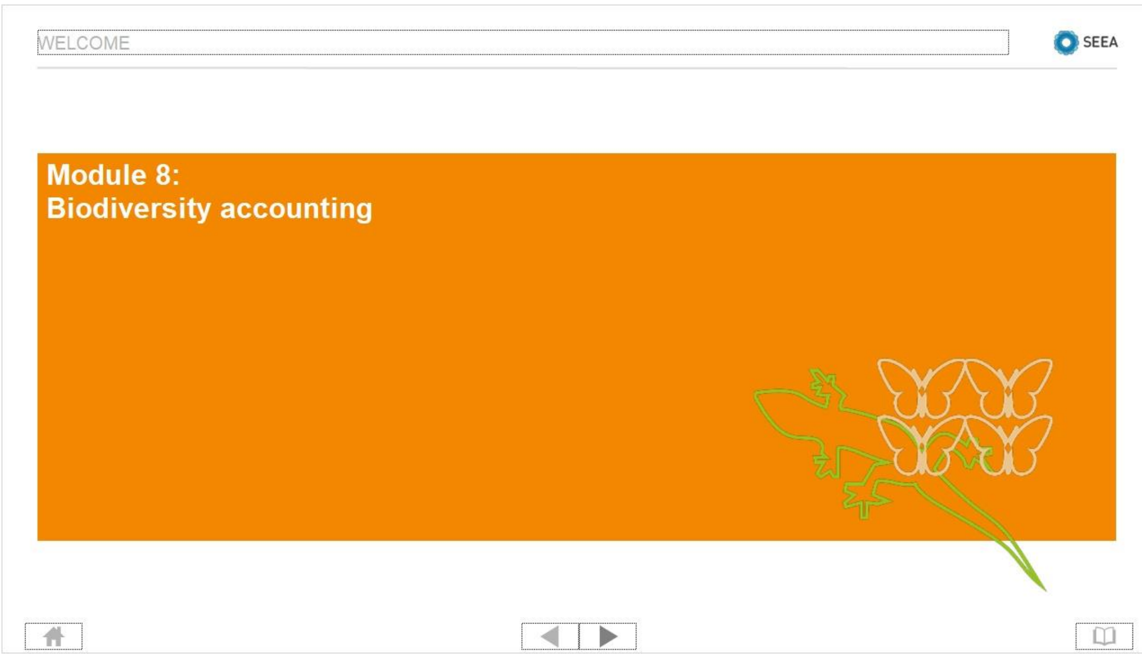
SEEA_EnvAcc_M8_EN

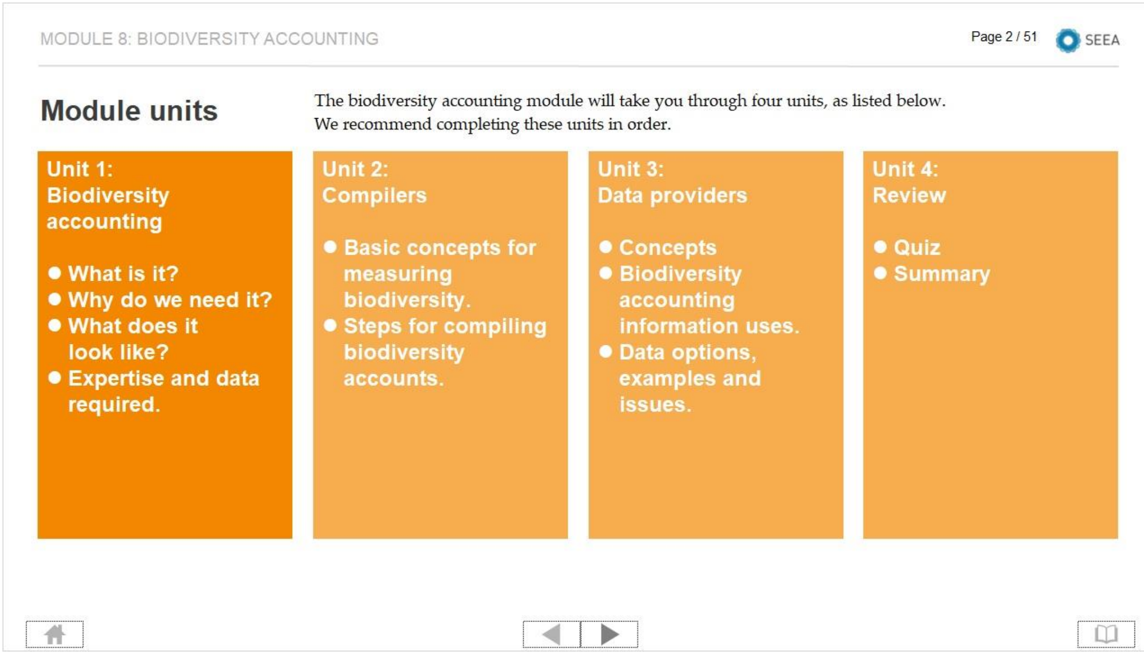
1. Module 1 - Introduction

1.1 Welcome

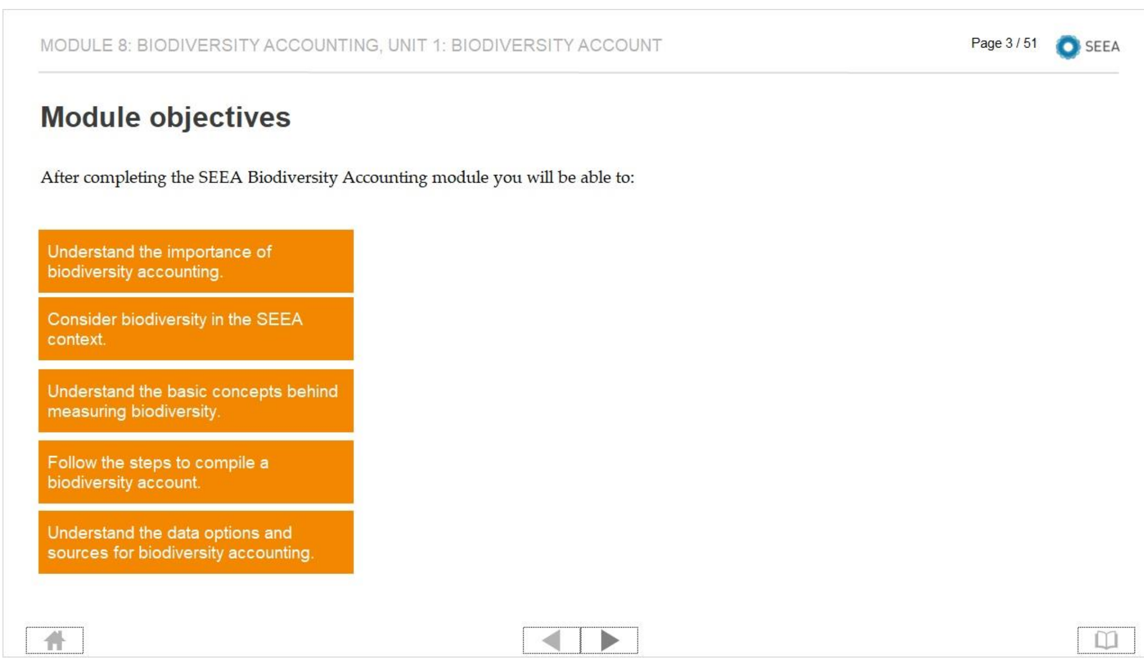


Notes:

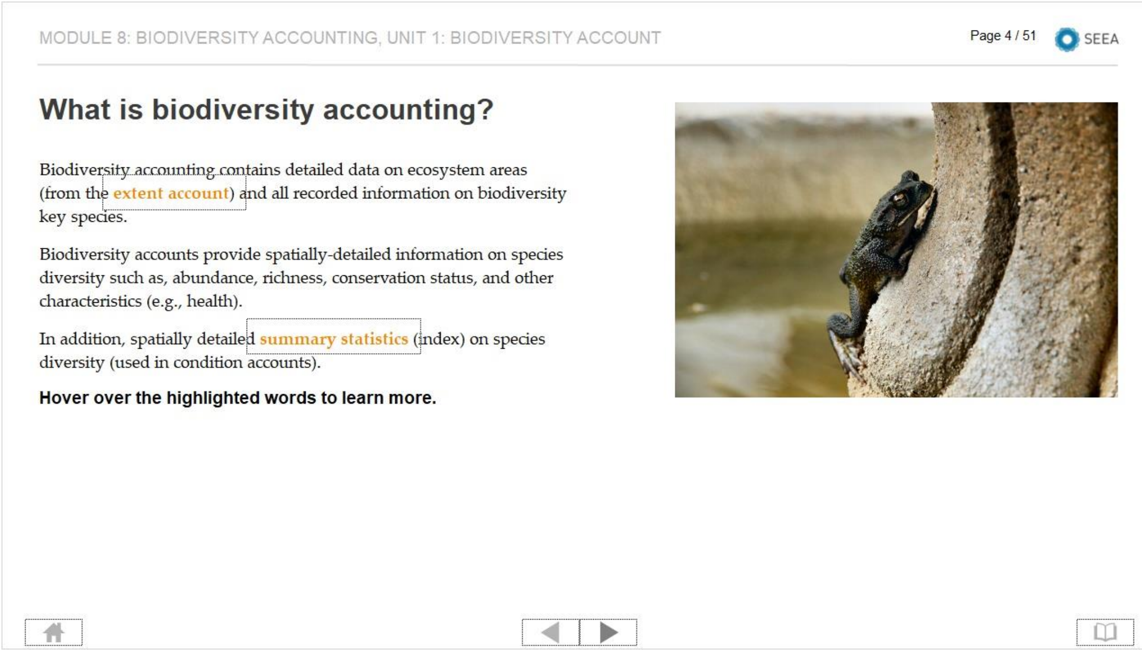
1.2 Module units



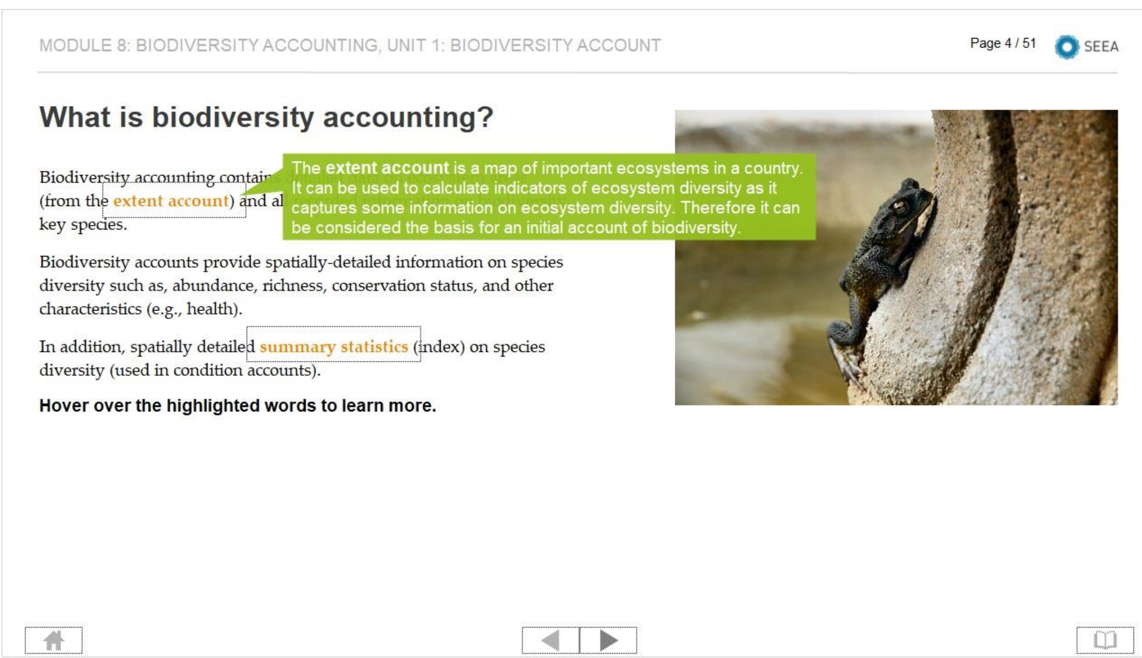
1.3 Module objectives



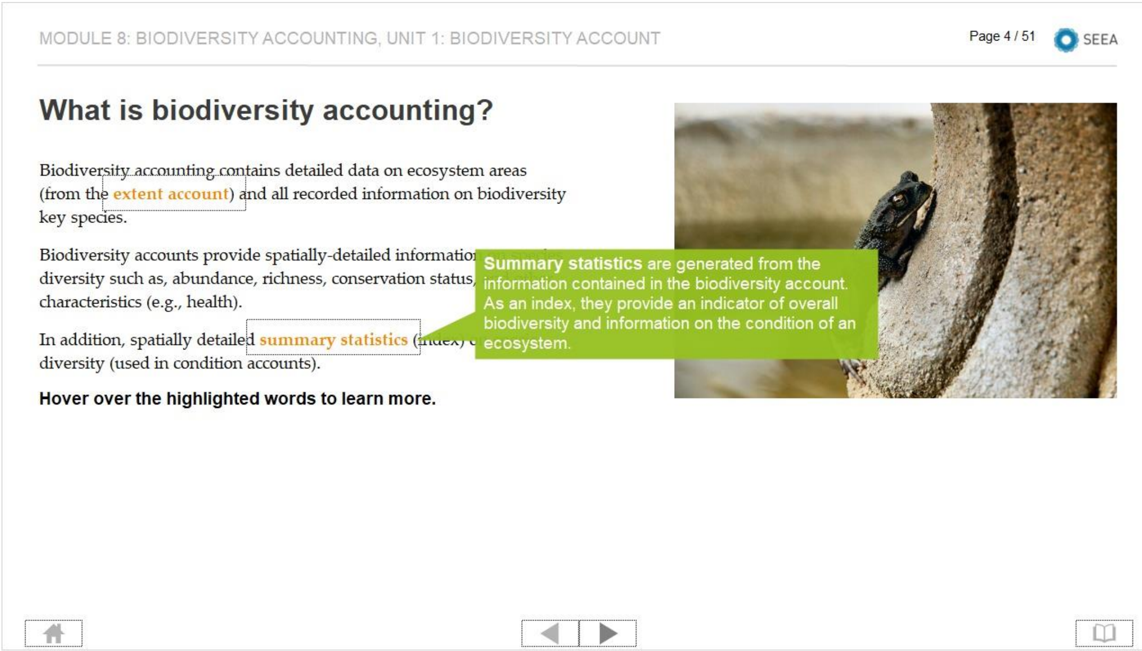
1.4 What is Biodiversity Accounting?



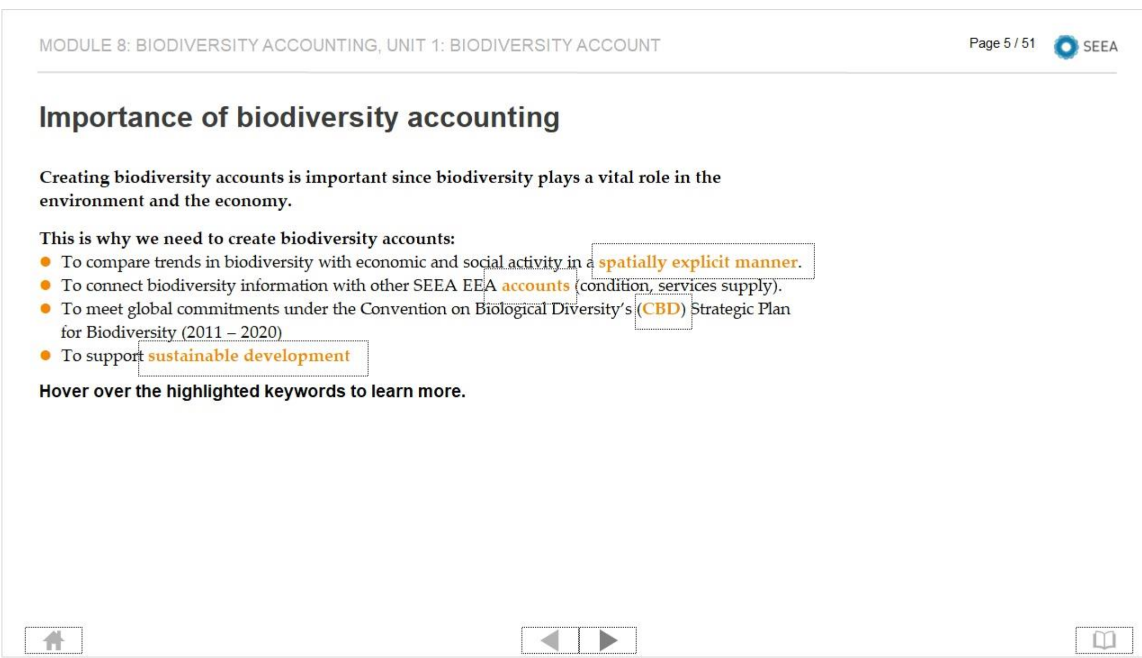
Explanation 1 (Slide Layer)



Explanation 2 (Slide Layer)



1.5 Importance of Biodiversity Accounting



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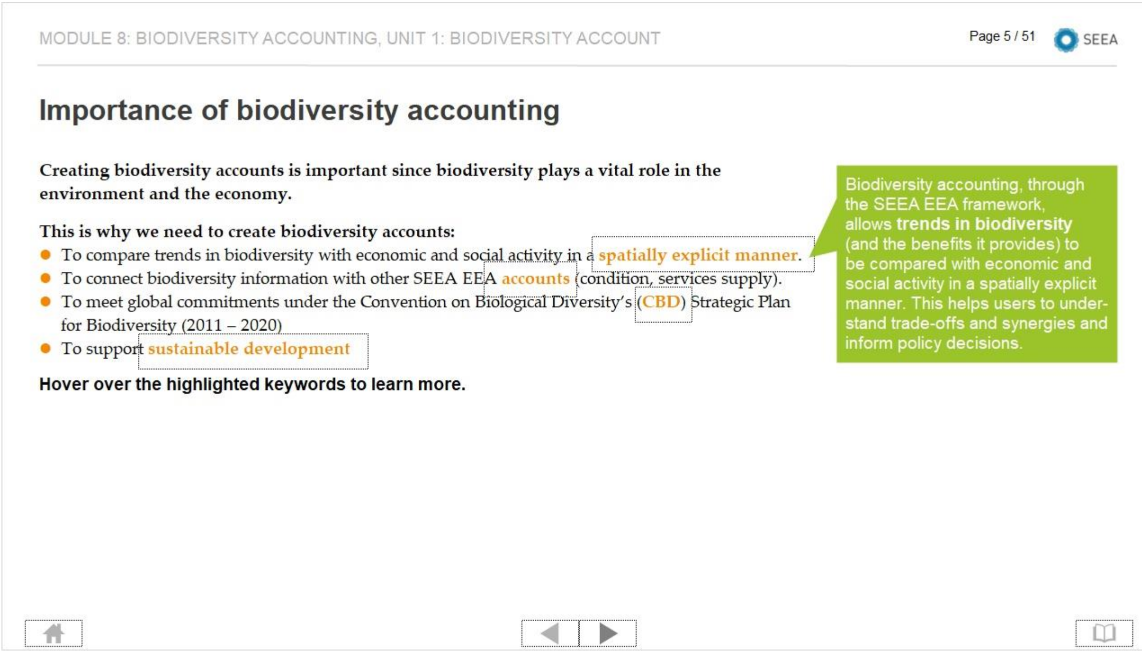

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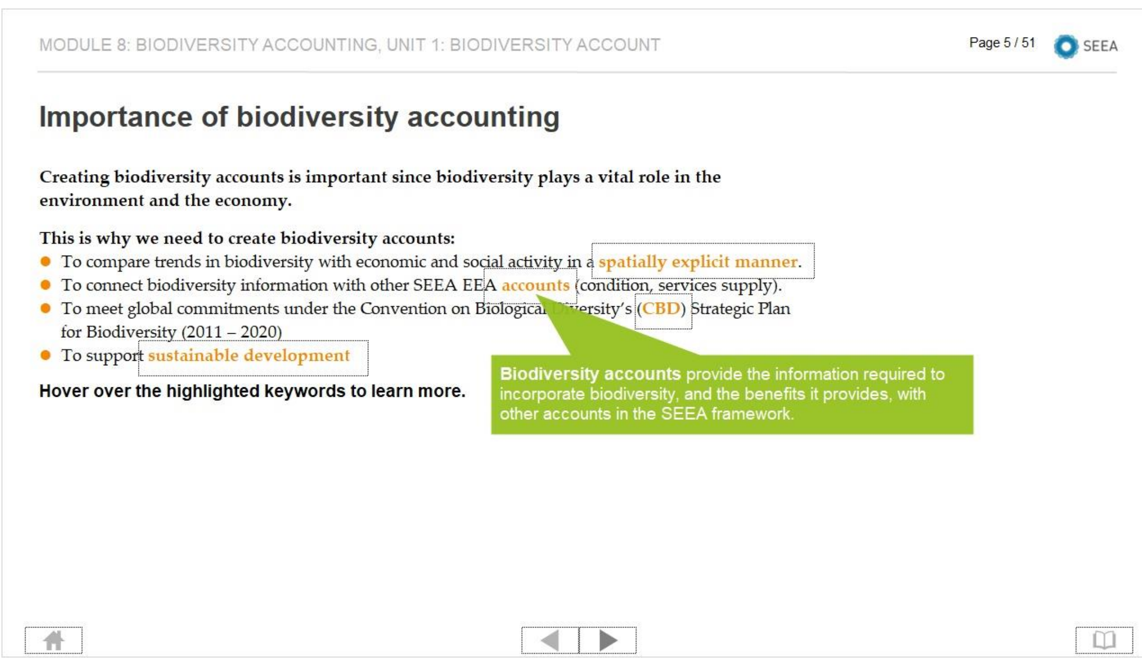

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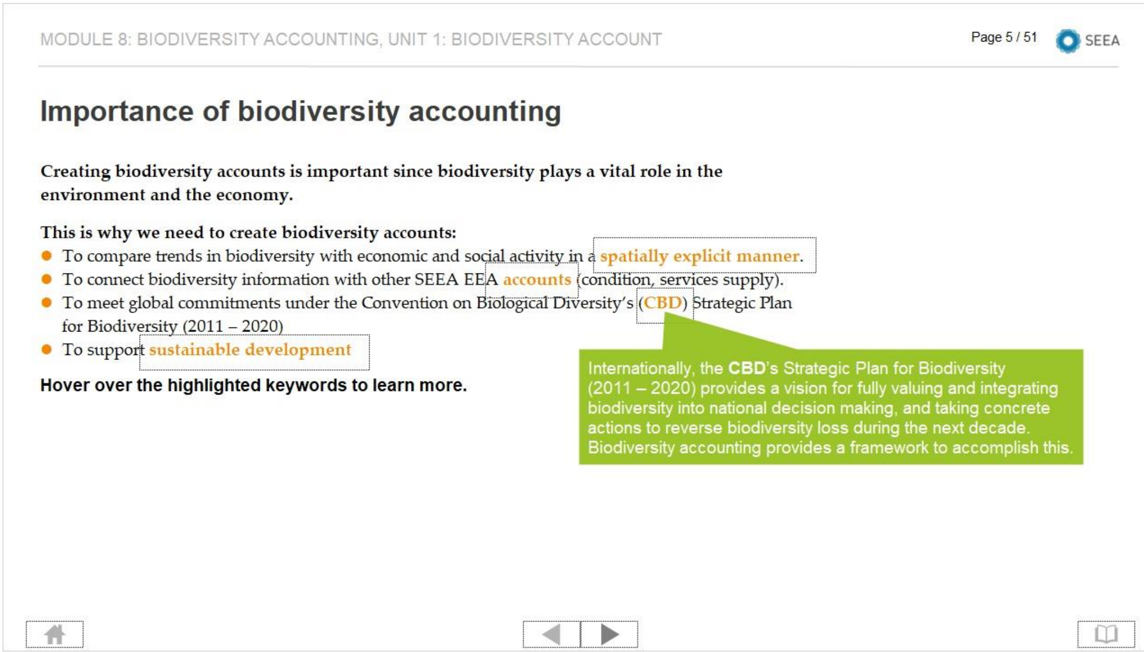

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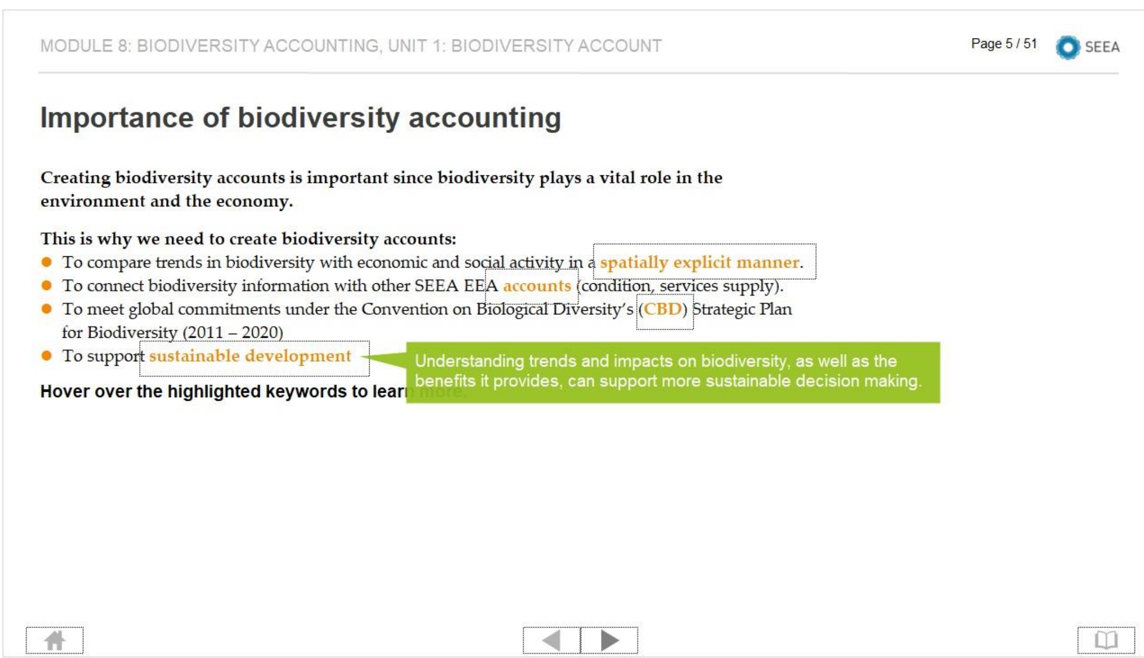
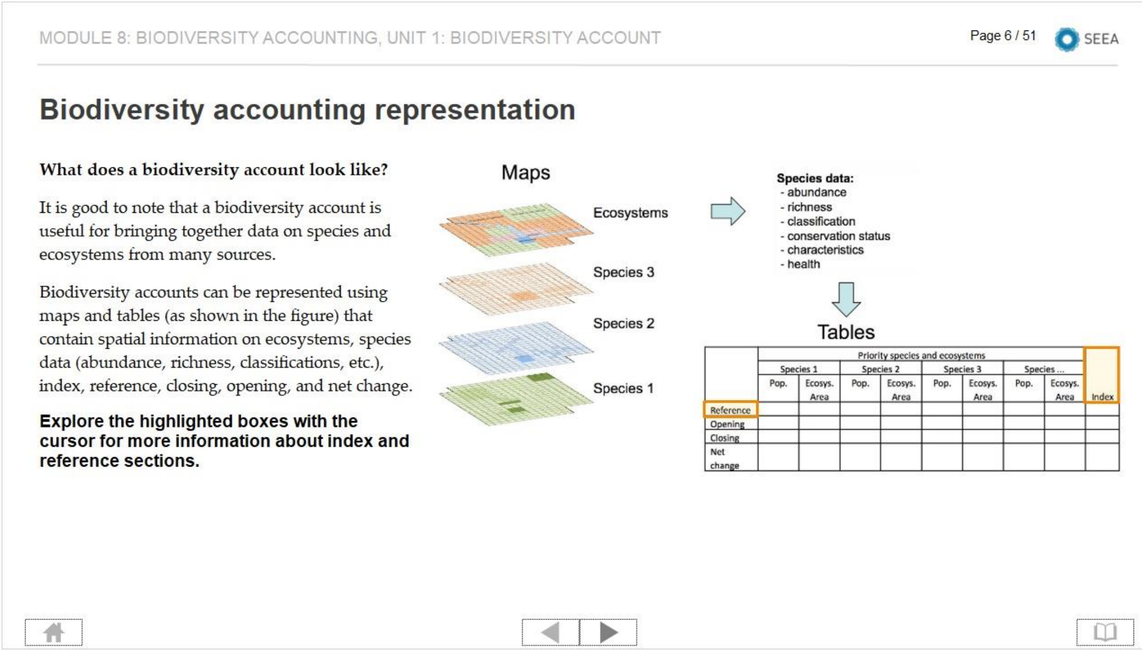


1.6 Biodiversity Accounting Representation



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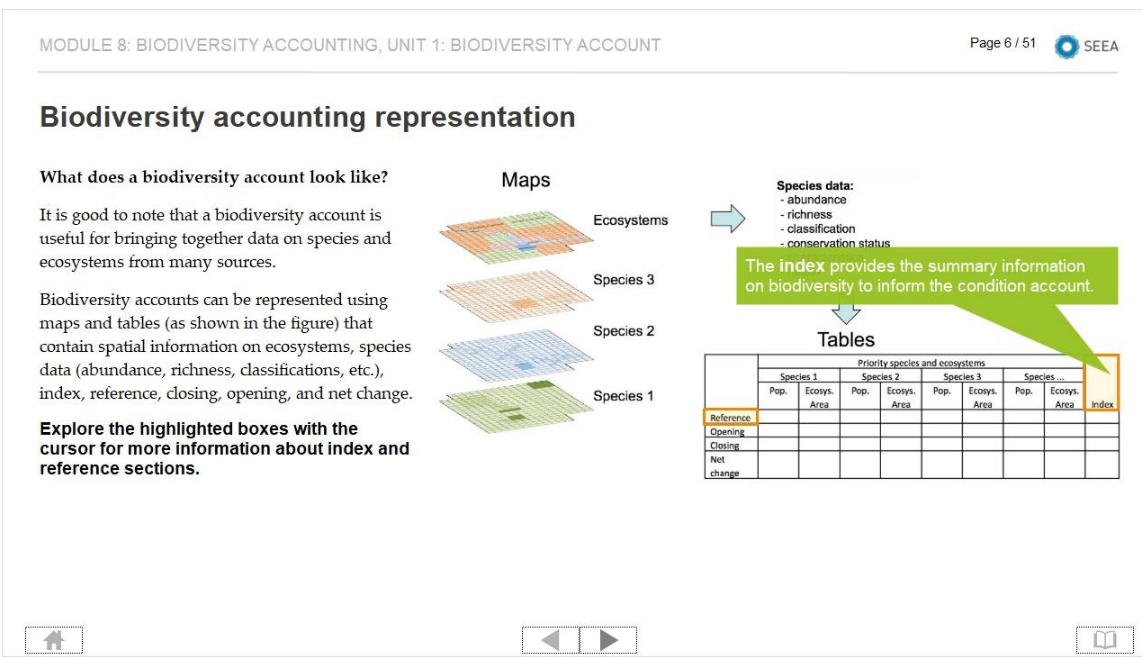


Explanation 2 (Slide Layer)

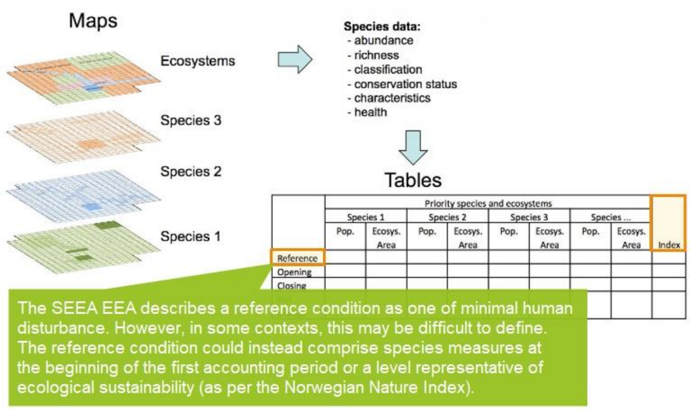
Biodiversity accounting representation

What does a biodiversity account look like?

It is good to note that a biodiversity account is useful for bringing together data on species and ecosystems from many sources.

Biodiversity accounts can be represented using maps and tables (as shown in the figure) that contain spatial information on ecosystems, species data (abundance, richness, classifications, etc.), index, reference, closing, opening, and net change.

Explore the highlighted boxes with the cursor for more information about index and reference sections.



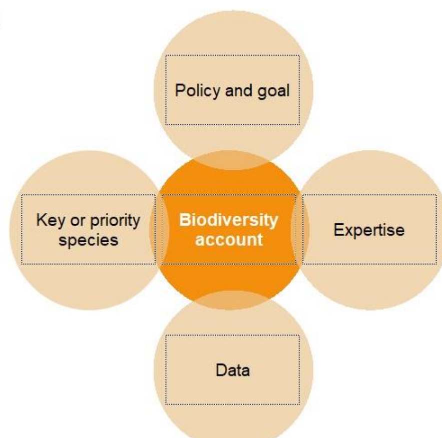
1.7 Biodiversity Account Data and Expertise Requirements

Biodiversity account data and expertise requirements

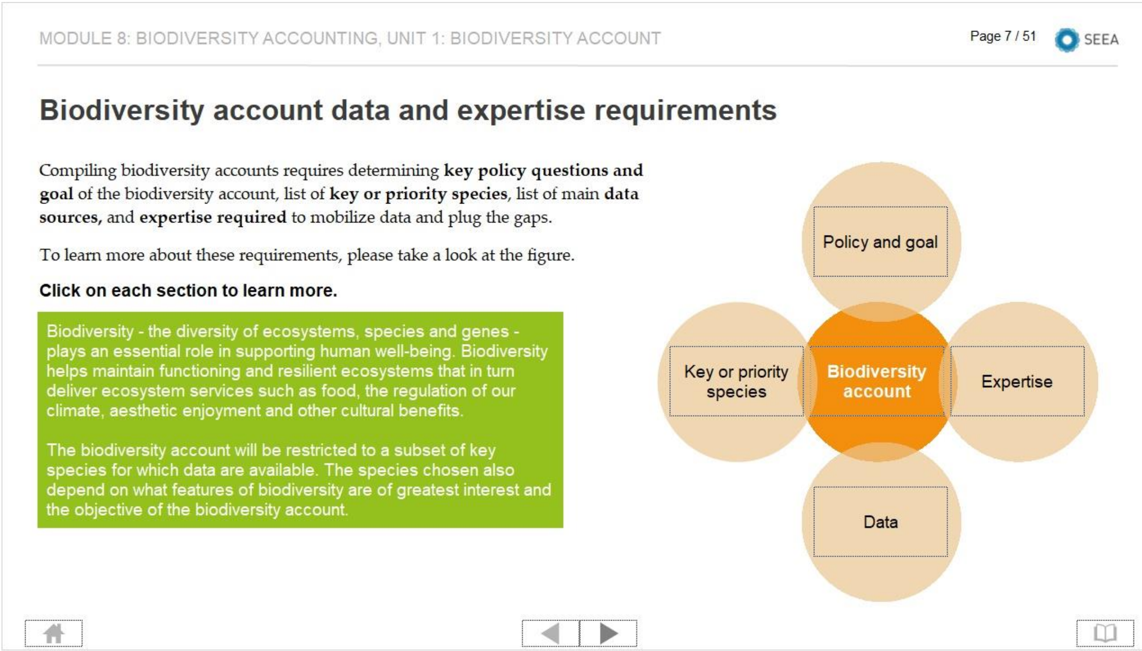
Compiling biodiversity accounts requires determining **key policy questions and goal** of the biodiversity account, list of **key or priority species**, list of main **data sources,** and **expertise required** to mobilize data and plug the gaps.

To learn more about these requirements, please take a look at the figure.

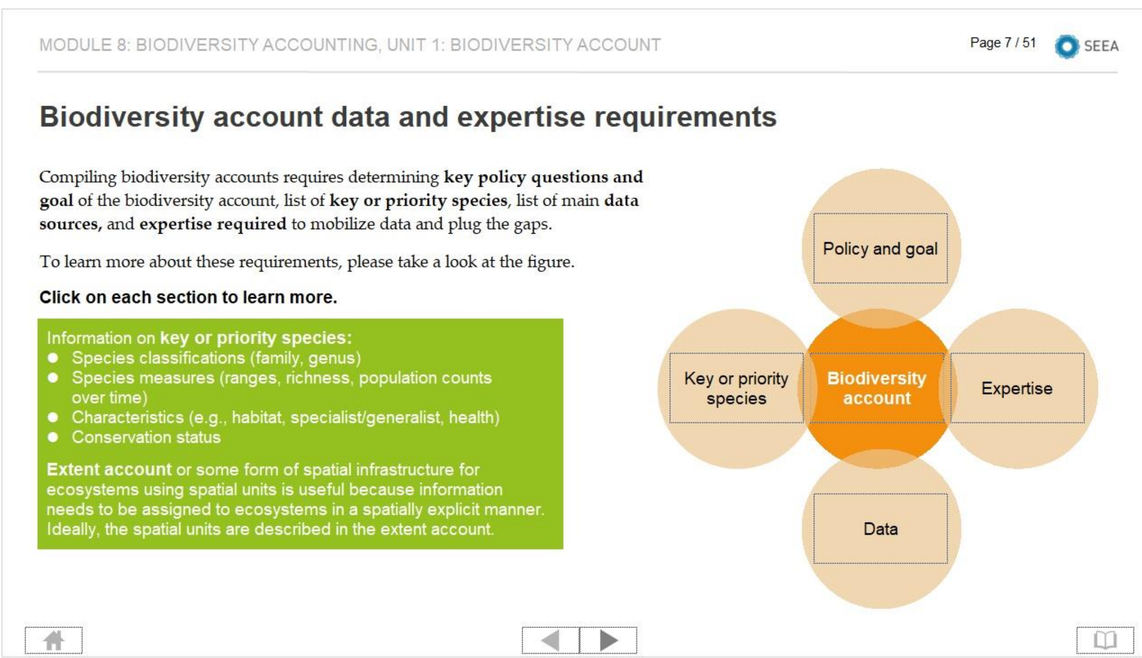
Click on each section to learn more.



Explanation 1 (Slide Layer)



Explanation 2 (Slide Layer)



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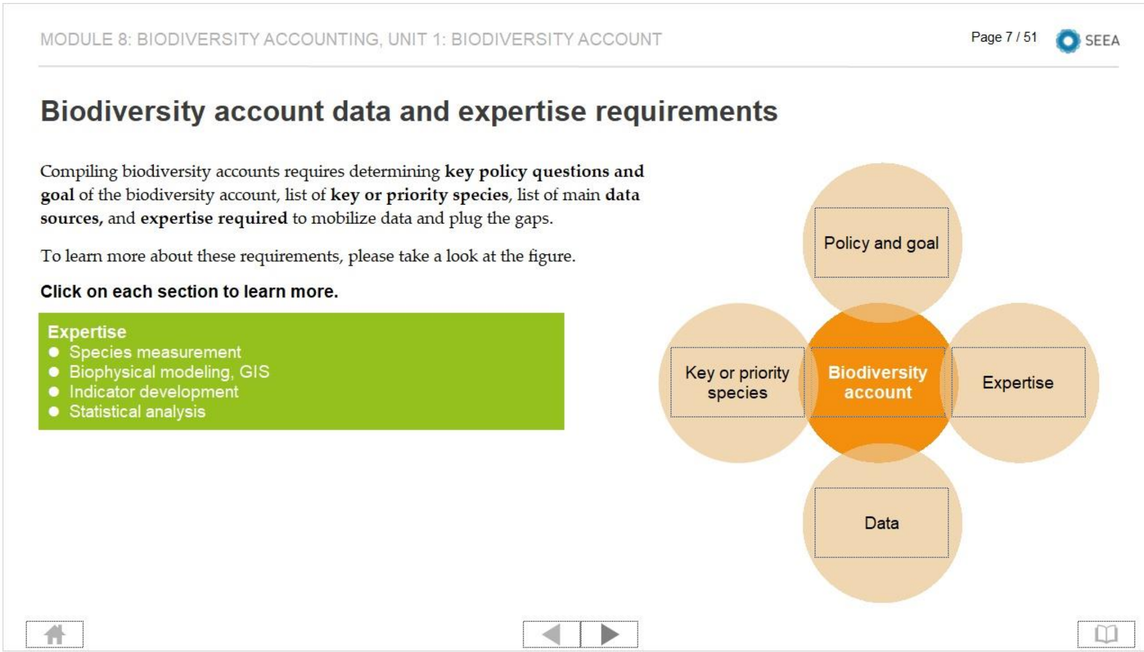

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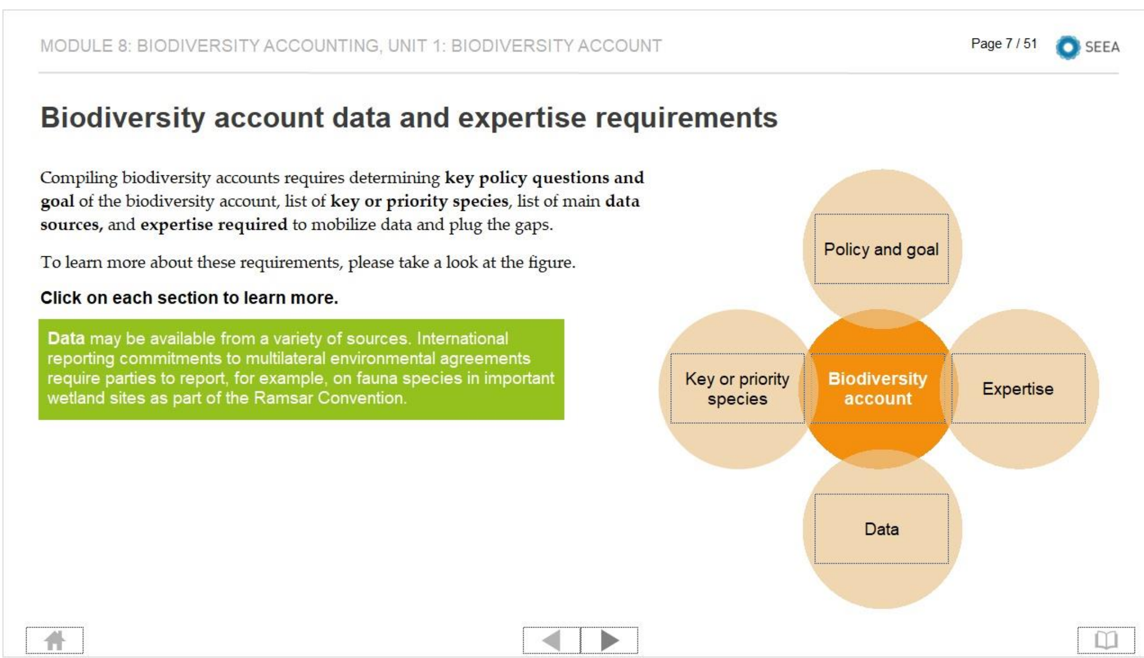

1.8 Module units

MODULE 8: BIODIVERSITY ACCOUNTING

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Module units

The biodiversity accounting module will take you through four units, as listed below. We recommend completing these units in order.

Unit 1: Biodiversity accounting

- What is it?
- Why do we need it?
- What does it look like?
- Expertise and data required.

Unit 2: Compilers

- Basic concepts for measuring biodiversity.
- Steps for compiling biodiversity accounts.

Unit 3: Data providers

- Concepts
- Biodiversity accounting information uses.
- Data options, examples and issues.

Unit 4: Review

- Quiz
- Summary

1.9 Unit 2

MODULE 8: BIODIVERSITY ACCOUNTING, UNIT 2: COMPILERS

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Unit 2: Compilers

In this unit, we will learn the basic concepts for measuring biodiversity and the basics for compiling biodiversity accounts.

Let's move on and start learning.

1.10 Biodiversity in the SEEA-EEA

MODULE 8: BIODIVERSITY ACCOUNTING, UNIT 2: COMPILERS

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Biodiversity in the SEEA-EEA

To get started with the concepts behind biodiversity, we quote the following statement from the Convention on Biological Diversity (**CBD**) - United Nations report issued in **1992,**

> "Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".

Quoted from: CBD – UN Report (1992)

Convention on Biological Diversity

www.cbd.int/

1.11 Biodiversity in the SEEA-EEA

MODULE 8: BIODIVERSITY ACCOUNTING, UNIT 2: COMPILERS

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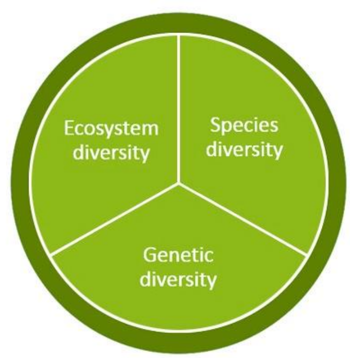
Biodiversity in the SEEA EEA

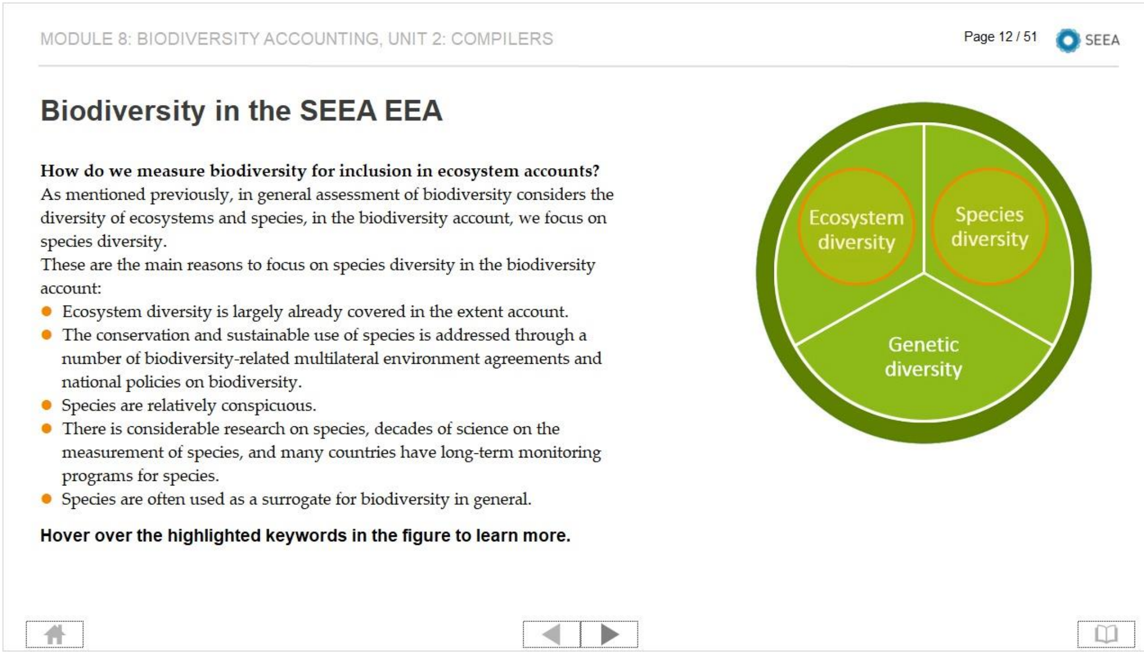
The three components in the SEEA EEA for biodiversity are as follows:

- **Ecosystem diversity,**
- **Species diversity, and**
- **Genetic diversity.**

The measurement of biodiversity is focused on the assessment of **diversity of species**, although changes in the **diversity of ecosystems** is also an important output, derived from the measurement of changes in ecosystem extent and condition. The **genetic diversity** could be captured, but is not given a specific consideration due to the complexity involved in measuring this aspect of biodiversity.



1.12 Biodiversity in the SEEA-EEA



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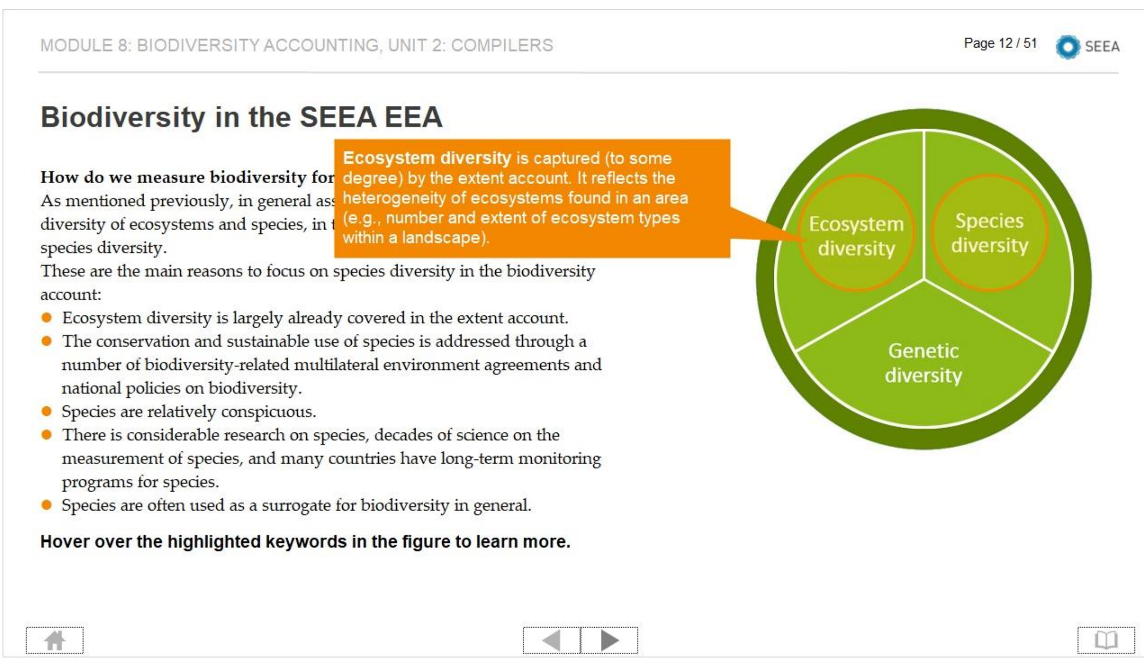

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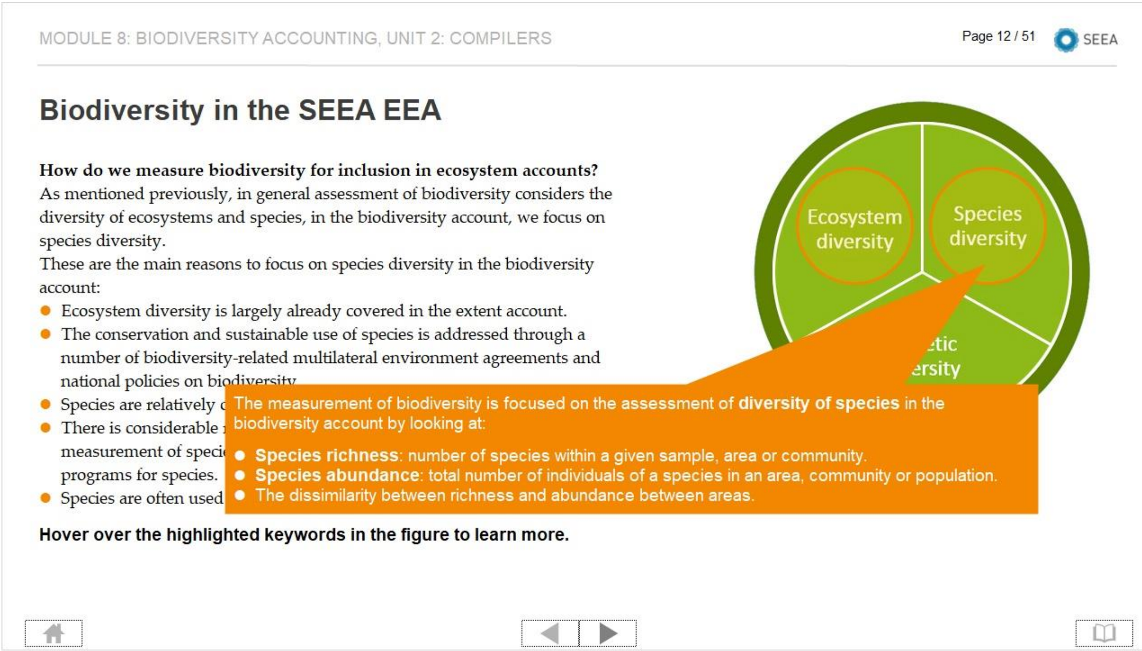
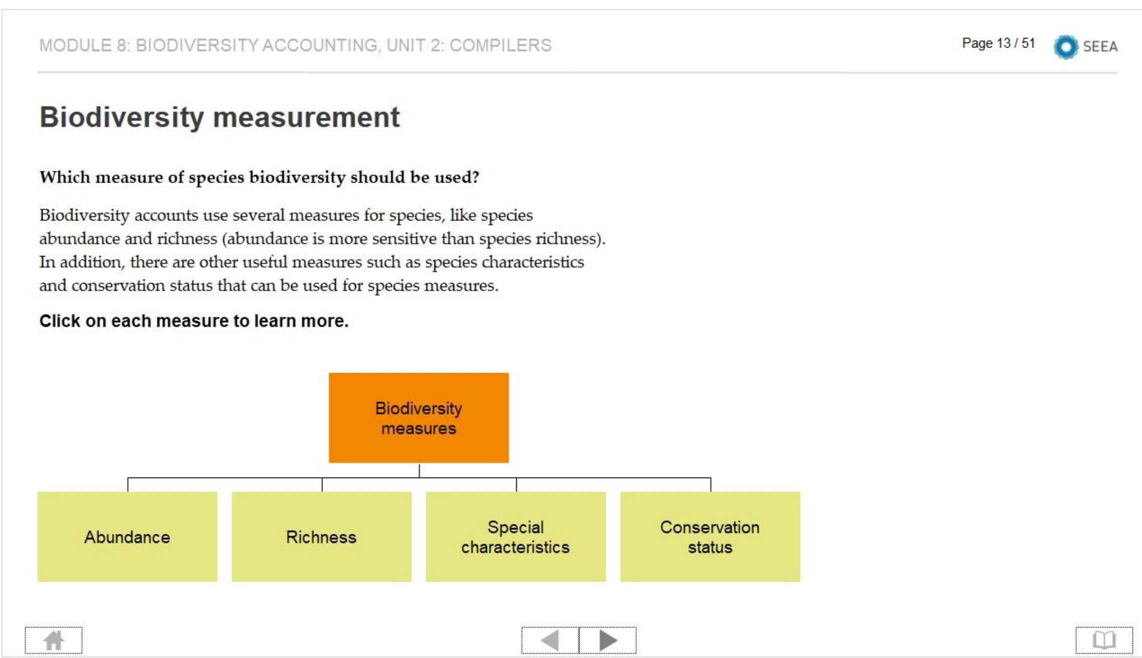


1.13 Biodiversity Measurements



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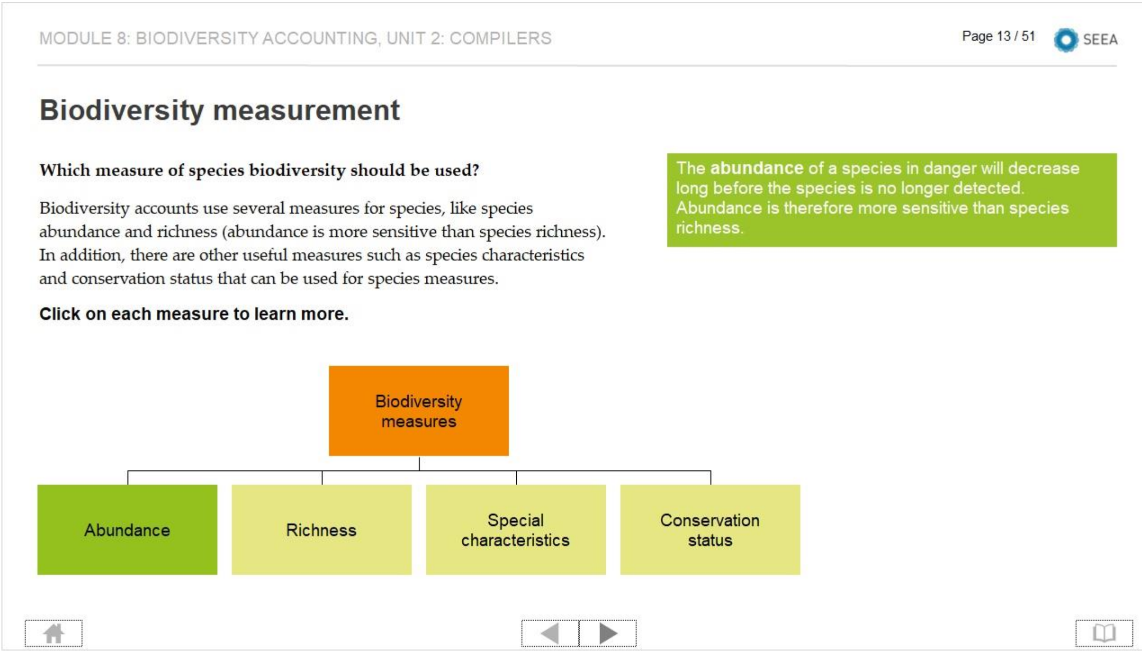

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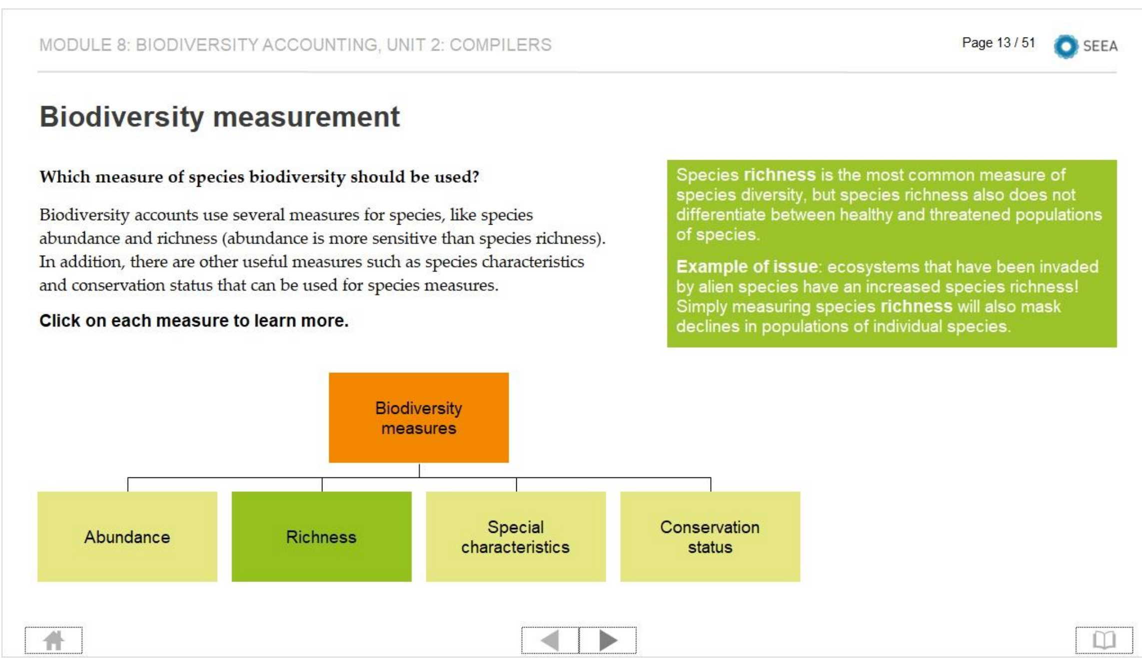

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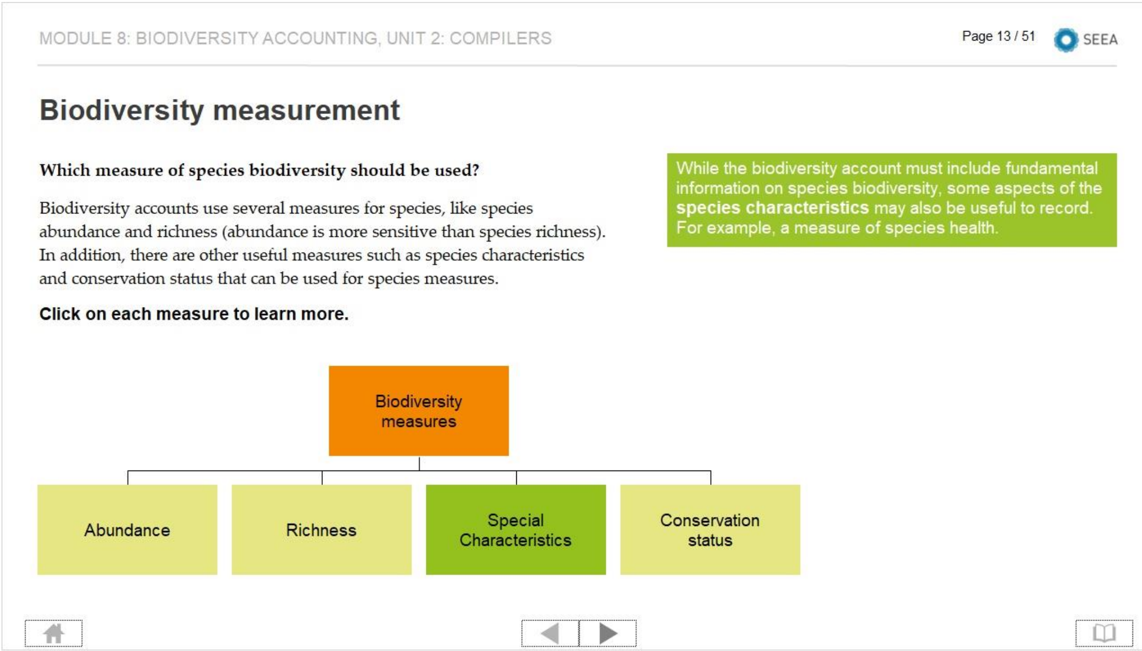

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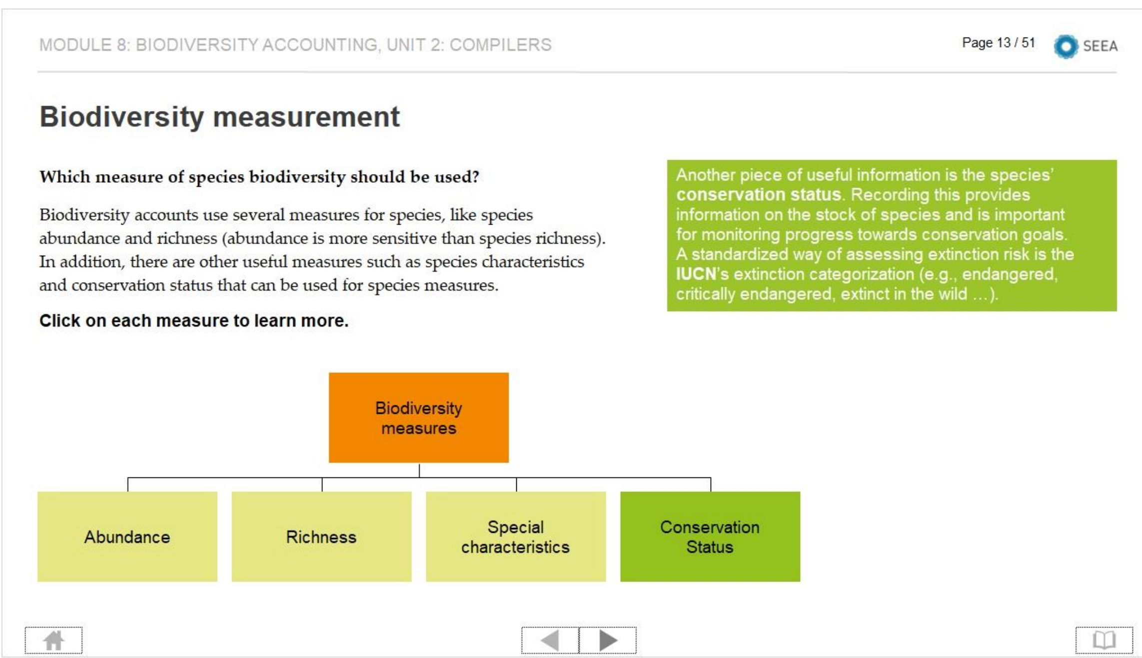
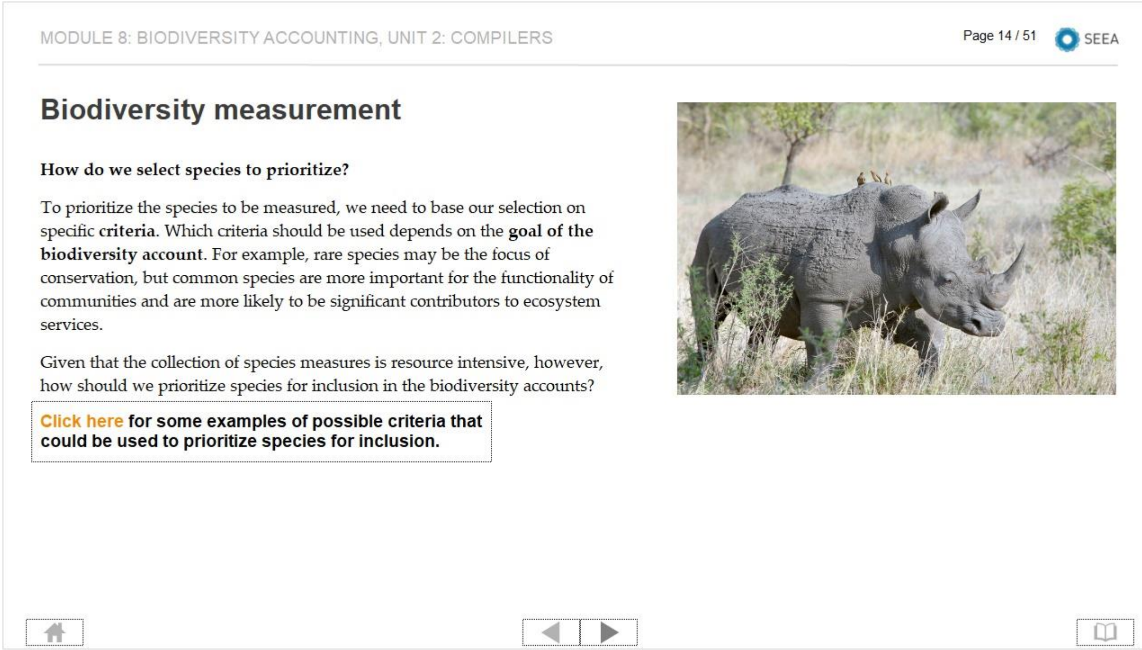


1.14 Biodiversity Measurements



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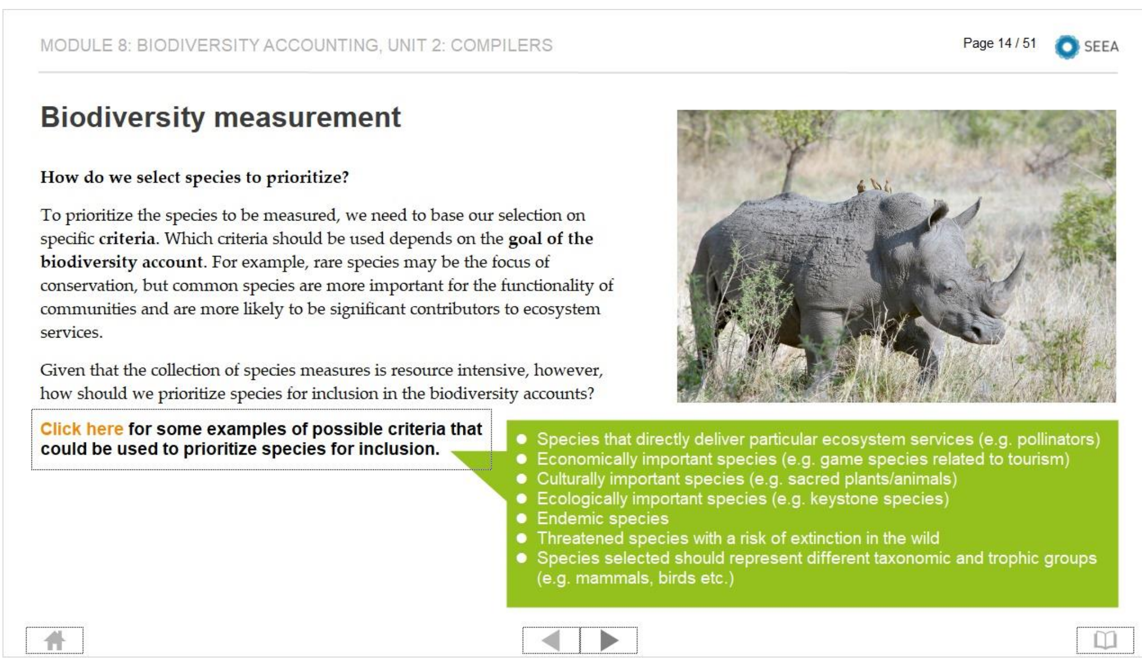
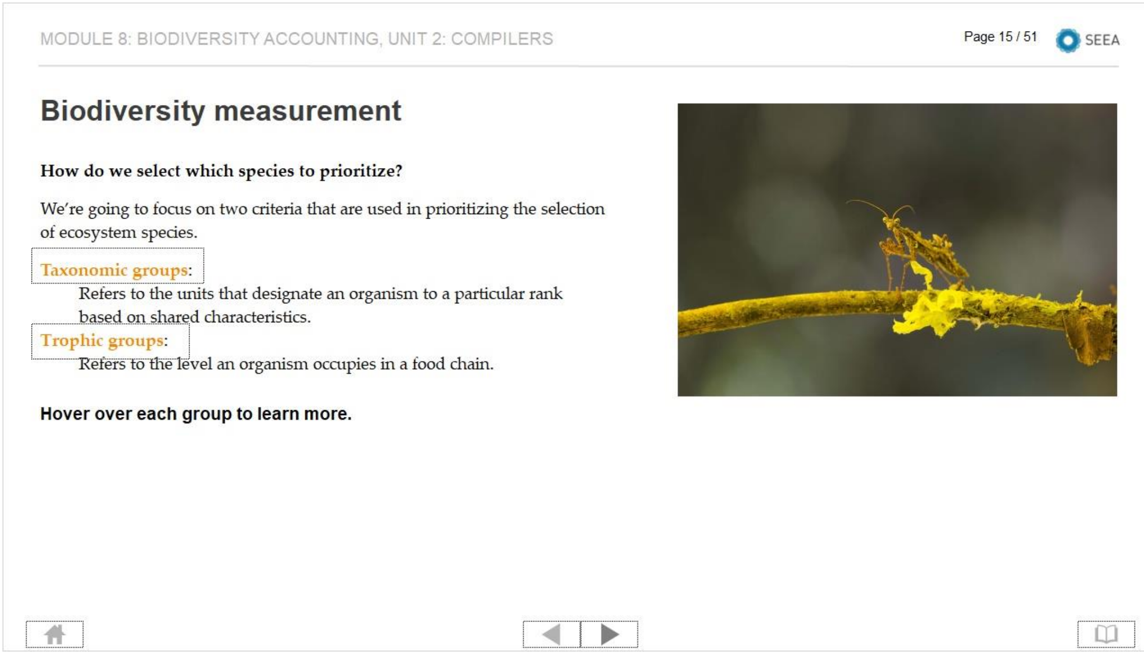


1.15 Biodiversity Measurements



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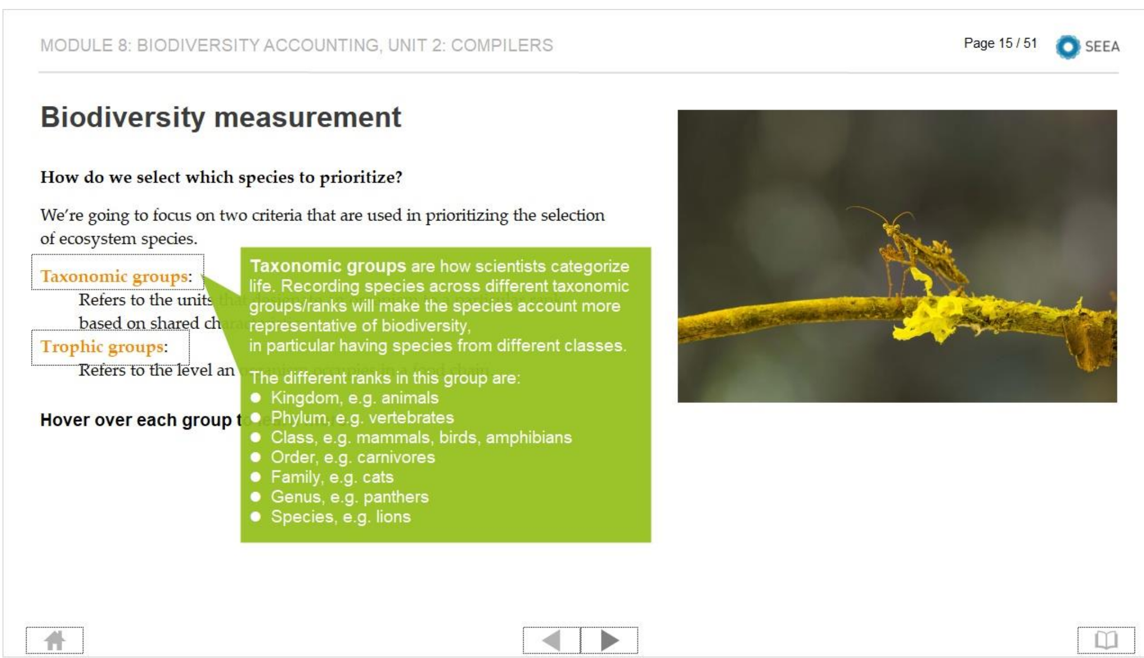

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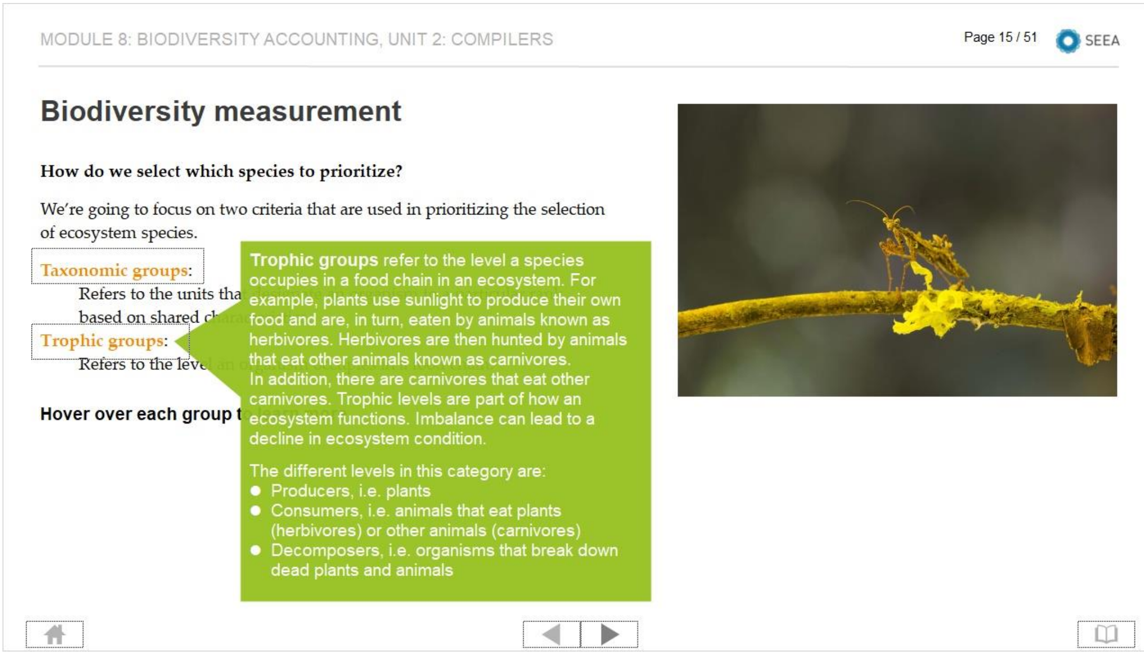
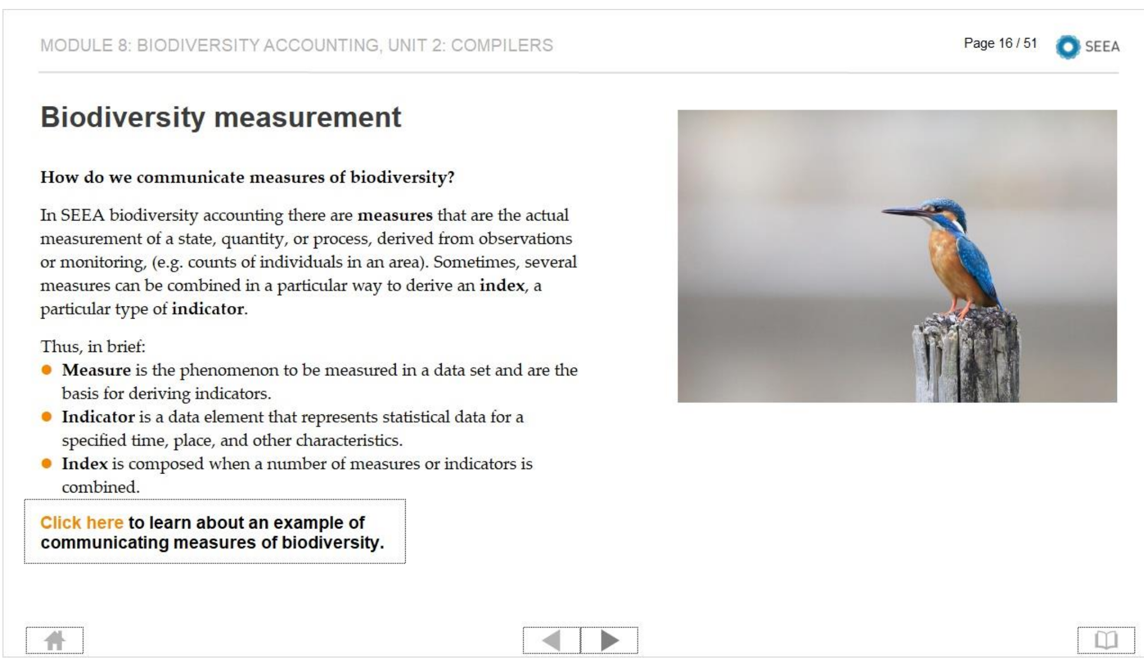


1.16 Biodiversity Measurements



Explanation 1 (Slide Layer)

Biodiversity measurement

How do we communicate measures of biodiversity?

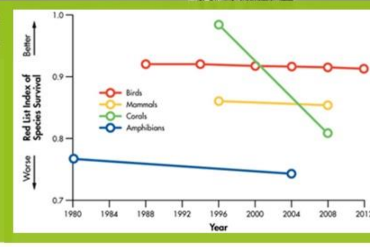
In SEEA biodiversity accounting there are **measures** that are the actual measurement of a state, quantity, or process, derived from observations or monitoring, (e.g. counts of individuals in an area). Sometimes, several measures can be combined in a particular way to derive an **index**, a particular type of **indicator**.

Thus, in brief:

- **Measure** is the phenomenon to be measured i
  basis for deriving indicators.
- **Indicator** is a data element that represents stat
  specified time, place, and other characteristics.
- **Index** is composed when a number of measur
  combined.

Click here to learn about an example of communicating measures of biodiversity.

For example, the Red List Index for birds shows changes in threat status over time, obtained through a specific formula. Indices, like those of the Red List, make up an important set of indicators due to their ability to communicate processes in a way that's easy to understand. They include some very popular social and ecological indicators, for example, the Human Development Index and Living Planet Index.



1.17 Biodiversity Measurements

Biodiversity measurement

How do we use data and information in biodiversity accounts?

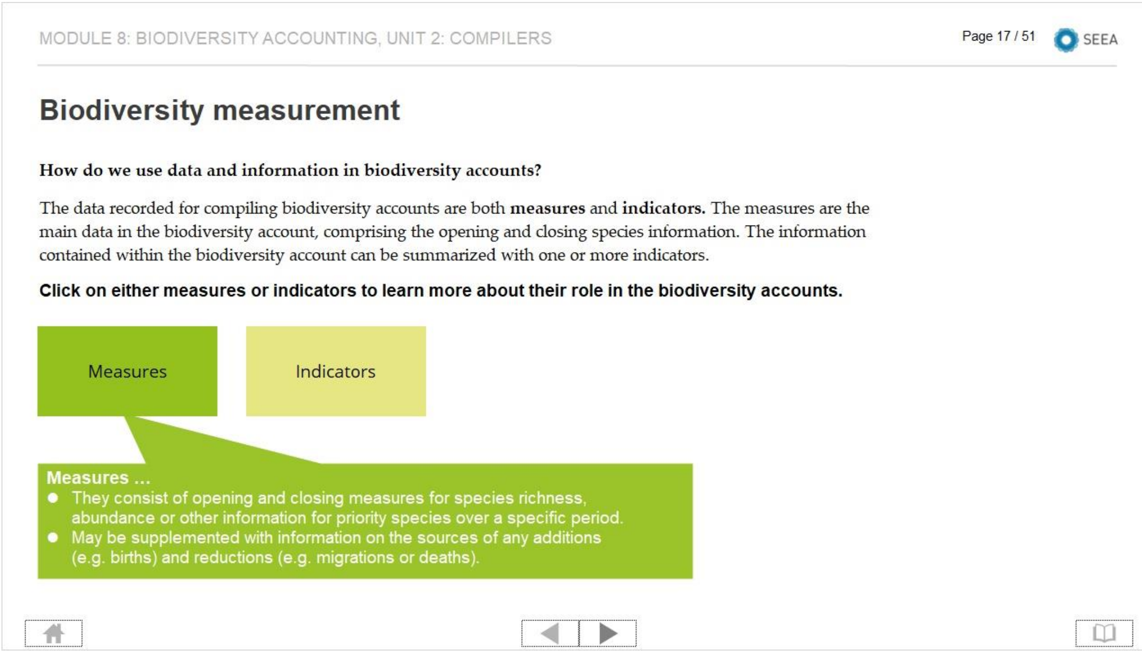
The data recorded for compiling biodiversity accounts are both **measures** and **indicators.** The measures are the main data in the biodiversity account, comprising the opening and closing species information. The information contained within the biodiversity account can be summarized with one or more indicators.

Click on either measures or indicators to learn more about their role in the biodiversity accounts.

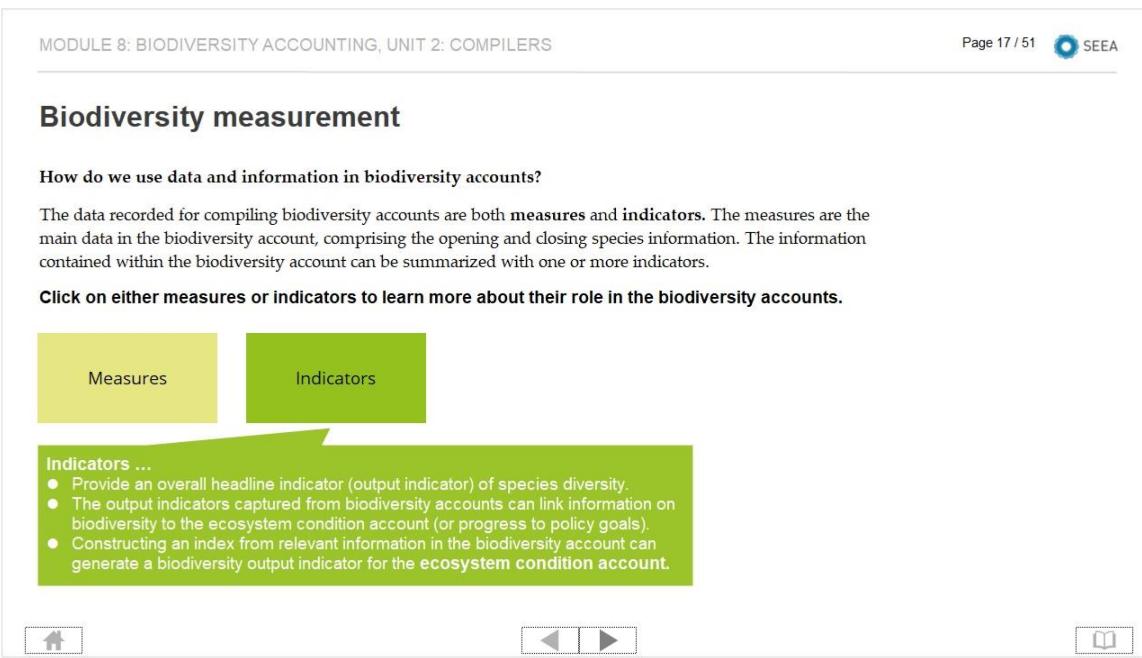
Measures

Indicators

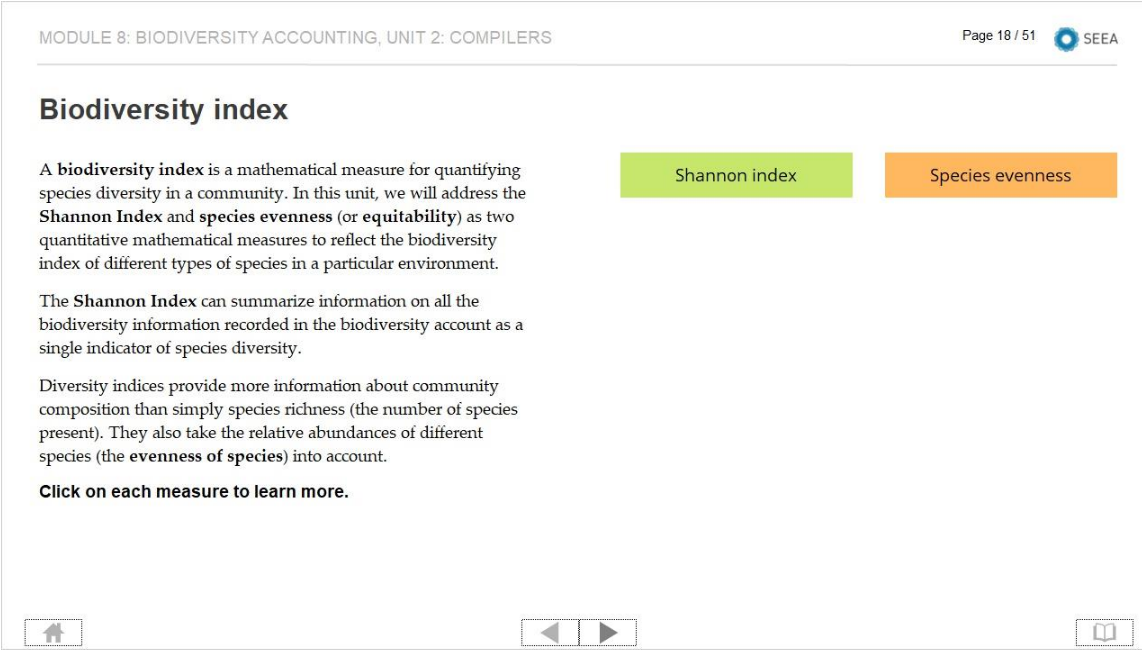
Explanation 1 (Slide Layer)



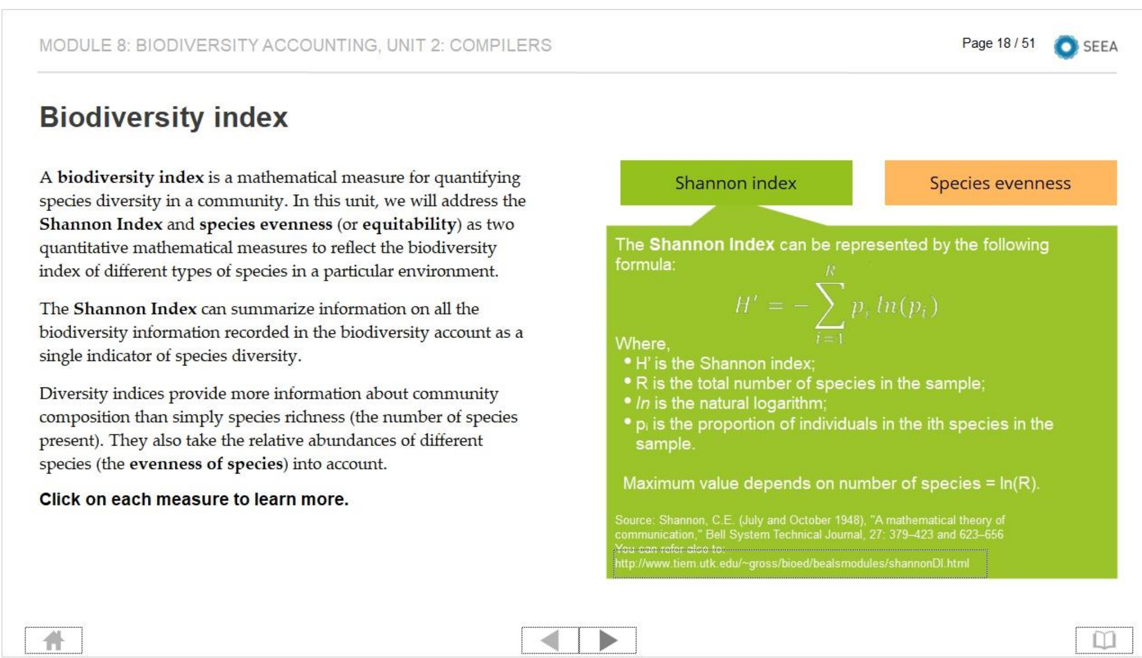
Explanation 2 (Slide Layer)



1.18 Biodiversity Index



Explanation 1 (Slide Layer)



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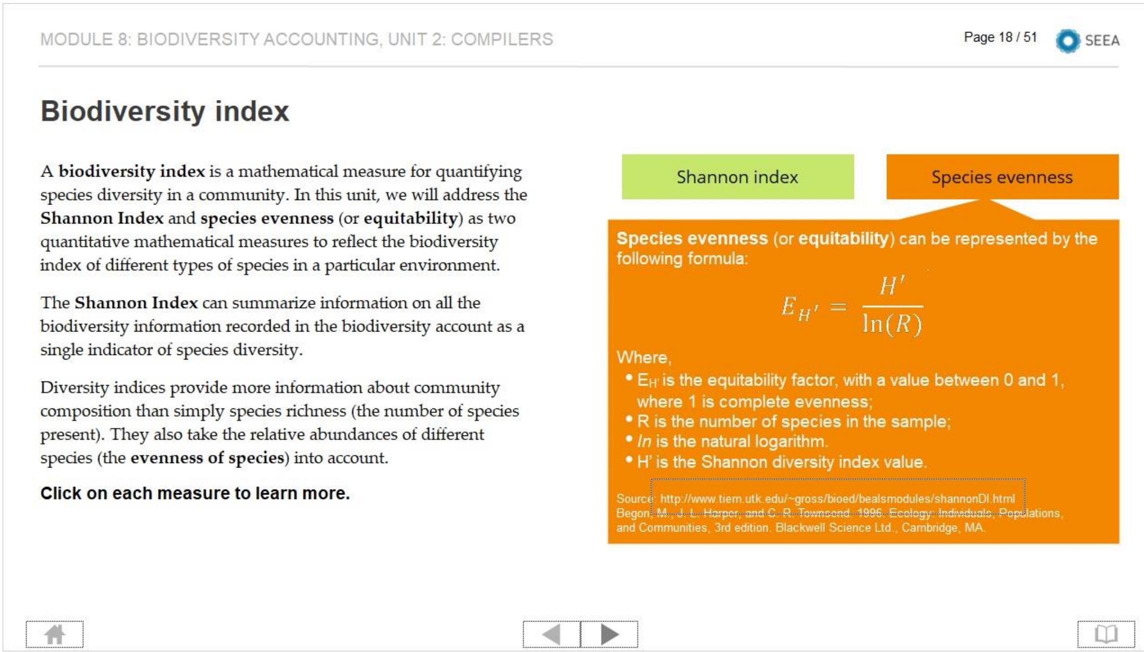
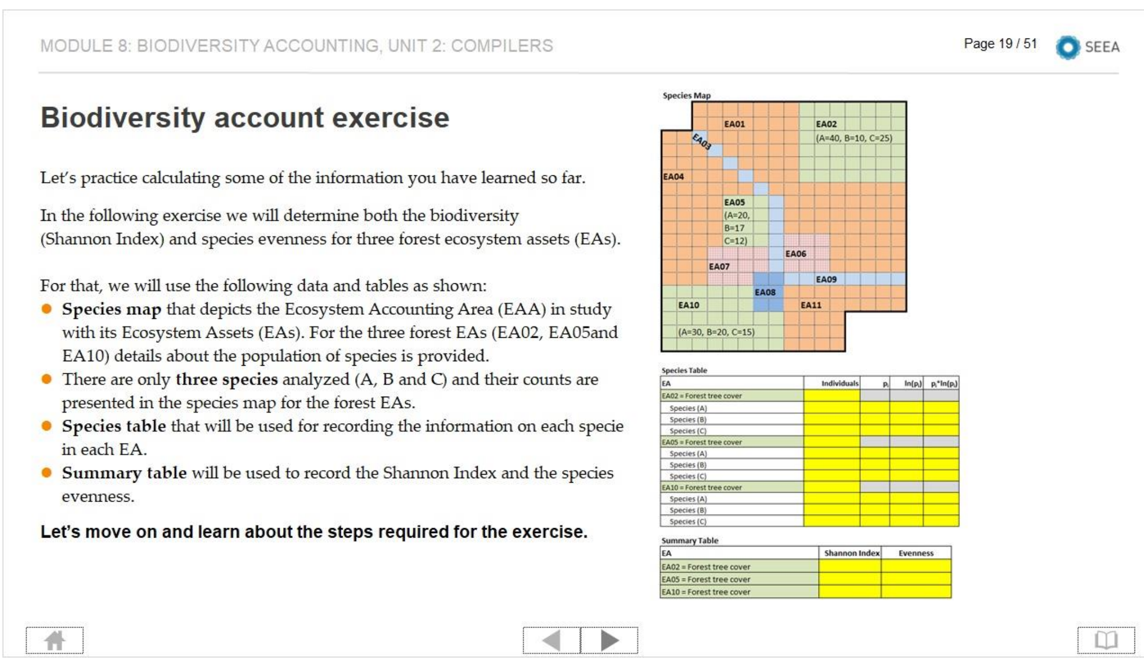
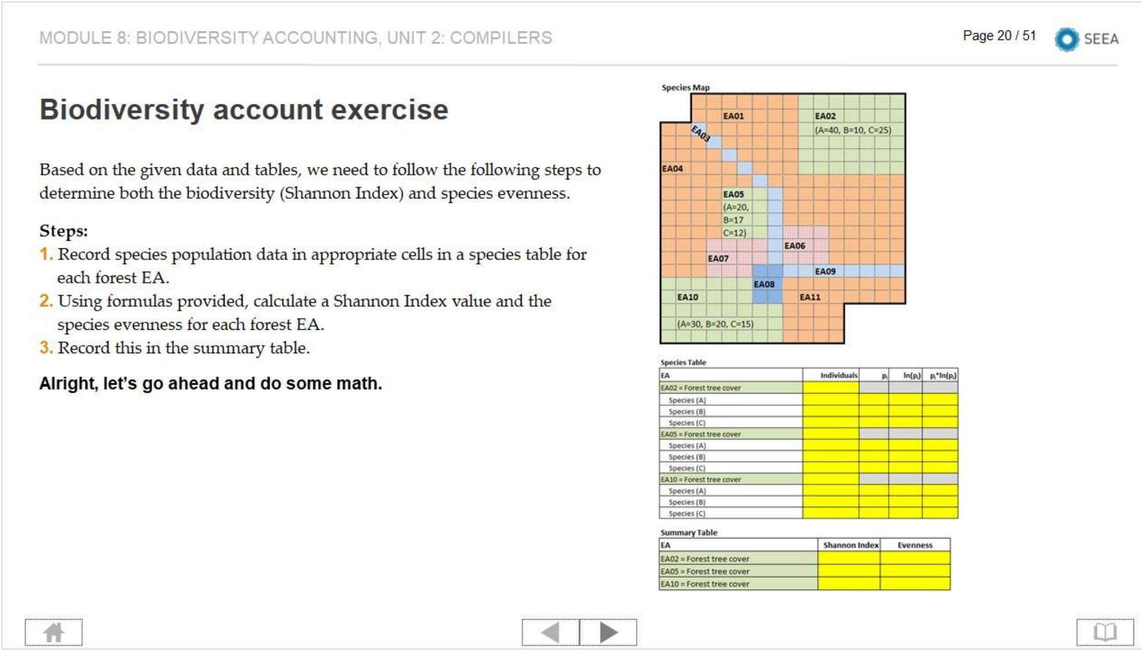


1.19 Biodiversity Account Exercise

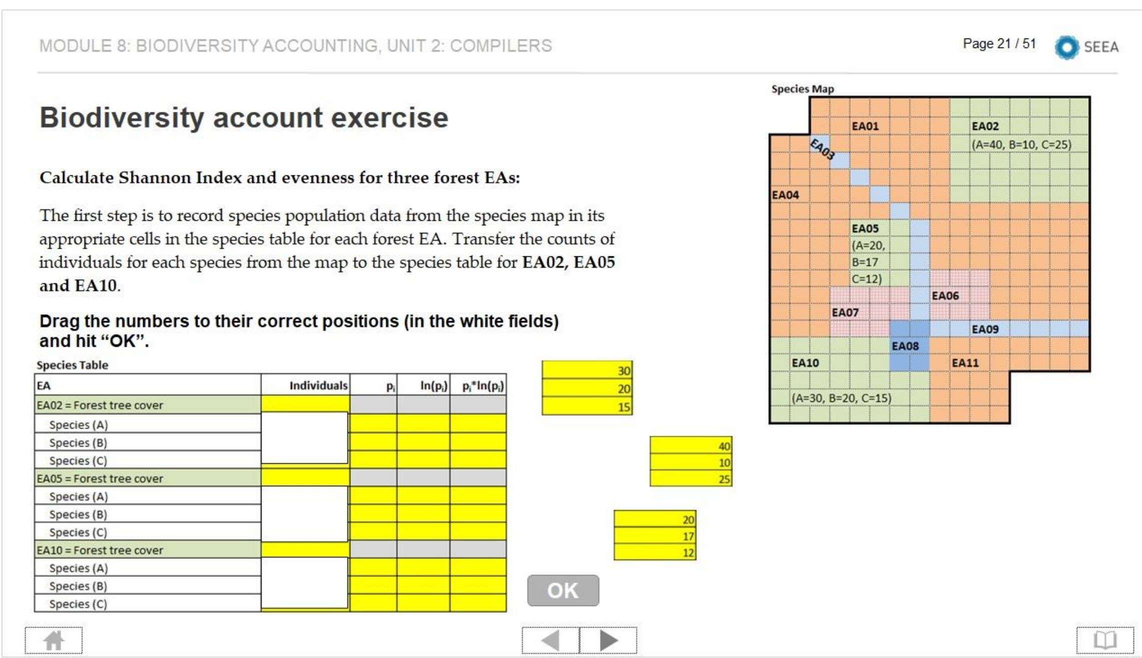


1.20 Biodiversity Account Exercise



1.21 Biodiversity Account Exercise

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



Drag Item	Drop Target
Picture 4	Rectangle 1
Picture 5	Rectangle 2
Picture 6	Rectangle 3

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

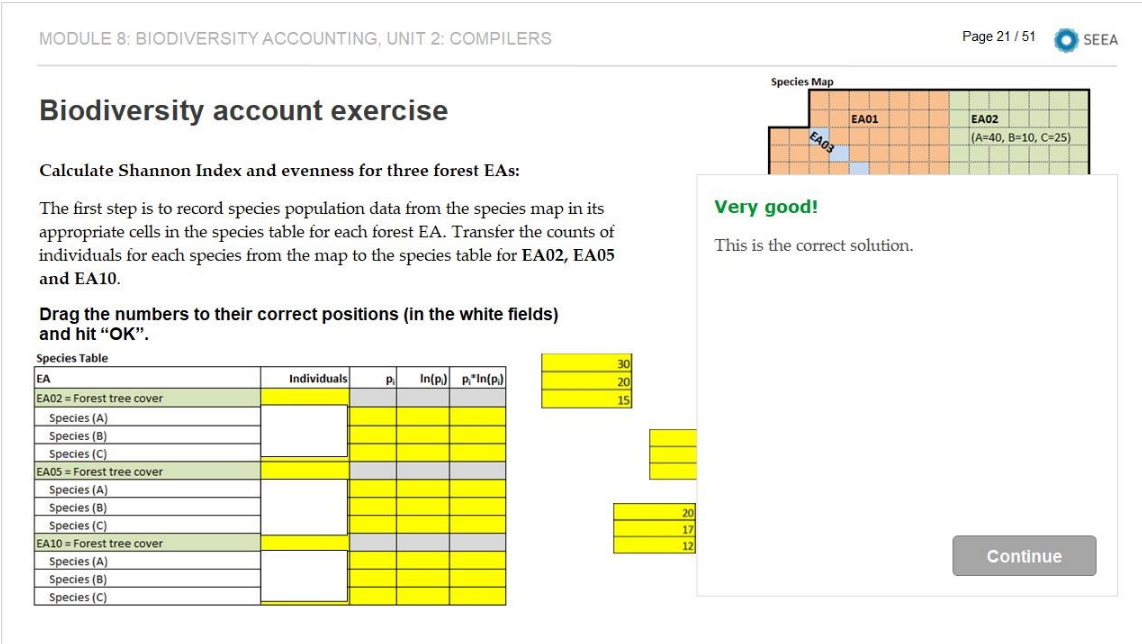
Feedback when correct:

This is the correct solution.

Feedback when incorrect:

Take a look at the solution.

Very good! (Slide Layer)



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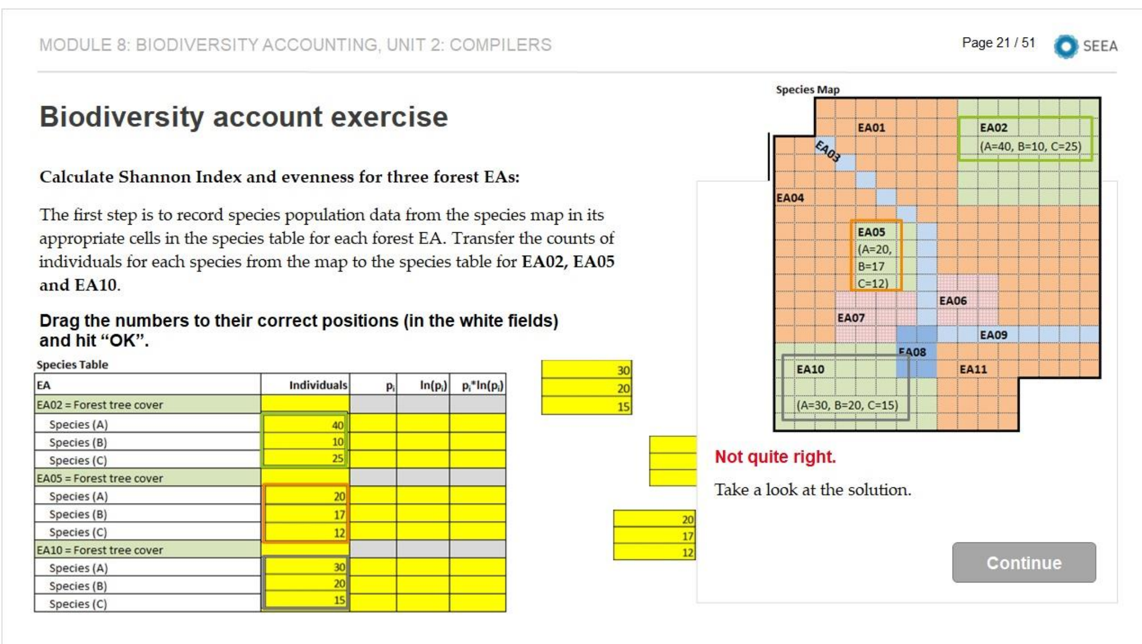
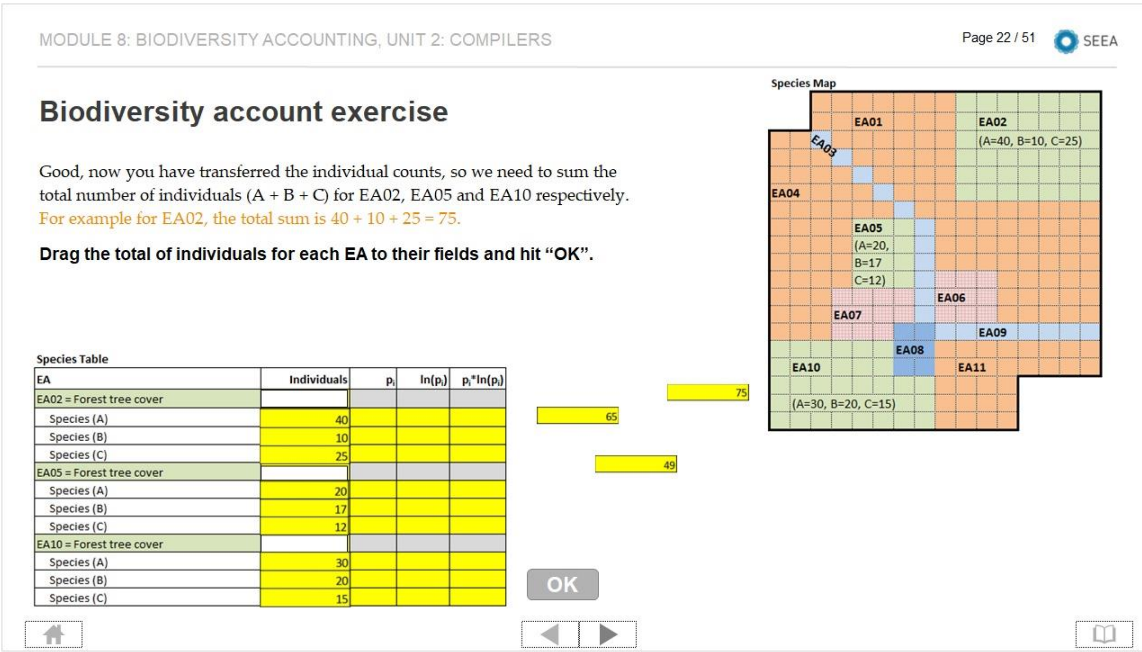


1.22 Biodiversity Account Exercise

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



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Picture 4	Rectangle 1
Picture 5	Rectangle 2
Picture 6	Rectangle 3

Drag and drop properties
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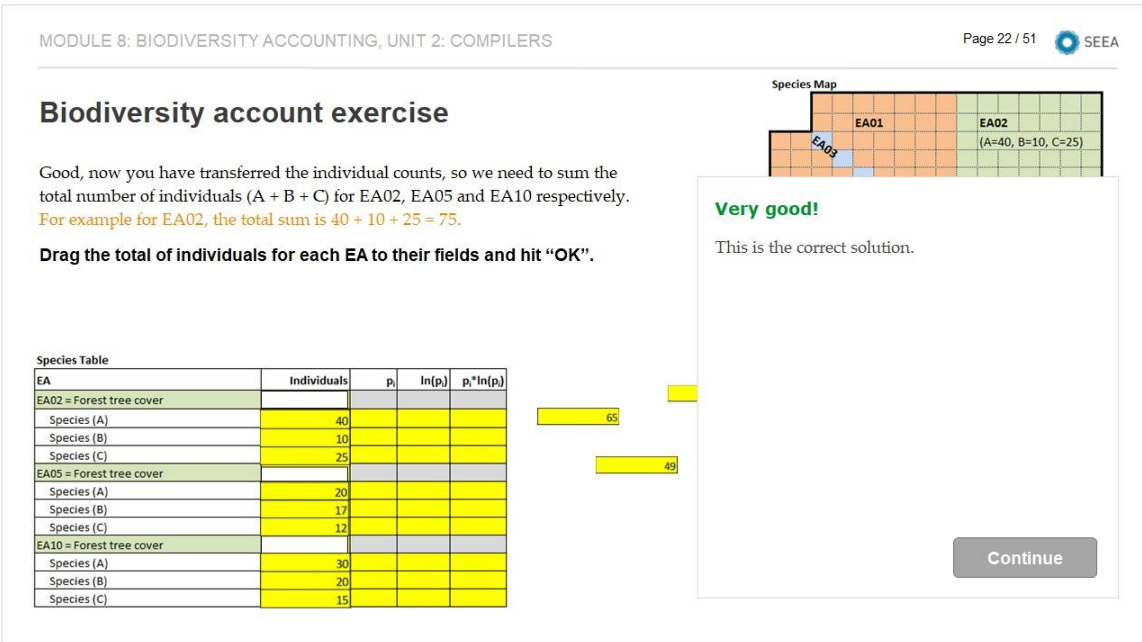
Very good! (Slide Layer)



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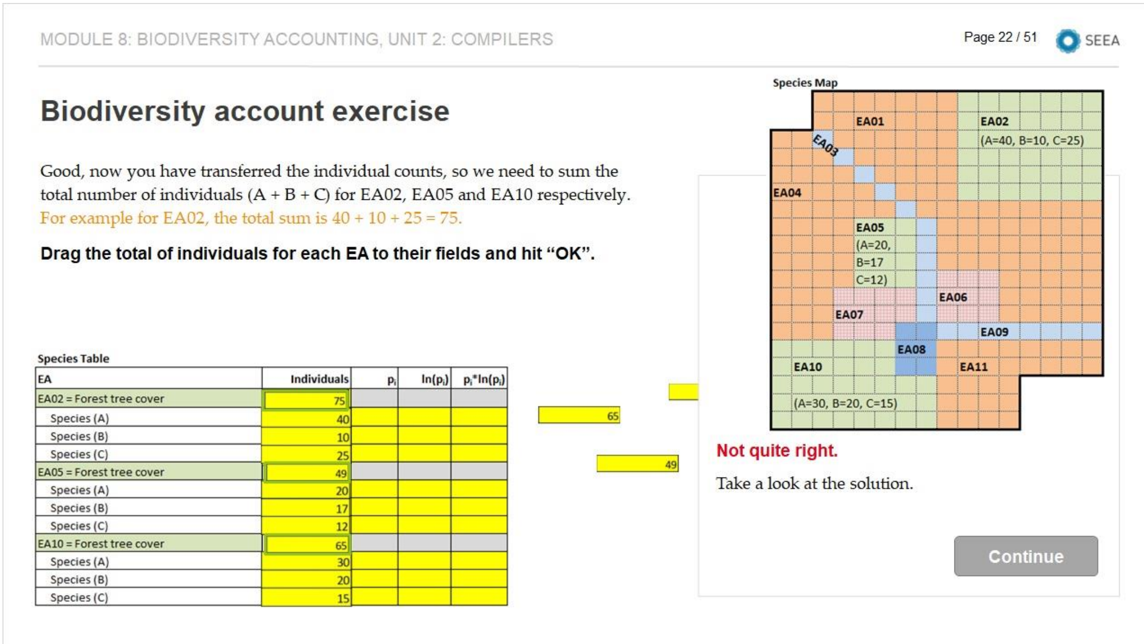
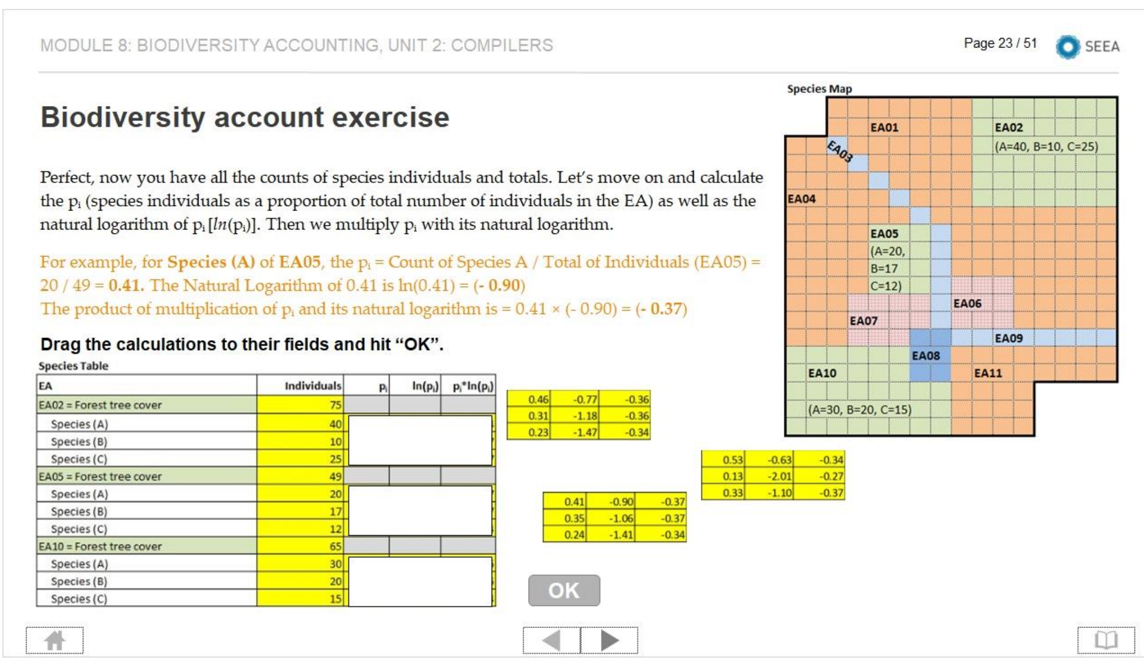


1.23 Biodiversity Account Exercise

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



Drag Item	Drop Target
Picture 4	Rectangle 1
Picture 5	Rectangle 2
Picture 6	Rectangle 3

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

Feedback when correct:

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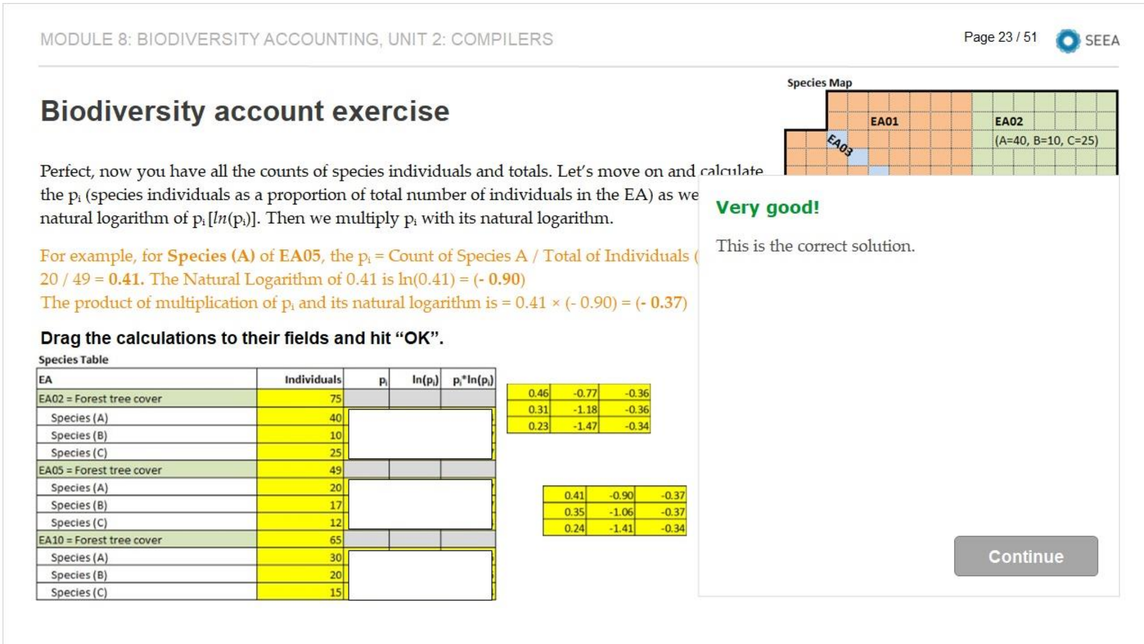
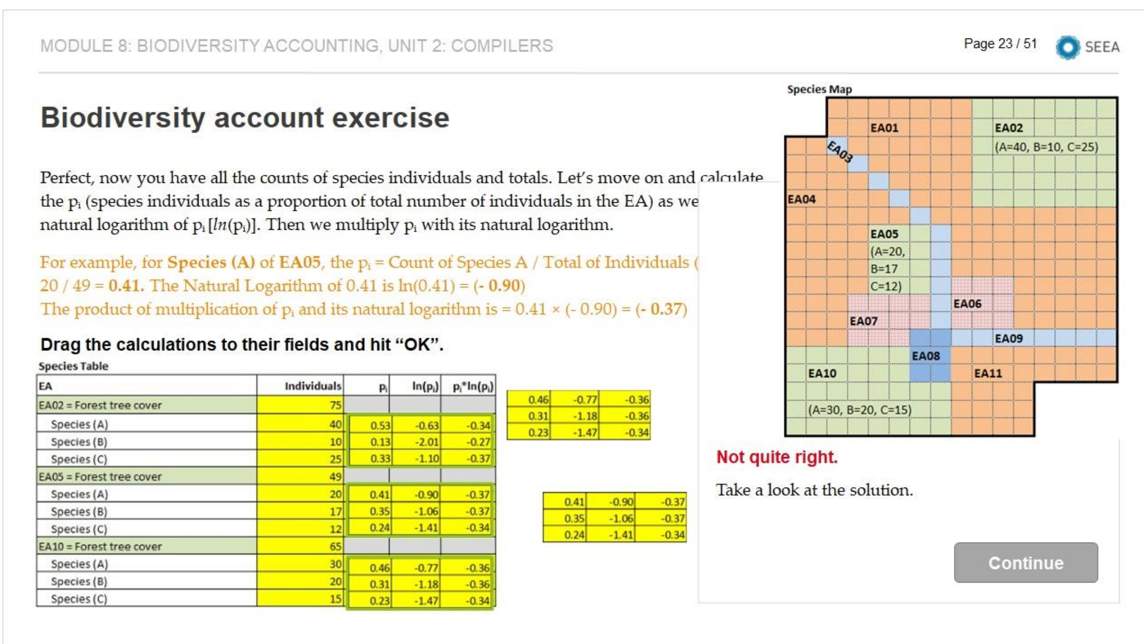
Feedback when incorrect:

Take a look at the solution.

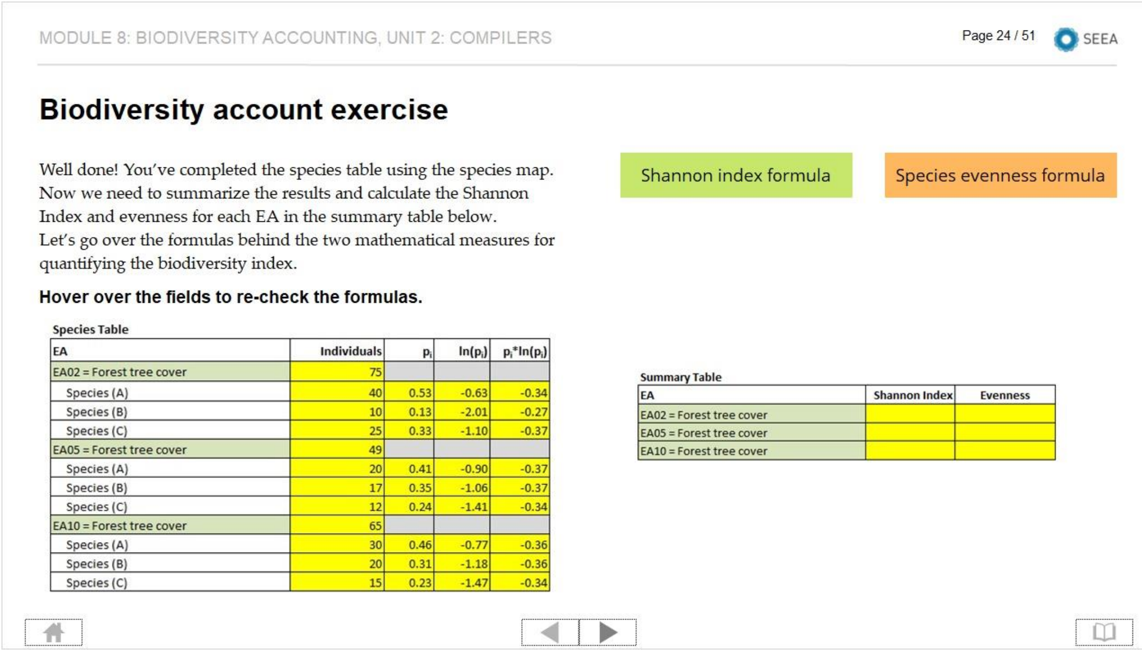
Very good! (Slide Layer)



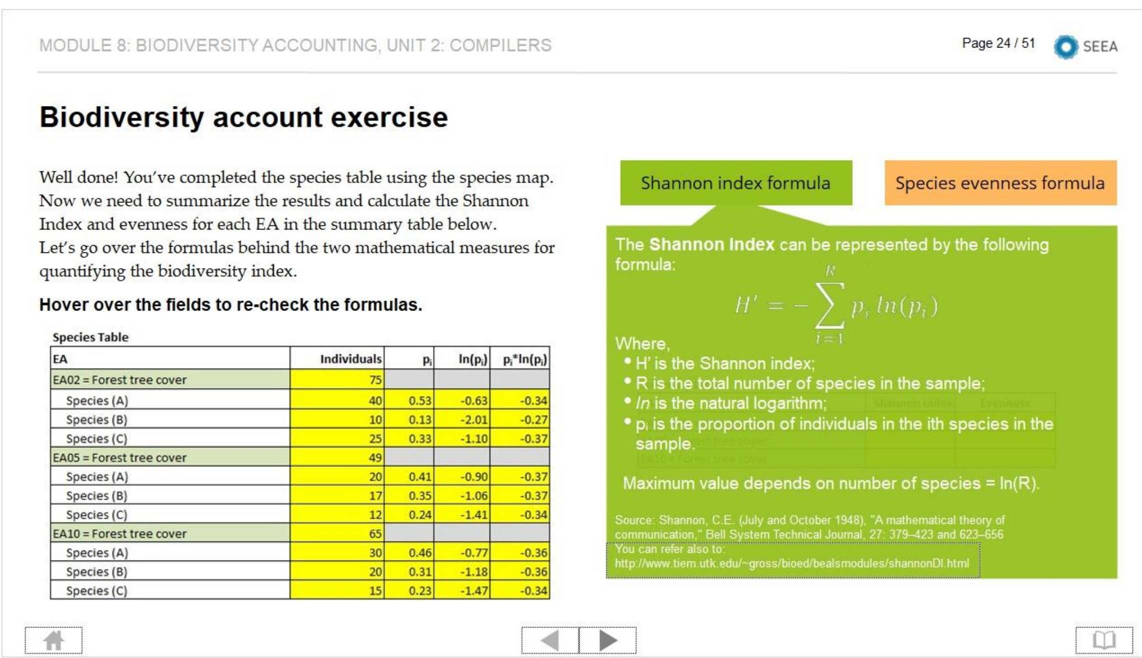
Not quite right. (Slide Layer)



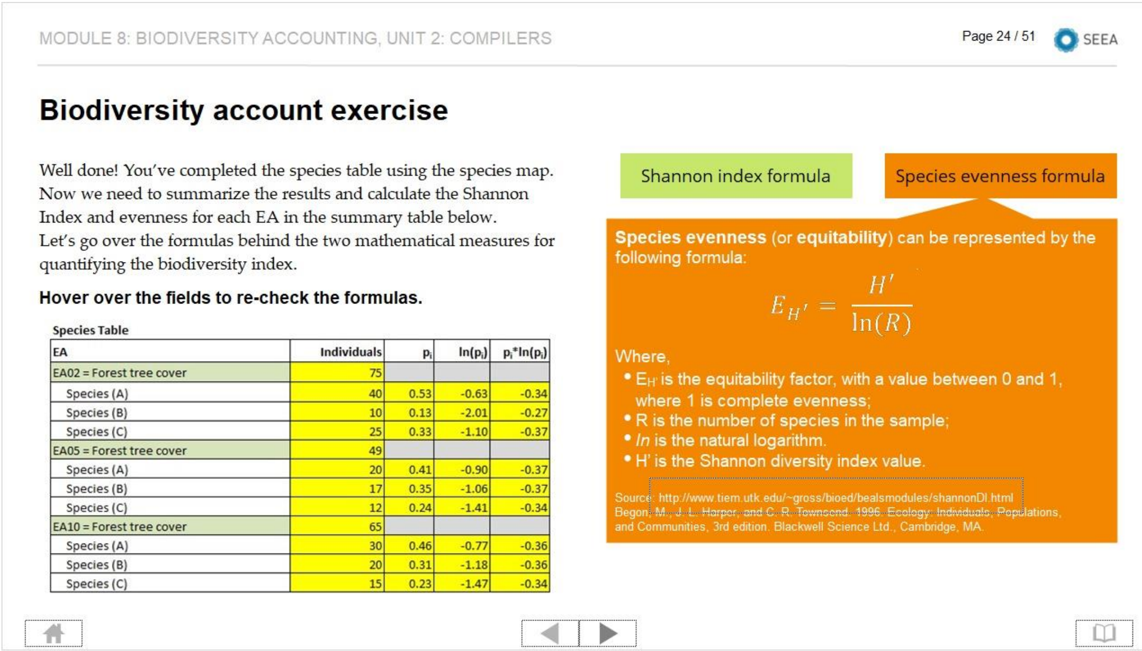
1.24 Biodiversity Index



Explanation 1 (Slide Layer)

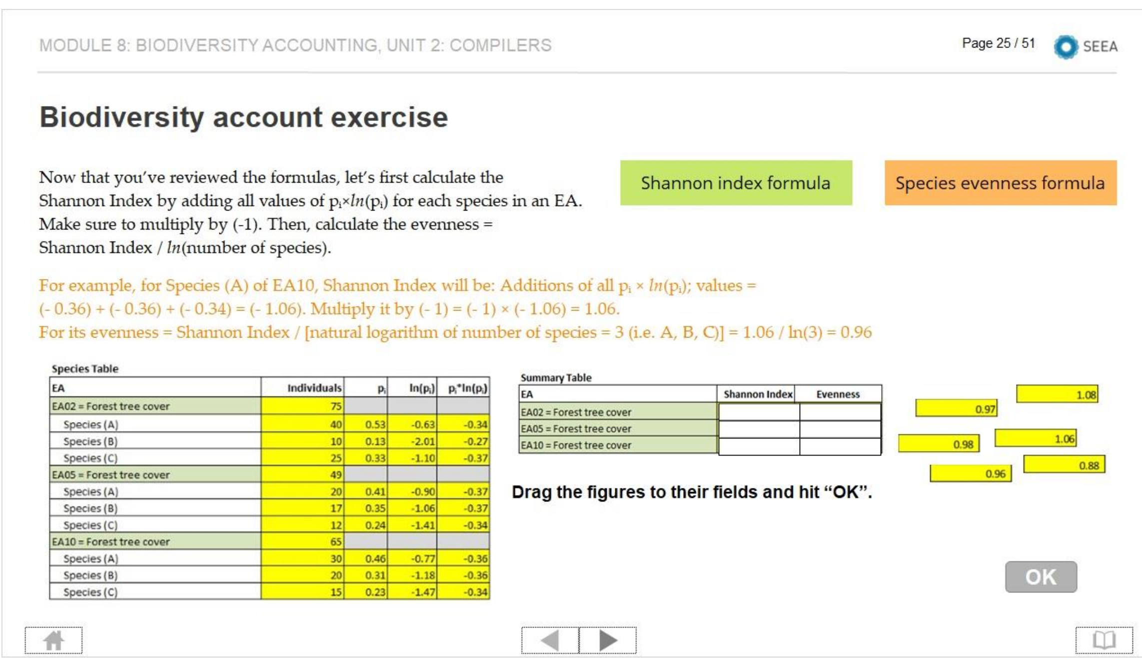


Explanation 2 (Slide Layer)



1.25 Biodiversity Account Exercise

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



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Picture 4	Rectangle 2
Picture 5	Rectangle 3
Picture 8	Rechteck 4
Picture 10	Rechteck 5
Picture 9	Rechteck 6

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

Feedback when correct:

This is the correct solution.

Feedback when incorrect:

Take a look at the solution.

Very good! (Slide Layer)

Biodiversity account exercise

Now that you've reviewed the formulas, let's first calculate the Shannon Index by adding all values of $p_i \times ln(p_i)$ for each species in an EA. Make sure to multiply by (-1). Then, calculate the evenness = Shannon Index / ln(number of species).

For example, for Species (A) of EA10, Shannon Index will be: Additions of all $p_i \times ln(p_i)$; (- 0.36) + (- 0.36) + (- 0.34) = (- 1.06). Multiply it by (- 1) = (- 1) × (- 1.06) = 1.06.
For its evenness = Shannon Index / [natural logarithm of number of species = 3 (i.e. A, B,

Species Table

EA	Individuals	p_i	$ln(p_i)$	$p_i*ln(p_i)$
EA02 = Forest tree cover	75			
Species (A)	40	0.53	-0.63	-0.34
Species (B)	10	0.13	-2.01	-0.27
Species (C)	25	0.33	-1.10	-0.37
EA05 = Forest tree cover	49			
Species (A)	20	0.41	-0.90	-0.37
Species (B)	17	0.35	-1.06	-0.37
Species (C)	12	0.24	-1.41	-0.34
EA10 = Forest tree cover	65			
Species (A)	30	0.46	-0.77	-0.36
Species (B)	20	0.31	-1.18	-0.36
Species (C)	15	0.23	-1.47	-0.34

Summary Table

EA	Shannon Index	Evenness
EA02 = Forest tree cover	0.97	0.88
EA05 = Forest tree cover	1.08	0.98
EA10 = Forest tree cover	1.06	0.96

Very good!

This is the correct solution.

Continue

Not quite right. (Slide Layer)

MODULE 8: BIODIVERSITY ACCOUNTING, UNIT 2: COMPILERS

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Biodiversity account exercise

Now that you've reviewed the formulas, let's first calculate the Shannon Index by adding all values of $p_i \times ln(p_i)$ for each species in an EA. Make sure to multiply by (-1). Then, calculate the evenness = Shannon Index / ln(number of species).

For example, for Species (A) of EA10, Shannon Index will be: Additions of all $p_i \times ln(p_i)$; (- 0.36) + (- 0.36) + (- 0.34) = (- 1.06). Multiply it by (- 1) = (- 1) × (- 1.06) = 1.06.
For its evenness = Shannon Index / [natural logarithm of number of species = 3 (i.e. A, B,

Species Table

EA	Individuals	p_i	$ln(p_i)$	$p_i*ln(p_i)$
EA02 = Forest tree cover	75			
Species (A)	40	0.53	-0.63	-0.34
Species (B)	10	0.13	-2.01	-0.27
Species (C)	25	0.33	-1.10	-0.37
EA05 = Forest tree cover	49			
Species (A)	20	0.41	-0.90	-0.37
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Summary Table

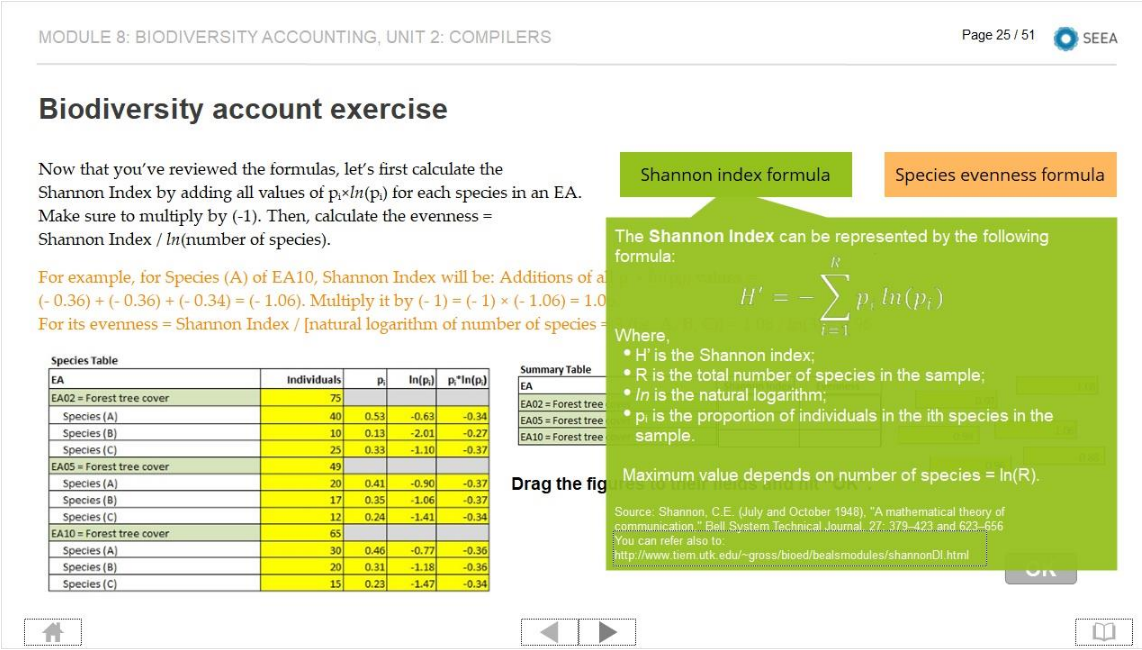
EA	Shannon Index	Evenness
EA02 = Forest tree cover	0.97	0.88
EA05 = Forest tree cover	1.08	0.98
EA10 = Forest tree cover	1.06	0.96

Not quite right.

Take a look at the solution.

Continue

Explanation 1 (Slide Layer)



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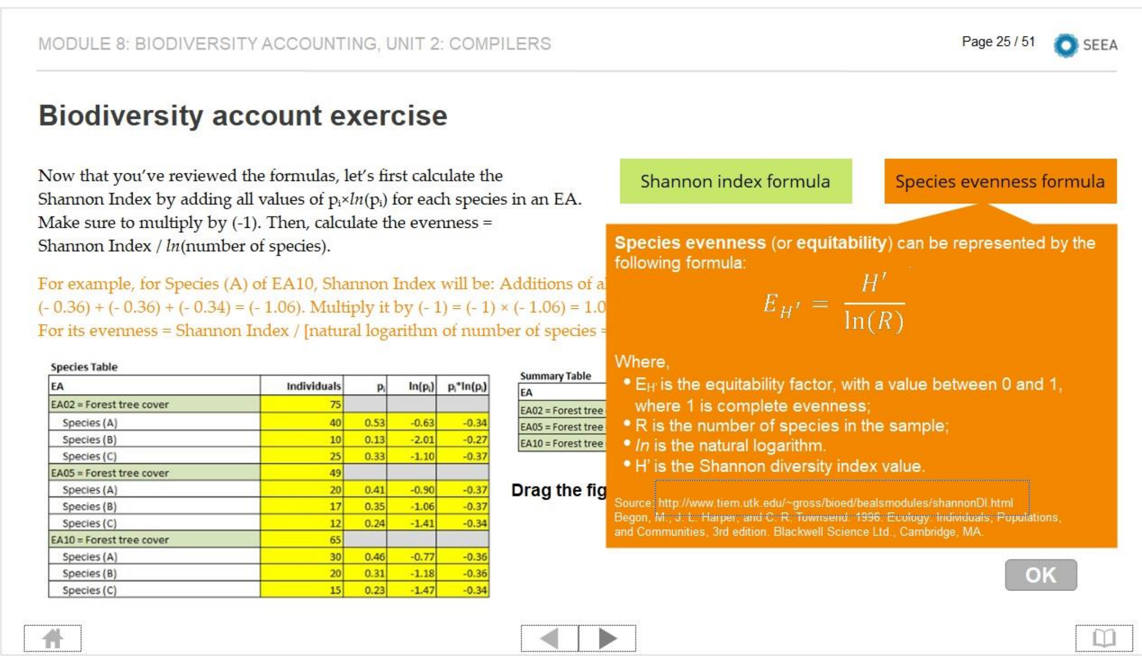
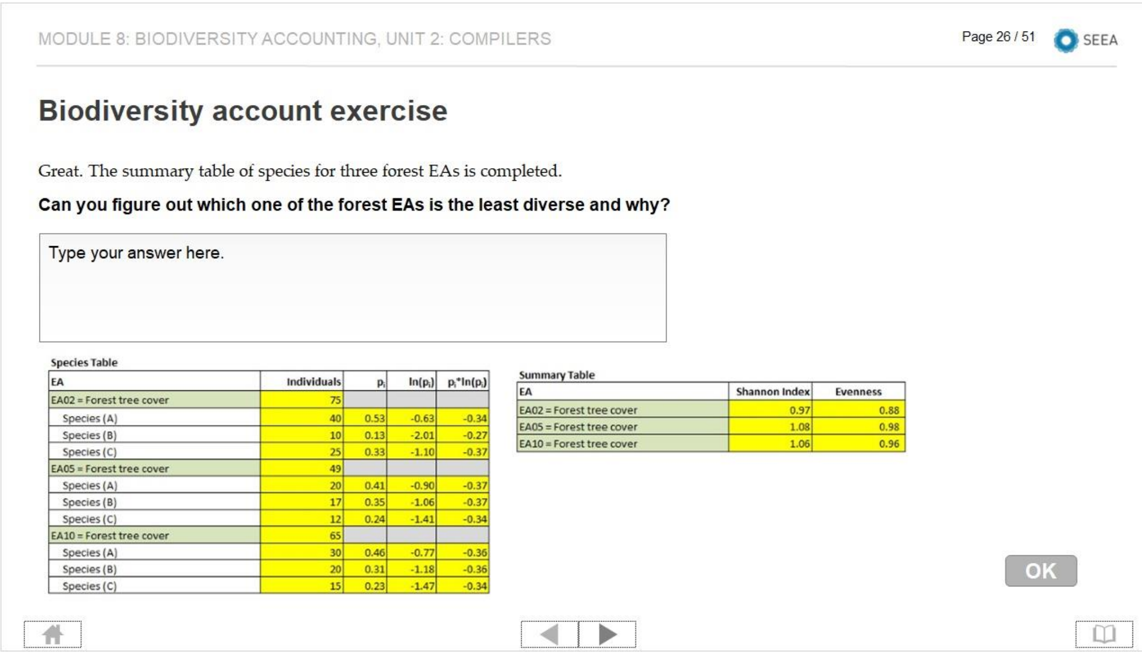


1.26 Biodiversity Account Exercise

(Text Entry, 10 points, 1 attempt permitted)



Species Table

EA	Individuals	p_i	$ln(p_i)$	$p_i*ln(p_i)$
EA02 = Forest tree cover	75			
Species (A)	40	0.53	-0.63	-0.34
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Summary Table

EA	Shannon Index	Evenness
EA02 = Forest tree cover	0.97	0.88
EA05 = Forest tree cover	1.08	0.98
EA10 = Forest tree cover	1.06	0.96

Not serious, but anyway … (Slide Layer)

Biodiversity account exercise

Great. The summary table of species for three forest EAs is completed.

Can you figure out which one of the forest EAs is the least diverse and why?

Type your answer here.

Species Table

EA	Individuals	p_i	$ln(p_i)$	$p_i*ln(p_i)$
EA02 = Forest tree cover	75			
Species (A)	40	0.53	-0.63	-0.34
Species (B)	10	0.13	-2.01	-0.27
Species (C)	25	0.33	-1.10	-0.37
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Summary Table

EA	Shannon Index	Evenness
EA02 = Forest tree cover	0.97	0.88
EA05 = Forest tree cover	1.08	0.98
EA10 = Forest tree cover	1.06	0.96

Not serious, but anyway …

Continue

Thank you, that was close. (Slide Layer)

Biodiversity account exercise

Great. The summary table of species for three forest EAs is completed.

Can you figure out which one of the forest EAs is the least diverse and why?

Type your answer here.

Species Table

EA	Individuals	p_i	$ln(p_i)$	$p_i*ln(p_i)$
EA02 = Forest tree cover	75			
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Summary Table

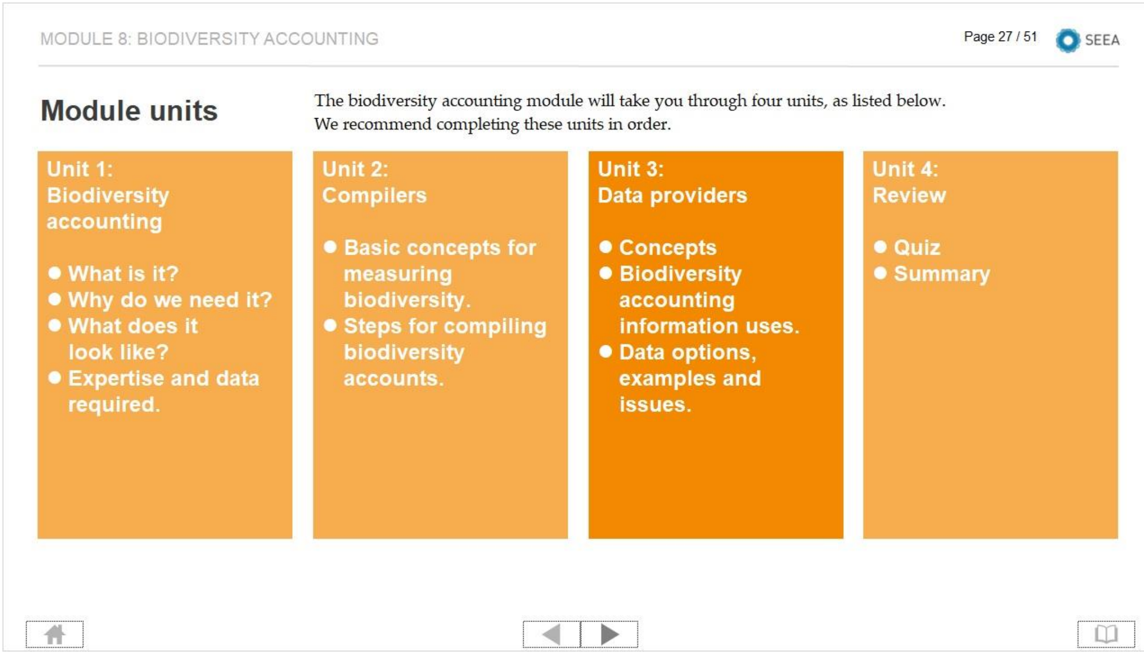
EA	Shannon Index	Evenness
EA02 = Forest tree cover	0.97	0.88
EA05 = Forest tree cover	1.08	0.98
EA10 = Forest tree cover	1.06	0.96

Thank you, that was close.

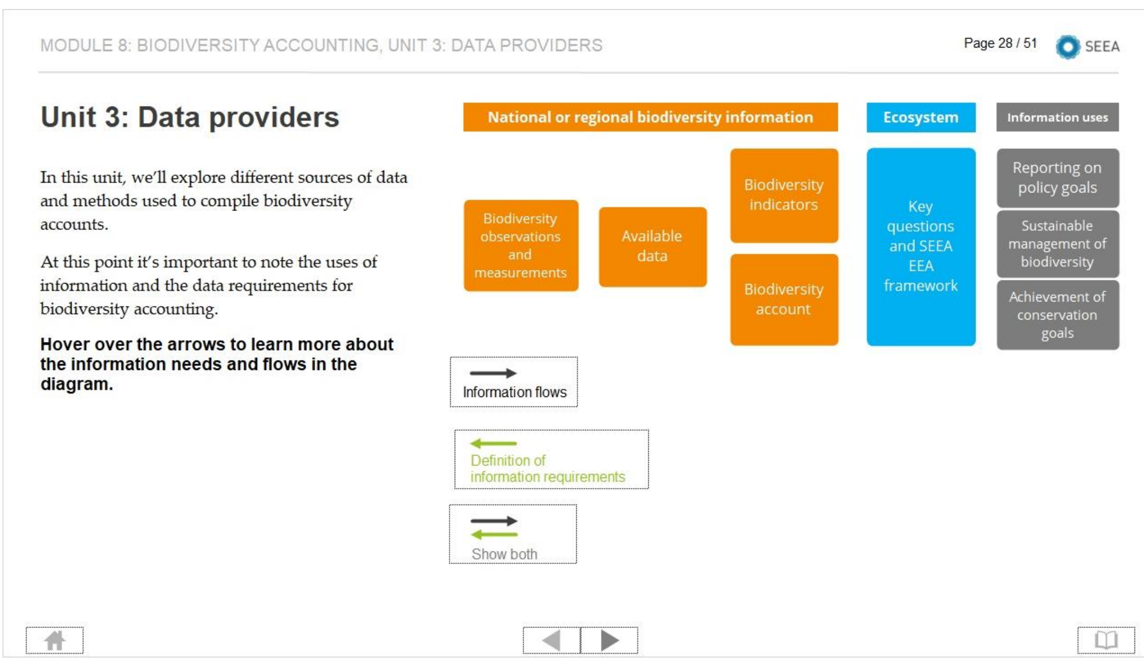
So you just finished Unit 2.

Continue

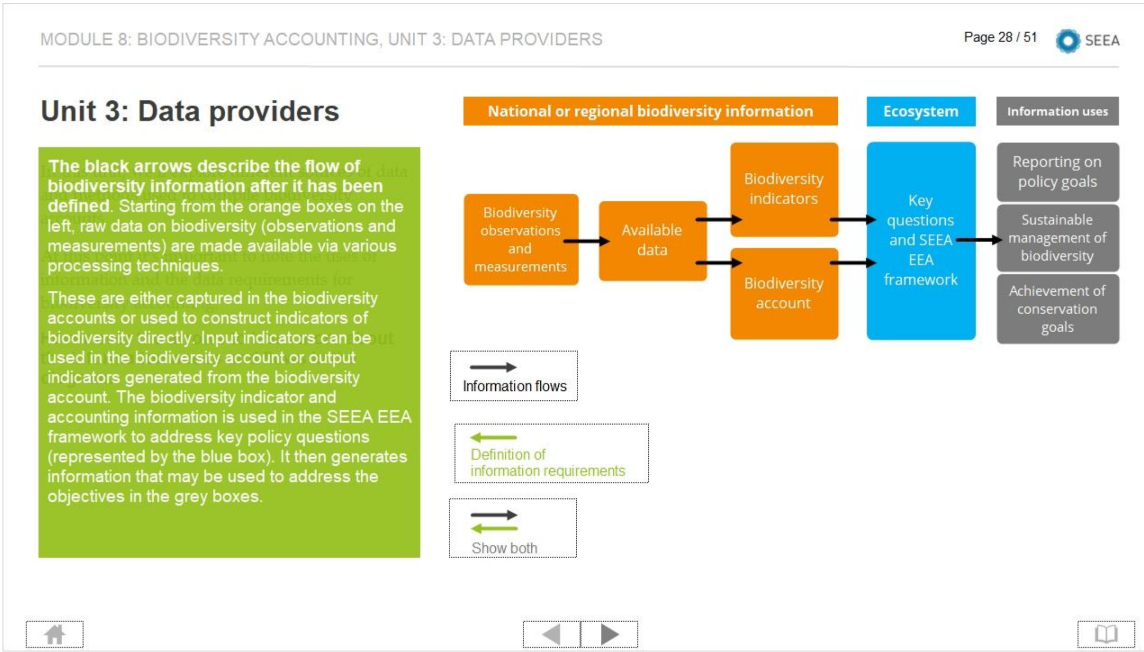
1.27 Module units



1.28 Unit 3



Explanation 1 (Slide Layer)



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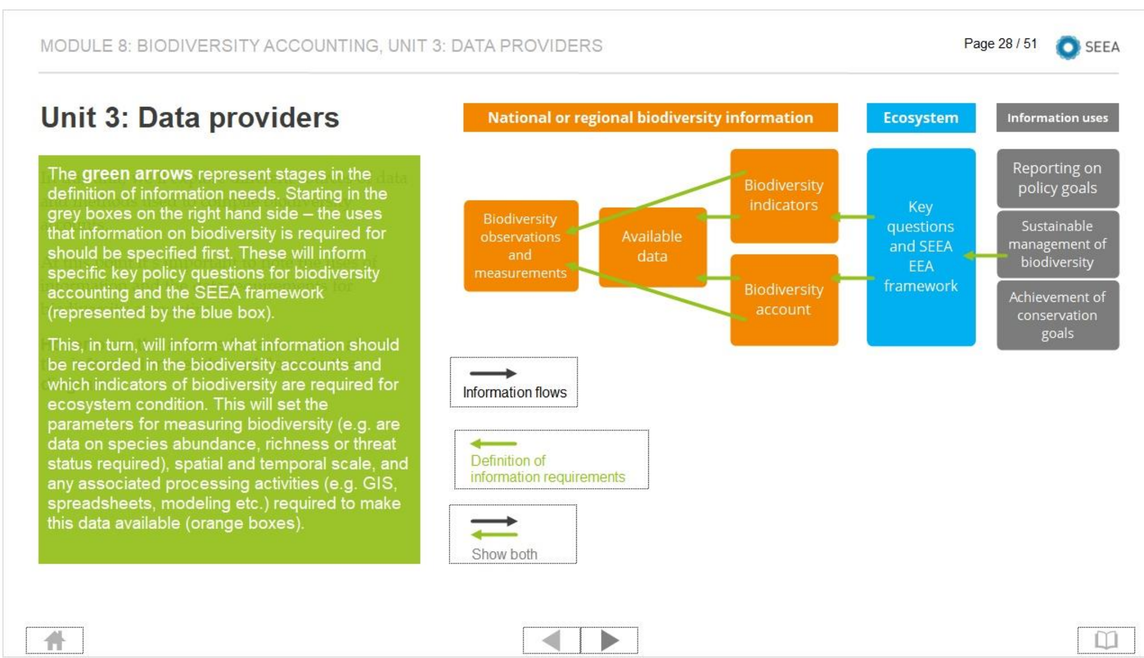

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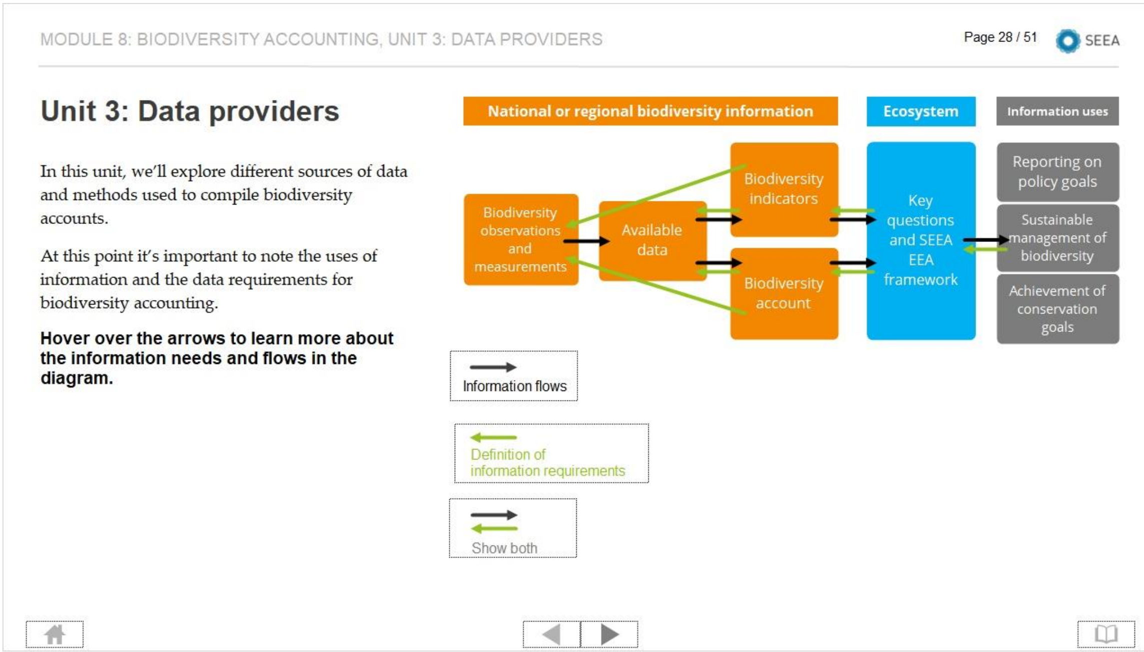


1.29 Policy questions - Example

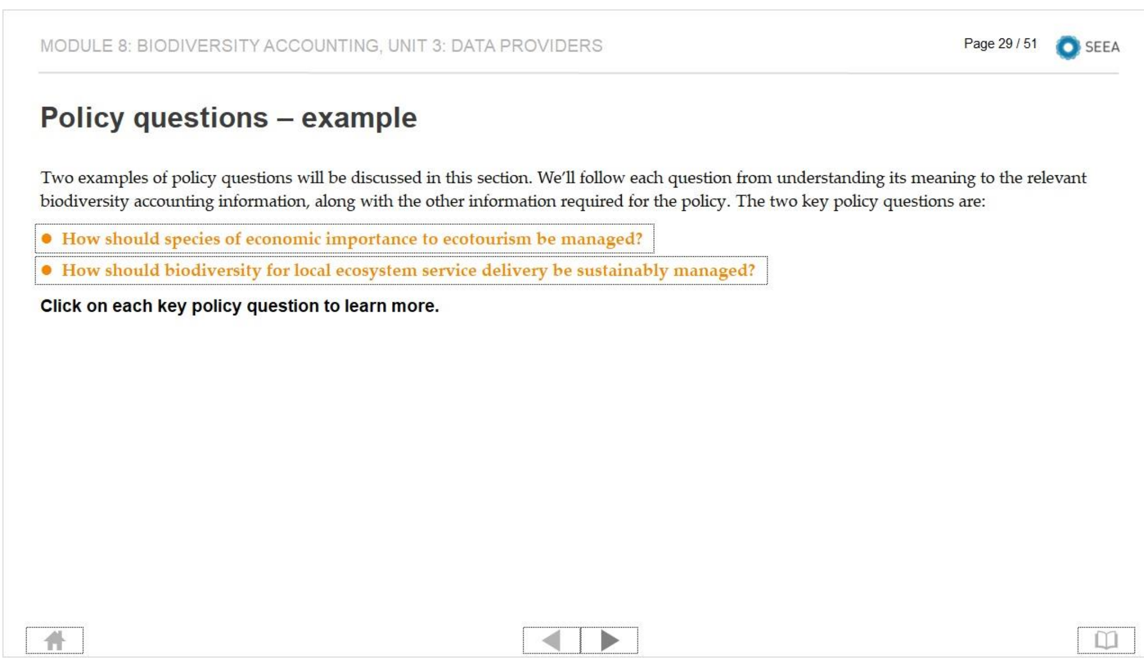


Diagram 1 (Slide Layer)

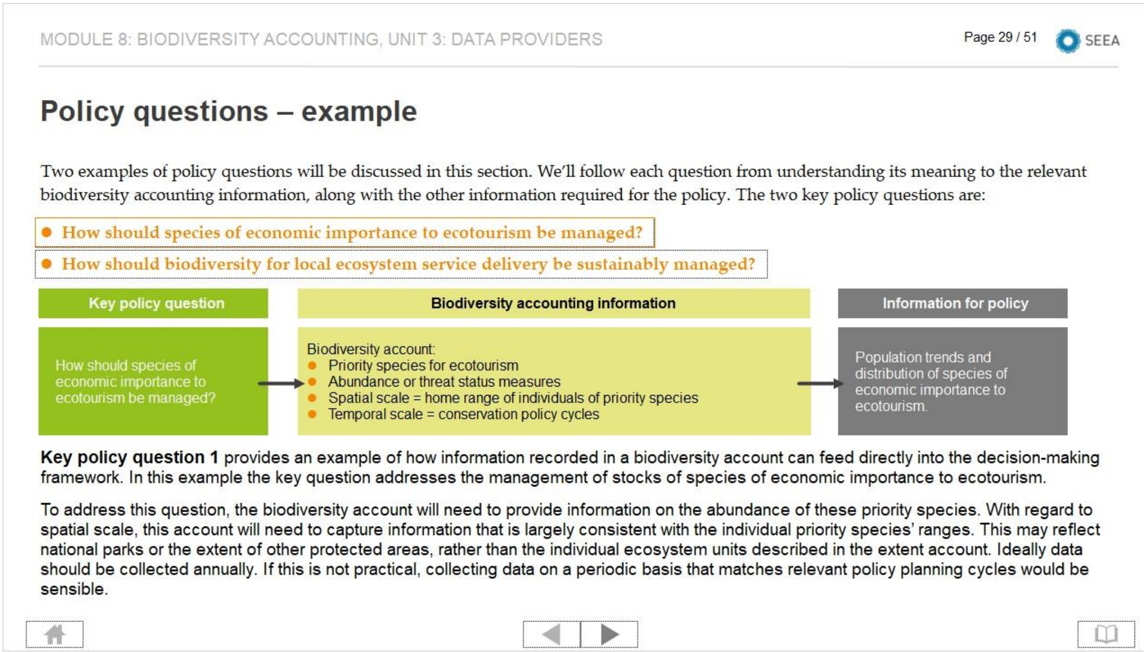
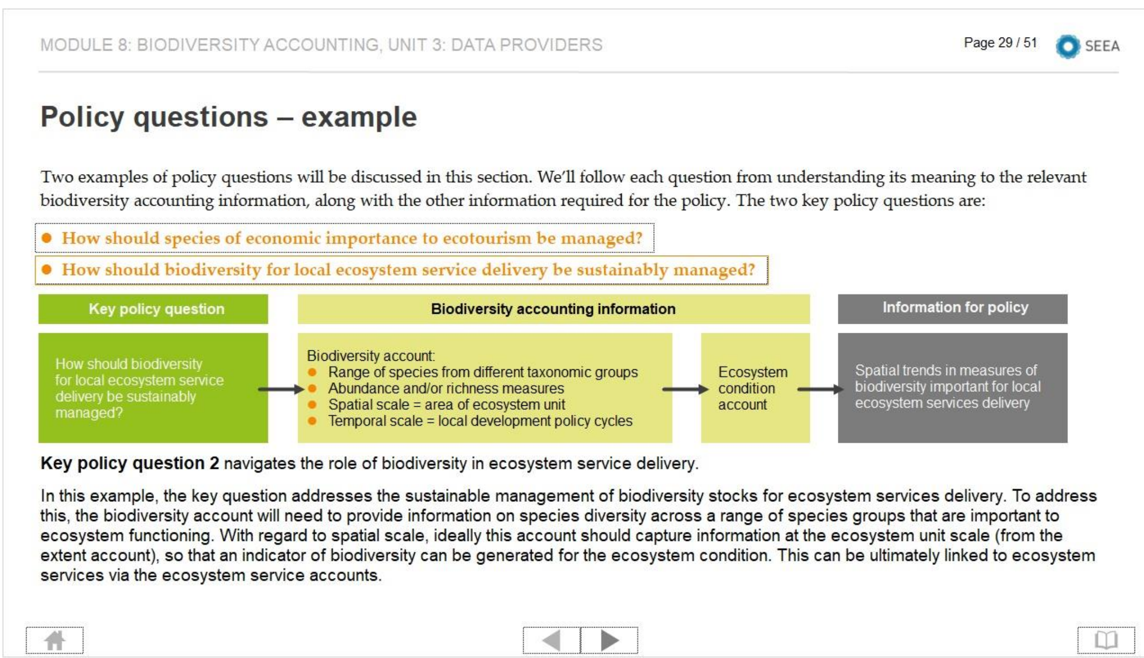
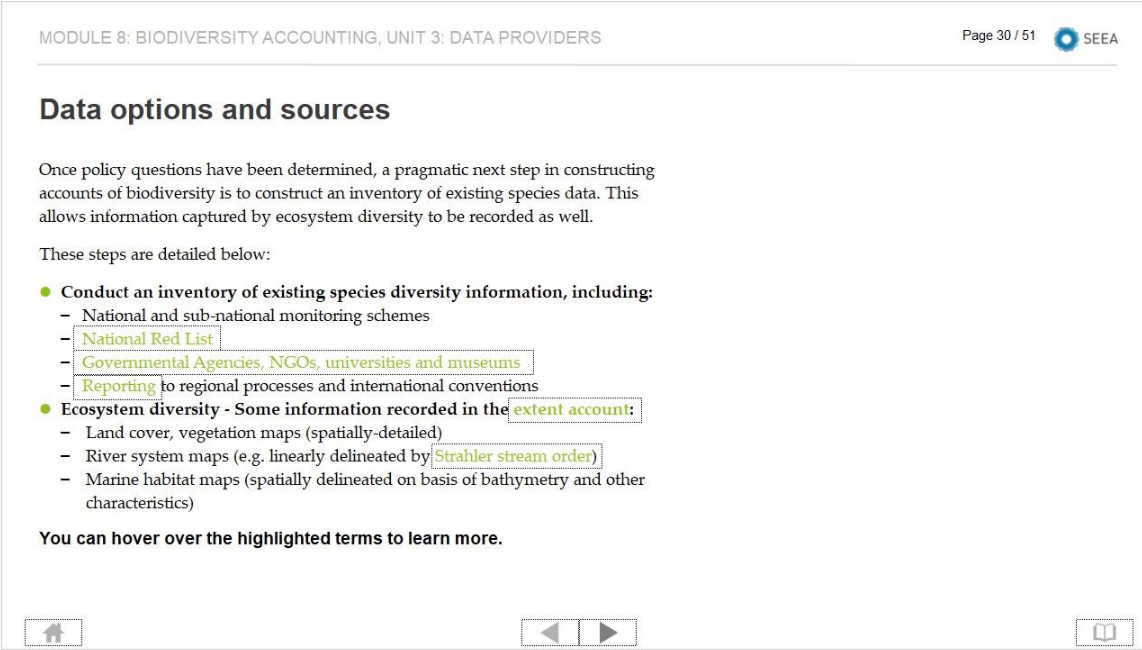


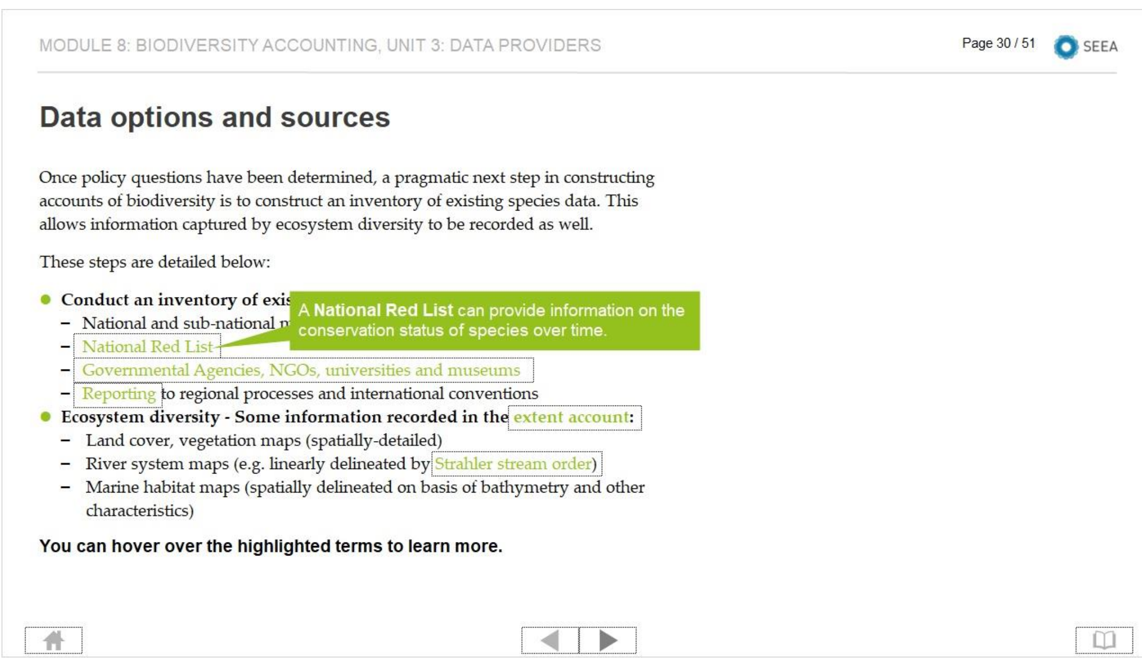
Diagram 2 (Slide Layer)



1.30 Data options and sources



Explanation 1 (Slide Layer)



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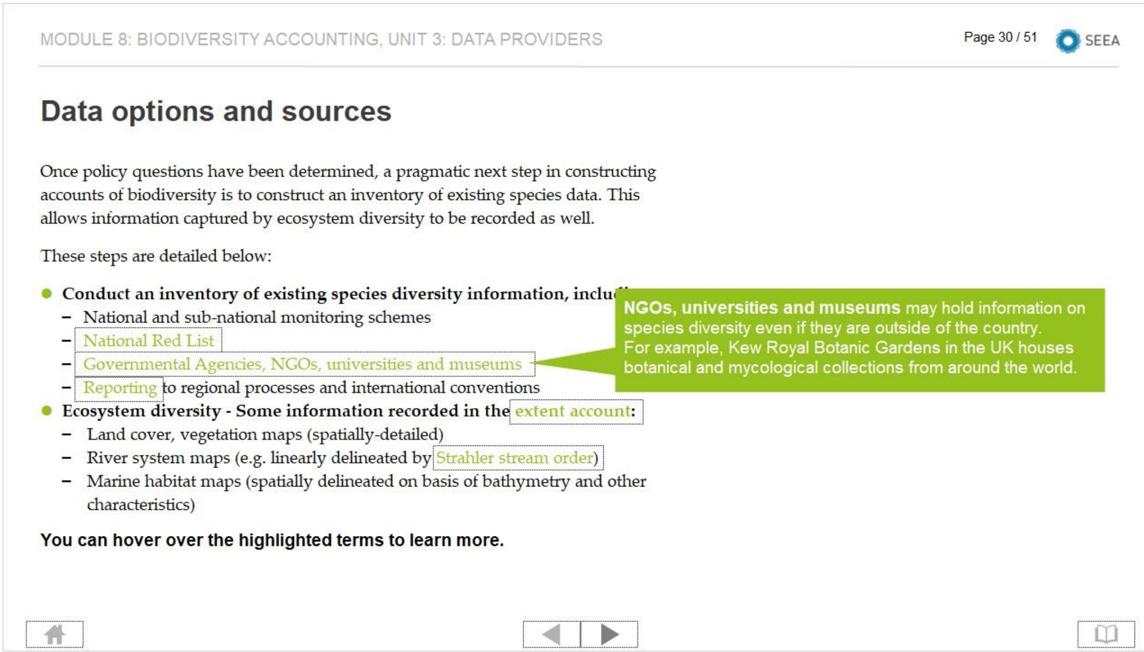

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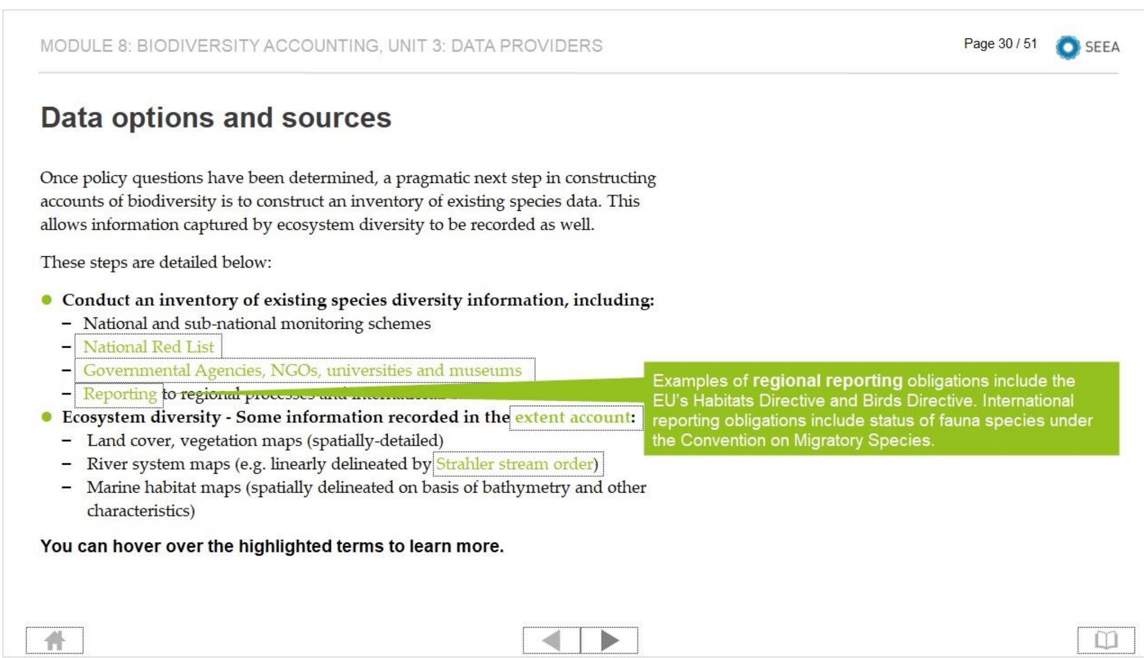
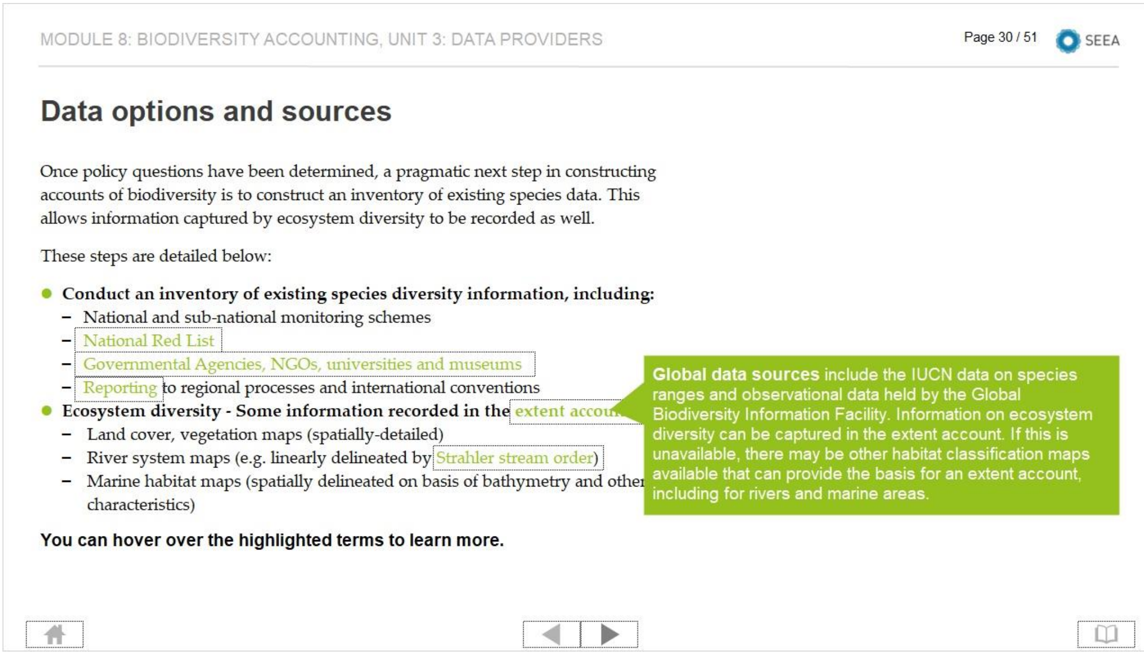
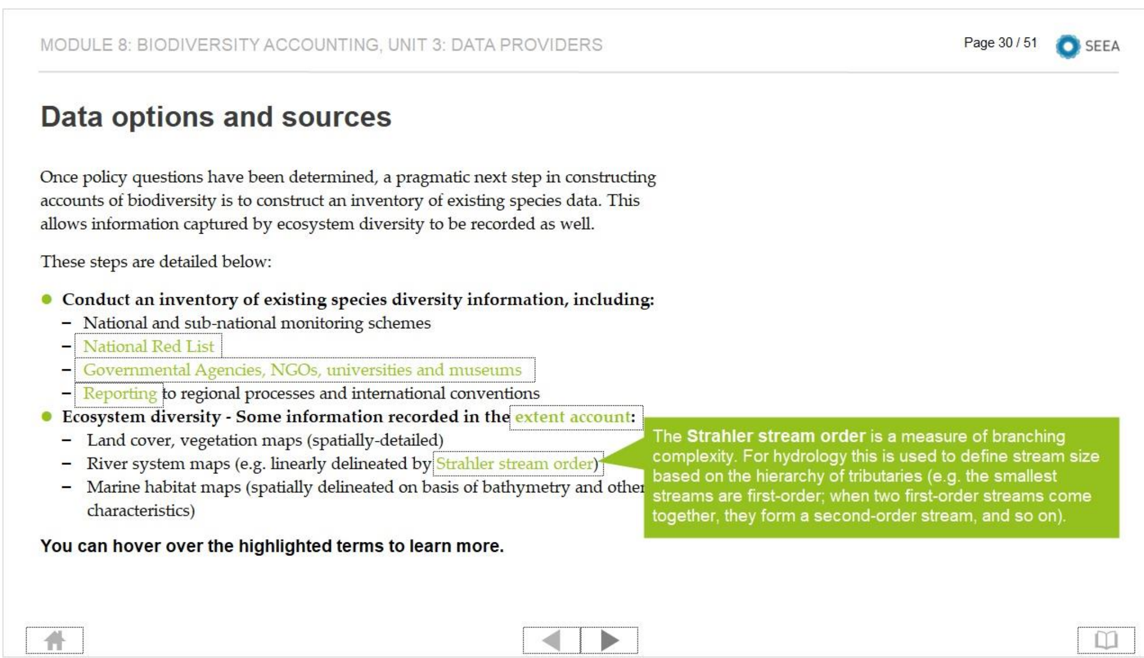


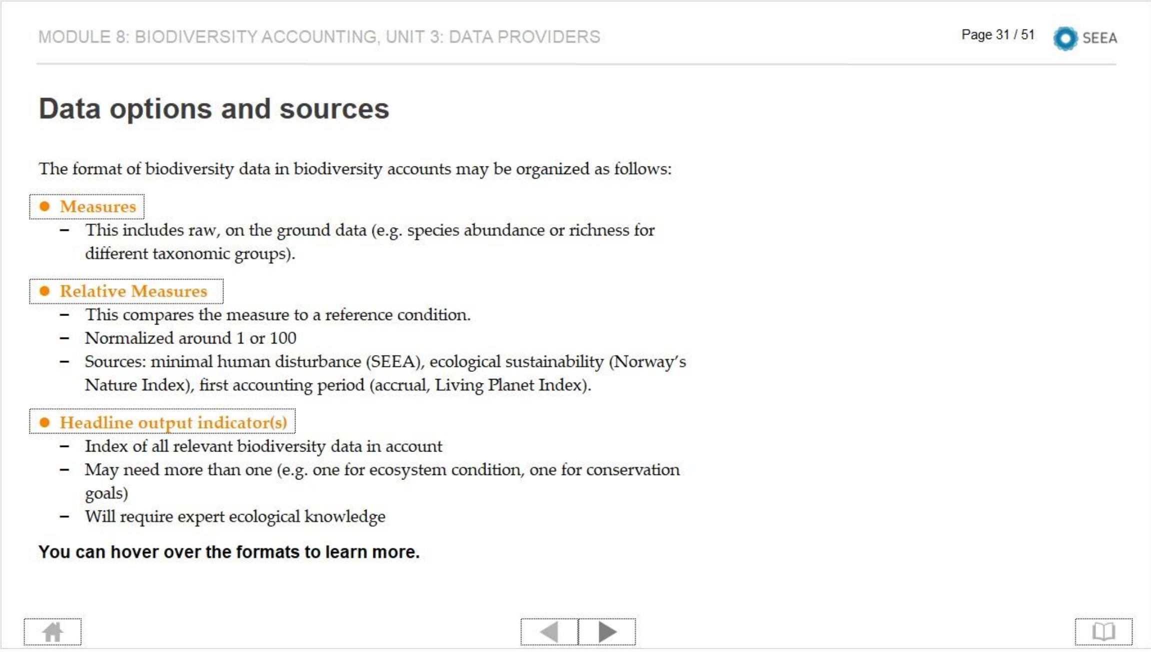
Explanation 4 (Slide Layer)



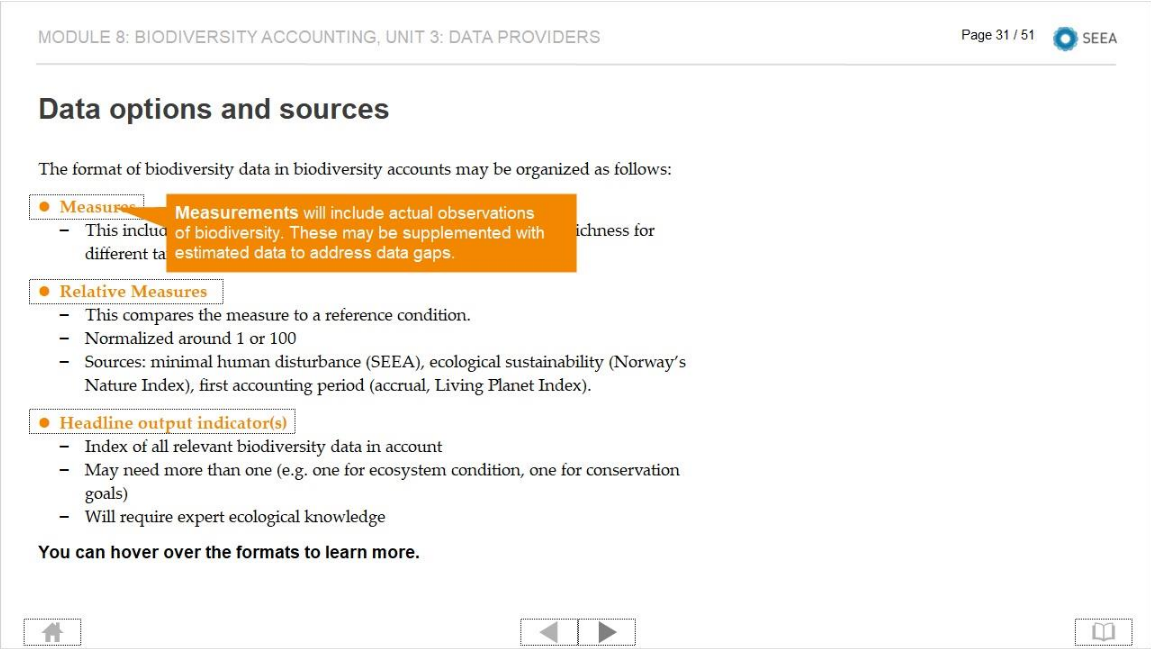
Explanation 5 (Slide Layer)



1.31 Data options and sources



Explanation 1 (Slide Layer)



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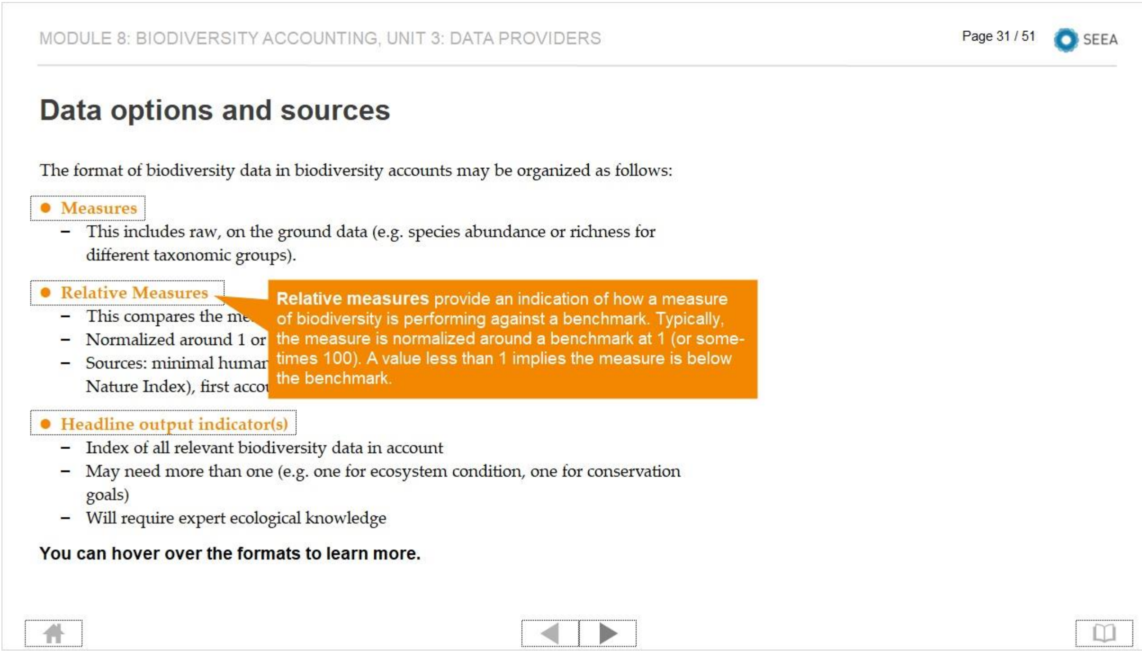

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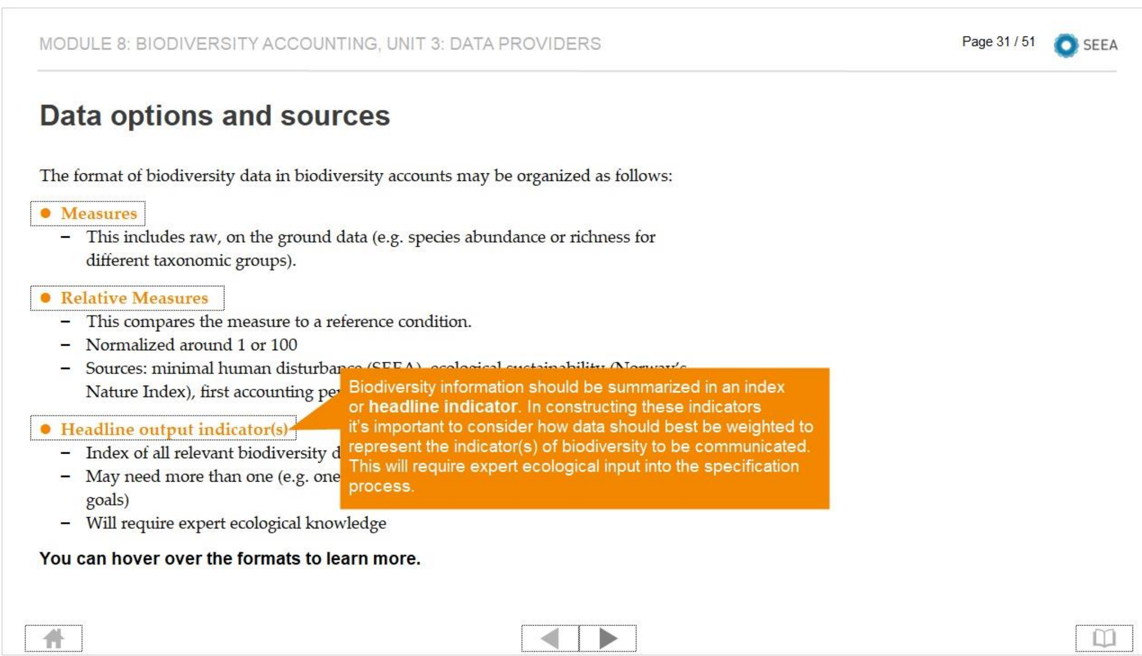
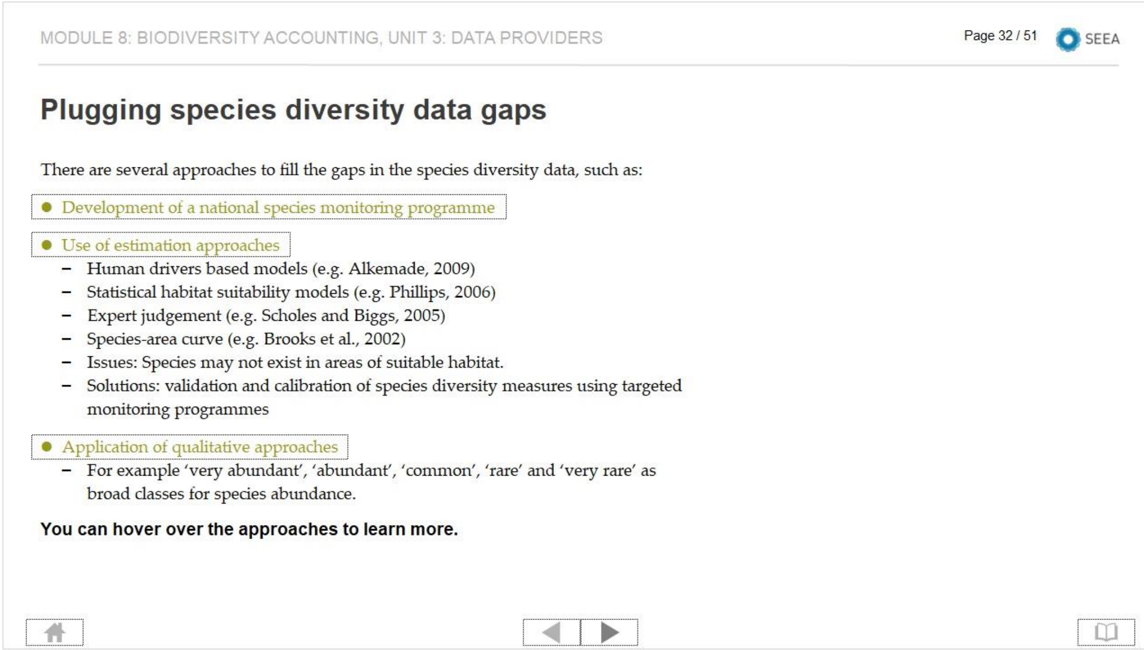
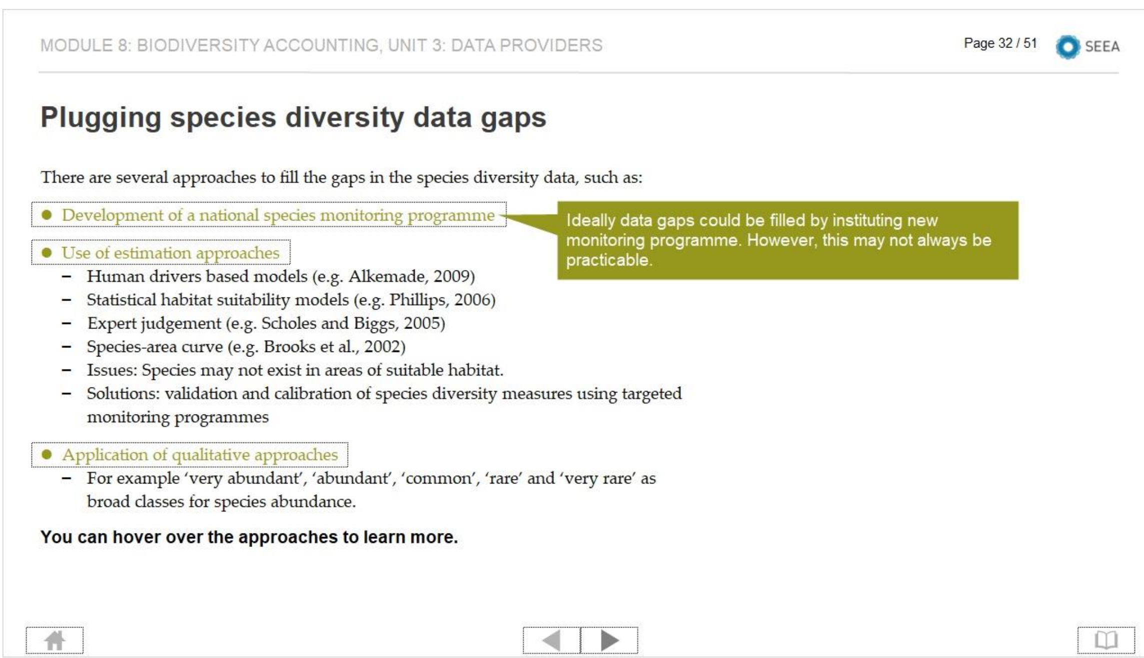


1.32 Plugging species diversity data gaps



Explanation 1 (Slide Layer)



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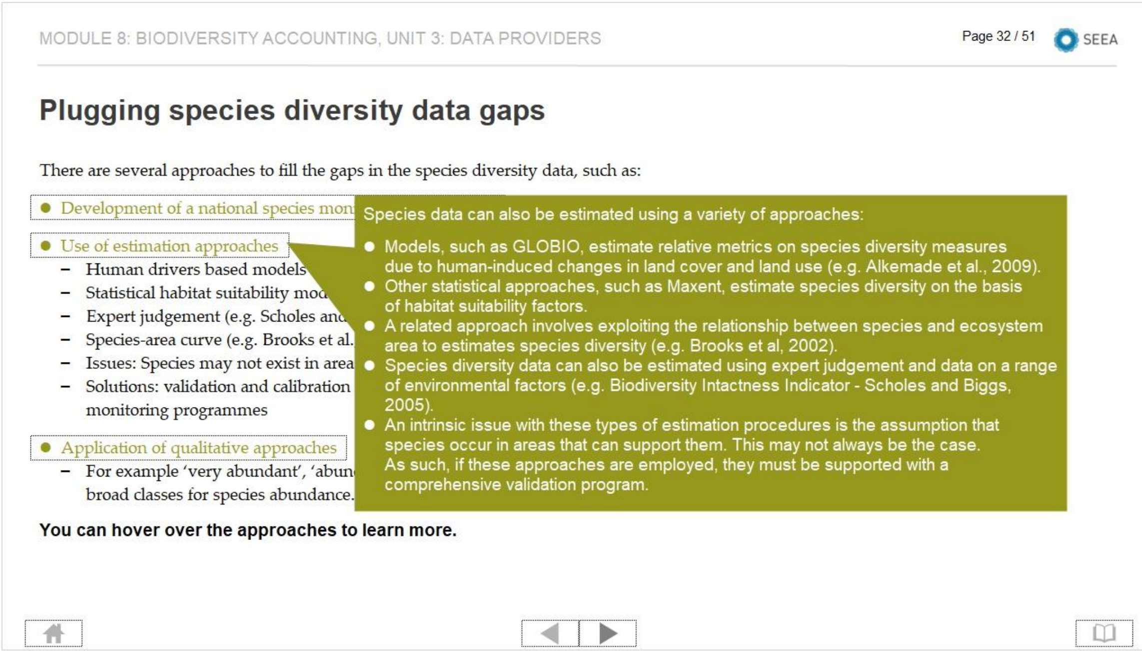
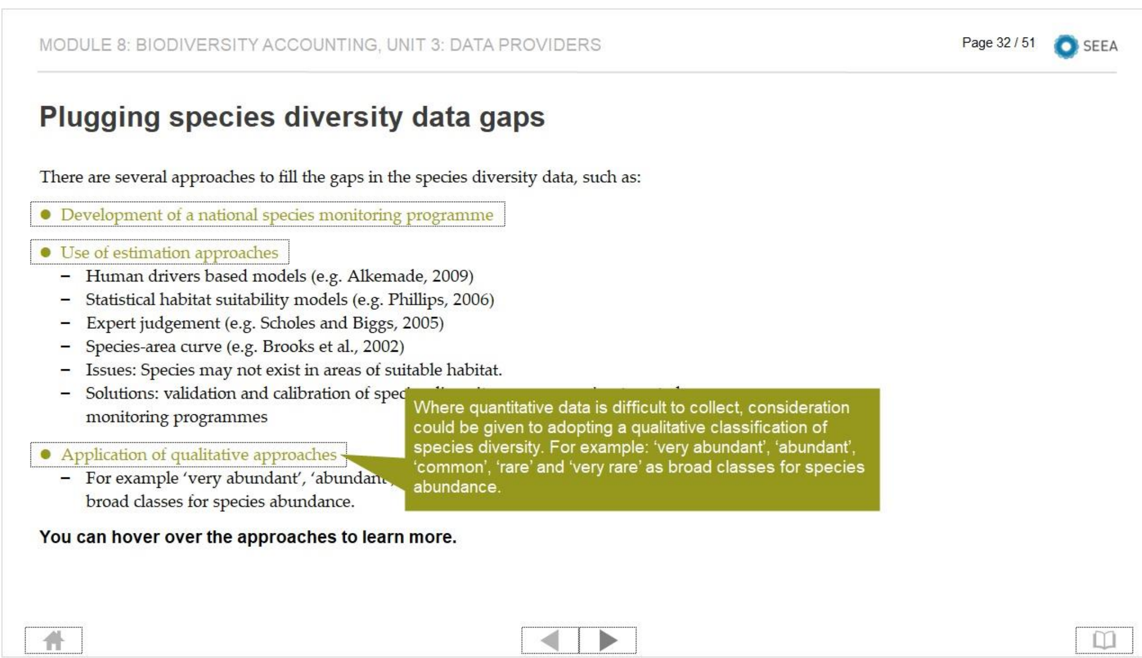
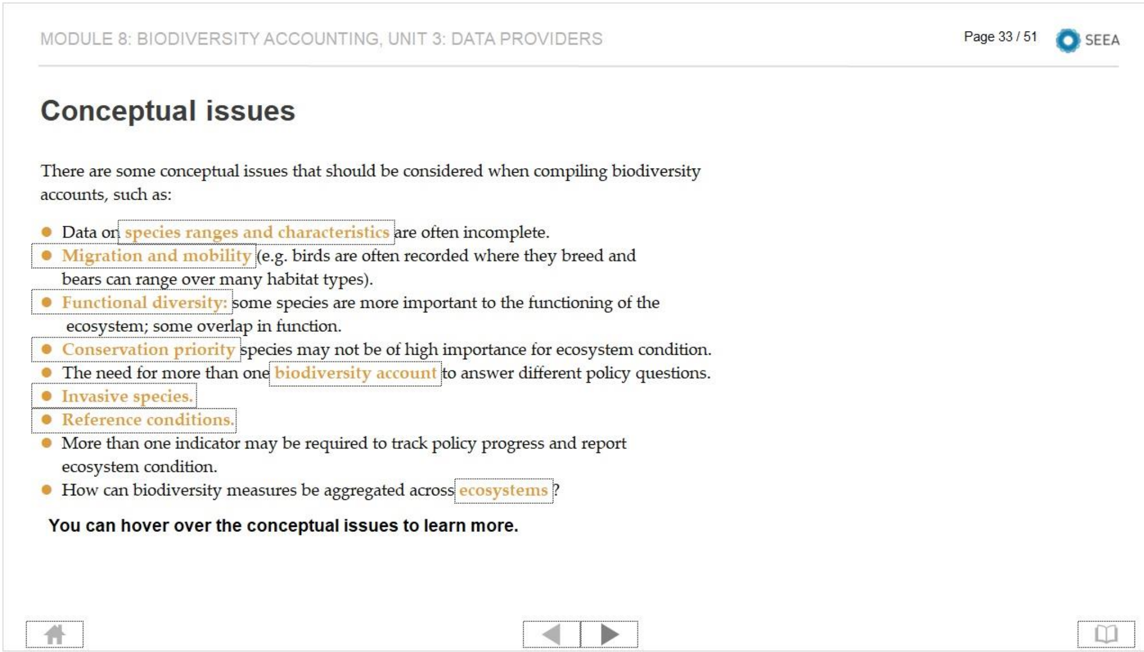


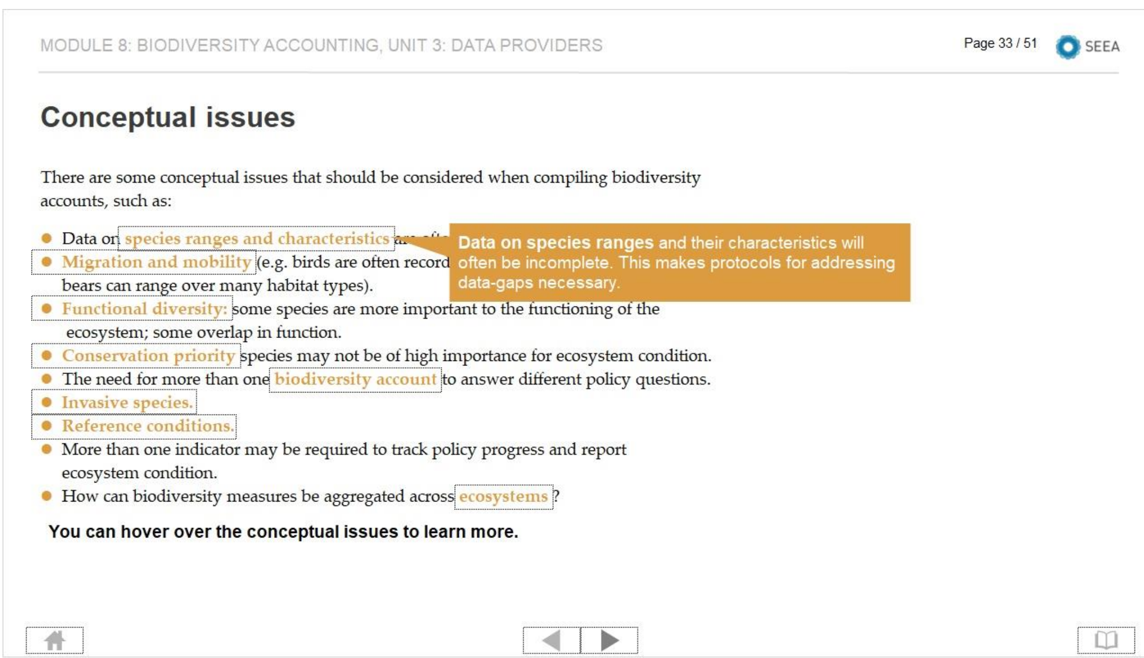
Explanation 3 (Slide Layer)



1.33 Conceptual issues



Explanation 1 (Slide Layer)



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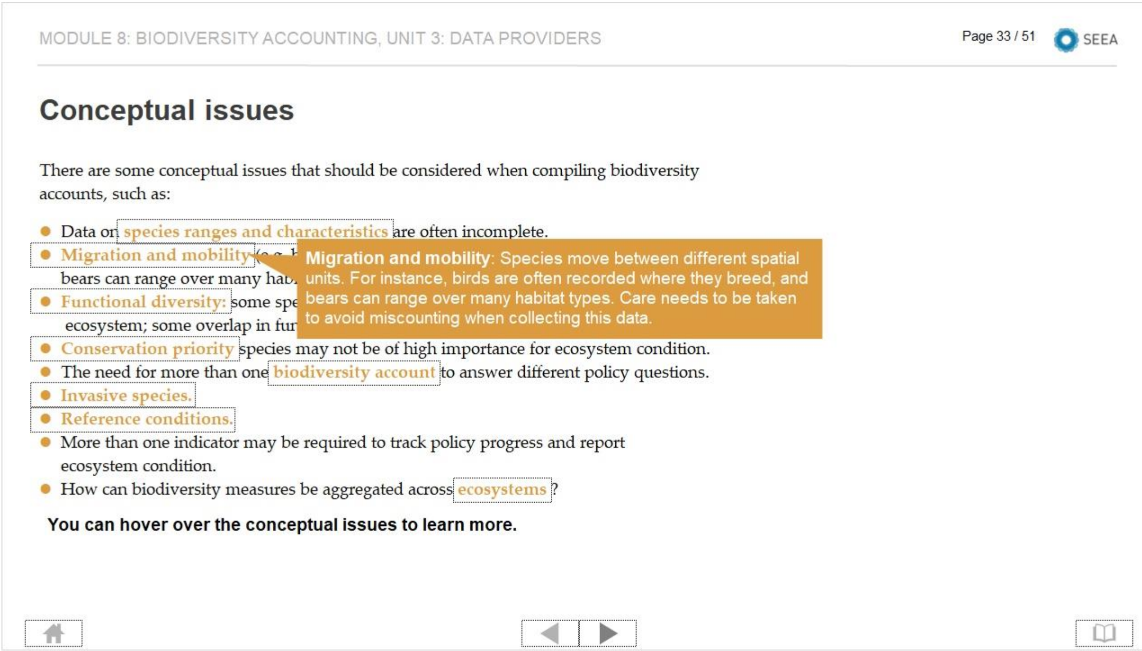

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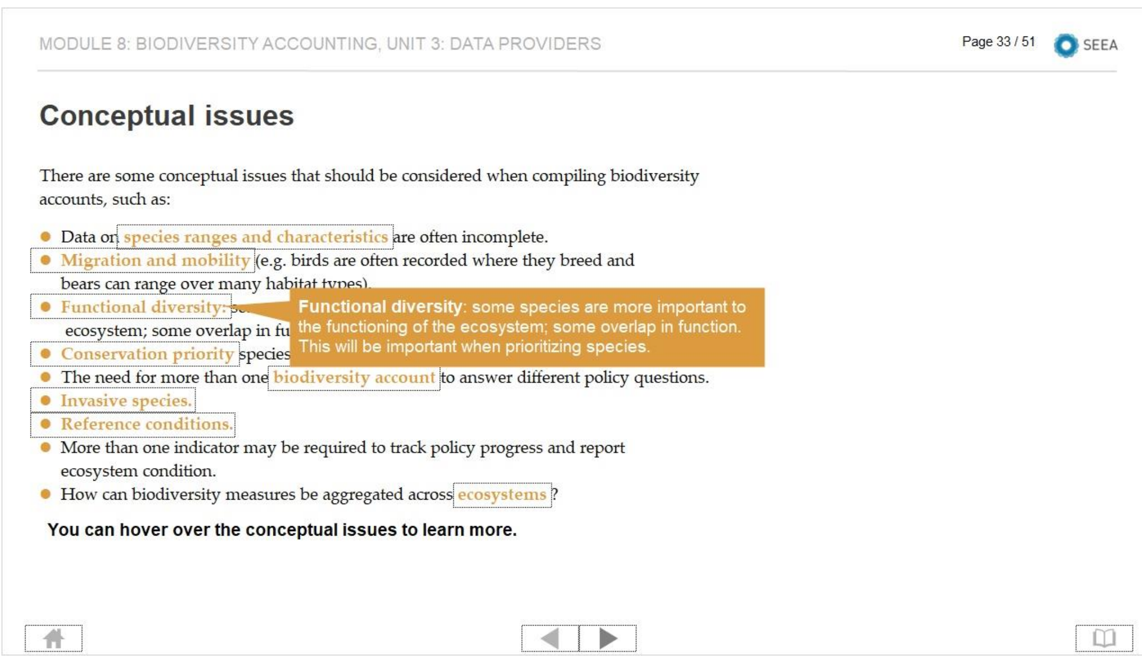
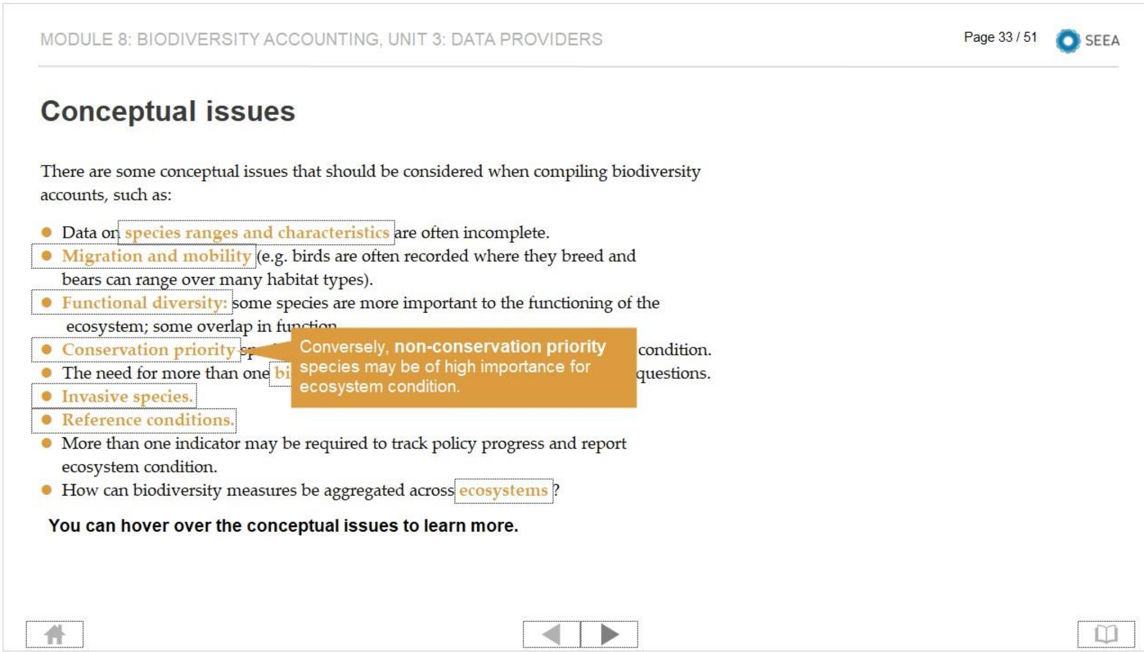


Explanation 4 (Slide Layer)



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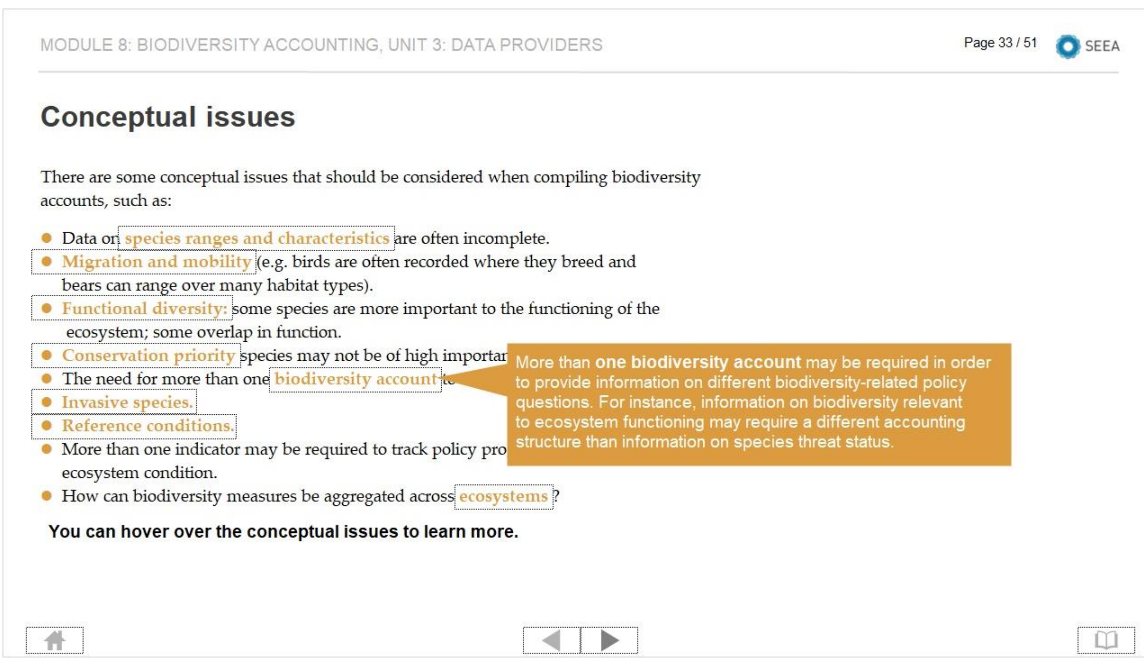

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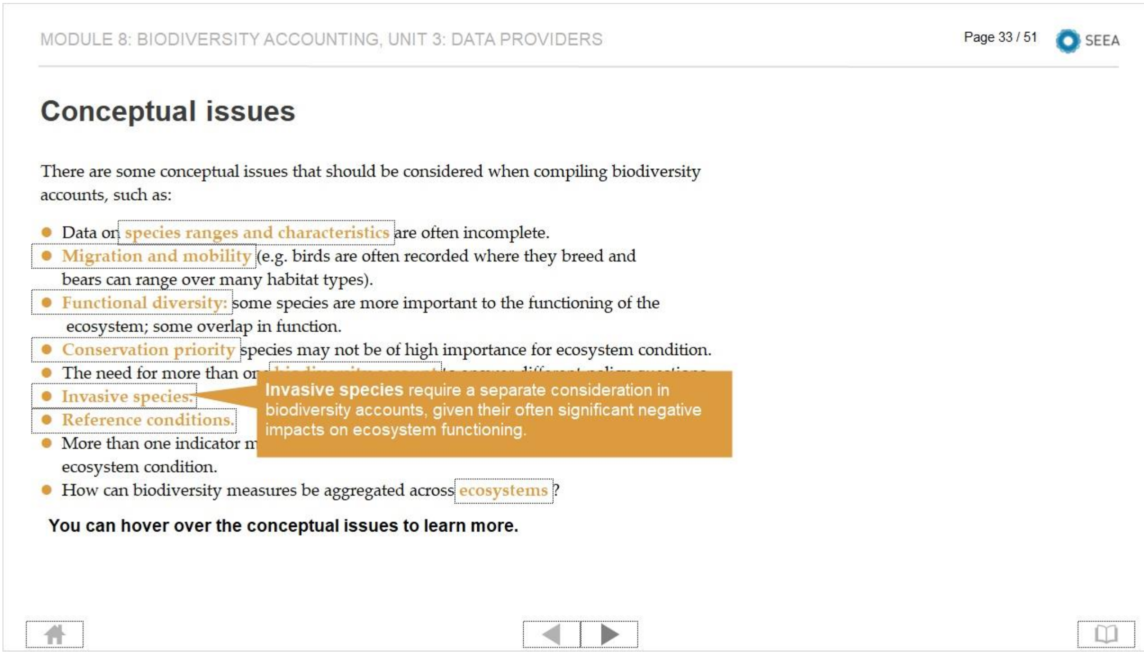

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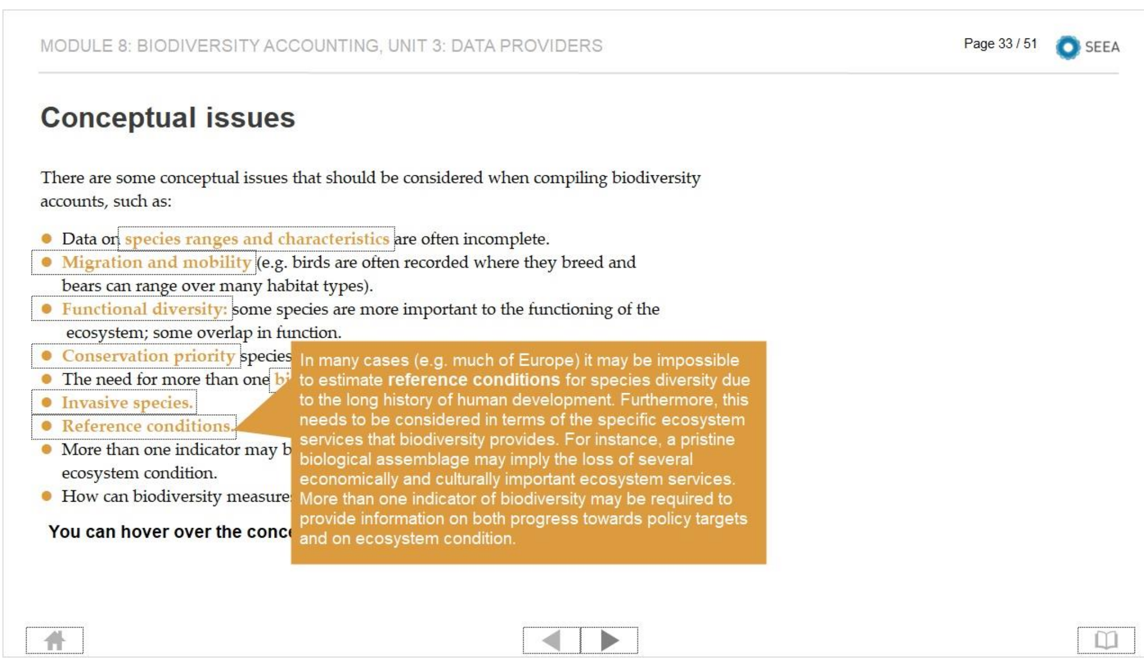
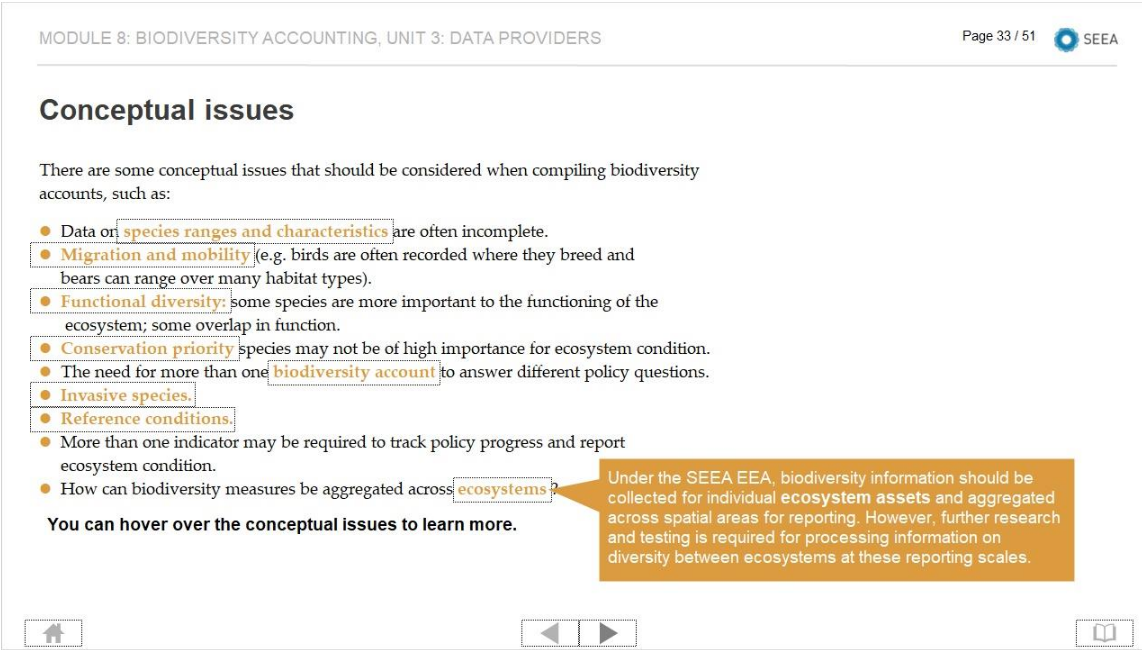
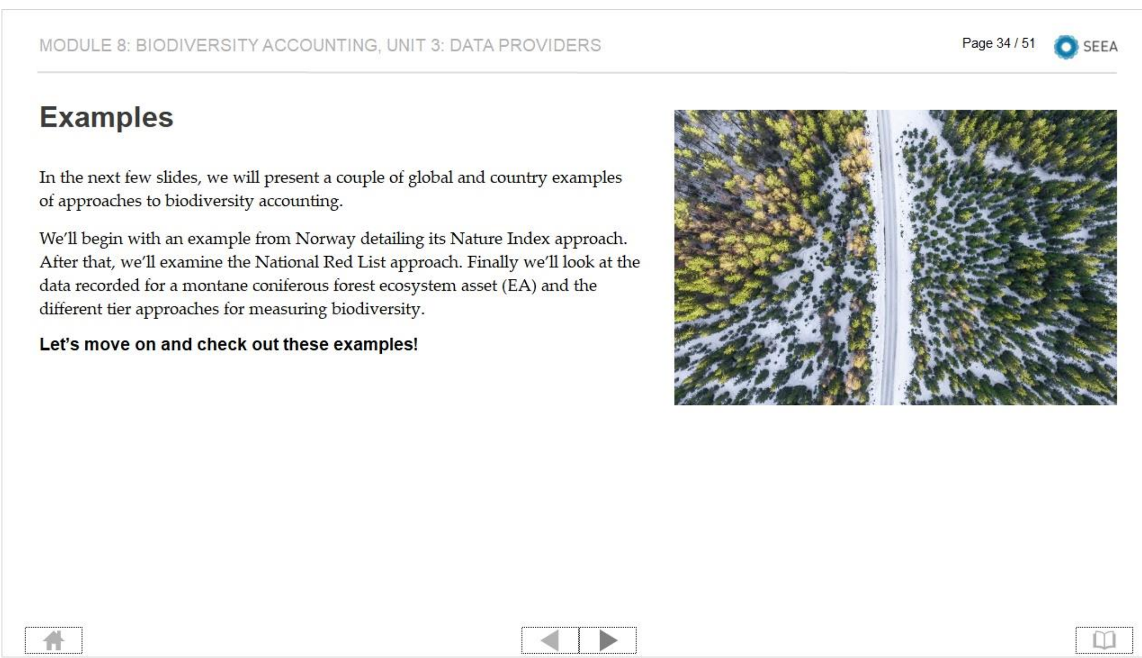


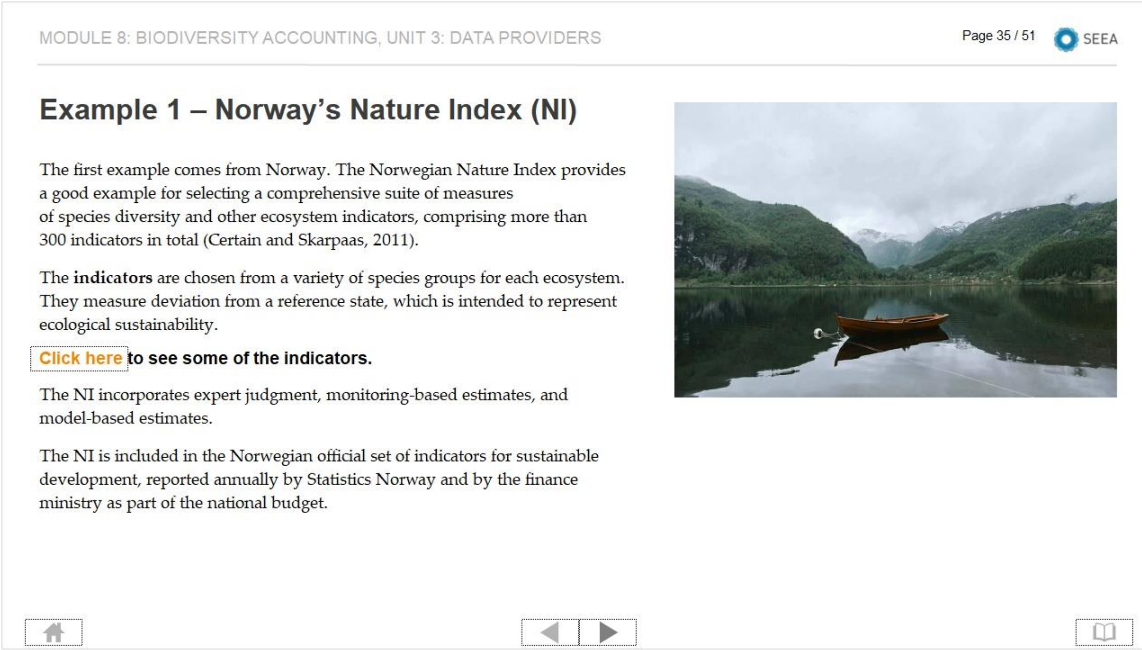
Explanation 8 (Slide Layer)



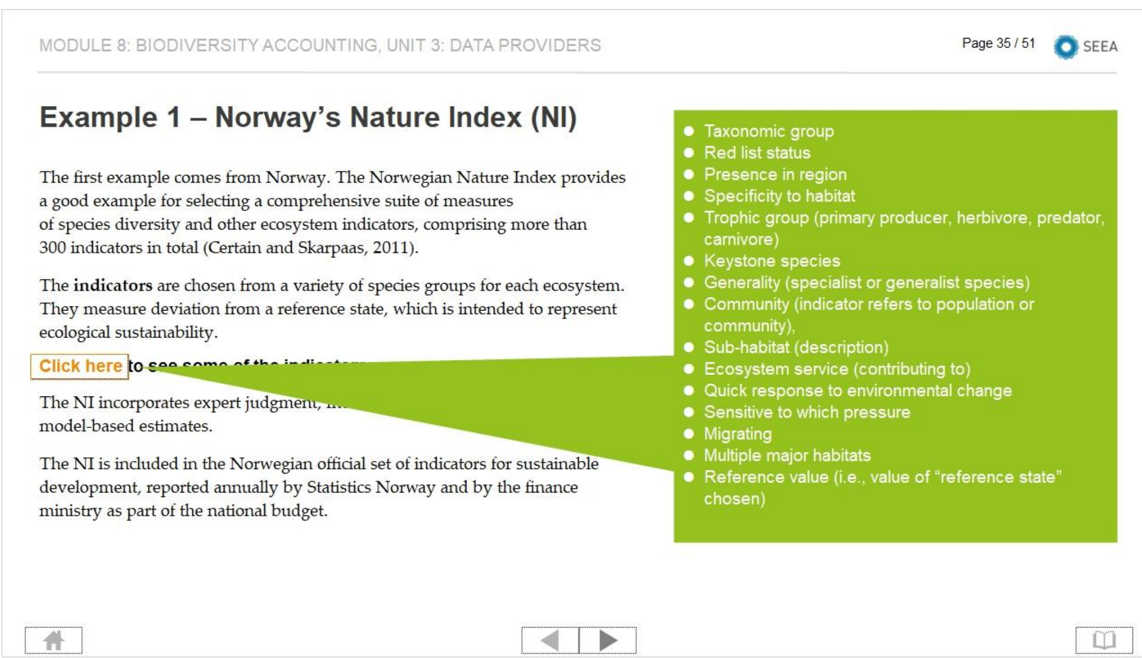
1.34 Examples



1.35 Example 1 - Norway



Explanation 1 (Slide Layer)



1.36 Example 1 - Norway

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Example 1 – Norway's Nature Index (NI)

Norway's Nature Index approach consists of four steps that will eventually calculate the NI value for a species group over a spatial area of interest in the ecosystem.

The four steps are:

A. **Construct** an index for a species group based on relative measures of key species in an ecosystem.
B. **Combine** several indexes for ecosystem area.
C. **Aggregate** the combined NI value across all ecosystems in a spatial area.
D. The aggregated value of NI in a spatial area is **aggregated across all spatial areas** in the ecosystem.

Let's move on and go through each step in an example to learn more about the calculations.

1.37 Example 1 - Norway

MODULE 8: BIODIVERSITY ACCOUNTING, UNIT 3: DATA PROVIDERS

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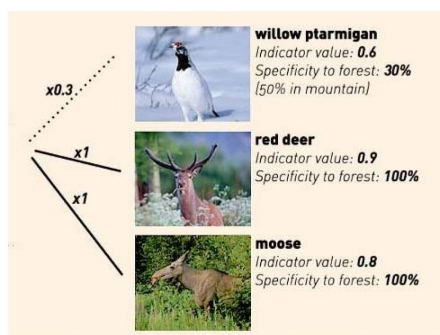
Example 1 – Norway's Nature Index (NI)

A. Consider a set of indicator values in the same spatial unit, same major ecosystem and same trophic group.

As shown in the figure to the right, data about three indicators are provided for the primary consumer in the forest of a given spatial unit.

For example:
To calculate the indicator for primary consumers in a forest ecosystem, you need to calculate the weighted average of the **indicator value** according to the **specificity** of the indicators to the major ecosystem (i.e. 30 % for willow ptarmigan, 100 % for red deer, and 100 % for moose.) =
(0.6 * 0.3 + 0.9 * 1.0 + 0.8 * 1.0) / (0.3 + 1.0 + 1.0) = **1.88 / 2.3 = 0.82**

Thus, the Nature Index for the primary consumers in a forest ecosystem is **NI value =** 0.82



1.38 Example 1 - Norway

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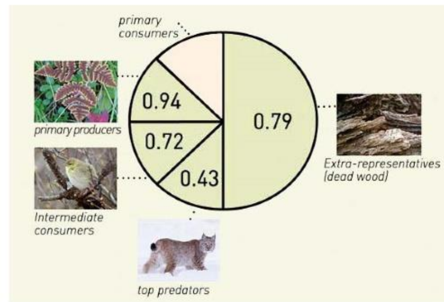
Example 1 – Norway's Nature Index (NI)

B. Consider the NI within a spatial unit and a major ecosystem:

As shown in the figure, several indicators for different trophic groups are combined to give an overall headline index or indicator. Different weights are determined based on the ecological importance of each indicator. For a forest ecosystem, 'deadwood' is the most important indicator of forest health. It contributes 50% to the overall NI, while the other four provide only 12.5% to overall NI.

For example:
To calculate the Nature Index =
0.79 * 0.5 + (0.82 + 0.43 + 0.94 + 0.72) * 0.125 = **0.76**

Therefore, the overall headline index or indicator **(NI) value is** 0.76 within this major ecosystem area.



1.39 Example 1 – Norway

MODULE 8: BIODIVERSITY ACCOUNTING, UNIT 3: DATA PROVIDERS

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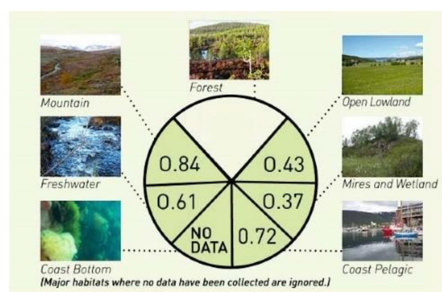
Example 1 – Norway's Nature Index (NI)

C. Considering the NI (0.76) for the forest from step B, we will aggregate all NI values from different ecosystems across a spatial area.

All the NI values for each ecosystem with data available within a spatial unit are aggregated using a **simple average** method.

For example:
There are six (6) ecosystems (mountain, freshwater, forest, open lowland, mires and wetland, coast pelagic) with NI data. Thus, the simple average of NI = (0.61 + 0.84 + 0.76 + 0.43 + 0.37 + 0.72) / 6 = **0.62**.

Thus, the overall index or indicator **(NI) value** within this spatial unit is **0.62**.



1.40 Example 1 – Norway

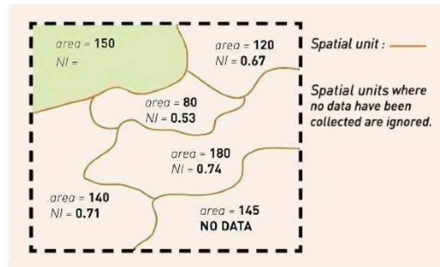
Example 1 – Norway's Nature Index (NI)

D. Considering the NI (0.62) for the spatial unit calculated in step C, we will average NI values over several spatial areas (units).

All the NI values for each spatial unit are aggregated over a spatial area of interest, using an **area weighting average** to adjust NI values.

For example:
as per the figure, there are five (5) areas with NI data totaled as:
150+120+80+140+180 = **670** (total area)
NI weighted average per area = ∑NI*Area / Total Area.
∑NI*Area = 0.62 * 150 + 0.67 * 120 + 0.53 * 80 + 0.71 * 140 + 0.74 * 180 = **448.4**
Thus, the NI values weighted average = 448.4 / 670 = **0.67**

Thus, the overall index or indicator **(NI) value** across all spatial units is 0.67



1.41 Example 2 - IUCN

Example 2 – IUCN National Red List

The second example examines the **National Red List** approach. It is useful for biodiversity accounting as it provides information on the status of the stock of species of concern within a country.

Click here to learn more about the Red List

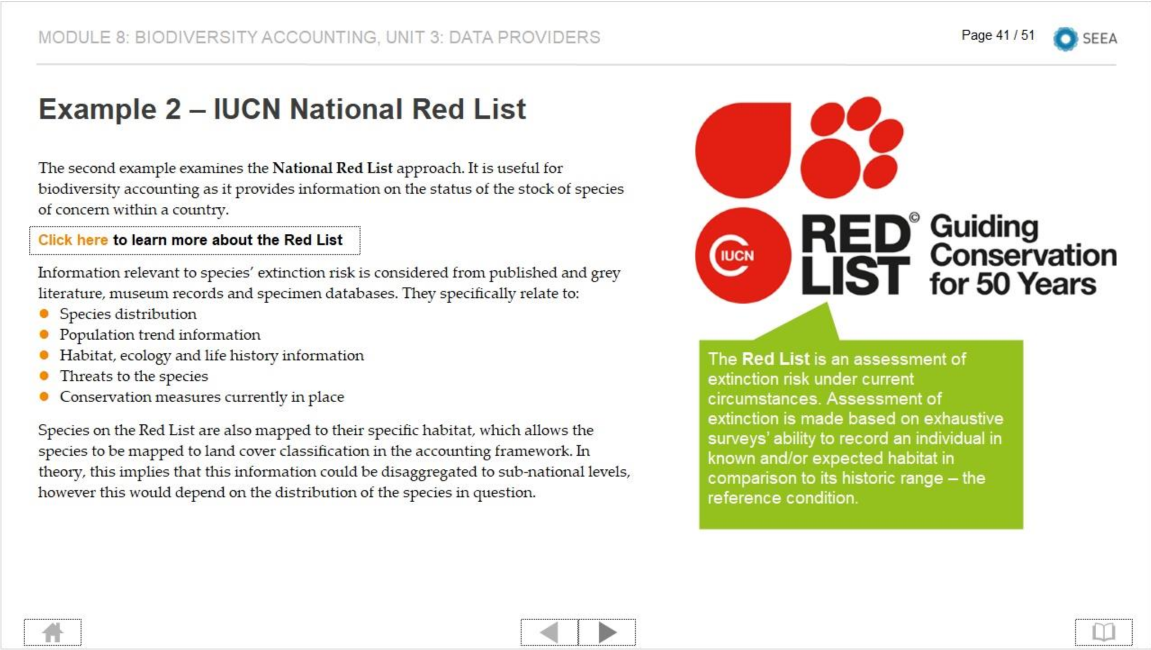
Information relevant to species' extinction risk is considered from published and grey literature, museum records and specimen databases. They specifically relate to:

- Species distribution
- Population trend information
- Habitat, ecology and life history information
- Threats to the species
- Conservation measures currently in place

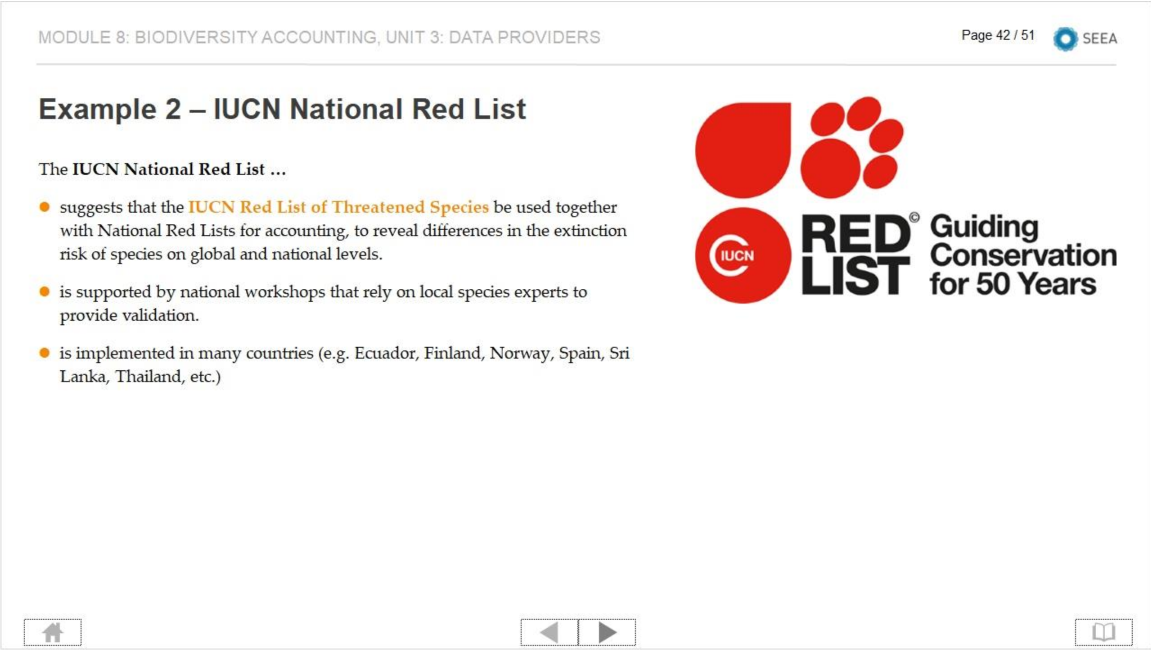
Species on the Red List are also mapped to their specific habitat, which allows the species to be mapped to land cover classification in the accounting framework. In theory, this implies that this information could be disaggregated to sub-national levels, however this would depend on the distribution of the species in question.

IUCN RED LIST© Guiding Conservation for 50 Years

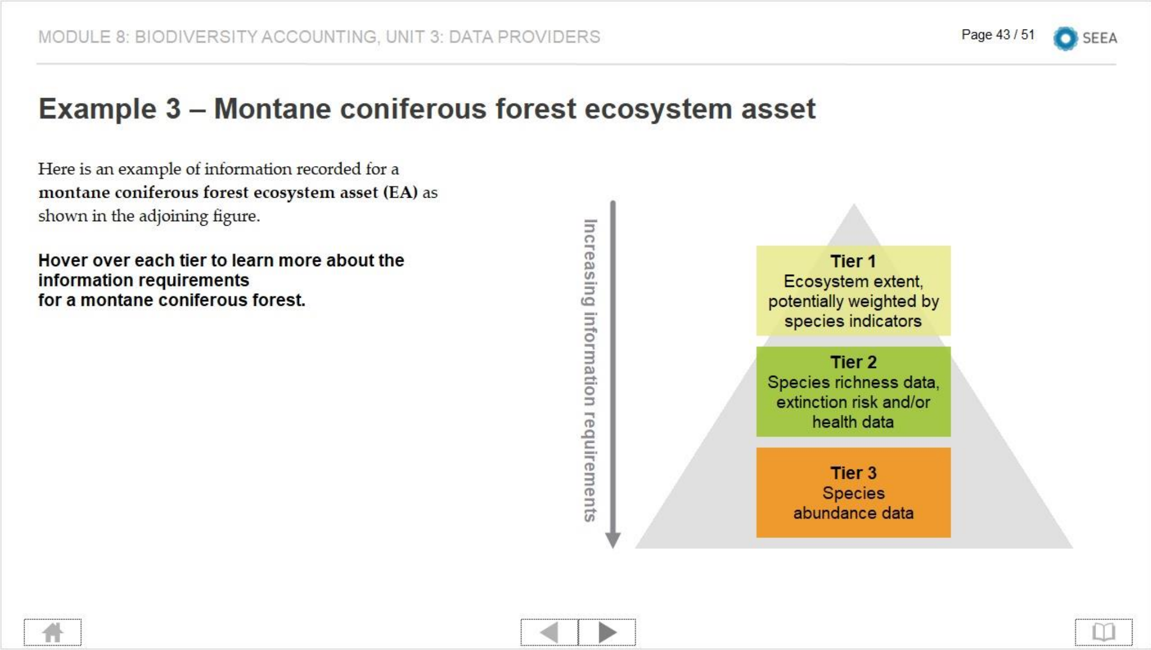
Explanation (Slide Layer)



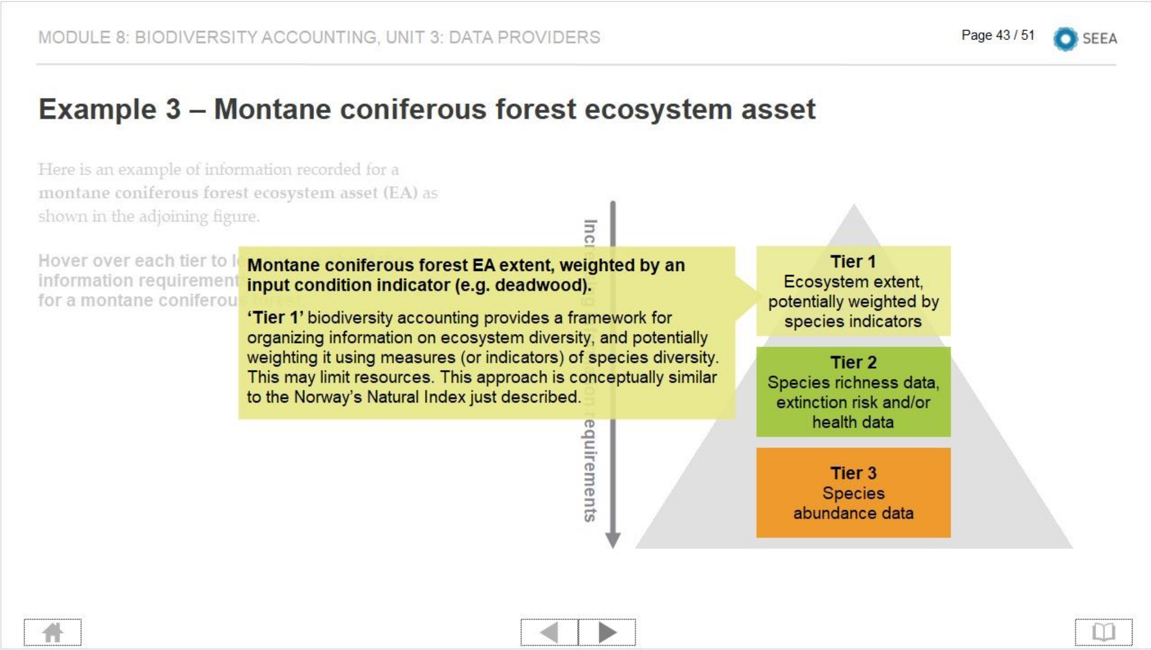
1.42 Example 2 - IUCN



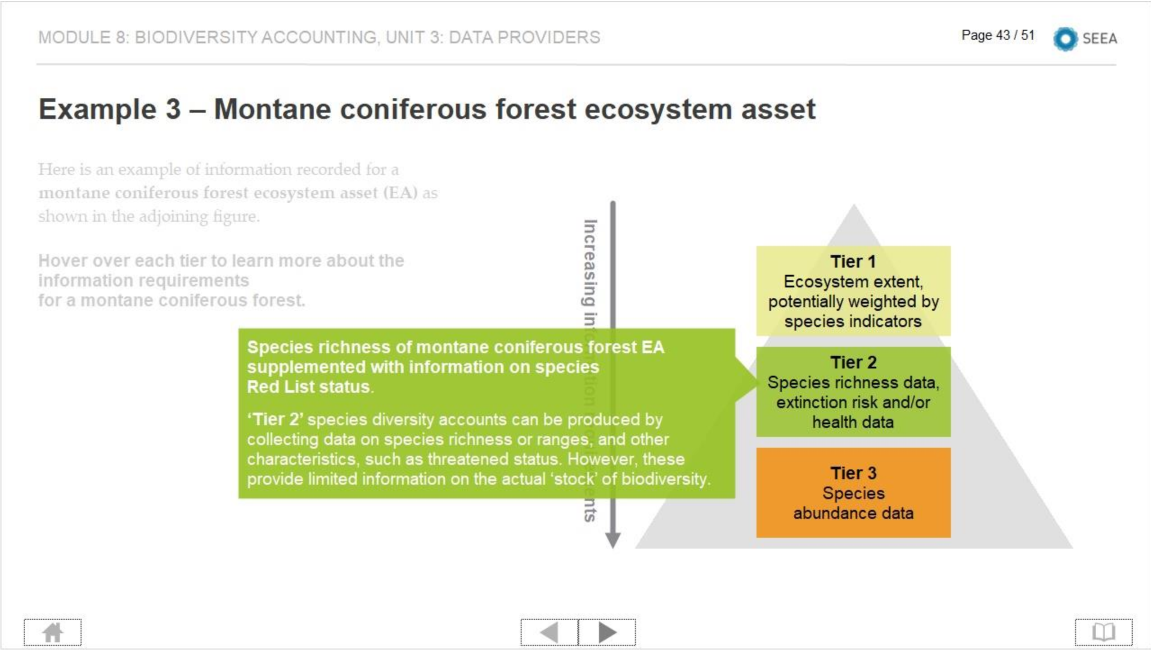
1.43 Example 3



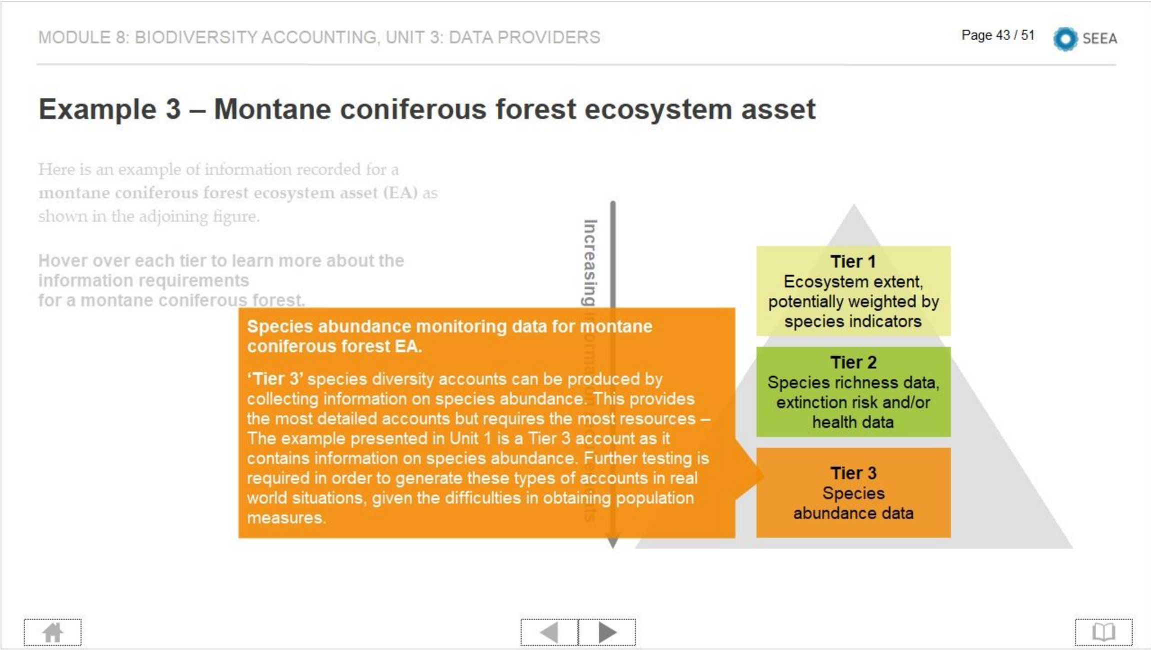
Explanation 1 (Slide Layer)



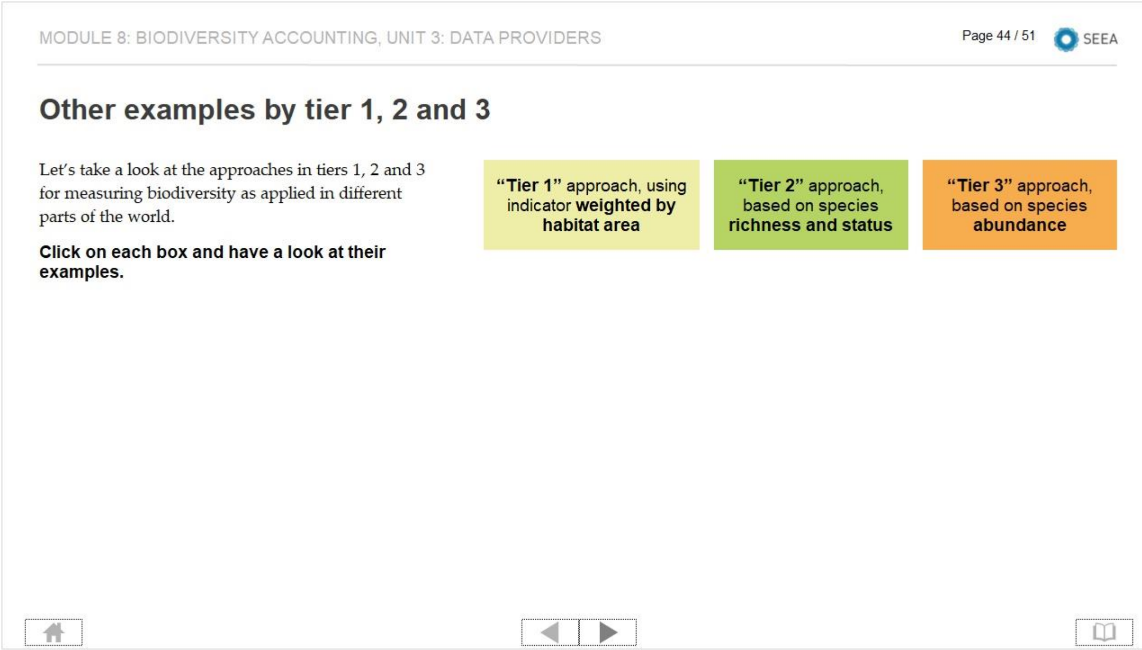
Explanation 2 (Slide Layer)



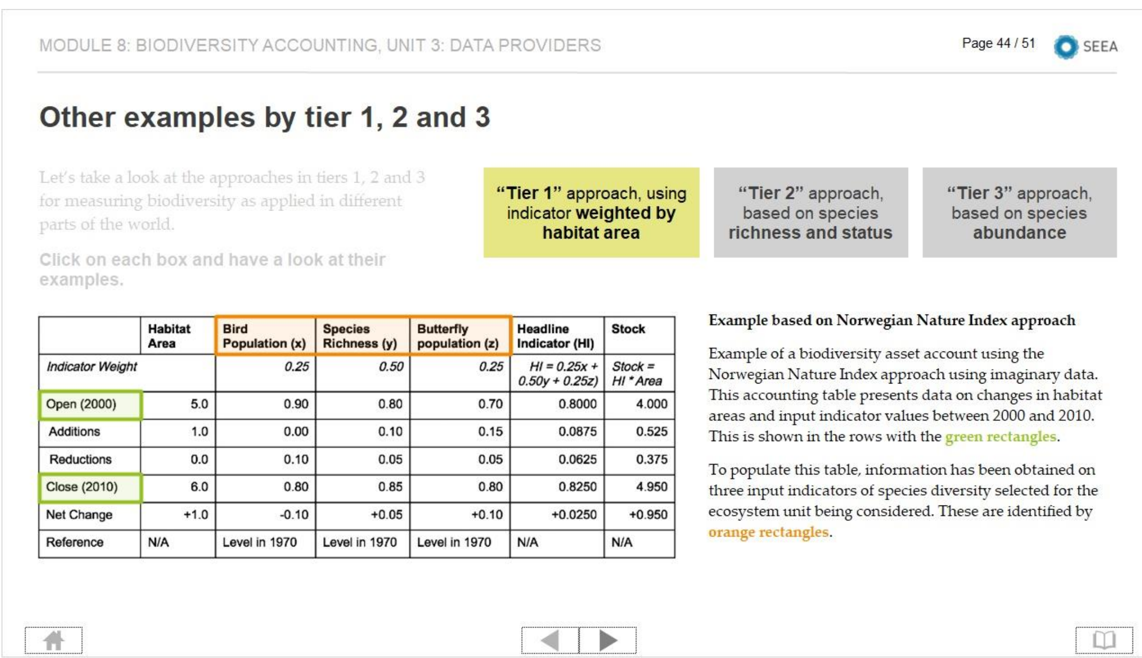
Explanation 3 (Slide Layer)



1.44 Example 4

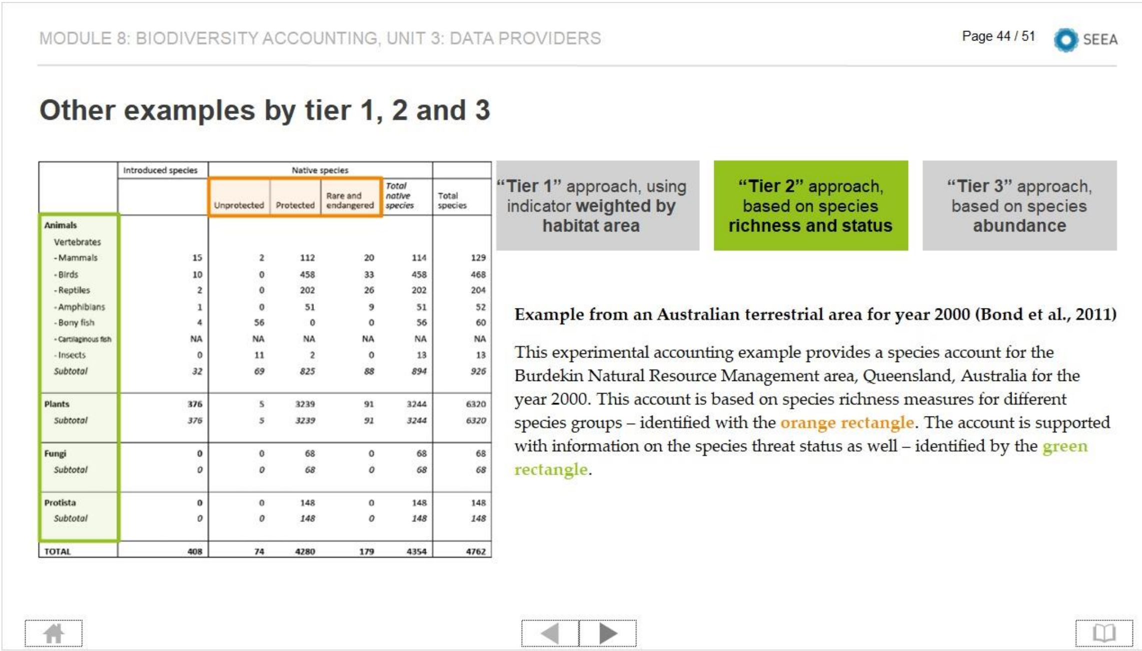


Explanation 1 (Slide Layer)



	Habitat Area	Bird Population (x)	Species Richness (y)	Butterfly population (z)	Headline Indicator (HI)	Stock
Indicator Weight		*0.25*	*0.50*	*0.25*	*HI = 0.25x + 0.50y + 0.25z)*	*Stock = HI * Area*
Open (2000)	5.0	0.90	0.80	0.70	0.8000	4.000
Additions	1.0	0.00	0.10	0.15	0.0875	0.525
Reductions	0.0	0.10	0.05	0.05	0.0625	0.375
Close (2010)	6.0	0.80	0.85	0.80	0.8250	4.950
Net Change	+1.0	-0.10	+0.05	+0.10	+0.0250	+0.950
Reference	N/A	Level in 1970	Level in 1970	Level in 1970	N/A	N/A

Explanation 2 (Slide Layer)



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Other examples by tier 1, 2 and 3

	Introduced species	Native species				
		Unprotected	Protected	Rare and endangered	*Total native species*	Total species
Animals						
Vertebrates						
- Mammals	15	2	112	20	114	129
- Birds	10	0	458	33	458	468
- Reptiles	2	0	202	26	202	204
- Amphibians	1	0	51	9	51	52
- Bony fish	4	56	0	0	56	60
- Cartilaginous fish	NA	NA	NA	NA	NA	NA
- Insects	0	11	2	0	13	13
Subtotal	*32*	*69*	*825*	*88*	*894*	*926*
Plants	376	5	3239	91	3244	6320
Subtotal	*376*	*5*	*3239*	*91*	*3244*	*6320*
Fungi	0	0	68	0	68	68
Subtotal	*0*	*0*	*68*	*0*	*68*	*68*
Protista	0	0	148	0	148	148
Subtotal	*0*	*0*	*148*	*0*	*148*	*148*
TOTAL	**408**	**74**	**4280**	**179**	**4354**	**4762**

"**Tier 1**" approach, using indicator **weighted by habitat area**

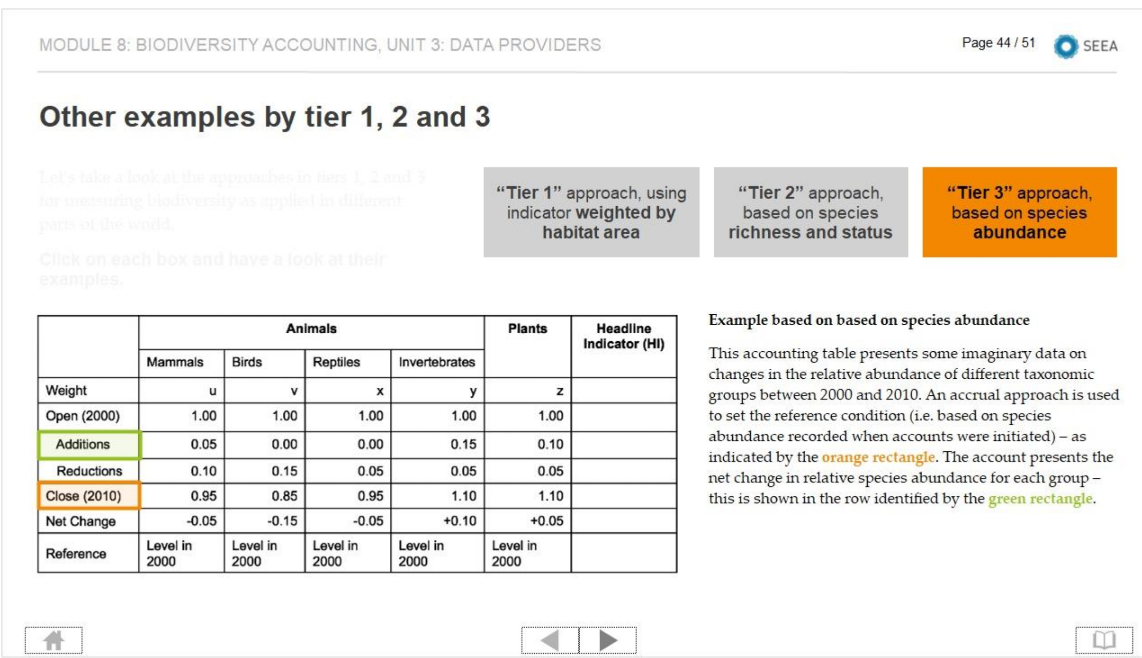
"**Tier 2**" approach, based on species **richness and status**

"**Tier 3**" approach, based on species **abundance**

Example from an Australian terrestrial area for year 2000 (Bond et al., 2011)

This experimental accounting example provides a species account for the Burdekin Natural Resource Management area, Queensland, Australia for the year 2000. This account is based on species richness measures for different species groups – identified with the orange rectangle. The account is supported with information on the species threat status as well – identified by the green rectangle.

Explanation 3 (Slide Layer)



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Other examples by tier 1, 2 and 3

"**Tier 1**" approach, using indicator **weighted by habitat area**

"**Tier 2**" approach, based on species **richness and status**

"**Tier 3**" approach, based on species **abundance**

	Animals				Plants	Headline Indicator (HI)
	Mammals	Birds	Reptiles	Invertebrates		
Weight	u	v	x	y	z	
Open (2000)	1.00	1.00	1.00	1.00	1.00	
Additions	0.05	0.00	0.00	0.15	0.10	
Reductions	0.10	0.15	0.05	0.05	0.05	
Close (2010)	0.95	0.85	0.95	1.10	1.10	
Net Change	-0.05	-0.15	-0.05	+0.10	+0.05	
Reference	Level in 2000	Level in 2000	Level in 2000	Level in 2000	Level in 2000	

Example based on based on species abundance

This accounting table presents some imaginary data on changes in the relative abundance of different taxonomic groups between 2000 and 2010. An accrual approach is used to set the reference condition (i.e. based on species abundance recorded when accounts were initiated) – as indicated by the orange rectangle. The account presents the net change in relative species abundance for each group – this is shown in the row identified by the green rectangle.

1.45 Last page

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Last page

Great!
You have now completed Units 1, 2, and 3.

Let's move on to the **questions and answers section** to review the biodiversity accounting knowledge you've learned in this module.

1.46 Module units

MODULE 8: BIODIVERSITY ACCOUNTING

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Module units

The biodiversity accounting module will take you through four units, as listed below.
We recommend completing these units in order.

Unit 1: Biodiversity accounting

- What is it?
- Why do we need it?
- What does it look like?
- Expertise and data required.

Unit 2: Compilers

- Basic concepts for measuring biodiversity.
- Steps for compiling biodiversity accounts.

Unit 3: Data providers

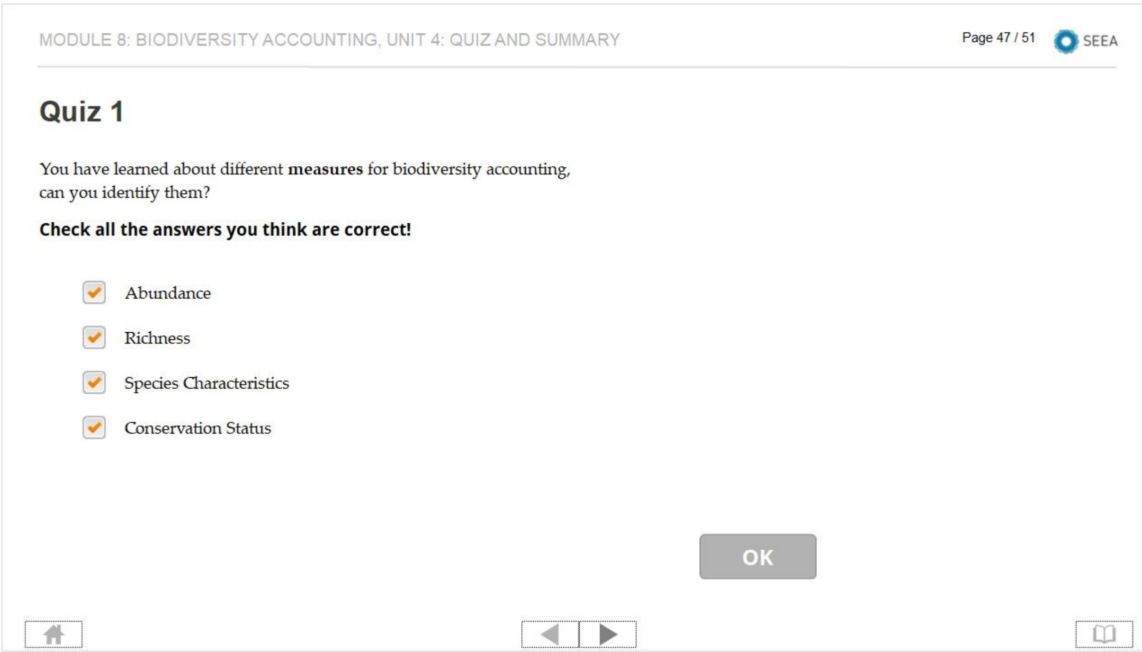
- Concepts
- Biodiversity accounting information uses.
- Data options, examples and issues.

Unit 4: Review

- Quiz
- Summary

1.47 Quiz

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
X	Abundance
X	Richness
X	Species Characteristics
X	Conservation Status

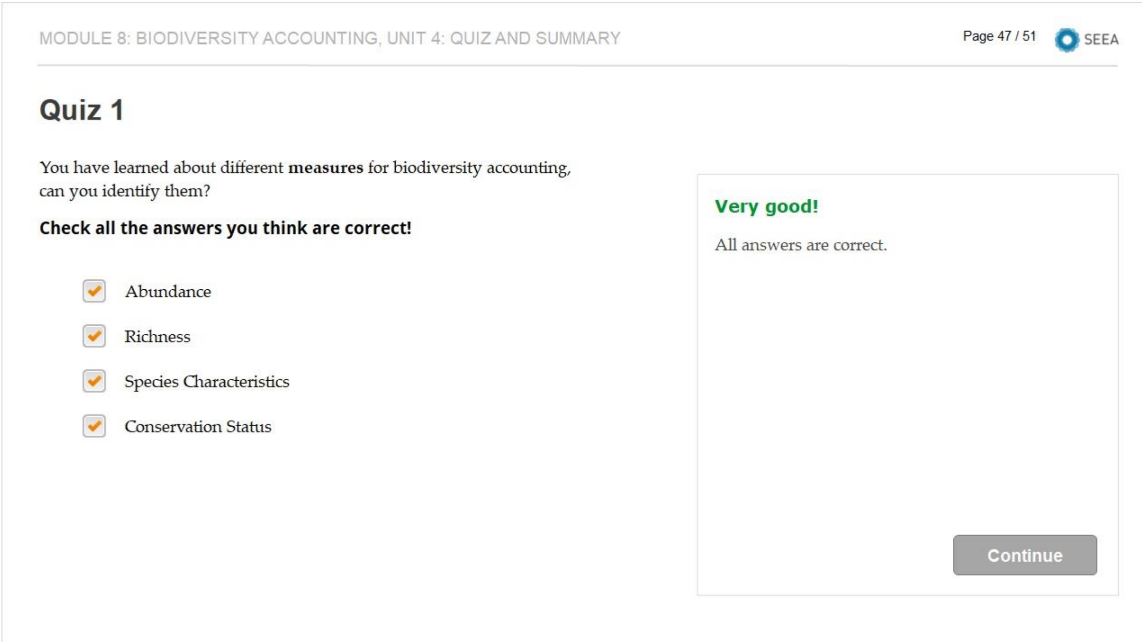
Feedback when correct:

All answers are correct.

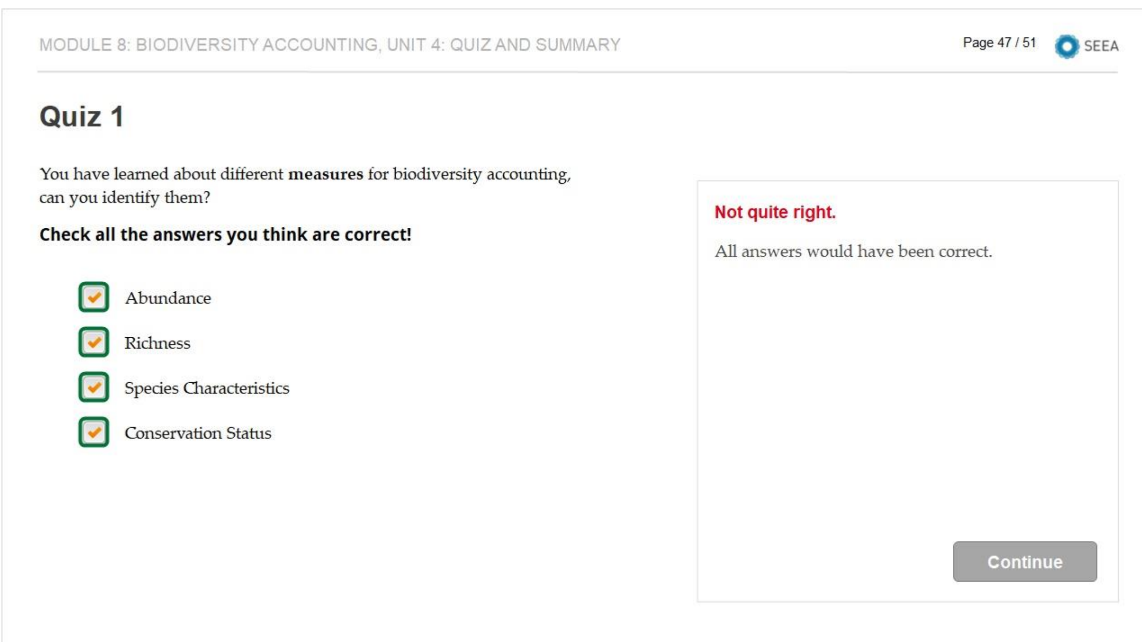
Feedback when incorrect:

All answers would have been correct.

Correct (Slide Layer)

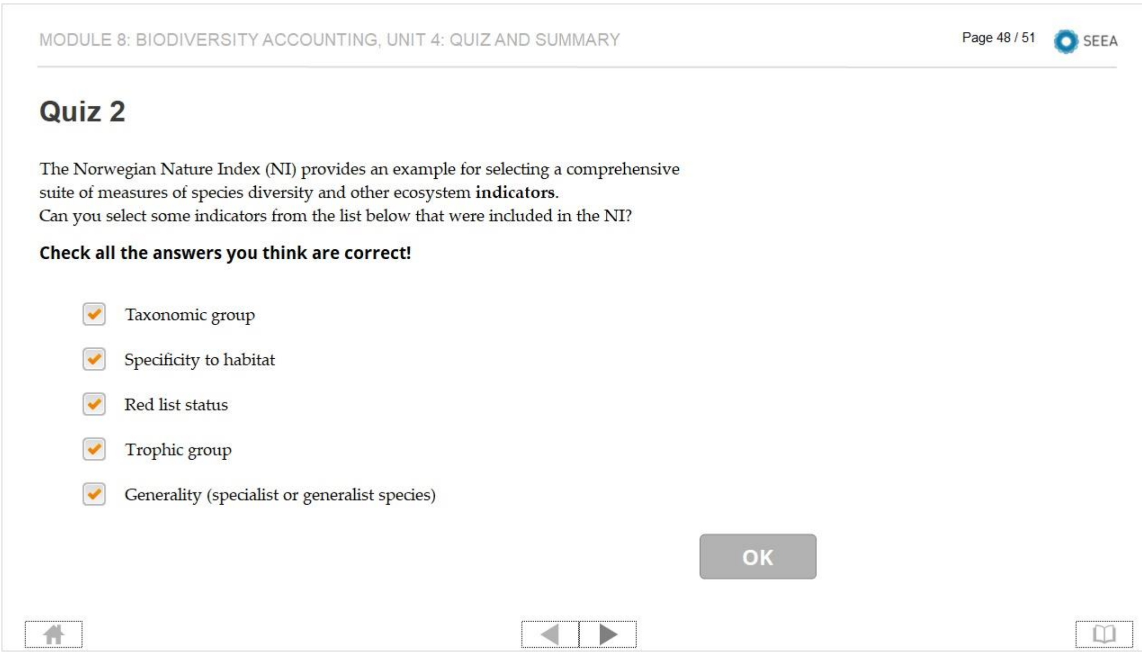


Incorrect (Slide Layer)



1.48 Quiz

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
X	Taxonomic group
X	Specificity to habitat
X	Red list status
X	Trophic group
X	Generality (specialist or generalist species)

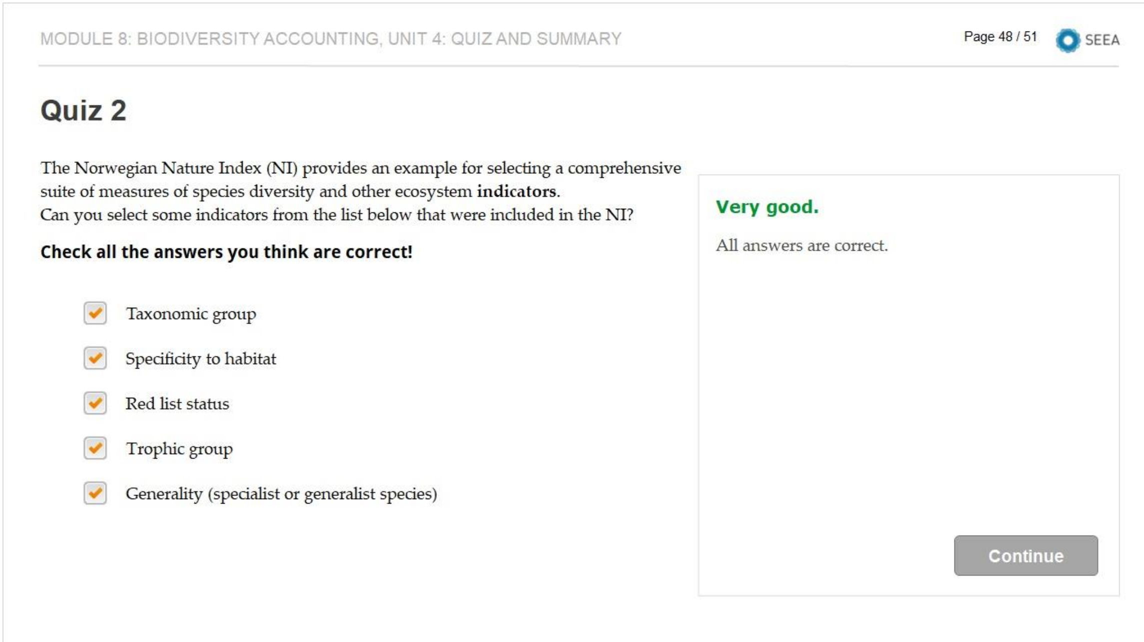
Feedback when correct:

All answers are correct.

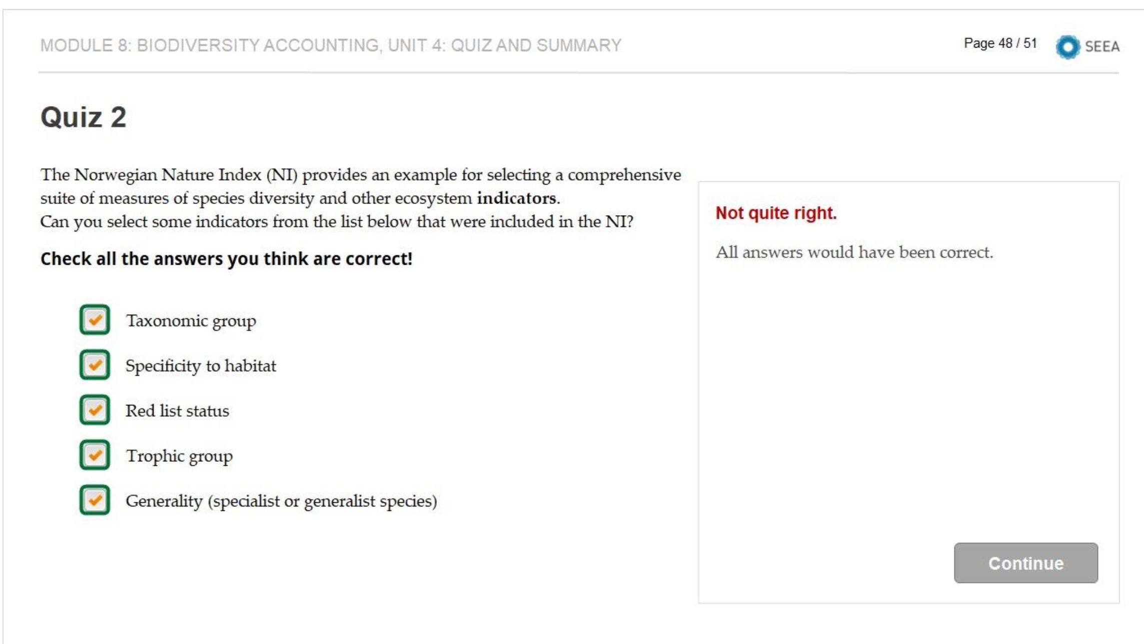
Feedback when incorrect:

All answers would have been correct.

Correct (Slide Layer)

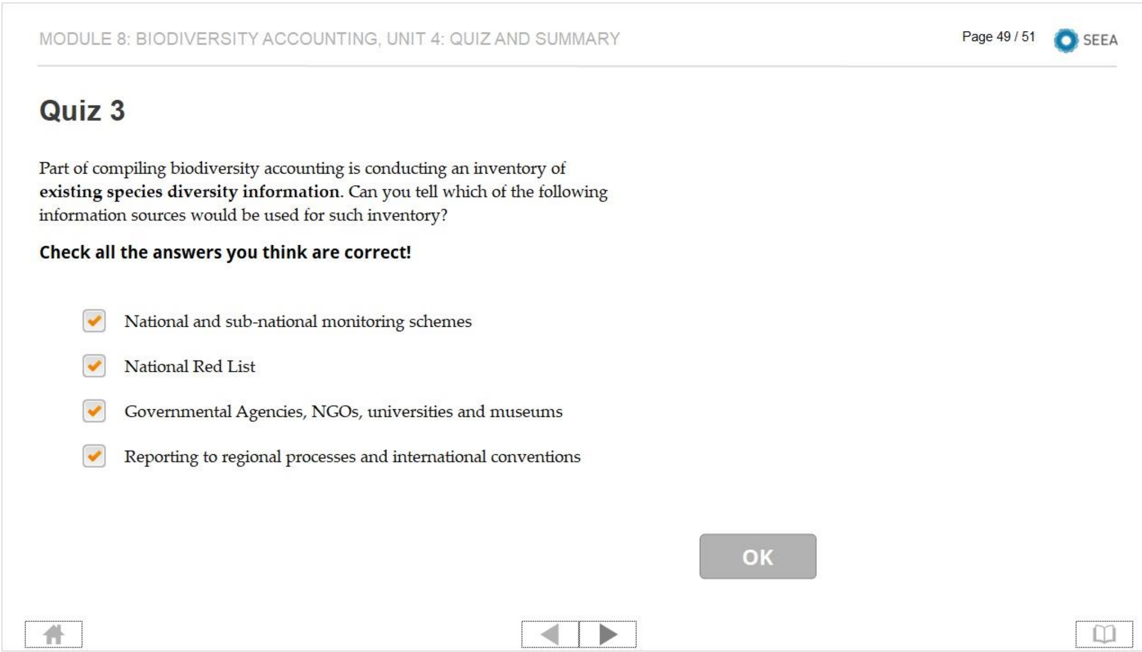


Incorrect (Slide Layer)



1.49 Quiz

(Multiple Response, 10 points, 1 attempt permitted)



Correct	Choice
X	National and sub-national monitoring schemes
X	National Red List
X	Governmental Agencies, NGOs, universities and museums
X	Reporting to regional processes and international conventions

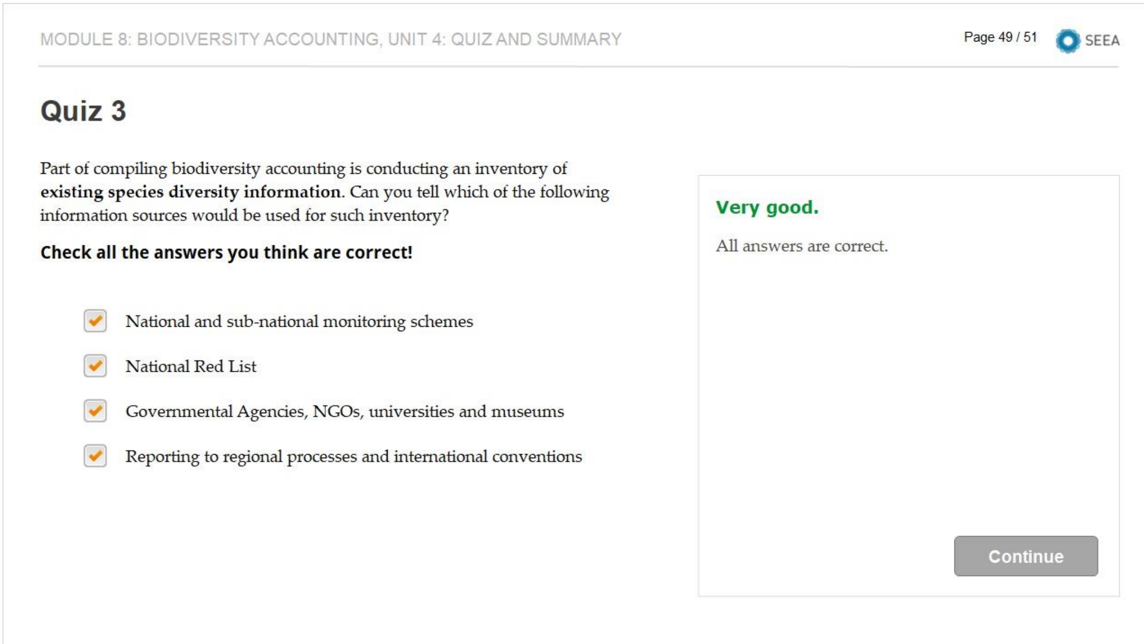
Feedback when correct:

All answers are correct.

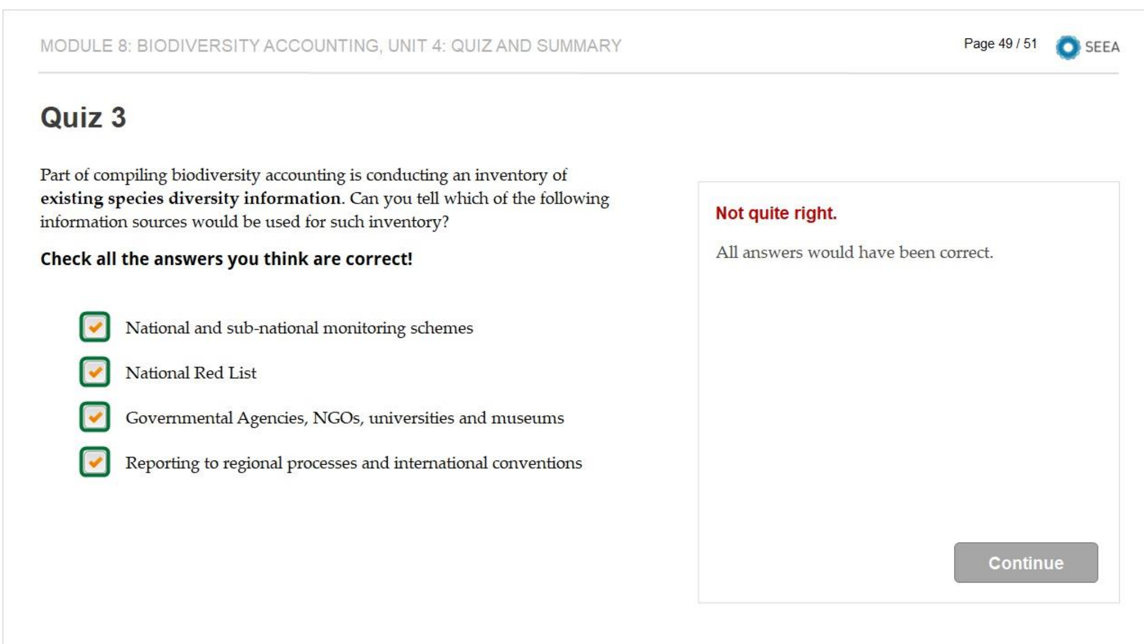
Feedback when incorrect:

All answers would have been correct.

Correct (Slide Layer)



Incorrect (Slide Layer)



1.50 Summary

Summary

Now that you've reached the end of this module, you've been equipped with the knowledge and skills to:

- Understand biodiversity accounting
- Incorporate biodiversity accounting in the wider framework of SEEA
- Understand the basic concepts for measuring biodiversity
- Learn the steps for compiling a biodiversity account
- Navigate the data options and sources behind biodiversity accounting
- Understand the important conceptual issues for biodiversity
- Learn from other countries' approaches to measuring biodiversity

Further Information:

- System of Environmental-Economic Accounting 2012 – Experimental Ecosystem Accounting (**SEEA EEA**)
- System of Environmental-Economic Accounting 2012 – Central Framework (**SEEA CF**)
- SEEA-EEA Technical Recommendations (forthcoming)
- Secretariat for the Convention on Biological Diversity (SCBD) - Quick Start Package (QSP) (Weber, 2014). Available online at www.ecosystemaccounting.net. Includes free GIS software and tutorials.
- National Biodiversity Strategies and Action Plans (Training modules at www.cbd.int/nbsap/training/)
- World Bank **WAVES**
- Statistics Canada - Measuring Ecosystem Goods and Services Teacher's Kit

1.51 References

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