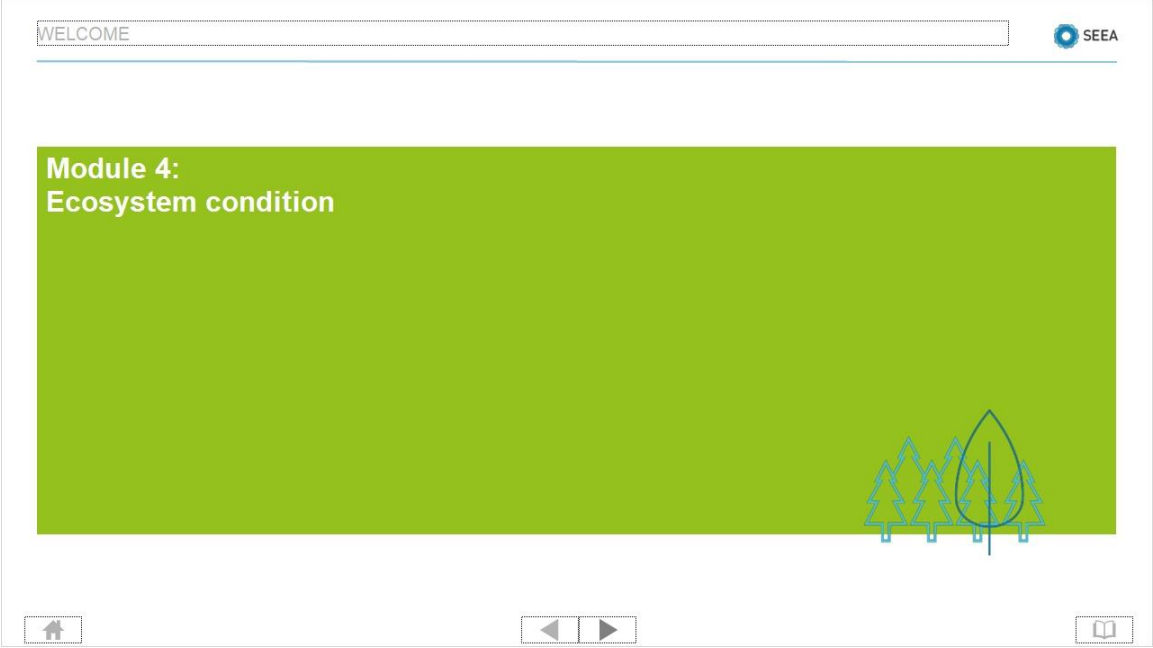
SEEA_EnvAcc_M4_EN

1. Module 1 - Introduction

1.1 Welcome



Notes:

1.2 Welcome…

Welcome…

… to the **fourth module on Experimental Ecosystem Accounting!**

This module is designed to give you an overview of the ecosystem condition account. The following topics will be covered:

- Introduction
- Approaches to measurement of ecosystem condition
- Ecosystem condition accounts
- Developing indicators of ecosystem characteristics
- Recommendations for compiling
- Issues for research

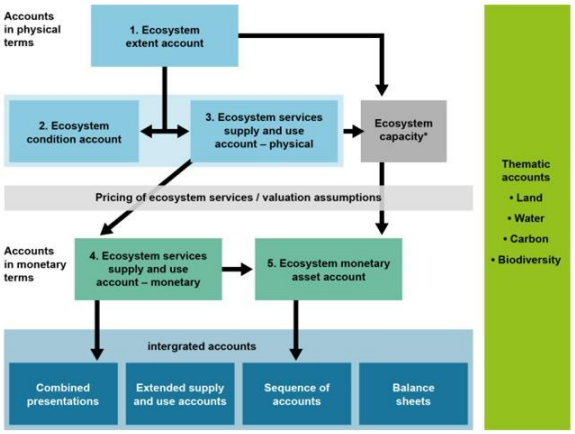
We appreciate your interest in accounting for the environment!

1.3 Ecosystem condition account

Ecosystem condition account

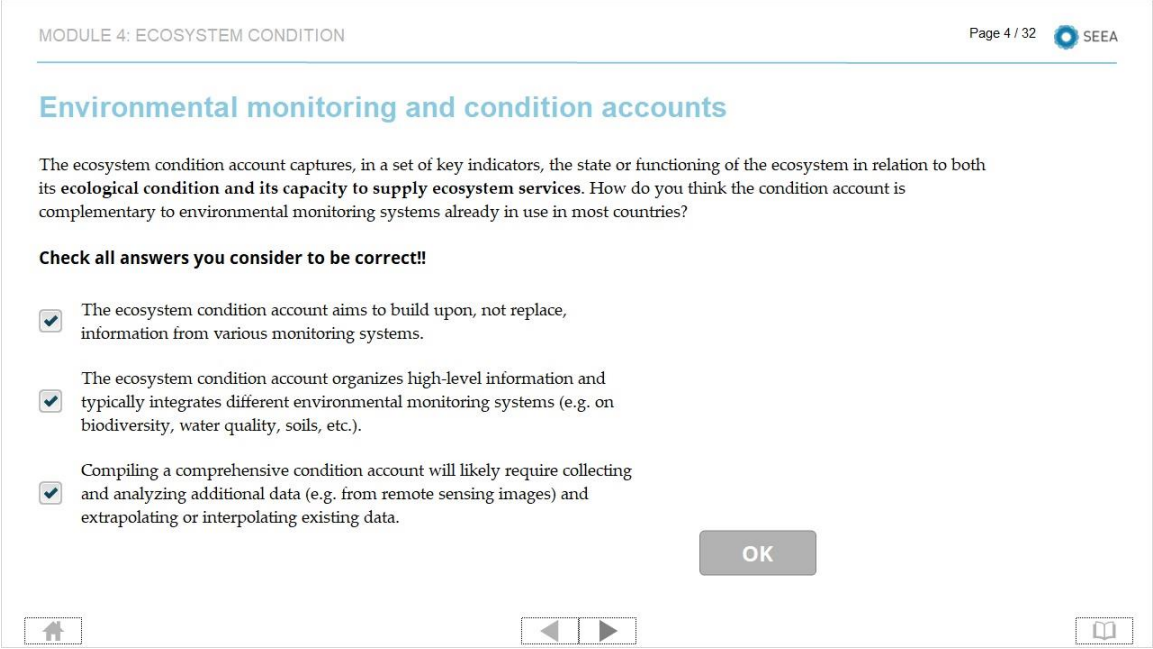
In the SEEA framework for ecosystem accounting, **the ecosystem condition account is the second core account** to be compiled:

- Ecosystem condition reflects the **overall quality of an ecosystem asset in terms of its characteristics.**
- The measurement of condition may provide information on the **capacity of ecosystems** to provide **ecosystem services into the future.**
- Ecosystem condition is measured by **collating indicators for various ecosystem characteristics** for different ecosystem types.
- A key challenge for ecosystem accounting is developing full coverage of measures in a manner that **supports aggregation and comparison.**



1.4 Environmental monitoring and condition accounts

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
X	The ecosystem condition account aims to build upon, not replace, information from various monitoring systems.
X	The ecosystem condition account organizes high-level information and typically integrates different environmental monitoring systems (e.g. on biodiversity, water quality, soils, etc.).
X	Compiling a comprehensive condition account will likely require collecting and analyzing additional data (e.g. from remote sensing images) and extrapolating or interpolating existing data.

Feedback when correct:

The main benefit of compiling an ecosystem condition account lies in the integration of different sets of information and in the subsequent potential to combine this information with information on ecosystem services flows and monetary value of ecosystem assets.

This integrated approach offers a more comprehensive insight into changes in ecosystems compared to individual datasets, thereby expanding the policy use of environmental information.

Feedback when incorrect:

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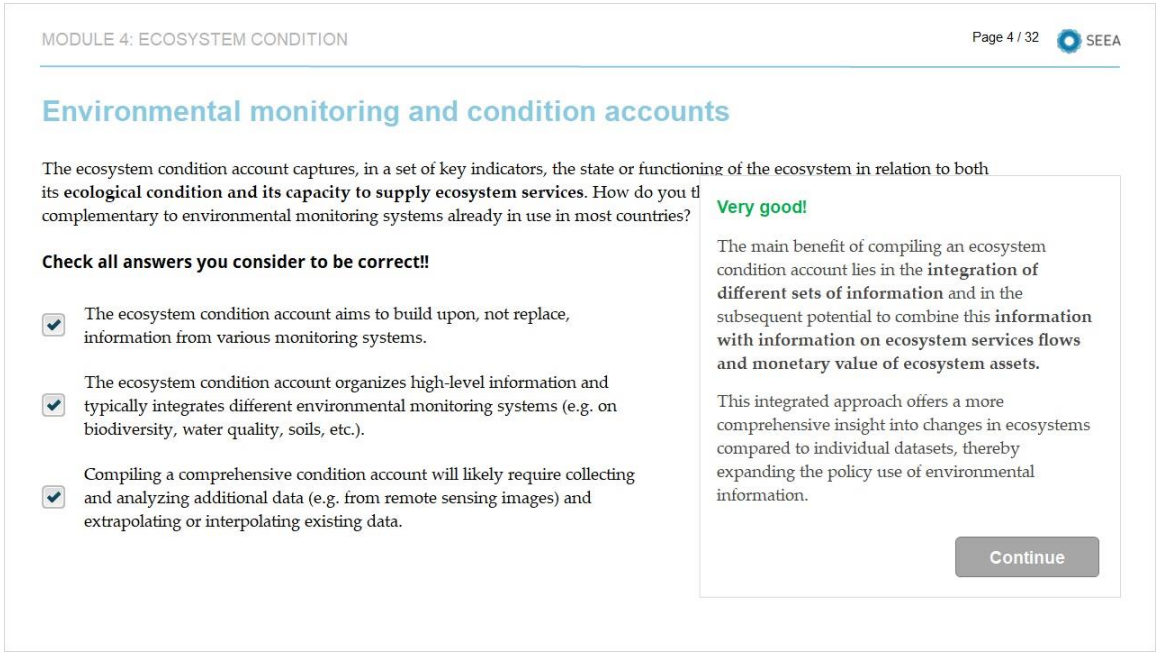
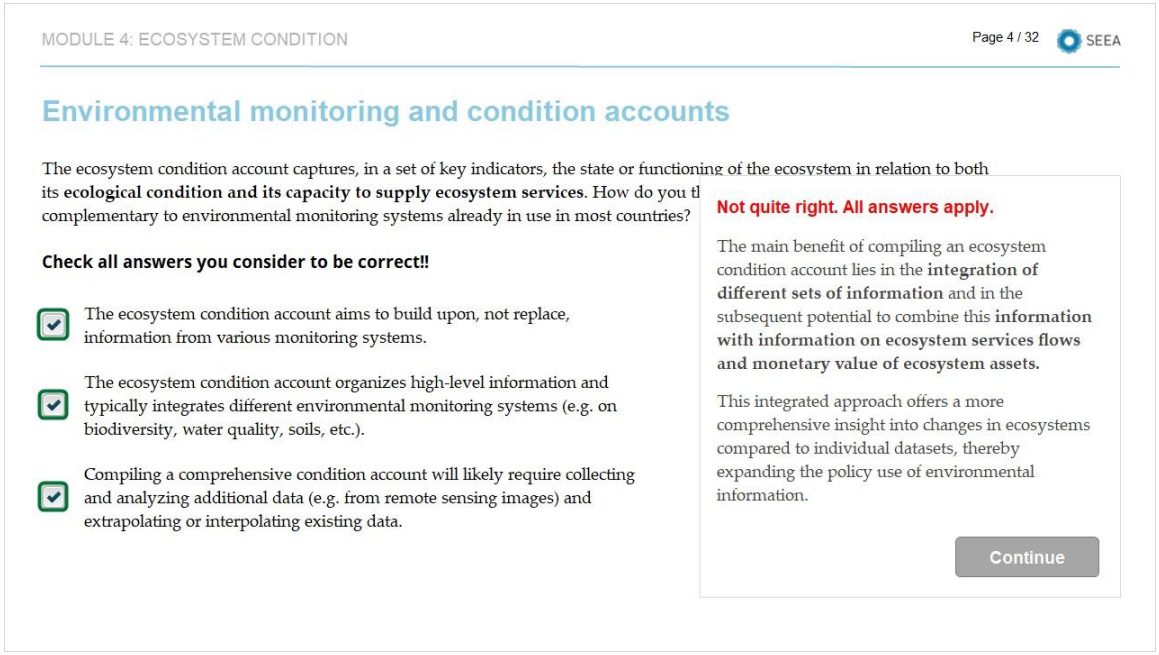
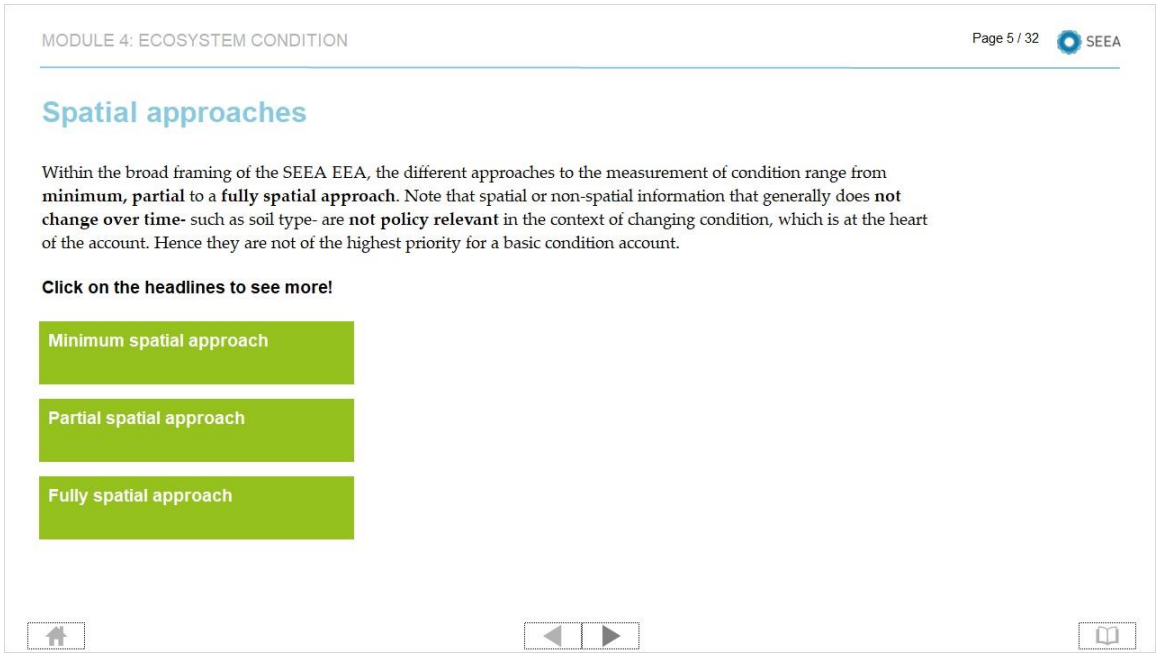
Correct (Slide Layer)



Incorrect (Slide Layer)



1.5 Spatial approaches

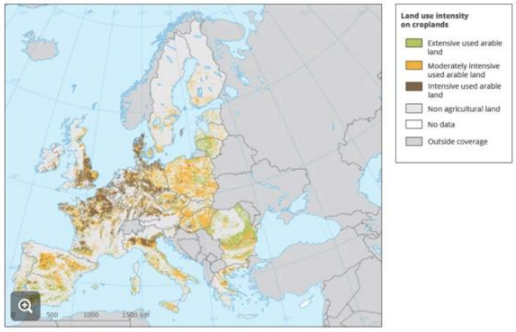


1.6 What do condition accounts measure?

What do condition accounts measure?

Indicators in the ecosystem condition account reflect the **general condition or state** of an ecosystem and the relevant trends in that condition:

- These indicators may reflect such aspects as the occurrence of species, soil characteristics, water quality and ecological processes (e.g. net primary production).
- The indicators selected should be **relevant for policy and decision making** and reflect policy priorities (e.g. preservation of native habitat); pressures on ecosystems (e.g. deposition levels of acidifying compounds versus critical loads for such compounds) or the **capacity of ecosystems to generate one or more services** (e.g. attractiveness of the ecosystem for tourism).
- **Different ecosystem types require different indicators**. For example, condition indicators relevant for forests will be less relevant for cropland.



Land use intensity on arable land (non-permanent crops) in Europe, derived from crop yields and nitrogen fertilizer application. Intensive land use can eventually reduce the productivity of the land and its ability to provide multiple functions and services.

Source: European Environment Agency, European ecosystem assessment 2015

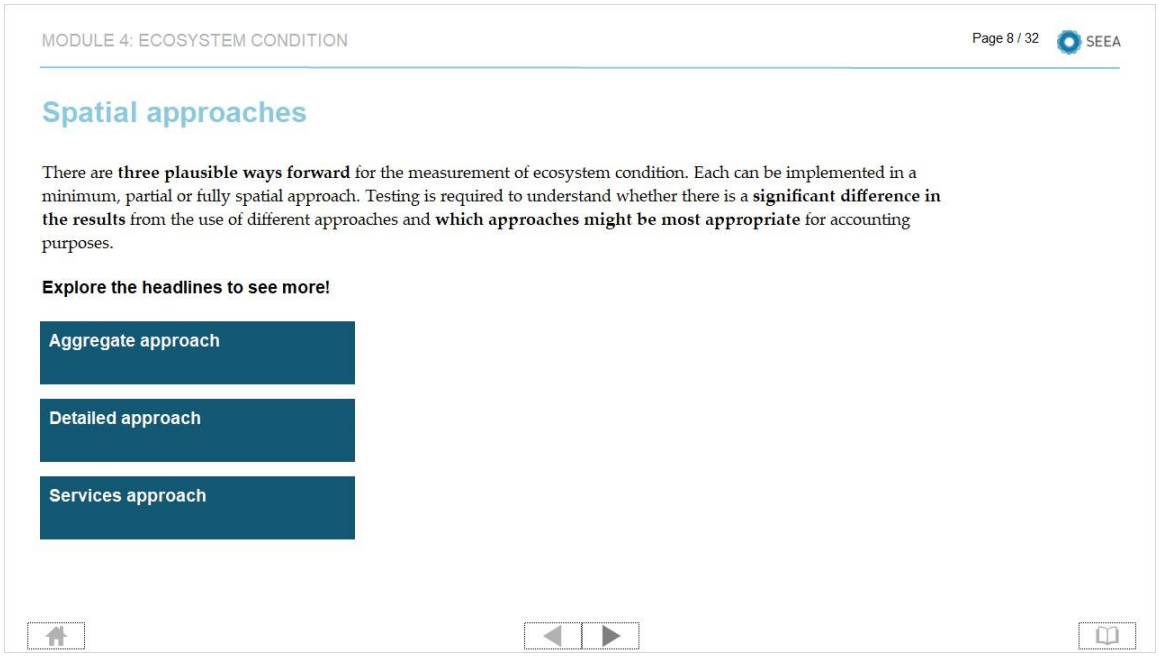
1.7 Considerations in selecting condition indicators

Considerations in selecting condition indicators

The relevance of ecosystem condition indicators depends upon context and the indicators should take into consideration the **specific characteristics** of the included ecosystem types (ETs), the **likely uses** of the ecosystem assets (EAs) and **data availability**.

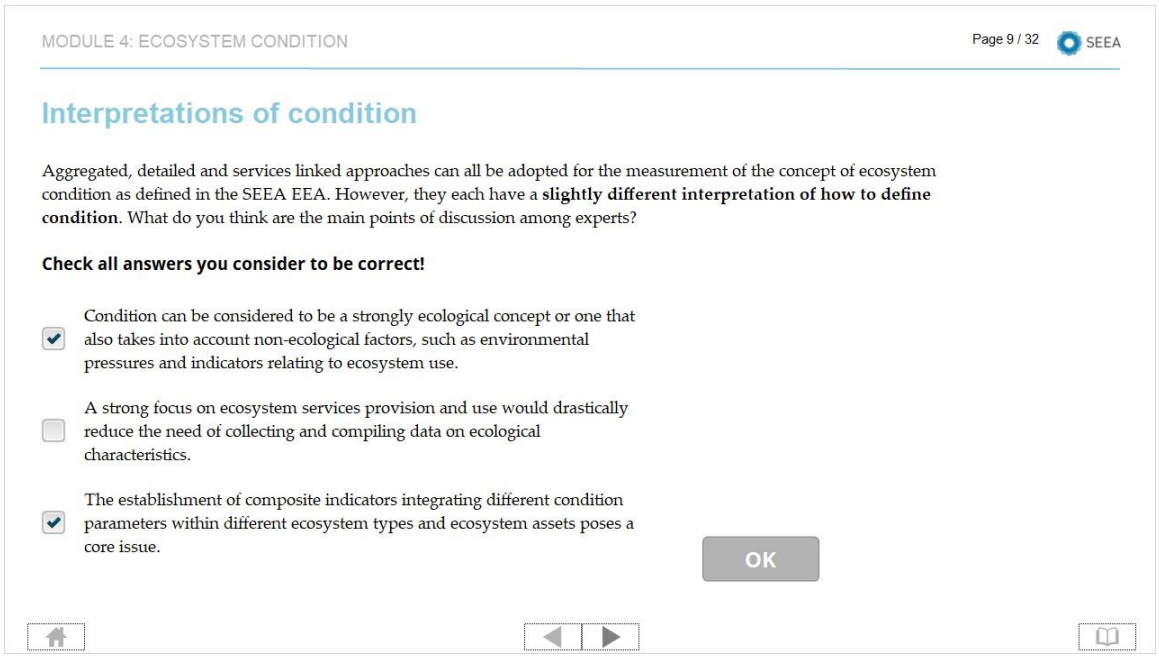
Hover over the fields to see more considerations!

1.8 Spatial approaches



1.9 Interpretations of conditInterpretations of condition

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
X	Condition can be considered to be a strongly ecological concept or one that also takes into account non-ecological factors, such as environmental pressures and indicators relating to ecosystem use.
	A strong focus on ecosystem services provision and use would drastically reduce the need of collecting and compiling data on ecological characteristics.
X	The establishment of composite indicators integrating different condition parameters within different ecosystem types and ecosystem assets poses a core issue.

Feedback when correct:

The compilation of ecological characteristics that can be monitored over time and compared across ecosystem types and across countries will be important in all cases.

But different interpretations will lead to the selection of different characteristics and indicators, and a key area of ongoing research and discussion relates to this topic – the appropriate selection of ecosystem characteristics for the measurement of condition for accounting purposes.

Feedback when incorrect:

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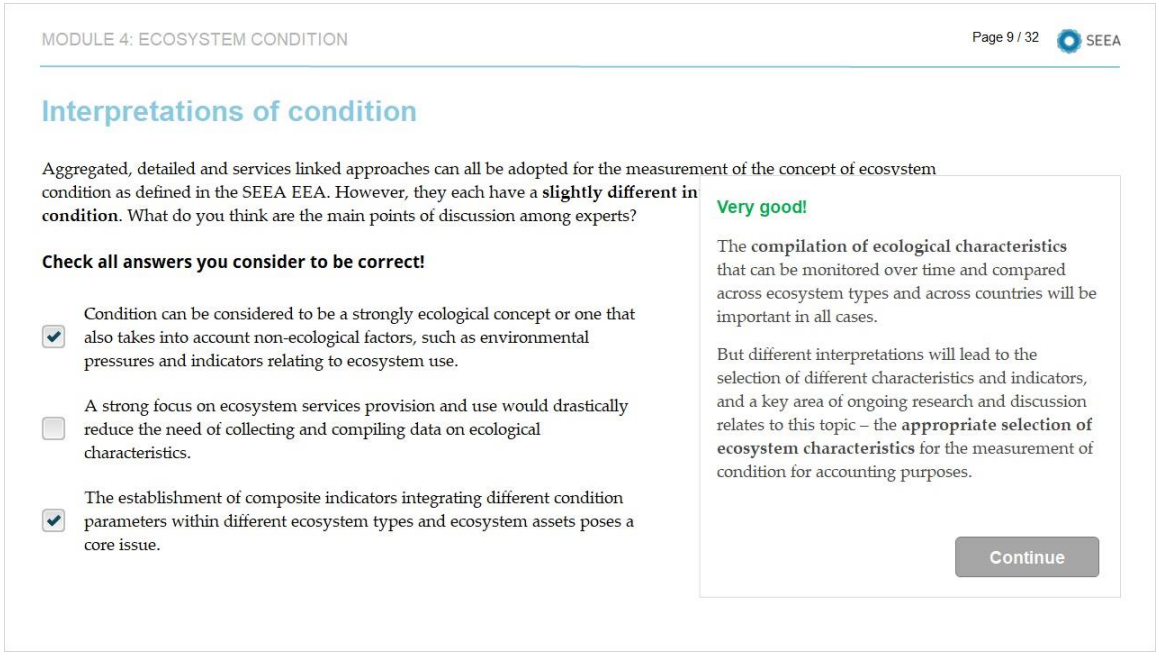
Correct (Slide Layer)



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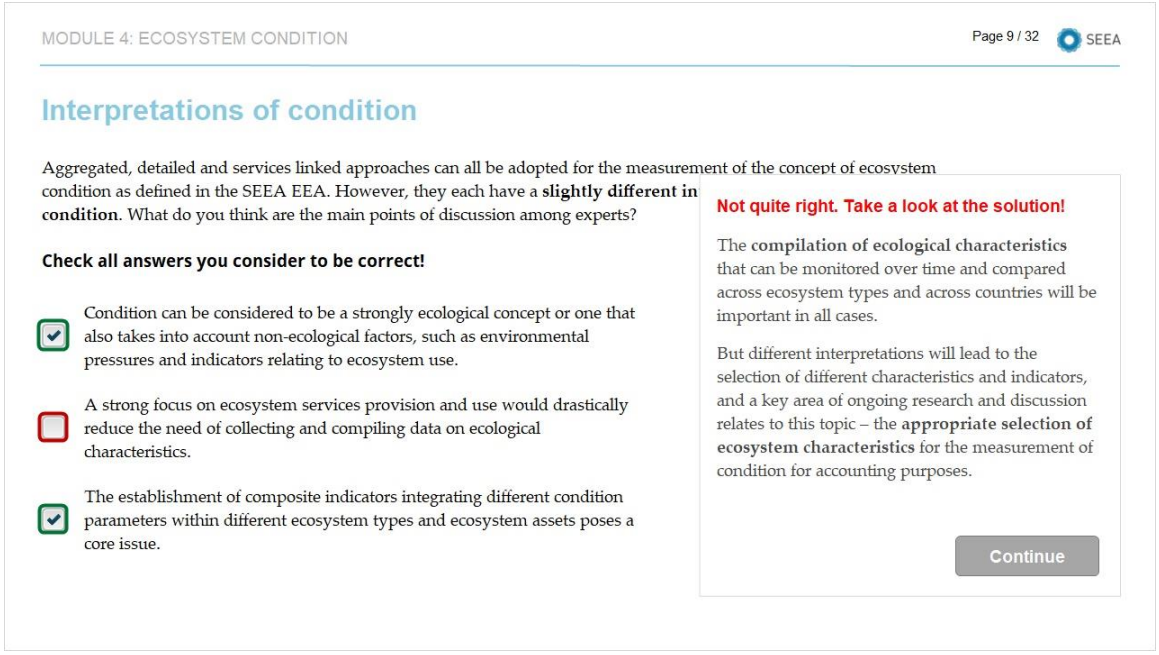

1.10 Working with experts

MODULE 4: ECOSYSTEM CONDITION

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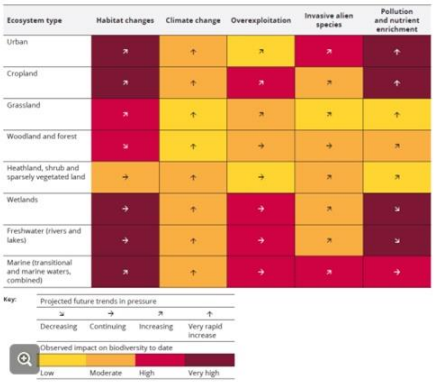
Working with experts

It is not possible to come up with a single set of indicators of ecological condition that applies to all ecosystem asset classes; however, **some indicators are likely to be common across more than one asset class:**

- Ecologists in the different classes (terrestrial, freshwater, marine) have done substantial thinking on how to measure ecosystem condition, and it is important **to draw on this existing work** in the process of developing the condition accounts for a particular class of assets.
- It is essential for ecologists to be **closely involved in the selection of indicators** of ecological condition and in determining the method used for aggregating them, to ensure that the result is ecologically meaningful and sensible.



Trends in pressures on ecosystems in Europe: Habitat change and pollution/nutrient enrichment are estimated to have caused the greatest overall impact across ecosystems until now, but climate change pressures are projected to significantly increase across all ecosystems in the future.

Source: European Environment Agency, Mapping and assessing the condition of Europe's ecosystems: progress and challenges (https://www.eea.europa.eu/publications/mapping-europes-ecosystems)

1.11 Ecosystem condition accounts

MODULE 3: ECOSYSTEM EXTENT

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Ecosystem condition accounts

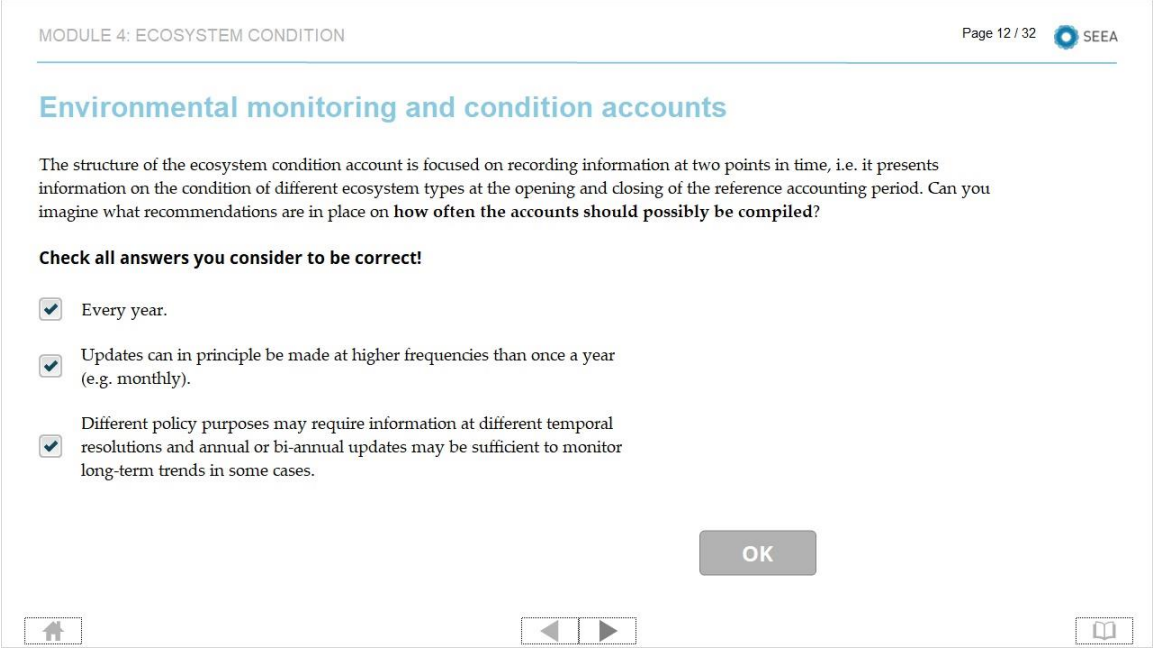
This example shows a basic **condition account compiled in physical terms** using a variety of indicators for selected characteristics. The accounting structure provides a basis for organizing relevant indicators by ecosystem types and for distinct points in time (opening and closing of the accounting period).

Explore the highlighted areas to get more information!

		Proxy ecosystem type (based on land cover)														
		Artificial surfaces	Herbaceous crops	Woody crops	Multiple or layered crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers	Inland water bodies	Coastal water and inter-tidal areas	Sea and marine areas
Example indicators of condition		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vegetation (e.g. native cover)	Opening condition															
	Closing condition															
Water quality (e.g. turbidity, pH)	Opening condition															
	Closing condition															
Soil (e.g. erosion, pH, nutrients)	Opening condition															
	Closing condition															
Carbon (e.g. net primary productivity)	Opening condition															
	Closing condition															
Biodiversity (e.g. species richness)	Opening condition															
	Closing condition															
Habitats (e.g. fragmentation)	Opening condition															
	Closing condition															
Overall index of condition	Opening condition															
	Closing condition															

1.12 Environmental monitoring and condition accounts

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
X	Every year.
X	Updates can in principle be made at higher frequencies than once a year (e.g. monthly).
X	Different policy purposes may require information at different temporal resolutions and annual or bi-annual updates may be sufficient to monitor long-term trends in some cases.

Feedback when correct:

Ecosystem condition accounts should generally

be compiled once a year.

It is particularly useful when accounts are developed for multiple years in order to record trends/changes in ecosystem condition and, as relevant, the spatial variability of these trends.

The increasing availability of processed remote sensing data facilitates regular updates at higher frequencies.

Feedback when incorrect:

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It is particularly useful when accounts are developed for multiple years in order to record trends/changes in ecosystem condition and, as relevant, the spatial variability of these trends.

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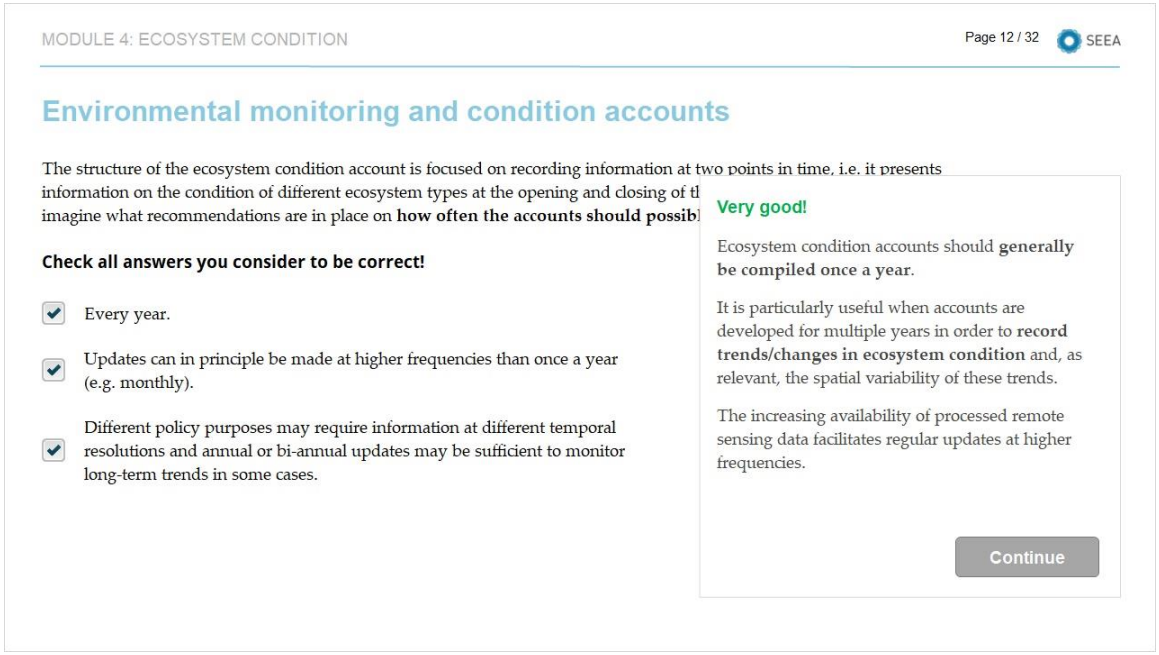
Correct (Slide Layer)



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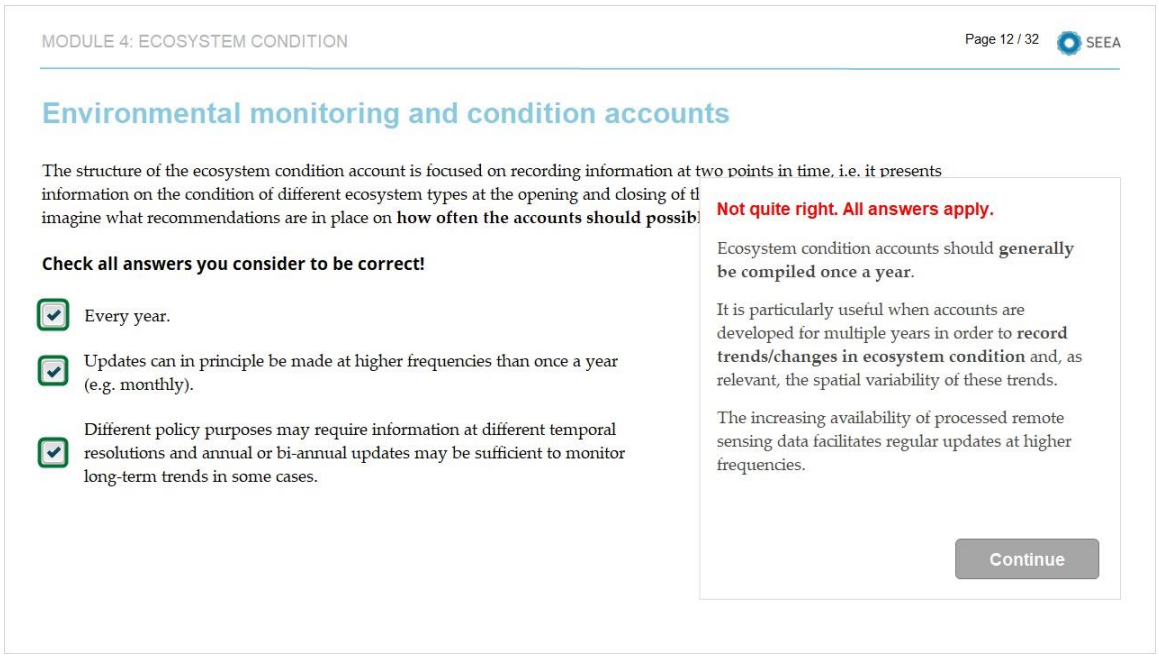

1.13 Developing indicators of ecosystem condition

Developing indicators of ecosystem condition

The development of indicators to assess condition is an ongoing challenge. For a given characteristic, often the research enables the **relative importance of the different factors to be weighted** to provide an appropriate composite index:

- The challenge is not whether indicators of specific characteristics can be measured, but **rather which characteristics are relevant** and how the indicators might be combined.
- In a **fully spatial approach**, information on each selected characteristic would be measured or downscaled to basic units level.
- However, there will be situations in which **downscaling makes little conceptual sense** or implies assumptions that are not appropriate. For example, in measuring ecosystem condition for **the purpose of providing habitats**, measures of fragmentation and connectivity are highly relevant and only measureable at a multiple ecosystem asset level.

Indicator	Description
Tree cover*	Determined as the percent of area classified as forest at 25 metre resolution mapping using Landsat imagery following the National Carbon Accounting System (NCAS) classification (Furby, 2002).
Land cover	Land cover classification from Geoscience Australia Dynamic Land Cover Data (Lymburner et al., 2011).
Soil exposure*	Annual mean percentage of soil that is unprotected by living vegetation or litter. Derived from a fractional cover algorithm that exploits MODIS satellite imagery to estimate fractions of photosynthetic vegetation, non-photosynthetic vegetation and exposed (Guerschman et al., 2015).
Fire intensity and occurrence	Annual maximum fire intensity (°C) and average frequency, respectively, of fire mapped at 2.5 km resolution as derived from the Geoscience Australia Sentinel system. (Geoscience Australia, 2014).
Inundation*	Percent of area covered by water at least once during the year as mapped from MODIS satellite observations following the methodology of Guerschman and colleagues (Guerschman et al., 2011).
Vegetation leaf area*	Annual mean leaf area index (area of leaf per area of ground) (m^2m^{-2}) as estimated from MODIS satellite imagery (Yang et al., 2006).
Carbon fire emissions	Annual emission of carbon from wildfire estimated the Global Fire Assimilation System v1.2 (Kaiser et al., 2012).
Vegetation carbon uptake*	Gross primary production, the amount of carbon taken up by the vegetation through photosynthesis, as estimated by the OzWALD model-data fusion system (Yebra et al., 2015).
Precipitation, soil moisture, runoff and river inflow*	The OzWALD model-data fusion system was used to populate precipitation (rainfall and snowfall), soil moisture, runoff and river flow (van Dijk, 2010).

(*denotes indicators included in environmental condition score)

Terrestrial environmental condition indicators developed for the federal district, Australian Capital Territory (ACT), based on remotely sensed data which can be produced annually for all of Australia.

Source: Office of the Commissioner for Sustainability and the Environment

1.14 Number of indicators

(Multiple Response, 10 points, 1 attempt permitted)

Number of indicators

It is not expected that the measurement of condition for each ecosystem type would require the use of a vast number of characteristics. From an ecosystem accounting perspective, the intention remains to **provide a broad indication of the level and change in condition** rather than to fully map the functioning of every ecosystem asset. How many indicators would you say are recommended based on assessments already conducted?

Check one answer you consider to be correct!

- [ ] 1 – 4
- [x] 4 – 8
- [ ] 8 – 12

OK

Correct	Choice
	1 – 4
X	4 – 8
	8 – 12

Feedback when correct:

A key element of accounting is monitoring change over time and hence a focus on those characteristics that reflect changes in ecosystem condition is an important consideration.

Based on assessments of various projects, it seems that for most ecosystem types a set of 4 – 8 indicators can provide a sound/robust set of information to enable assessment of the overall condition of an ecosystem asset.

Feedback when incorrect:

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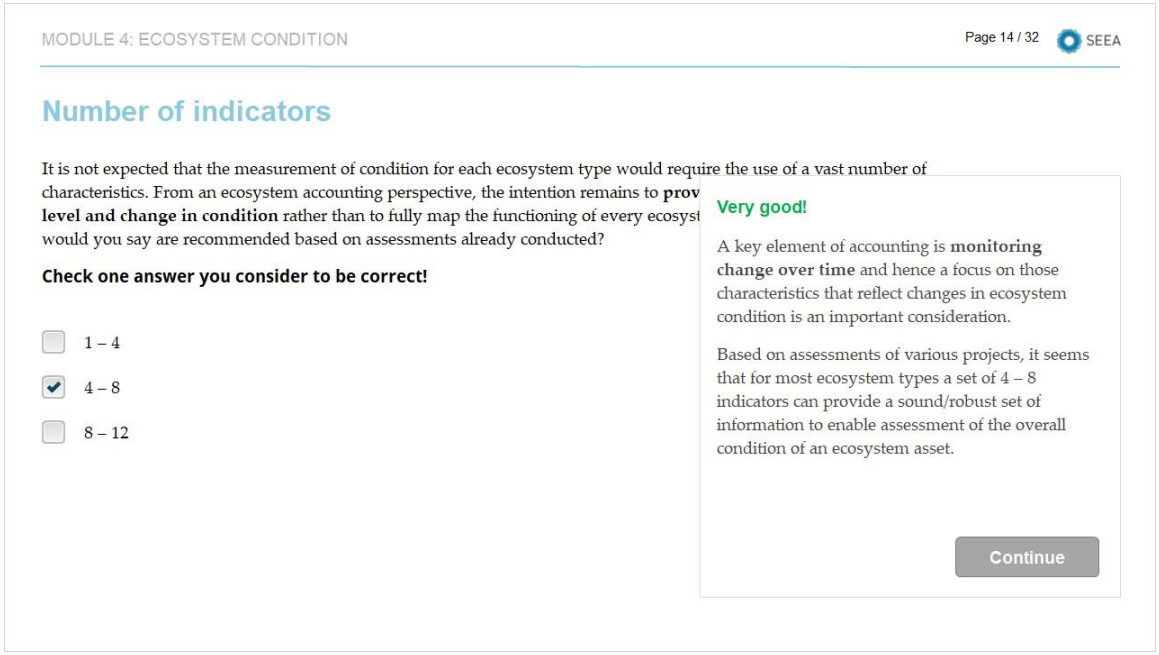
Correct (Slide Layer)



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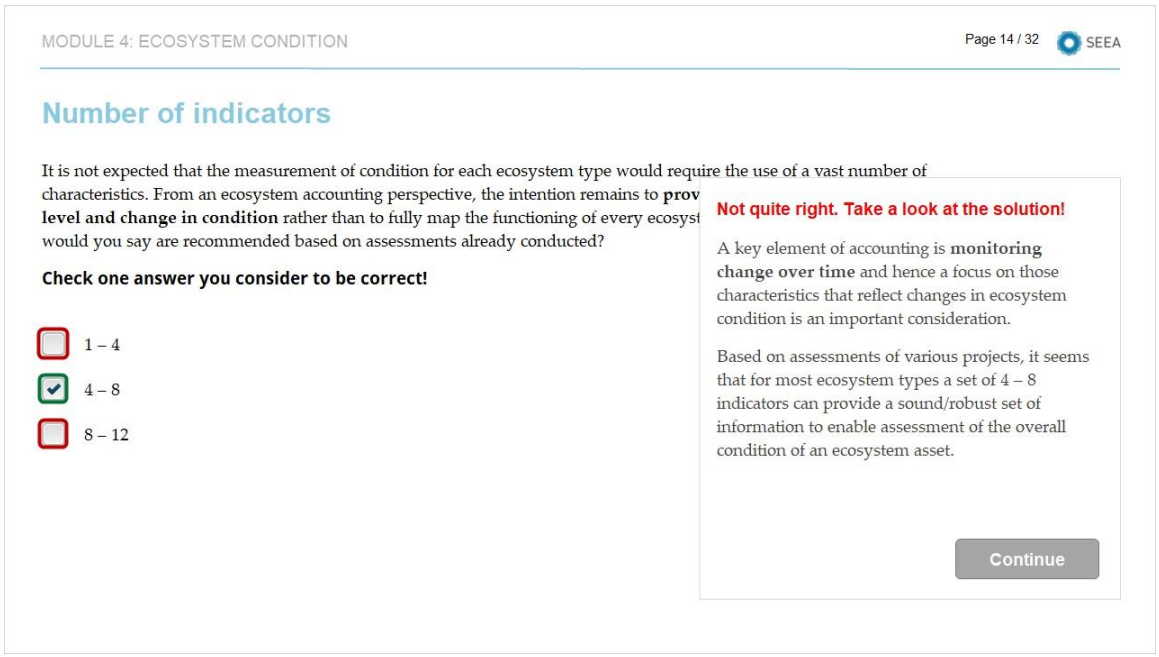


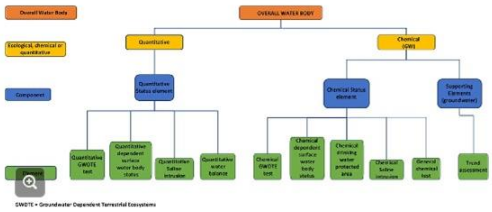
1.15 Considerations for selecting indicators

Considerations for selecting indicators

Five considerations that should be used in selecting indicators are:

- The degree to which the indicator reflects the overall ecological condition of the ecosystem or key processes within it and is able to **signal changes in this condition**.
- The degree to which the indicator can be linked to measures of **potential ecosystem services supply**.
- How easy it is for policy makers and the general public to **understand and correctly interpret** the indicator.
- Data availability and **scientific validity of measurement approaches** for the indicator.
- The possibility to generate new data **cost effectively**.

Note: In general, ecosystem condition will be **more strongly linked to potential ecosystem services supply** than to actual supply since the potential does not depend on the **extent of use** of the ecosystem by people.



The figure above shows the classification hierarchy for groundwaters, which can inform the considerations for selecting indicators. Please click on the figure to zoom in.

Source: Catchment Data Explorer, UK Environment Agency (http://environment.data.gov.uk/catchment-planning/help)

1.16 Ecosystem condition and services supply

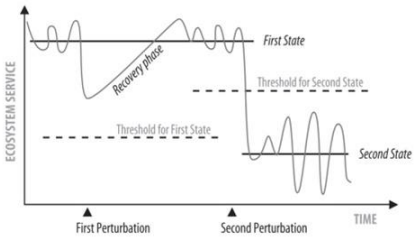
(Drag and Drop, 10 points, 1 attempt permitted)

Ecosystem condition and services supply

It is important to understand the **relationship between the condition of an EA and each of the services it provides**. For example, a small change in coastal water quality can have only a small impact on tourism but a big impact on corals providing coastal protection.

The figure illustrates the level of provisioning of an ecosystem service that has been perturbed twice. Can you explain **what happened after** each of the occurrences?

Drag the texts to the corresponding fields!



The system can recover, with its resilience being measured by the duration of the recovery phase.

The system crosses the second threshold, leading to a regime shift and losses of related services.

OK

Drag Item	Drop Target
The system can recover, with its resilience being measured by the duration of the recovery phase.	Rectangle 1
The system crosses the second threshold, leading to a regime shift and losses of related services.	Rectangle 2

Drag and drop properties
Return item to start point if dropped outside the correct drop target
Snap dropped items to drop target (Snap to center)
Allow only one item in each drop target
Delay item drop states until interaction is submitted

Feedback when correct:

The dashed lines illustrate the two thresholds:

After the first perturbation the system recovers – crossing the threshold of the second state does not cause a shift because the system stays in the first state.

The second perturbation causes crossing the second threshold, which leads to a regime shift or a catastrophic change to an alternative stable state.

The relationship between condition and service supply is often non-linear and not easy to predict. Both types of accounts - condition and services supply - are therefore needed to inform on policy decisions aimed at preserving

a condition that facilitates service supply!

Feedback when incorrect:

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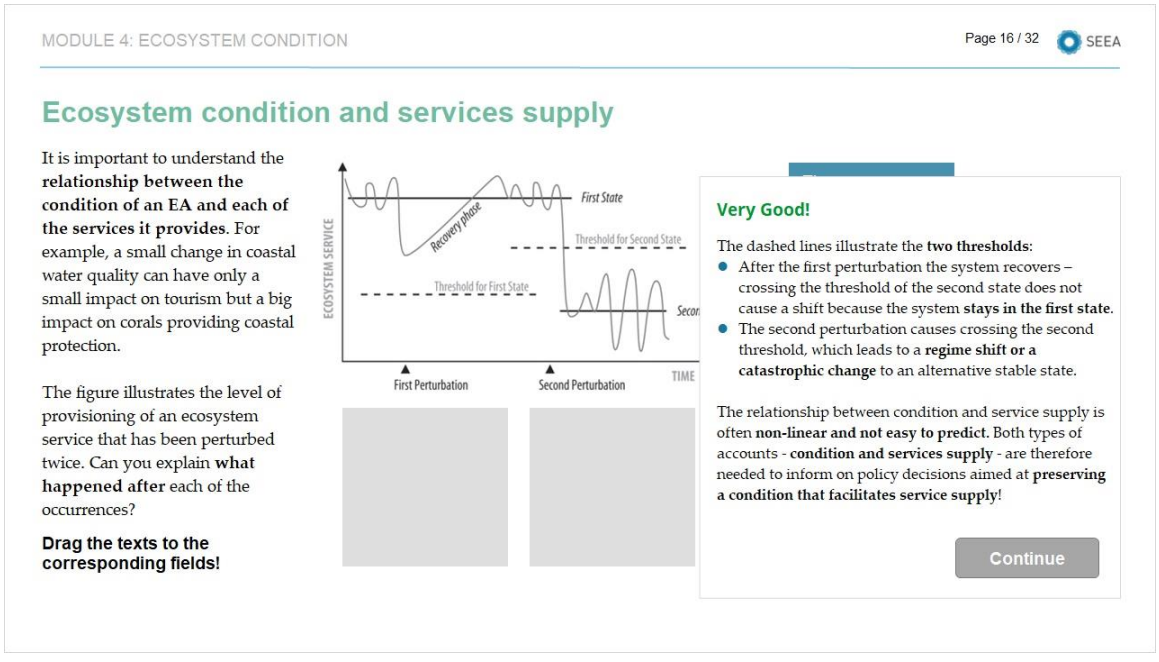
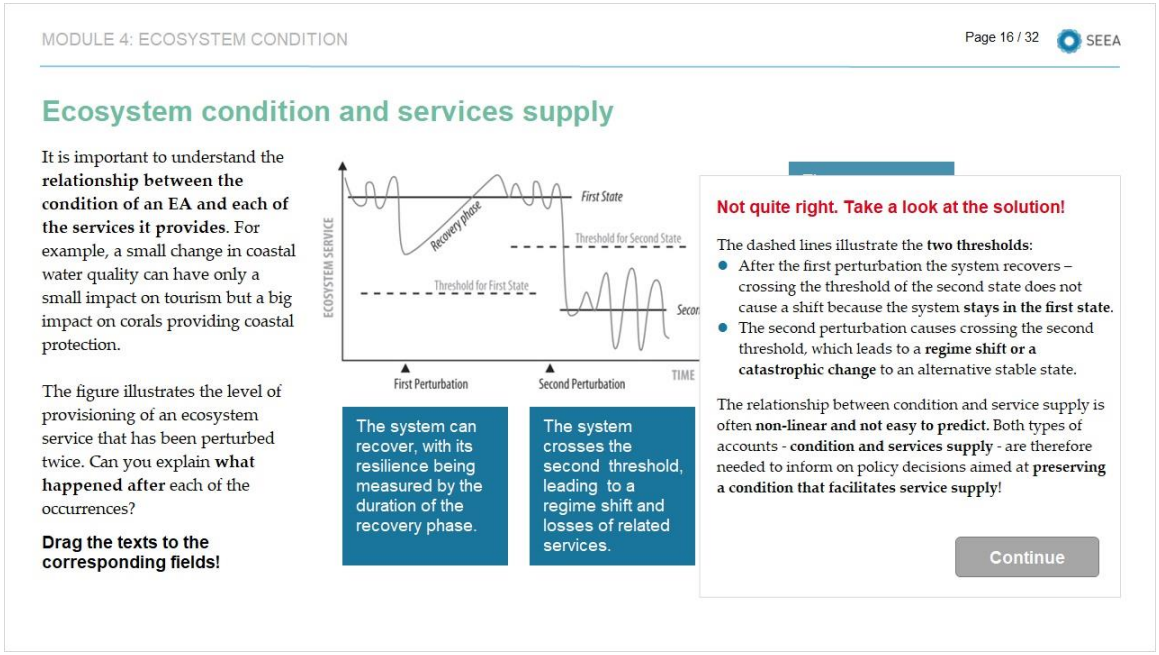
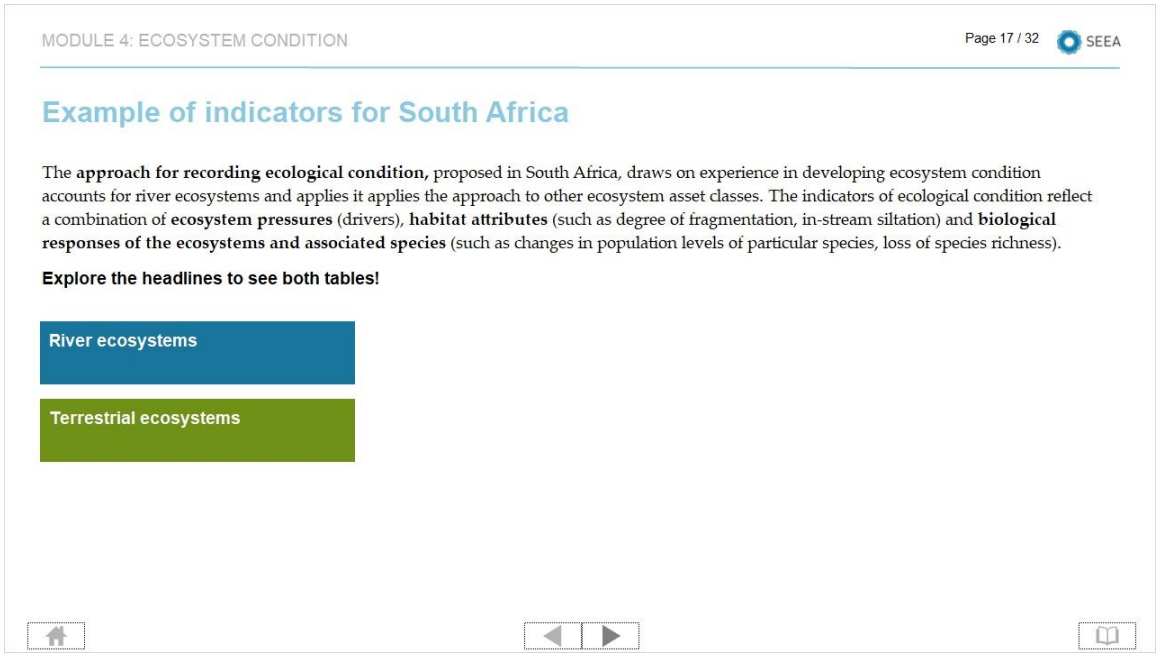
Very Good! (Slide Layer)



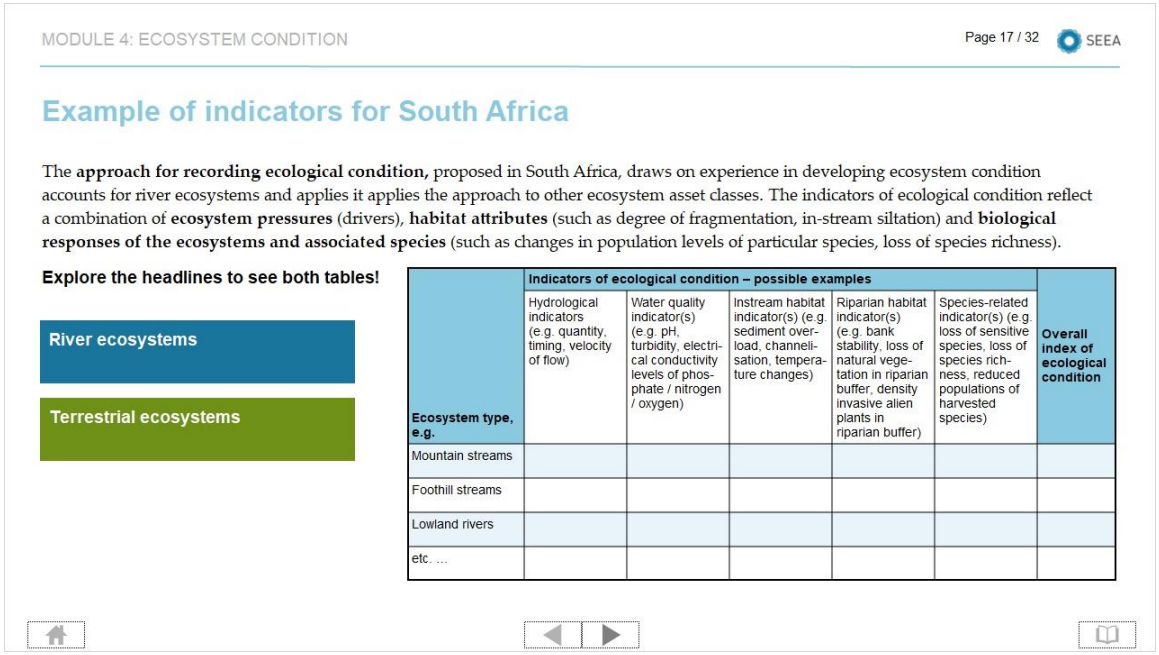
Not quite right. Take a look at the solution! (Slide Layer)



1.17 Example of indicators for South Africa



Untitled Layer 1 (Slide Layer)



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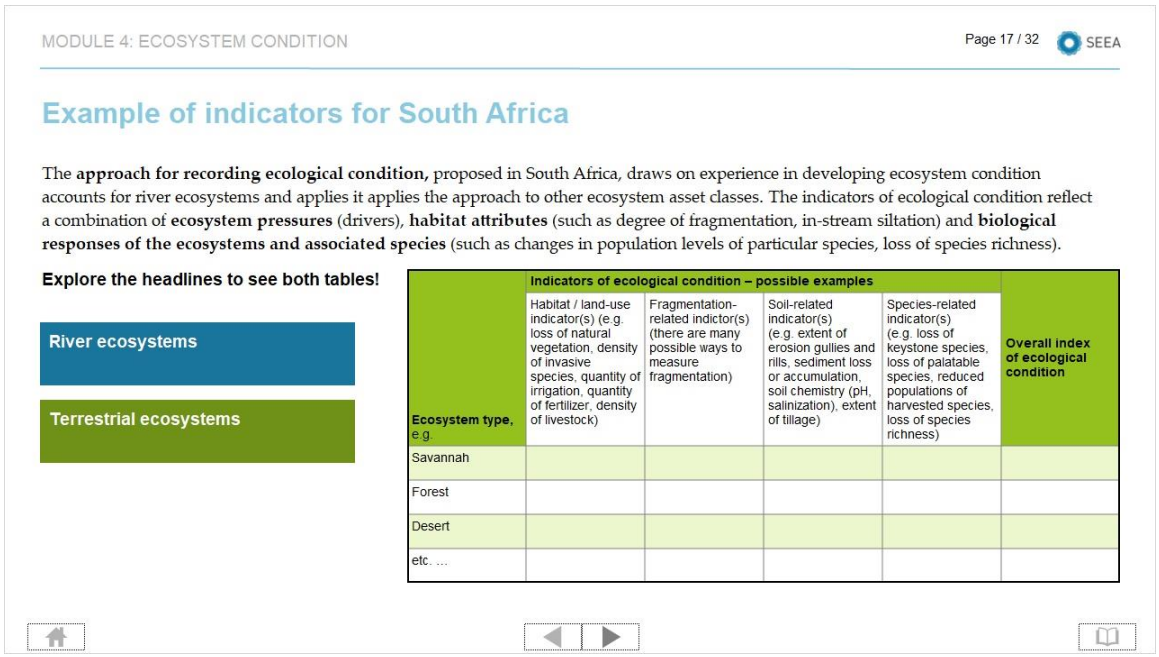
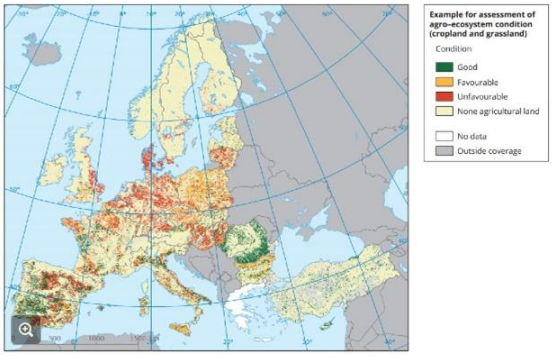


1.18 Aggregate measures of condition

Aggregate measures of condition

After identifying indicators of individual characteristics, the next question becomes if **aggregation of indicators to obtain overall measures of condition** for a single ET (or multiple EAs) within an EAA is required:

- Ideally, **macro-level information** would give a sense of the overall condition of each ecosystem relative to another as well as relative to relevant thresholds and limits, recognizing the need for specialist ecological knowledge to define such thresholds and limits.
- However, especially in early phases of account development, care needs to be taken to communicate any **uncertainties and limitations** to the users of the accounts. In the near future, condition accounts may be insufficiently detailed to **serve as the sole source of information for decision making**, but site-specific resource management questions will be able to use the accounts as a starting point for discussion.



Map of cropland and grassland (agro ecosystem) condition in Europe, based on aggregated assessment of multiple pressures and species or habitat conservation status. The units are classified from unfavourable to good because the input consists of information in different units.

Source: European Environment Agency, European ecosystem assessment 2015 (https://www.eea.europa.eu/publications/european-ecosystem-assessment/)

1.19 Continuum of information

Continuum of information

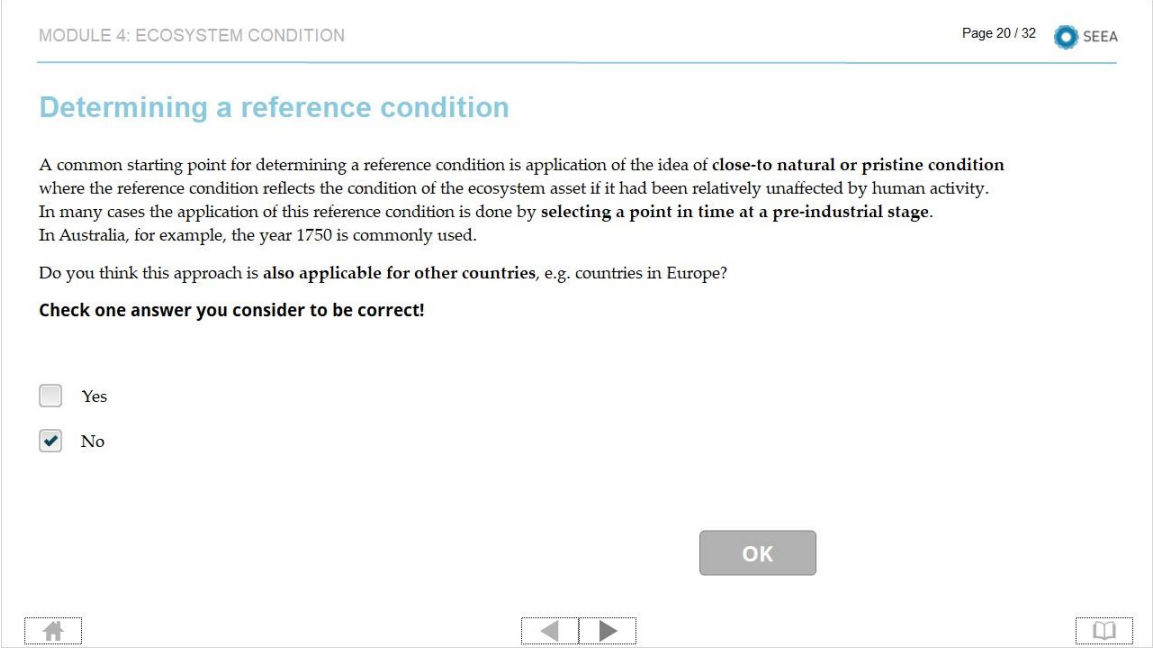
In moving from individual indicators of specific characteristics to information on relative overall condition, a **continuum of information** can be described. Moving along the continuum reflects the use of additional information and assumptions. In general terms: **As the number of ecosystem types increases, it is likely to be more difficult to make comparisons.**

Explore the headlines to get more information!

1. **Measure directly**
2. **Compare with known baseline**
3. **Form composite indicator**
4. **Combine indicators**
5. **Compare across different ecosystem types**

1.20 Determining a reference condition

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
	Yes
X	No

Feedback when correct:

What constitutes a natural ecosystem can lead to significant debate particularly in those countries where human influence on the landscape has been evident for thousands of years.

For example, almost all of Europe may be considered to have been forested at one point in time, but the

use of this as a reference condition for the current

mix of ecosystem types is likely inappropriate be-cause most of Europe’s landscapes have been modified by people for several thousands of years. Many flora and fauna species have had time to ad-

just and would not necessarily benefit from con-version to full forest cover.

Feedback when incorrect:

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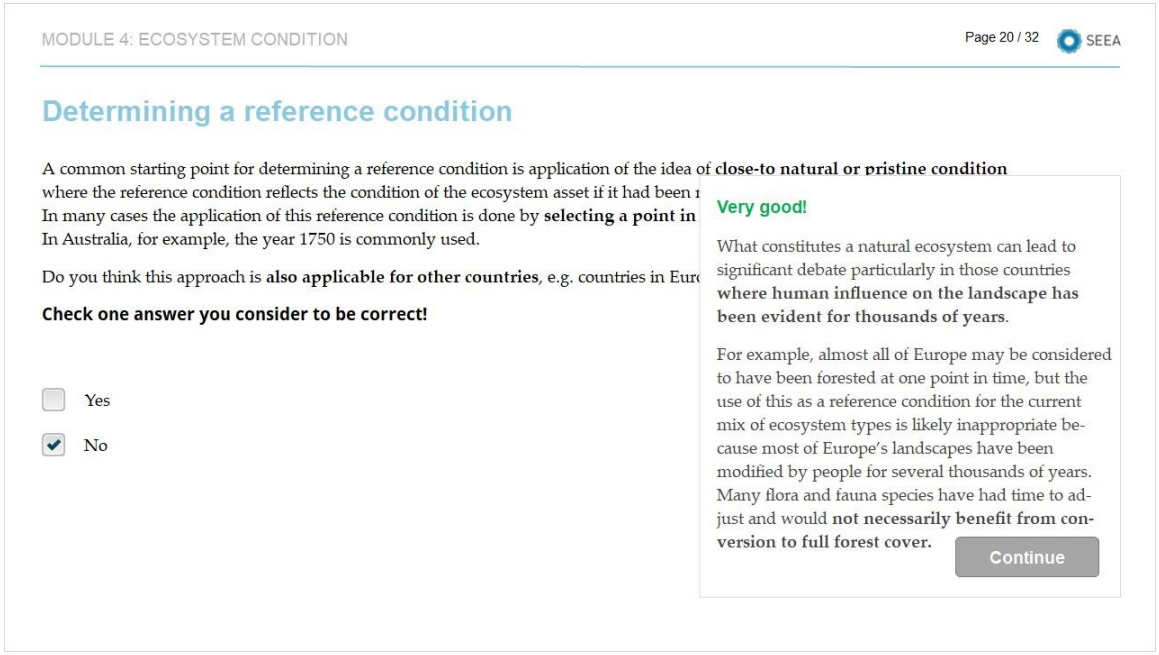
just and would not necessarily benefit from con-version to full forest cover.

Correct (Slide Layer)



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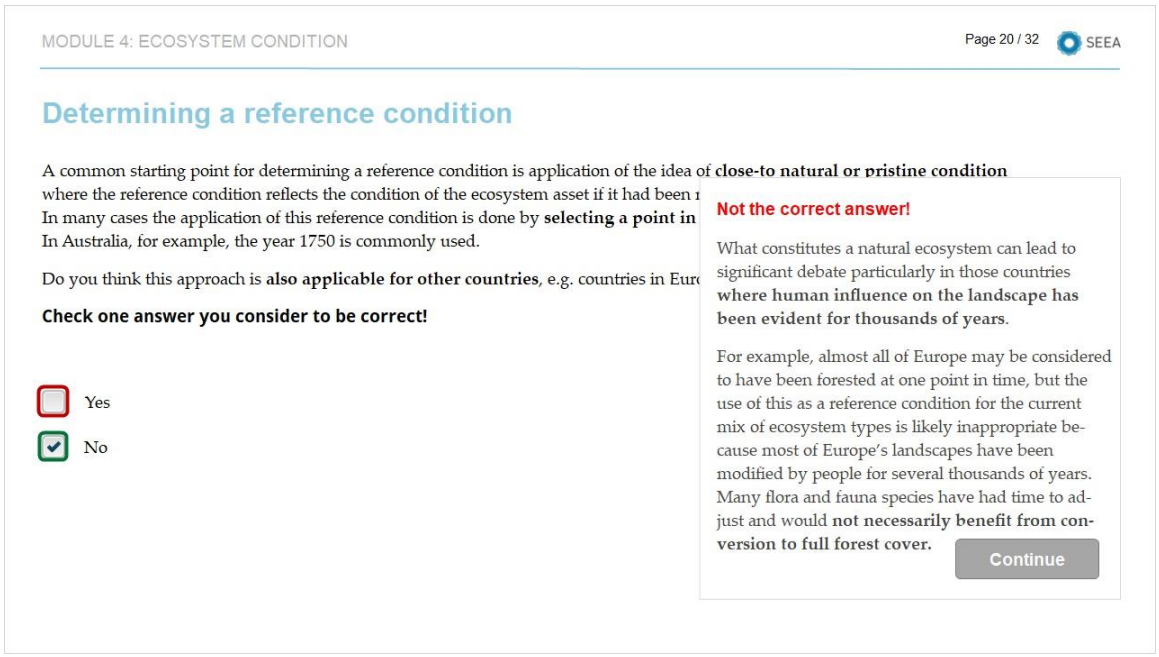
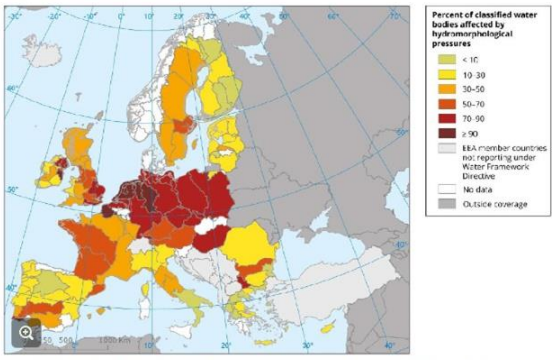


1.21 Natural reference condition and services

Natural reference condition and services

Another concern about the use of natural reference conditions for ecosystem accounting is that they will not take into account the **current use** of the ecosystem:

- If the focus of condition measurement is on the **potential to supply ecosystem services**, assessment of condition in terms of "distance from natural" will not compare like with like. This links directly to the discussion on the use of ecological and non-ecological factors in the assessment of condition.
- Therefore, it may be sufficient to use the **condition at the beginning of the accounting period** (or when the accounts started to be compiled) as a reference condition and measure the actual condition relative to that. The difficulty with this approach is that ecosystems that may have been **heavily degraded in the past** will be compared from the same starting point as those that have **not been degraded at all**.



Percent of classified water bodies (in different river basin districts) affected by hydromorphological pressures in Europe. Hydro morphological pressures include straightening of water ways and building of dams and weirs interrupting movement of migratory fish and changing freshwater habitat's abilities to provide flood protection. In the EU Water Framework Directive, this condition is separated from water quality issues.

Source: European Environment Agency, WISE-WFD database, June 2015.

1.22 Aggregation of spatially variable indicators

(Multiple Response, 10 points, 1 attempt permitted)

Aggregation of spatially variable indicators

Another initial question in accounting for ecosystem condition is **how spatially variable indicators can be aggregated** both within and between ecosystems. Depending on the indicators concerned, aggregation may make no sense. What do you think about the indicators given below – which is the one perfectly fit for aggregation?

Check one answer you consider to be correct!

- [x] Function as CO_2-sink
- [ ] Soil nutrient concentration
- [ ] Measures of biodiversity or species abundances

OK

Correct	Choice
X	Function as CO2-sink
	Soil nutrient concentration
	Measures of biodiversity or species abundances

Feedback when correct:

Aggregating the ability to bind CO2 may help in determining one country's ability to reach its goal in fighting climate change.

Soil nutrient concentration or biodiversity may be highly relevant as indicators of ecosystem condition, and have important repercussions for potential services supply, but aggregating these indicators is meaningless since this may theoretically include 50% of the area with very low and 50% of the area with very high values.

Therefore, classifications or comparison with reference conditions (e.g. deviation from not degraded situation) may be required.

Feedback when incorrect:

Aggregating the ability to bind CO2 may help in determining one country´s ability to reach its goal in fighting climate change.

Soil nutrient concentration or biodiversity may be highly relevant as indicators of ecosystem condition, and have important repercussions for potential services supply, but aggregating these indicators is meaningless since this may theoretically include 50% of the area with very low and 50% of the area with very high values.

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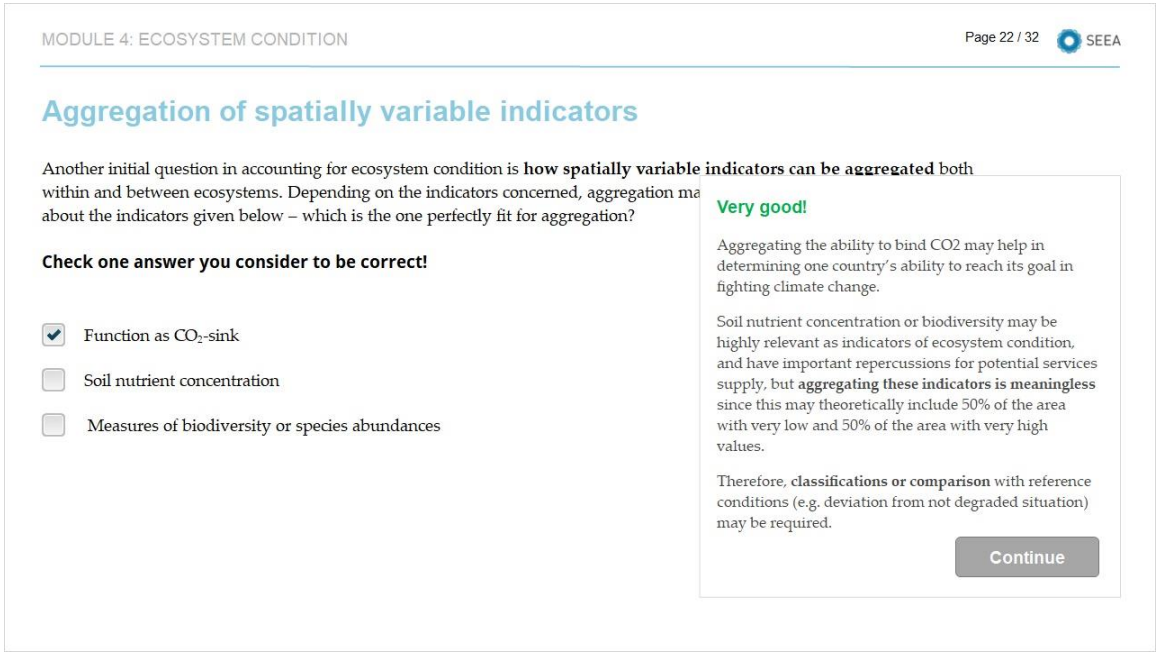
Correct (Slide Layer)



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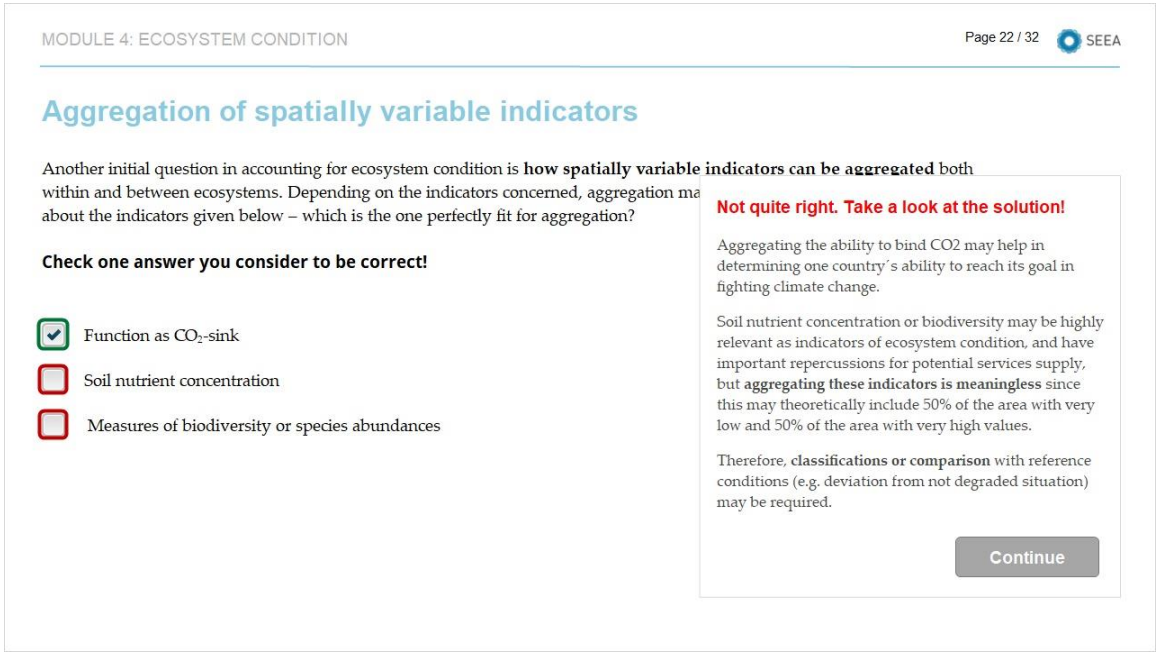
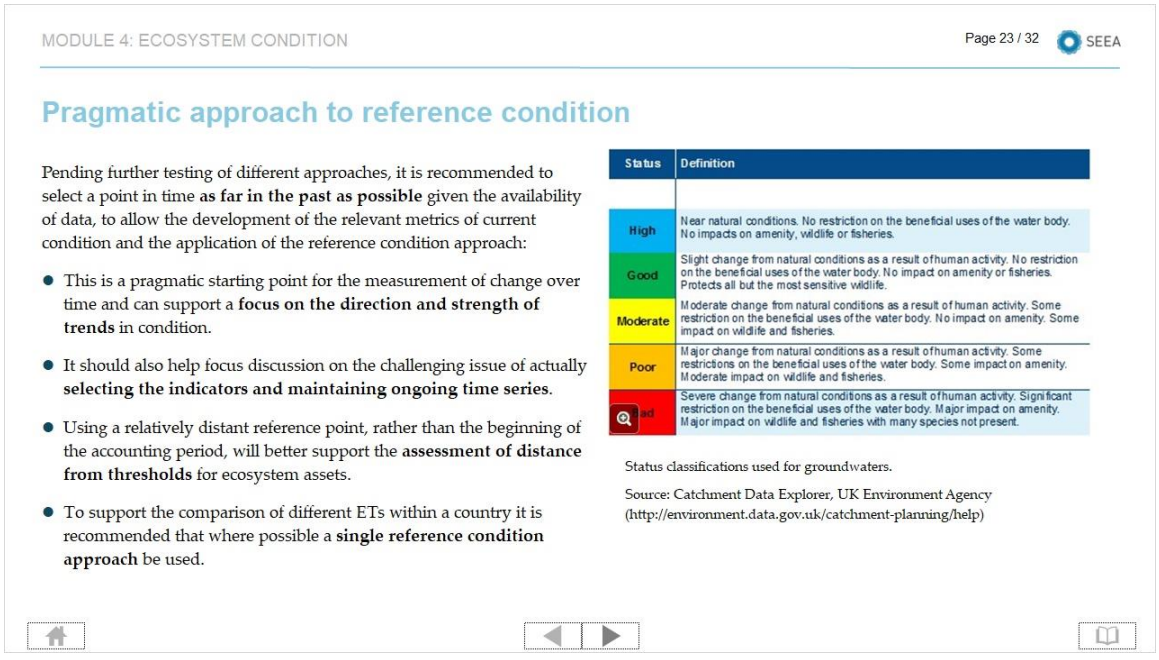
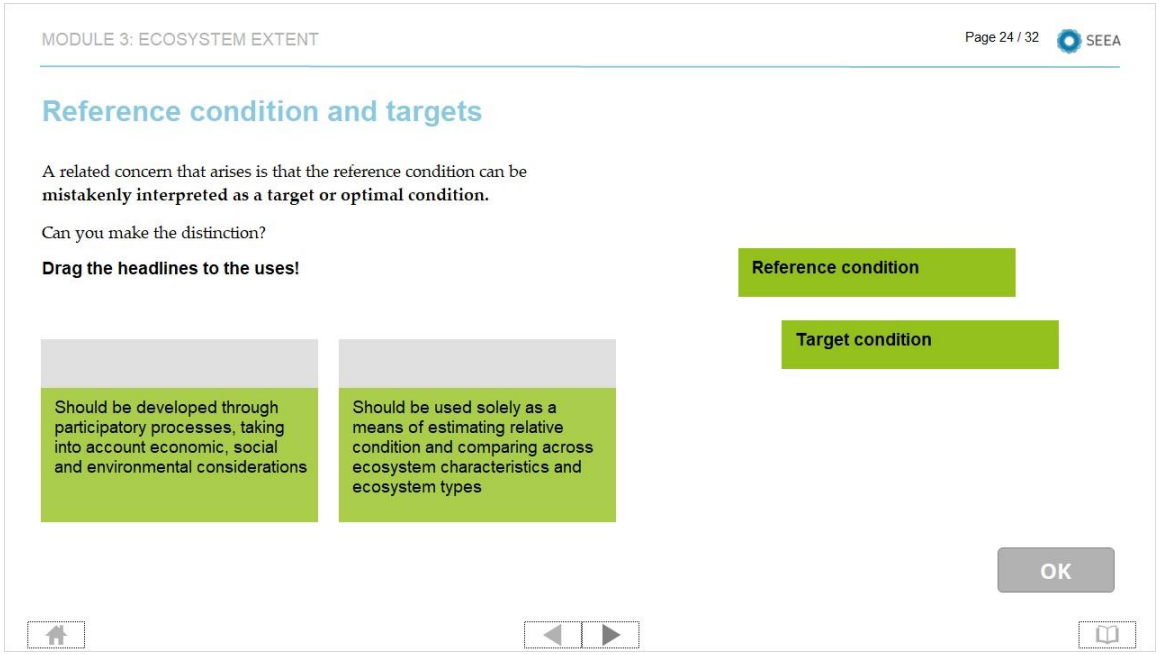


1.23 Pragmatic approach to reference condition



1.24 Reference condition and targets

(Drag and Drop, 10 points, 1 attempt permitted)



Drag Item	Drop Target
Target condition	Rechteck 4
Reference condition	Rechteck 5

Drag and drop properties
Snap dropped items to drop target (Tile)
Delay item drop states until interaction is submitted

Feedback when correct:

A clear distinction should be made between reference and target conditions. For example, in urban areas the actual condition would be likely very low to a reference condition of the previous natural state. Hence, it would be inappropriate to suggest that the target condition should be the natural state.

A more appropriate target condition in urban areas might be the planting of trees to contribute to improved air quality.

Generally, it would be expected that information on the actual and reference condition presented in ecosystem accounts would be useful input to a discussion of target conditions.

Feedback when incorrect:

A clear distinction should be made between reference and target conditions. For example, in urban areas the actual condition would be likely very low to a reference condition of the previous natural state. Hence, it would be inappropriate to suggest that the target condition should be the natural state.

A more appropriate target condition in urban areas might be the planting of trees to contribute to improved air quality.

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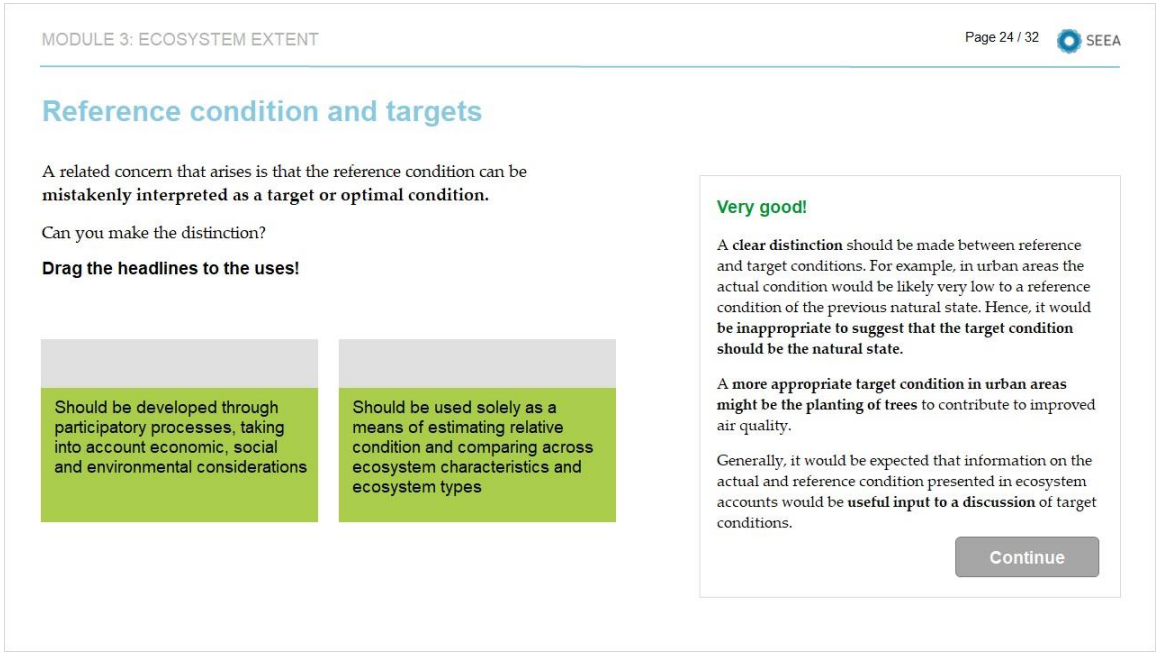
Correct (Slide Layer)



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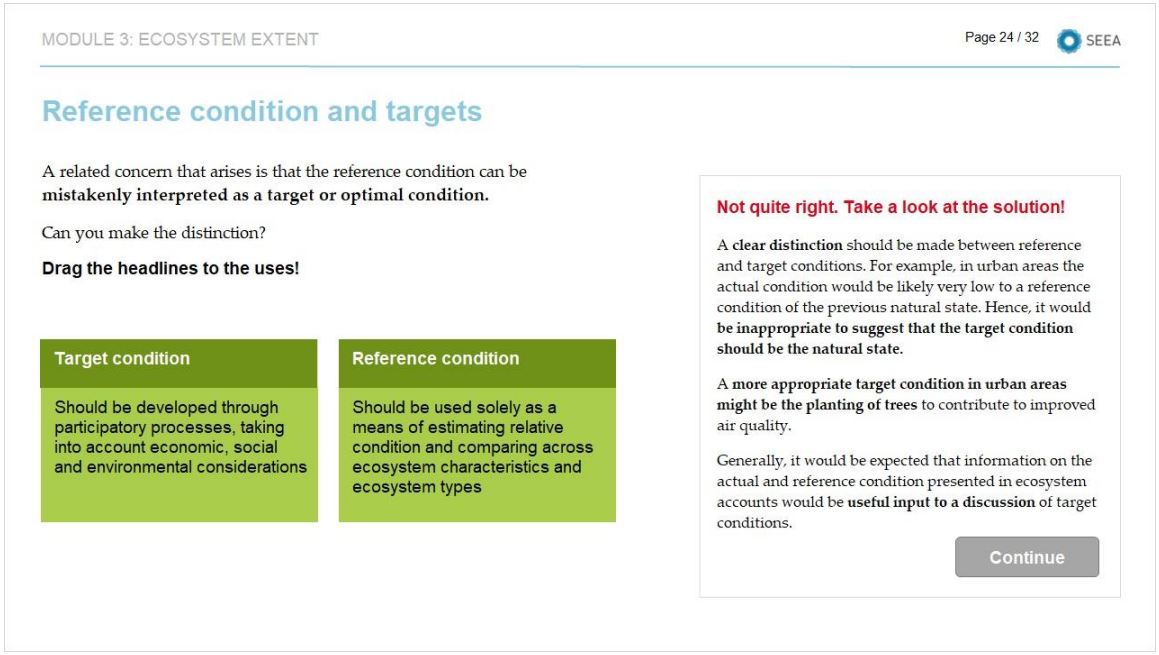
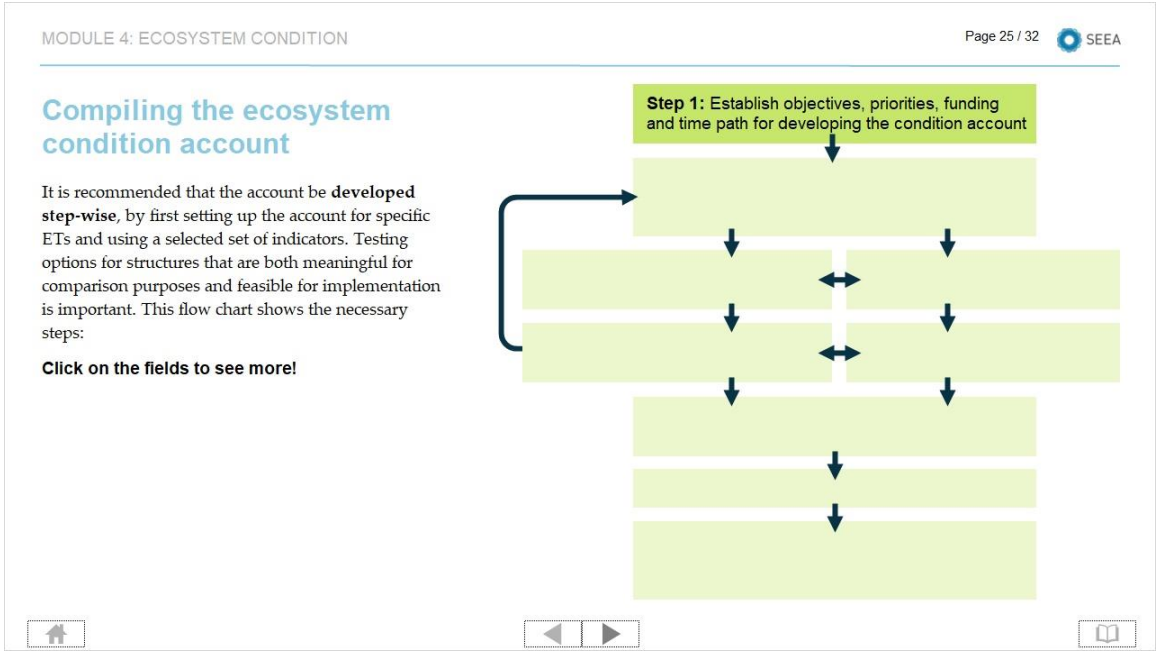
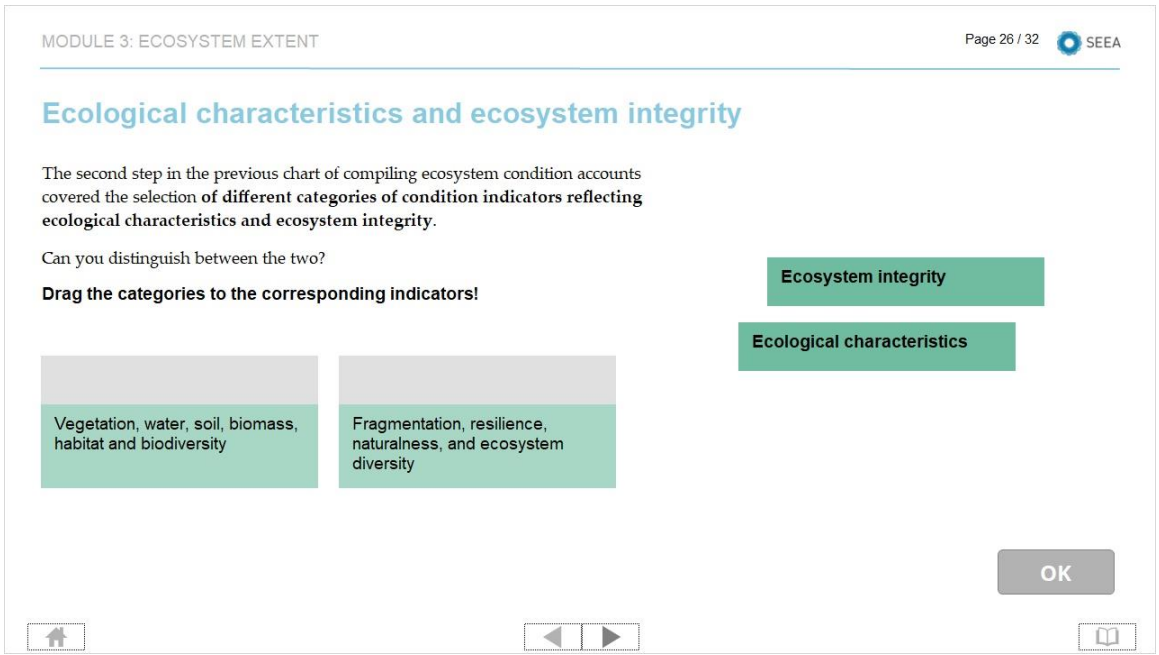


1.25 Compiling the ecosystem condition account



1.26 Ecological characteristics and ecosystem integrity

(Drag and Drop, 10 points, 1 attempt permitted)



Drag Item	Drop Target
Ecosystem integrity	Rechteck 5
Ecological characteristics	Rechteck 4

Drag and drop properties
Return item to start point if dropped outside the correct drop target
Snap dropped items to drop target (Snap to center)
Allow only one item in each drop target
Delay item drop states until interaction is submitted

Feedback when correct:

Condition indicators represent the main ecological characteristics of the ETs. Where relevant, condition indicators related to land, water and forests should be compiled following the accounting of the SEEA Central Framework.

Compilers may also consider whether indicators reflecting ecosystem integrity or indicators of pressures on ecosystems (or drivers for ecosystem change) should be included in the condition account to support a connection to the potential or future supply of ecosystem services.

Feedback when incorrect:

Condition indicators represent the main ecological characteristics of the ETs. Where relevant, condition indicators related to land, water and forests should be compiled following the accounting of the SEEA Central Framework.

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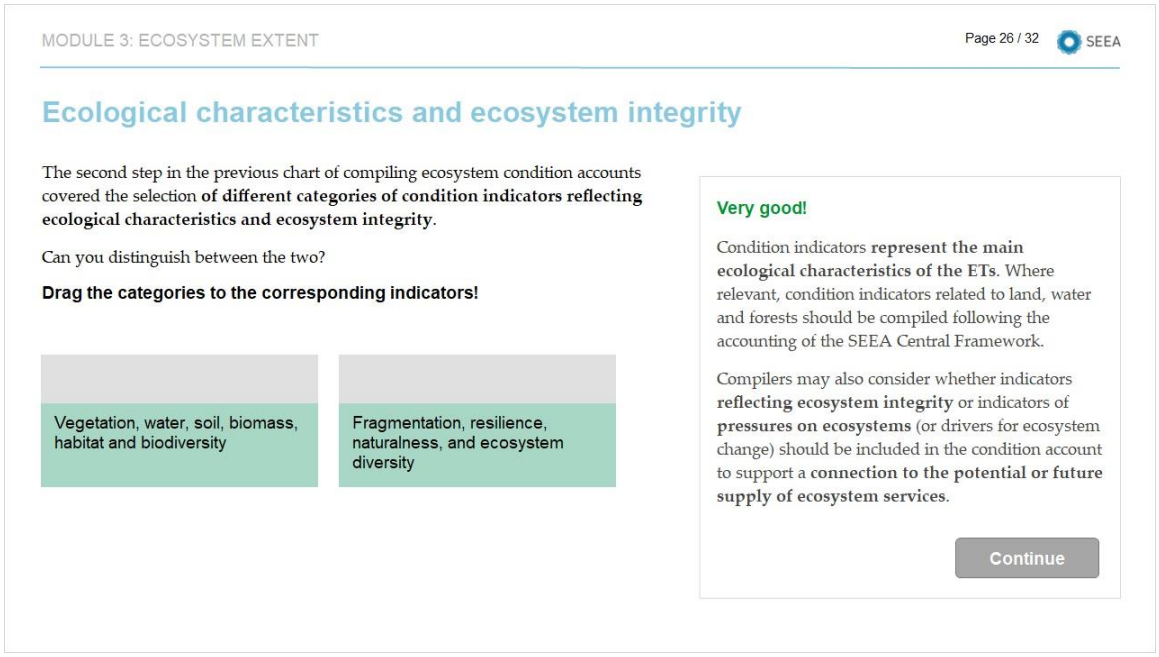
Correct (Slide Layer)



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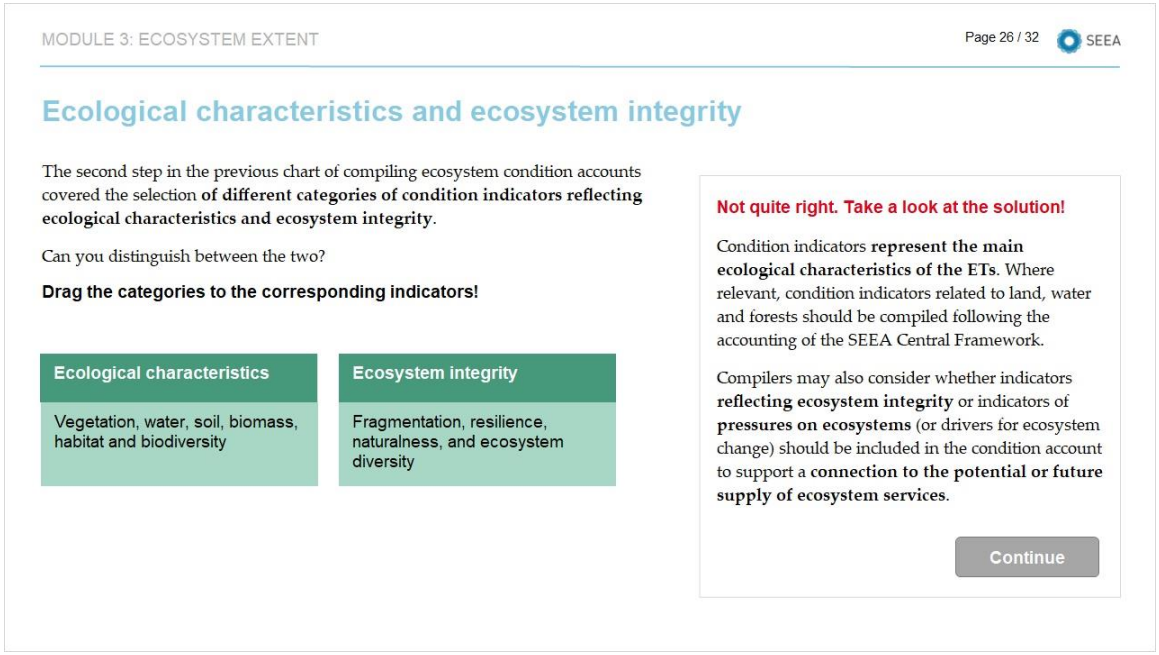
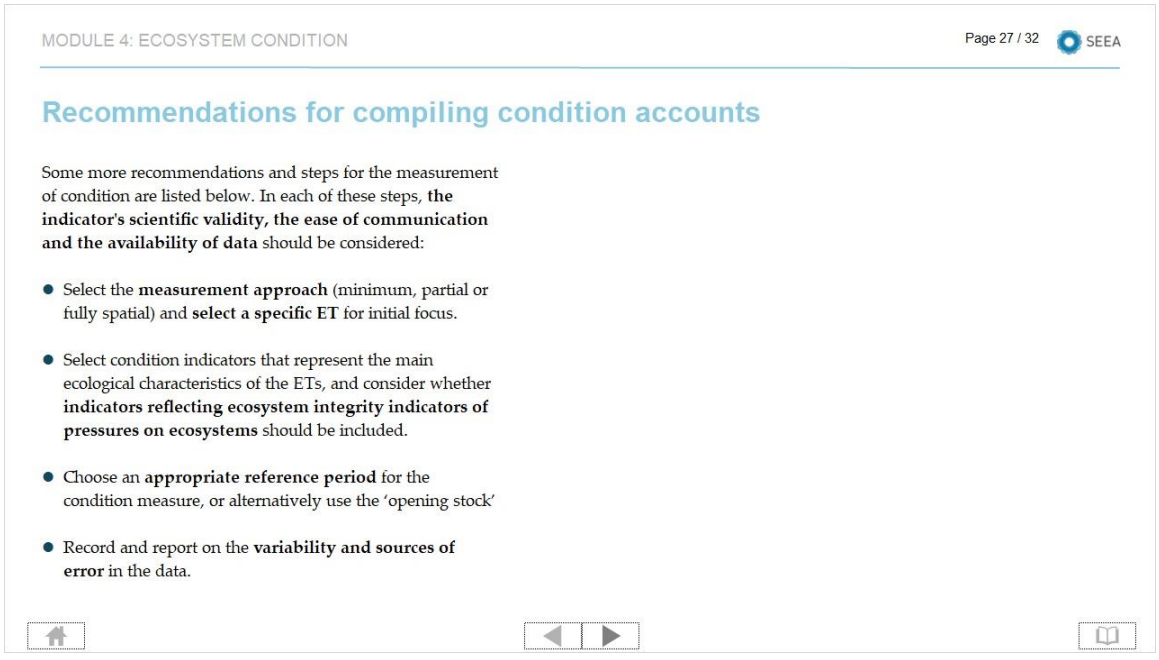


1.27 Recommendations for compiling condition accounts

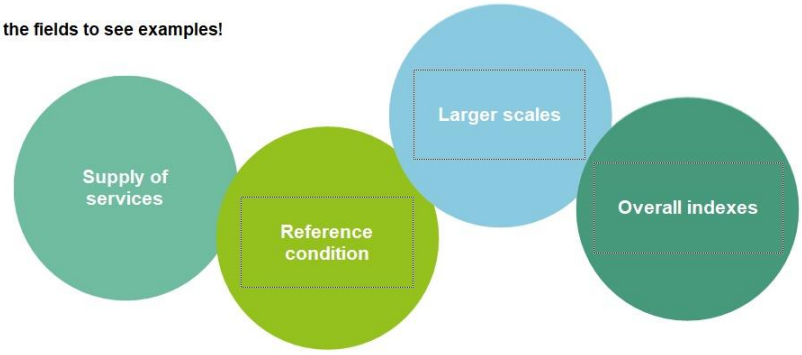


1.28 Issues for further research

Issues for further research

At this stage in the development of ecosystem accounting, most importantly a clearer direction is needed on the extent to which the characteristics used for the measurement of condition **go beyond ecological characteristics and also incorporate non-ecological characteristics**, for example indicators of environmental pressures. But there are more areas of research:

Hover over the fields to see examples!

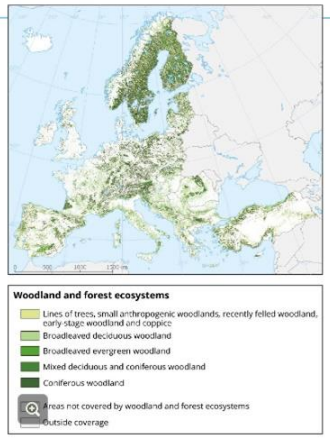


1.29 Data sources

Data sources

Data sources will vary depending on the indicator selected. Satellite based data are useful especially in providing the **breadth of data across different ecosystem assets**:

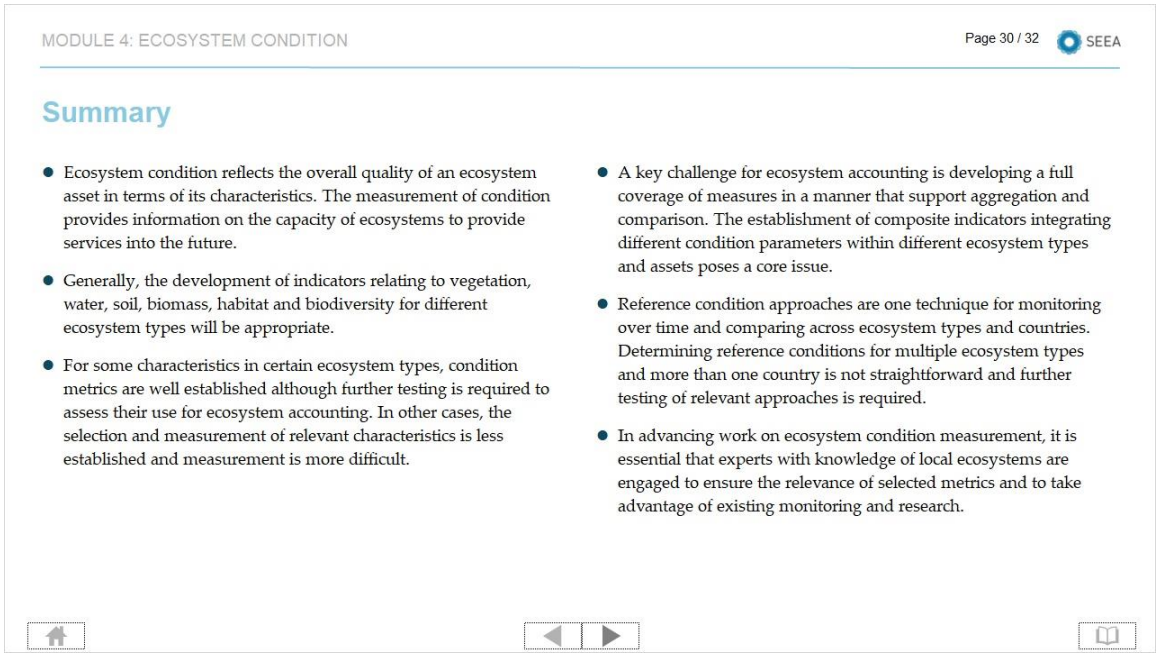
- Compilers are encouraged to consider the **work described in the project research papers**, the outcomes from testing in different projects, and to **engage with national experts** on different ecosystems and biodiversity measurement.
- Another starting point may be discussions with **experts involved in national reporting** on the state and trends in biodiversity with the framework of the Convention on Biological Diversity (CBD). Other international programs on ecosystem monitoring and measurement include the collection of information to monitor the UN Sustainable Development Goals and data collected through the GEOSS program.
- Within **Europe**, projects such as Mapping and Assessment of Ecosystems and their Services (MAES), the EU Habitat Directive and Copernicus will provide relevant information.



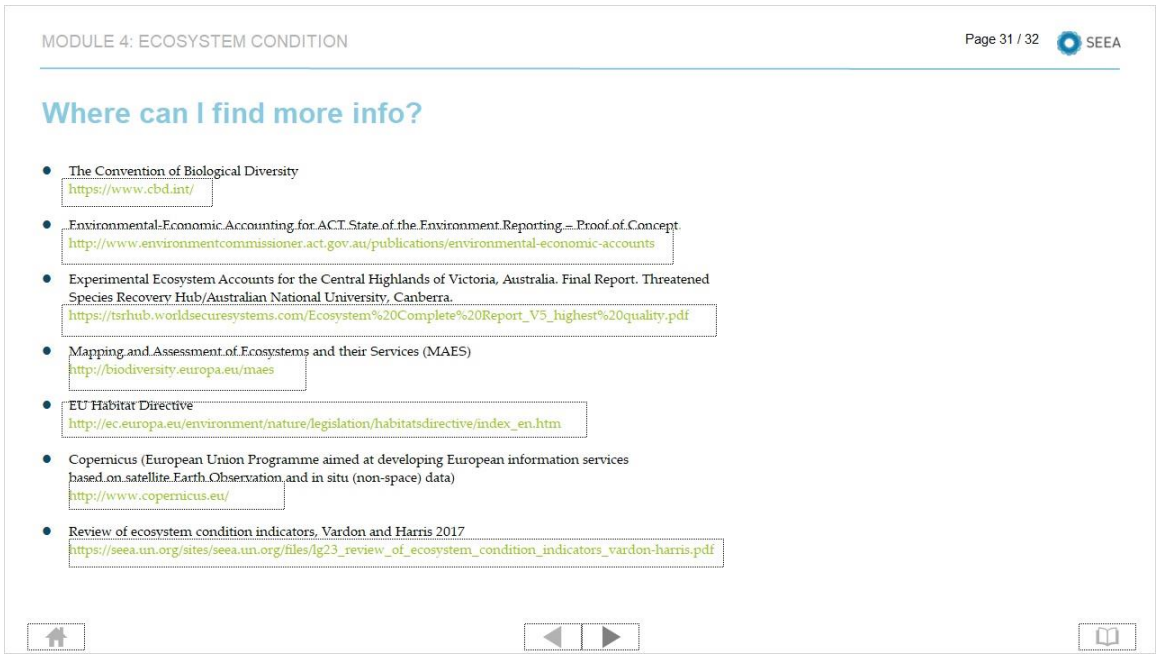
Forests are a particular ecosystem type to commence testing given the significant literature on the measurement of forest characteristics. Recent assessments under the Habitats Directive reveal that only 15% in Europe are in favourable conservation status.

Source: European Environment Agency, DiscoMap 2015

1.30 Summary



1.31 Where can I find more info?



1.32 Wrapping up…

Wrapping up…

This is the last screen in Module 4 of the training on experimental ecosystem accounting – which entails you may now commence with the modules about ecosystem services and compiling the thematic accounts.

We hope this first overview provided you with sufficient knowledge and reassurance to proceed on your way!

Please stay tuned by checking out our websites for new publications and information about regional workshops and working groups that may be of assistance in completing your task.

Thanks for learning!