IUCN habitat classification that is not mentioned is that it builds up from legal units and is thus quite policy relevant."*
>
> *"the IUCN RLE has an obvious link to the Red List Index, making it more likely that it will be useful for policy."*
>
> *"the paper does not mention of Chapter 4 of SNA or SEEA CF section 2.6 in setting up the design criteria. […] the ability to separately identify economic ownership of ecosystem assets is critical to allow for linkages between ecosystem accounts, SEEA central framework and the SNA."* and *"It would be worthwhile to clarify the linkages between terminology used in Ecosystem accounts and how it links into SEEA CF and the SNA. For example economic and environmental assets need to be defined so that they only have at most one economic owner to be consistent with the SNA. It would follow that the same ecosystem asset cannot be owned by more than one unit for SNA purposes."*

A third reviewer underscores that land management and use are important factors in shaping ecosystems. What matters is "not land use or management factors (such as level of fertilisation or cultivation method) [...] but the expression of the land use influence in the vegetation present":

> *"Land use and management are critical factors in shaping many semi-natural ecosystem types in Europe but they find their expression in the vegetation present, in particular for grassland ecosystems, for which clearly specified vegetation community types have been identified (cf. the Braun-Blanquet system)."*

This reviewer notes that land management and use are at best "proxy factors for mapping ecosystems types as the focus of measurement should be on the inherent ecological features of each ecosystem type."

An additional issue with respect to criterion 6 is that two reviewers observe that unlike the other design criteria, criteria 5 (practicable) and 6 (linkable) are not discussed in-depth. Their recommendation is that all six design criteria should receive the same (detailed) attention. As a result, as one reviewer explains, "it is not immediately obvious to me how the results of the review and the design criteria were linked via the questions guiding the review in all cases. It would be helpful to the reader to set this out a bit more explicitly, otherwise you have to work through it all yourself."

2. Issues with respect to the five options

Relevant question:

- Question 3: Of the five options described for a reference ecosystem type classification scheme, which option do you prefer (Discussion paper 1.1 section 5)?

The five options are:

1. IUCN RLE
2. USGS
3. Bridge
4. Habitat (e.g. IUCN; Eunis)
5. Land cover (e/g/ LCCS; Corine)

2.1 Summary of responses by experts

Overall, most experts preferred the conceptual depth and ecological clarity of Option 1(IUCN, RLE) but also valued the data provisioning merits of Option 2 (USGS), which often resulted in a stated preference for bridging them, either implicitly, or as an explicit preference for Option 3. Numerically, there seemed to be tie between Options 1 and 3.

2.2 Agruments in favour and arguments against each option

Option 1: IUCN RLE

Arguments in favour

- "IUCN RLE seems really promising, as a project. I do not see it viable to develop something new and the RLE seems like the most well developed option"
- "Option 1 (IUCN ET) seems to the most practical solution, because it seems to be feasible for mapping at any scale from local to global. Also, updating the classification would be much easier when coming from only one source"
- "IUCN ET can accommodate local classifications/maps where they exist, but aid their development where they don't exist"
- "conceptually sound"
- "the advantages are clear. It complies with the design data, classification is based on its conceptual and it includes approach"
- "I also like and appreciate the "fuzzy" approach [to transitional ecosystems] of IUCN ET"
- "this is an only international ecosystem classification which has theoretical foundation and takes ecosystem as its conceptual base, it considers ecosystems as assets (stocks). IUCN ET classification has by default a wide coverage globally and it should in principle have also terminology in place. It claims to provide the possibility for disaggregation on national level."

- "this classification focuses most on identifying ecosystem types in a structured manner that relates well to currently available ecological knowledge"

Arguments against

- "it has not actually been mapped or officially published"
- "it is a challenging to get all the information and data"
- "The IUCN RLE has not been made available yet and hence the applicability and practicability has not been tested. The detailed levels of IUCN RLE ET classification are not described in document (and have not been made public yet) hence it is still too early to consider this classification to be the best option"
- "We do have a concern that this classification may not fully represent the diversity of agricultural ecosystem types that are important in the European context."

Option 2: USGS

Arguments in favour

- "It is shown to be possible to map"
- "Availability of data already classified gives some weight to option 2"

Arguments against

- "It is unclear to me if regular production is assured"
- "similar shortcomings for ecosystems shaped by agricultural land use as Option 1"

Option 3: Bridge

Arguments in favour

- "For [guidance on how to drill down and nationalize] I like the bridging option [3?]"
- "is the most comprehensive as the union of the other two"
- "would be an interesting approach to fill weaknesses of both option 1 and 2"
- "the most satisfying for ecosystem accounting in practice (hence the idea to do it in the first place)"
- "as a temporary fix" [until Option 1 maps are available]
- "While bridging gaps between the two classifications, some of aspects of anthropogenic interventions like mining, aquaculture, etc may be considered appropriately, since these are important with respect to ecosystems monitoring"
- "an 'operationalisation' of IUCN ET based on lessons from USGS/ESRI sounds to be a good option."
- "The option of using the combination of IUCN and USGS classifications is the most suitable, cause it allows to use the strengths of both IUCN and USGS classification and maximises the use of the available information"

Arguments against

- "methodological implications much more unclear…"
- "it does not seem efficient to manage a completely new set of classifications (proposed by option 3)"

- "similar shortcomings for ecosystems shaped by agricultural land use as Option 1"

Option 4: Habitat (e.g. IUCN; Eunis)

Arguments in favour

- (none mentioned)

Arguments against

- "habitat level mapping is not appropriate. An ecosystem may contain one or many habitats"

Option 5: Land cover (e/g/ LCCS; Corine)

Arguments in favour

- "The best option from an ideal point of view would be option 1. We think however that from a practical point of view the better option is number 5. The terrestrial ecosystems are satisfactorily covered by this option, while coastal and marine ecosystem need a more in-depth consideration. Option 5 also allows to obtain statistical data on spatial units that are more suitable for evaluations based on e.g. shares of different ecosystem types on the total surface."

Arguments against

- (none mentioned)

2.3 Further comments by the Experts

- Many Experts struggle with the tension between a proper treatment of ecological principles and the availability of suitable data, and what implications that might have for the 'best' classification option.
- They also emphasize the benefits of existing methods and classifications (community support, updates), especially if they are "close enough", and are hesitant to embrace new approaches. This partly includes IUCN RLE due to its unpublished nature. Also, time, decision processes and costs should be considered.
- Several Experts highlight the need for an adequate treatment of strongly anthropogenic areas, including agricultural ecosystems, or e.g. anthropogenic pastures vs natural grassland
- As always, scaling issues are important, especially when mosaic-type landscapes involving linear ecosystems, e.g. streams and their riparian wetlands within a forested landscape matrix.
- EUNIS has not been evaluated properly

3. Issues with respect to the atmosphere

Relevant question:

- Question 4: Do you agree that the atmosphere should be considered part of other ecosystem assets (Discussion paper 1.3 section 4)?

Currently, it is not yet clear how the atmosphere should be treated in an ecosystem accounting context. In Discussion paper 1.3 two options are proposed:

1. **The atmosphere as a part of ecosystem assets**: The atmosphere/air directly above and within an ecosystem could thus be considered part of the ecosystem asset as one of its abiotic components. Several important ecological processes are based on the interaction with the atmosphere, including photosynthesis, respiration, nitrogen fixation, but also the impact of air pollution on vegetation and fauna. Accordingly, the air could be considered part of the ecosystem, similar as the soil water and soil are also considered to be part of the ecosystem.
2. **The atmosphere as a separate unit**: The atmosphere could also be considered as a separate unit in SEEA EEA, i.e. separate from 'other' ecosystem assets. The atmosphere could be seen as one unit, but could also possibly be subdivided into (vertical) subunits.

3.1 Summary of responses by experts

Of the 18 experts that addressed this question 12 experts preferred option 1, 3 experts preferred option 2, and 3 experts were inconclusive.

3.2 Main issues brought forward by experts

The main arguments provided by the experts supportive of option 1 include:

- The atmosphere does not support specific a community of biological organisms independent of terrestrial or marine ecosystem assets.
- The atmosphere is an important factor that intervenes with the condition of the ecosystems, consequently, it can be considered as an asset of the same.
- Integrating the atmosphere into the SEEA EEA facilitates its accounting and analysis.
- The need to link state / pressure condition indicators from the atmospheric concentration / deposition of pollutants to ecosystems in a spatially explicit manner
- The delineation of mutually exclusive boundary across regions and consistency of components within the spatial unit is difficult and highly variable.
- If the atmosphere is considered as a separate unit, it will not meet the criteria for ecosystem classification to be mappable and mutual exclusive.
- Option 1 is in line with WG2's inclusion of air under their ecosystem condition indicator class of "Physical and chemical state".
- Given the importance in terms of the cycle of elements such as carbon, nitrogen and oxygen, among others, the incorporation of the atmosphere in ecosystem accounting is a priority issue, as its absence means an incomplete environment that generates limitations of analysis.

The main arguments provided by the experts supportive of option 1 include:

- Having the atmosphere as a separate asset helps with the integration of the different accounts (asset condition and ecosystem services) and helps to make the link to the UNFCCC accounting and potential policy uses.
- One of the issues is the boundary of haze (Tran's boundary Haze Pollution) because the activity and the emission happened in two different places due to the movement of the wind. Therefore, ecosystem (land & atmosphere) cannot be measured at one place.

3.3 Some additional suggestions made by experts

- Consistency in treatment of logic across marine and atmosphere, however, the lack of biota in the atmosphere (relative to marine pelagic) is a substantial difference.
- The discussion should be extended to further vertical geo-layers that sometimes pop up as 'ecosystems' to distinguish, namely: soil, groundwater
- The discussion on the atmosphere is far too narrow and seems to constantly focus on the single issue of carbon emissions.
- Consider carbon storage as a condition, not a service.
- Provide more explanation to the link and treatment of the atmosphere in SEEA CF
- Add examples how this is done in practice, what does this mean practically for accounting

4. Issues with respect to the marine environment

Relevant question:

- Question 5: Should the spatial approach also be applied to all parts of the oceans or should we distinguish different ecosystem assets also in a vertical direction (Discussion paper 1.3 section 5)?

The main issue here is whether and how the spatial approach of SEEA EA for ecosystem assets can be applied to the marine environment. In Discussion paper 1.3 two options are proposed to define ecosystem assets for the marine environment:

1. **Each area of the seas/oceans belongs to one single ecosystem asset**. When we follow the reasoning that the ecosystem asset is best envisaged as a three dimensional column, an ecosystem for the seas/oceans would include the entire water column and underlying sediments (plus a part of the overlying atmosphere) delineated by a certain area.
2. **Ecosystem assets in the seas/oceans should also be delineated in a vertical direction**. Particularly for deep pelagic waters, ecosystems near the seafloor will be very different from ecosystems within the water column, which in turn will be very different from ecosystems near the surface waters. Accordingly, it then makes more sense to describe the condition, biodiversity and supply of services for different ecosystem assets.

4.1 Summary of responses by experts

Of the 20 experts that addressed this question 4 experts preferred option 1, 6 experts preferred option 2, and 4 experts were inconclusive. Interestingly, 6 experts suggested a stepwise approach, starting with the 2 dimensional delineation of ecosystems, followed (once more experience has been built) by disaggregation of ecosystem assets in a vertical direction.

4.2 Main issues brought forward by experts

The main arguments provided by the experts supportive of option 1 include:

- The condition of lower parts of the water column is strongly influenced by the condition of the top layers of oceans / seas, which would thus enable a proxy measure for the condition of lower parts of the water column.
- The measuring in Option 1 is suitable for the country in the early stage of compilation.
- Considering that the conceptual basis of the SEEA EEA should be applicable to all ecosystems regardless of whether they are continental or marine, it is technically suitable to apply the spatial approach also to the oceans.

The main arguments provided by the experts supportive of option 2 include:

- Given their very different ecological characteristics it seems important to recognise photic zones also as different ecosystem types.

- Differentiating the ocean as different ecosystems should be the most appropriate, because the characteristic condition of each part of the water column is different, in this way it would be able to analyze the sea without sub/overestimating data.
- This option is consistent with the ecosystem concept, in particular with the functional elements of ecosystem asset classification.
- From an oceans accounting perspective, it is important to distinguish different ecosystem assets in a vertical direction, rather than using a simply spatial approach.
- Even for shallow waters a distinction in the vertical direction could be highly relevant, in particular in the North, in regions with permanent ice cover which would make a region highly distinct from other regions with no or seasonal ice cover. Even within EEZ the water can be deep enough that there are significant differences between the surface and sea bottom.

Four experts suggested a step wise approach: As ocean accounting is so new and often focusses on shallow coastal marine environments, as a first step the 'simple' 2 dimensional approach can be applied. Once practical experience has been built, it may prove useful to move to disaggregation of ecosystem assets in a vertical direction. This approach allows to maintain the spatial approach (two-dimensional), without limiting it to the possibility of building tables with more detailed information for areas that are possible to have this information.

4.3 Additional suggestions made by experts

- The two options described would benefit from a better consideration on what they would mean in practice
- A different option may be included, namely to represent layers (multiple two-dimensional levels), also linked to property rights separation. This could be done by having further 2D layers of other ecosystem assets (e.g. the seabed, atmosphere) where necessary. This would capture the different features of the 3rd (vertical) dimension of the ecosystems being measured, without needing to actually use 3D measurement units, which would introduce data complications.
- Given the limited progress of science in understanding deep ocean waters, it is inappropriate to mention as criteria for selection between the spatial and vertical approaches the extent to which human activities have or have not impacted deeper marine ecosystems. This is an additional justification for contemplating a mixed approach to incorporate new information as ocean floor research progresses.

5. Issues with respect to urban areas

Relevant questions:

- Question 6: Determining the appropriate treatment of urban areas is not clear cut (Discussion paper 1.2). Consider the following questions:
- To what extent should the SEEA EEA provide guidance for countries on the delineation of urban EAA boundaries? (e.g., Is there a specific city size threshold that should be considered for ecosystem accounts for urban areas?)
- For ecosystem accounts focused on urban areas, would you prefer the approach of reporting the relative significance of urban green/blue as part of the extent tables or as part of the condition of the broader urban area? Why?
- Which of the described structural and functional characteristics of urban areas do you consider to be most important for an urban ecosystem typology and how might they be most logically ordered in a hierarchical structure?
- Do you have specific comments on the scale or size of urban ecosystem assets that should be separately identified in a set of ecosystem accounts for urban areas?

5.1 Summary of responses by experts

WG1 Discussion paper 1.2 covered several interrelated but separate issues relating to 1) the scope of ecosystem accounting for urban areas, 2) the selection of an urban ecosystem accounting area boundary (EAA), as well as 3) the elaboration of a classification structure for the urban ecosystem type (ET). It also discussed 4) presentation issues related to reporting of green and blue infrastructure within urban areas in the extent or condition tables. While there were commonalities in some of the comments received, the overall preferences expressed seem to be mixed.

For the first two issues—regarding the scope of ecosystem accounting in urban areas and whether or not guidance should be issued on the delineation of ecosystem account boundaries for urban areas—responses indicated that guidelines should not be issued, that they should be very flexible if issued, or that they should be provided to encourage comparability. It seems clear from responses that specific ecosystem accounts for urban areas will not be compiled universally. Some countries have both a policy need and the data to report on the extent and condition of green and blue infrastructure within urban areas at a scale that could be as detailed as 1 m patches of grassland or lines of trees. For other countries, this level of reporting is not a priority and is currently not feasible based on the data. For these countries the focus would likely be changes in the total extent of urban built-up area at a national, sub-national or metropolitan scale rather than detail on the green/blue embedded within this area. Given the above, it may make sense to provide some basic but optional/flexible suggestions on how the EAA might be reported to aid countries that will be compiling ecosystem accounts for urban areas and to maximize their usefulness for other reporting needs (e.g., SDGs and others).

Comments indicate that several issues might be clarified. For example, there was some agreement that the definition of ecosystem assets (EA) does not work well in urban areas. Comments were received on the need to be clear whether SEEA EEA was concerned with all green space or only green space that is publicly accessible.[1] It was also suggested by one reviewer that urban areas are not ecosystems but rather a reporting

[1] As this topic was not covered in detail in Discussion paper 1.2, possibly some confusion has arisen with regards to overlap with DRAFT SEEA Technical Note Access to public open space in cities – SDG 11.7.1.

boundary within which there are specific natural ecosystem assets that should be counted in detail, which might imply some confusion with the ET classification structure and the EAA definition proposed in SEEA EEA.

The paper was initially written with the assumption that a hierarchical classification for urban areas was desired (issue 3). From the responses, it is not clear that there is full agreement. Comments on the hierarchical structure for an urban ET class were mixed, with some indicating general agreement with the suggested sub-type characteristics (use, density, asset type etc.), some indicating that access and ownership are also important, and others suggesting that only a single (i.e., urban built-up) or possibly two-level urban ET class structure is needed. It was also suggested that the inclusion of urban ecosystem type sub-class detail be driven first by the need to distinguish the particular services provided by each sub-type.

There was general acknowledgment that data resolution has a major impact on the compilation of urban/green extents and that the highest resolution data available be used in urban areas given that they are price rich. Agreement was expressed that classes for urban green/blue areas should not duplicate natural and semi-natural sub-types. This latter point implies either that green/blue assets be attributed to their natural/semi-natural ET (logical when the asset is large, but problematic for a top-down assessment of ET and mutual exclusivity when applied to backyards or soccer pitches), that clearly differentiated urban ET sub-types be defined for the embedded green/blue assets in urban areas, or that embedded green/blue not be considered an urban ET sub-type but rather a feature of the built-up area (i.e., indicator in the condition table such as % green).

With regards to where information on urban green/blue extents should be reported (i.e., extent or condition tables, issue 4), there was a mixed response and reasonable arguments provided for the different positions. Taking into account these different arguments, the following considerations may provide useful guidance. 1) Where an urban EAA includes large natural and semi-natural areas (depends on boundary selection (inclusion of peri-urban) and presence of large parks) it likely makes the most sense to report these areas within the extent table. 2) Should the urban ET class structure be limited to built-up area or other top-level subclass, then there is a strong rationale to report the embedded smaller-scale green/blue as an indicator of condition (e.g. % imperviousness, % green). 3) Should the urban ET class structure be extensively defined and should data be available to account for green/blue features at the scale of publicly accessible local parks, private residential yards or even individual trees, these could theoretically be reported in either extent or condition tables since "the extent of 'minor' ecosystem types can be registered in the ECI [ecosystem condition indicators] class V [Landscape pattern], if necessary," as proposed by WG2 Discussion paper 2.3 (Czúcz, B. et al., 2019).) It should also be noted that accessibility is explicitly excluded from the typology of ecosystem indicators proposed in Discussion Paper 2.3., which may also support reporting in detailed extent account tables for urban EAA. Further exploration, testing and resolution of these issues, including the classification hierarchy and definitions for specific urban ecosystem sub types and scale is needed. Consideration should also be given to the possibilities for alignment with the definitions provided by UN-Habitat for SDG 11.7.1.

5.2 Main issues brought forward by experts

To what extent should the SEEA EEA provide guidance for countries on the delineation of urban EAA boundaries? (e.g., Is there a specific city size threshold that should be considered for ecosystem accounts for urban areas?)

- Many indicated it should be flexible and country-specific based on policy needs and data availability.
- However others indicate some guidance or harmonized approach with existing standards (e.g., Functional Urban Areas (FUA) or Degree of Urbanization) would improve comparability between countries and support other reporting efforts (e.g., SDGs).
- Some note that SEEA must be clear about what should be measured—all green space or just a subset that is public/used for people.

For ecosystem accounts focused on urban areas, would you prefer the approach of reporting the relative significance of urban green/blue as part of the extent tables or as part of the condition of the broader urban area? Why?

- Very mixed response.
- As extent – because of logic of reporting areas as extent; so that condition can be reported for each green/blue asset type; because it's important to get an accurate estimate of the extent of different types of green/blue in the urban environment.
- As condition – because green/blue is a condition of the urban area; where less data is available it makes sense; because having too many ET categories is not functional
- As hybrid – report larger continuous natural ET in urban areas as extent, report embedded green/blue urban assets as part of the larger built-up and can be reported on as condition indicators; report green/blue as extent where data exists, but otherwise report on it as a landscape-level characteristic of the urban area in the condition table.

Which of the described structural and functional characteristics of urban areas do you consider to be most important for an urban ecosystem typology and how might they be most logically ordered in a hierarchical structure?

- Some responses show general comfort with the characteristics (and order) as presented. Others add that public accessibility is important to include.
- Some indicate this level of detail is not necessary in an urban ecosystem type classification: from a single level or two-level classification only, to recognition that the highest level urban ecosystems types might be clearly defined but sub-types could be defined by users.
- One indicates urban is a management boundary not an ecosystem type – classify all urban/green within urban EAA according to a natural ET with an urban tag (urban lake, urban beach), or functional characteristics (areas of trees for cooling, for pollutant removal, or other issues of interest such as green walls or roofs).

Do you have specific comments on the scale or size of urban ecosystem assets that should be separately identified in a set of ecosystem accounts for urban areas?

- Leave to countries to determine
- As detailed as possible depending on data availability – e.g., 10m, 1m
- Proposed a size limit of 200 ha limit to differentiate urban green asset from green natural asset
- May require distinction between units of observation and units of aggregation

5.3 Additional comments received

- Definition of ecosystem asset—that they be continuous and that they have all the components to function—is problematic in urban areas. Very fragmented areas can still act as an asset (e.g., street trees and in pocket parks in cities) but small fragments of habitat may not have all the components to function. The definition does not allow for human-determined/dominated ecosystems (e.g., urban, cropland). If we would like to ensure internal consistency, it should be adjusted.

- Although there are practical examples provided in the paper where countries have developed urban ecosystem accounts, there are not sufficient elements for applicability in other regions and situations.

5.4 Written responses received to question 6

16 using the comment form, 1 providing detailed comments in Word, and 1 set of comment received prior to official circulation for comments.

6. Other issues

Relevant question:

- Question 7. Do you have any other comments on the draft papers?

Most comments were about three topics: definitions, naturalness and spatial issues:

Comments on **definitions**:

- It is not clear what the difference is between "ecosystems" and "**ecosystem types**"
- High-level **aquatic ecosystems** are called 'biomes', but they're not (because they're not based in pland life forms)
- The **wetland** definition does not follow the internationally agreed Ramsar definition. The Expert thinks it is important that these definitions and concepts of different ecosystem types are acknowledged by the SEEA as they are agreed across a large majority of countries and inform a number of reporting processes that the SEEA aims to support

On **naturalness**

- **Human interventions** should be identified better, e.g. by visualising the age of the ecosystems: natural, altered in the past (since the year 1800) but not since, altered recently (last 50 years), altered frequently, under constant supervision, in human use. Similar for road cutting through forests, or clear cuts.
- Similarly, the CBD definition for ecosystems does not really allow for **human-determined / dominated ecosystems**, like urban or cropland. The Expert suggests adjustment of the working definition, e.g. "A dynamic complex of plant, animal, and microorganism communities, their non-living environment, and the human society (dominant land uses) actively interacting as a functional unit.". Or alternatively: introduce "socio-ecological systems" alongside "ecosystems (s.s.)".
- There is an issue of the 'land cover inspired' interpretation of **what is natural, semi-natural etc.** For example, forests seem to be considered a 'natural' ecosystem type whereas in an ecological perspective many forests are actually heavily modified and far from a natural state in large parts of Europe and other densely populated parts of the world at least. We would argue that for ecosystem accounting ecological gradients and terms developed within ecological science should take precedence over land cover inspired interpretations. At the very least a discussion of this issue should be included in the paper on ecosystem type classifications and cross-reference be established to related sections in the papers on ecosystem condition

On **spatial issues** (scale, transitions,

- The discussion of **Ecotones** is important and may be useful to also highlight urban fringe areas, these are interesting and may not be considered by many readers.
- Similarly, The **Intertidal/coastal zone** provides a real challenge. In paper 1.1 and 1.3 it is stated as belonging to the land accounts, however it is difficult to see it as a separate area from the ocean accounts as obviously the two are interconnected. Where would we draw the line? "
- There is a need for more discussion on **scale/Basic Spatial Unit**. For example, would watersheds be an option of an ecosystem accounting area (EAA)?

- There is a constant challenge in dealing with **strongly linear ecosystems**, usually aquatic ecosystems (rivers, streams) and coastal ecosystems (coastlines, meeting place between sea and land), but maybe hedgerows, etc. as well. Any guidance on treating strongly linear ecosystems would be gratefully received.

Other comments

- There is interest in the efforts for systematic and intensive **training** on the methodology, e.g. on the understanding the conceptual issues and/or the SEEA-EEA compilation issues.