Condatis Training Worksheet

Condatis 1.1 • University of Liverpool

This worksheet is designed to guide you through performing an analysis in Condatis, in combination with the slides and presentation. As with any modelling exercise, it is vital that you understand *why* you are performing the chosen analysis, exactly what input data is needed and what outputs you are expecting, so that you can identify whether the process has run properly and make the most effective use of the results in spatial conservation prioritization.

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1. Introduction to training

Condatis 1.1 can be accessed here. For more information on Condatis, its origin and the projects currently underway, please have a look at our website.

Goals of training

To provide you with:

- A clear understanding of what analyses Condatis 1.1 can perform and when it is appropriate to use it;
- The knowledge to run your own connectivity analysis through Condatis;
- The ability to produce graphical outputs from the results files; and,
- The ability to interpret the results of the analysis and consider how you might incorporate them into a report.

Resources required for training:

- A laptop/desktop computer with access to the internet;
- Input data for each Condatis case study, downloadable from the website; and,
- This *Condatis Training Worksheet* and the presentation slides that accompany the training session.

For further guidance on how to prepare the raster files for input into Condatis, please see the online Help Documentation.

2. Reason for using Condatis

Below are some key questions to answer before you start your analysis in Condatis. There are no right or wrong answers, but a clear picture of what you want to achieve through using Condatis will help you to get the most out of the tool (further guidance is available in the online Help Documentation). An example set of answers has been provided for the three case studies used in this training session:

(i) The first *flow* demonstration analysis with automated selection of source and target regions, which explores the movement of woodland species through the 'Northern Forest' region;

(ii) The *Flow* demonstration analysis with *bottleneck* analysis, which explores the movement of heathland species from the south to the north of England; and

(iii) The *Prioritisation* demonstration analysis, which forms part of a conservation prioritisation planning exercise in Sabah, Malaysia, where a limited amount of resources have become available to increase the area of land under formal protection.

(i) *Flow* analysis 1 (auto source and target selection) – Northern Forest case study

What kind of species are you interested in?	*A woodland specialist species, of short- range (1km) dispersal ability, e.g. an arboreal mammal or woodland insect species*
Why do your species need to move between the focal source(s) and target(s)?	*Under climate change we expect many species to be shifting from South to North, but do not know precisely where they will start and end. The 'Northern Forest' tree planting has the potential to facilitate both south-north and east-west movement.*

What constitutes habitat for those species within the landscape?	*Habitat classified as 'Deciduous woodland' – in this example we used data available from Natural England's Priority Habitat Inventory, aggregated to 1km squares.*
Are you performing bottleneck analysis, i.e would you like to evaluate where the most powerful links in the habitat are? [No = perform *Flow* only; Yes = analyse *Bottlenecks*	*No - we are purely interested in how species use the habitat, rather than identifying potential choke points between a pre-determined source and target.*
Are you performing a prioritisation exercise, i.e. would you like to prioritise extra protection of existing habitat or restoration of degraded habitat? [No = perform *Flow* only; Yes = perform *Prioritisation*]	*No – we are purely interested in how species may move through existing habitat, rather than in identifying the priority sites for further protection/restoration.*
Who will be interested in the results, i.e. target audience? Why?	*Mersey Forest and the Woodland Trust– to provide an evaluation of the connectedness of a large forested region, and maybe to see how their past tree conservation and planting has provided connectivity. This may help guide management plans by visualising 'high flow' routes.*

(ii) *Flow* analysis 2 – England case study

What kind of species are you interested in?	*A heathland specialist species, e.g. a winged insect or non-migratory bird species of mid- (5km) to long-range (10km) dispersal ability.*
Why do your species need to move between the focal source(s) and target(s)?	*As the climate of the UK warms, species will generally be pushed to move northwards to track appropriate temperatures. Specifically in England, we want to facilitate movement between the south coast and to or beyond the Scottish border.*
What constitutes habitat for those species within the landscape?	*Habitat classified as one of 3 priority habitat types - Lowland heathland, Upland heathland and 'Mountain heath and willow scrub' - in Natural England's Priority Habitat Inventory.*
Are you performing bottleneck analysis, i.e would you like to evaluate where the most powerful links in the habitat are? [No = perform *Flow* only; Yes = analyse *Bottlenecks*	*Yes – we are interested in knowing where chokepoints in northward movement are located, which may constitute priority areas for habitat creation.*
Are you performing a prioritisation exercise, i.e. would you like to prioritise extra protection of existing habitat or restoration of degraded habitat? [No = perform *Flow* only; Yes = perform *Prioritisation*]	*No – we do not have in mind specific candidate areas for further protection/restoration (although looking at the bottlenecks may lead us to think of these next)*
Who will be interested in the results, i.e. target audience? Why?	*English/UK conservation organisations – to guide efforts in habitat conservation by highlighting key routes through the landscape where habitat is performing a connecting function that may not have been recognised before. This*

	may help inter-regional co-operation on preserving links, and assist in operationalising policies such as the 'nature recovery network'

(iii) *Prioritisation* analysis – Sabah case study

What kind of species are you interested in?	*A tropical forest-dependent species with mid-range (4km) dispersal ability, e.g. a forest butterfly.*
Why do your species need to move between the focal source(s) and target(s)?	*To track climate change – temperatures that are now typical of lowland protected areas (PAs) in Sabah are predicted to occur at higher elevation in c.2080. For long-term resilience we think species will need to move from lowland protected areas to Mount Kinabalu. Protected Area 1 (PA1) and PA2 are used as exemplar lowland protected areas from which species are expected to move out.*
What constitutes habitat for those species within the landscape?	*Rainforest – for this exercise we used freely available forest cover data from Gaveau et al. (2016).*
Are you performing bottleneck analysis, i.e would you like to evaluate where the most powerful links in the habitat are? [No = perform *Flow* only; Yes = analyse *Bottlenecks*	*No – we are interested in identifying areas of existing habitat to protect, rather than identifying areas where habitat creation may be beneficial.*
Are you performing a prioritisation exercise, i.e. would you like to prioritise extra protection of existing habitat or restoration of degraded habitat? [No = perform *Flow* only; Yes = perform *Prioritisation*] If yes, how will you classify the landscape into baseline habitat (that you assume will not change in future) and the prioritisation layer (which may or may not be habitat in future)?	*Yes - we would like to prioritise extra protection of the forest which currently exists outside protected areas (PAs), because this may be vulnerable to deforestation in future.* *Initially we will look at preserving the most important habitat for connecting two lowland PAs with Mount Kinabalu, without having a specific limit on the land area available for extra protection. All protected forest will go into the baseline habitat layer, and all unprotected forest into the prioritisation layer.*
Who will be interested in the results, i.e. target audience? Why?	*Conservation NGOs and government departments – to inform where their efforts to avoid deforestation in future should be focussed. In particular, to provide evidence for which unprotected areas of rainforest contribute the most to current connectivity and therefore would have the greatest connectivity "cost" if they were deforested, making them high priority for protection.*

3. Preparing data for Condatis

The data layers and parameters that are required for running a Condatis analysis are shown below, along with a brief description of how to create each input. *Flow 1* analysis is the most basic type for analysing a single landscape configuration (see the first case study below). *Flow 2* analysis requires additional input (see the second case study below) but provides the same output types as the

previous analysis plus additional ones. The *Prioritisation* analysis takes some additional inputs and gives some additional outputs (see third case study below), as well as giving flow outputs for the baseline landscape and the maximal landscape (with all baseline and proposed habitat). Raster layers (starred in the table below) can be created in QGIS, ArcGIS, R or other packages.

DATA LAYER/PARAMETER	EXPLANATION
All analysis needs:	
Reproductive Rate	Derived from ground data/expert knowledge; measured in individuals per km^2.
Dispersal Distance	Derived from ground data/expert knowledge; measured in km.
Habitat*	Raster, in geographical .tif format, where cells have a value between 0 and 1, according to the quantity/quality of habitat within each cell, and geographical co-ordinates are measured in metres.
***Flow 1 analysis* also needs:**	
Source and Target direction	Confirm you wish Condatis to Autogenerate a Source and Target layer and select the direction (source to target).
***Flow 2 analysis* also needs:**	
Source and Target*	Raster, in geographical .tif format of the same spatial resolution and coordinate system as the *Habitat* layer, where source grid cells (pixels) are given a value of '1'; target cells '2'.
Bottlenecks	Confirm that you wish bottlenecks within the habitat to be analysed by checking the box labelled *'compute bottlenecks',* and choose the number of bottlenecks to be displayed.
A *Prioritisation* analysis also needs:	
Source and Target*	Raster, in geographical .tif format of the same spatial resolution and coordinate system as the *Habitat* layer, where source grid cells (pixels) are given a value of '1'; target cells '2'.
Prioritisation layer*	Raster similar to the *Habitat* layer, which can represent habitat that does not currently exist, but where restoration is possible, or unprotected habitat that you may plan to conserve.
Stages	Choose how many analysis stages is appropriate given the desired specificity of results (better with more stages) and time available for analysis (slower with more stages).
Stage type	The two options are: (i) *Number based (equal number of cells dropped in each stage)*, or (ii) *Flow based (equal proportion of flow dropped in each stage)*. The number based output may be simpler, for ranking the landscape into broad bands, but the flow based output gives more detail in the high-flow areas, which we think may be more useful when you can only afford to protect/restore a very small proportion of the additional habitat.

4. GIS Layers provided

The geospatial layers for the *Flow* 1 *Flow* 2, and *Prioritisation* demonstration analyses are listed below and can be found in the *Inputs* folder within the *CondatisTrainingFiles.zip* package.

Condatis *Flow* 1 Inputs

Folder	File name (.tif unless stated)	Condatis input
Habitat	pdwoodaroundNforest1km	*Habitat Layer* – for Flow

Condatis *Flow* 2 Inputs

Folder	File name (.tif unless stated)	Condatis input
SourceTarget	Eng_SN	*Source and Target Layer*
Habitat	HeathEng1km	*Habitat Layer* – for Flow

Condatis *Prioritisation* Inputs

Folder	File name (.tif unless stated)	Condatis input
SourceTargets	SourceTarget1 SourceTarget2	*Source and Target Layers*
Habitat	Forestundrop	*Habitat Layer* – for Prioritisation
	Forestdrop	*Prioritisation Layer* – for Prioritisation
	ForestEx1	*Maximal Habitat Layer* – could be used for Flow analysis if wanted

Condatis Outputs

Output files are provided in case you wish to check your own Condatis outputs. These can be found in the *Outputs* folder within the *CondatisTrainingFiles.zip* package:

5. FLOW 1 analysis example

See section 2 for the rationale behind this example. Follow the slides in *CondatisTrainingExercise.pptx for FLOW 1, FLOW 2 and PRIORITISATION analyses* to log into Condatis and try this analysis for yourself. If desired, record the names of the files and parameters that you are using.

DATA LAYER/PARAMETER	FILE NAME/VALUE
Source and Target Direction	
Habitat	
Reproductive Rate (individuals per km^2)	
Dispersal Distance (km)	

Results – FLOW 1

Follow the *CondatisTrainingExercise.pptx* slides as above, to guide you through downloading your results. Look at them and consider how to interpret the key outputs. Record notes below to help you remember where to find results and what to look for when interpreting them.

OUTPUTS	WHERE TO FIND IT (FILE AND/OR FIGURE IN HTML REPORT)	INTERPRETATION
Flow map		
Progress map		
Overall speed		

Conclusions from *Flow 1* analysis

By performing this *Flow* analysis you get an overview of how and where existing deciduous woodland is providing functional south-north connectivity. Consider the conservation conclusions with help from the slides.

Where are the most important connectivity pathways for our species of interest? Is one pathway dominant or are there several alternatives?	

Note down any considerations you have for improving future Condatis analyses.

Comments on any processes that did/did not work as expected:	
Will you re-run the analysis? Why?	

Data Presentation – FLOW 1

For your chosen target audience, consider how you would present the data to get across the most important results you found above.

How will you present the data to your target audience?	
What, if any further analysis is needed to answer your original research question(s)?	

6. FLOW 2 analysis example

See section 2 for the rationale behind this example. Follow the slides in *CondatisTrainingExercise.pptx for FLOW and PRIORITISATION analyses* to log into Condatis and try this analysis for yourself. If desired, record the names of the files and parameters that you are using.

DATA LAYER/PARAMETER	**FILE NAME/VALUE**
Source and Target	
Habitat	
Reproductive Rate (individuals per km^2)	
Dispersal Distance (km)*	
Bottlenecks	

** You may like to try two theoretical dispersal distances, e.g. 5km/10km, so results can be compared*

Results – FLOW 2

Follow the *CondatisTrainingExercise.pptx* slides as above, to guide you through downloading your results. Look at them and consider how to interpret the key outputs. Record notes below to help you remember where to find results and what to look for when interpreting them.

OUTPUTS	WHERE TO FIND IT (FILE AND/OR FIGURE IN HTML REPORT)	INTERPRETATION
Flow map		
Progress map		
Overall speed		
Bottlenecks		

Conclusions from *Flow 2* analysis

By performing these two *Flow* analyses with bottlenecks you can observe how the distance an individual can disperse affects the pattern of range shifting across the landscape between the source and the target habitat, as well as the overall speed. When you have looked at both sets of results, think about their similarities and differences, and the conservation conclusions.

Where are the most important connectivity pathways for our species of interest?	
Where are the largest bottlenecks in the habitat? Does this make sense when you imagine the process of species progressing along the higher-flow routes? Do you think habitat restoration around the bottlenecks could help?	
Are the connectivity and bottlenecks patterns affected by dispersal distance? In what ways?	

Note down any considerations you have for improving future Condatis analyses.

Comments on any processes that did/did not work as expected:	
Will you re-run the analysis? Why?	

Data Presentation – FLOW 2

For your chosen target audience, consider how you would present the data to get across the most important results you found above.

How will you present the data to your target audience?	
What, if any further analysis is needed to answer your original research question(s)?	

7. PRIORITISTION by Dropping analysis example

See section 2 for the rationale behind this example. Follow the guidance in *CondatisTrainingExercise.pptx* to log into Condatis and try this analysis for yourself. If desired, record the names of the files and parameters that you are using.

DATA LAYER/PARAMETER	**FILE NAME/VALUE**
Source and Target	
Habitat	
Reproductive Rate (individuals per km^2)	
Dispersal Distance (km)	
Prioritisation layer	
Stage type *(circle choice)*	(i) *Number based (equal no. of cells dropped/stage)* (ii) *Flow based (equal proportion of flow dropped/stage)*
Dropping Stages *(circle choice)*	Maximum (one cell dropped at a time) 1000 100 (recommended) 50 10 (rough guide)

Results - PRIORITISATION

Follow guidance in *CondatisTrainingExercise.pptx* to download your results. Look at them and consider how to interpret the key output. Record notes below to help you remember where to find results and what to look for when interpreting them.

OUTPUTS	**WHERE TO FIND IT (FILE AND/OR FIGURE IN HTML REPORT)**	**INTERPRETATION**
Reduction in speed		
Trajectory of dropping		
Dropping Rank map		

Step Dropping Summary		
Speed loss map		

Write down the names of the output figures from your Condatis analyses, as shown in the results html, and describe your initial interpretation of the results. Repeat this for the other *Prioritisation* analysis, e.g. using PA2 (protected area 2) as the source instead of PA1.

Conclusions from the *Prioritisation* analysis

By performing these two *Prioritisation* analyses you will be able to observe where common connectivity routes from both source protected areas (PA1 and PA2) might be, and therefore the priority habitats for conserving under a limited budget. Consider your conservation conclusions and make notes below.

Where is the most important unprotected habitat for enabling populations to move from both source PAs to Mount Kinabalu?	
Could a high proportion of connectivity be preserved with a small proportion of the habitat?	
Could one corridor be effective for both source PAs?	

Note down any considerations you have for improving future Condatis analyses.

Comments on any processes that did/did not work as expected:	
Will you re-run the analysis? Why?	

Data Presentation - PRIORITISATION

For your chosen target audience, consider how you would present the data to get across the most important results you found above.

How will you present the data to your target audience?	
What, if any further analysis is needed to answer your original research question(s)?	

8. Feedback & information

Once you have completed the training, please provide us with advice on how we might improve it in the future by filling out the Feedback Form. If you require further assistance in using Condatis or would like to be added to the Condatis Network mailing list, please email contact@condatis.org.uk.

This worksheet was developed by Lydia Cole, Jenny Hodgson, Kath Allen and Tom Travers. We would like to thank NERC for supporting this training, and Drs Jamie Alison and Sarah Scriven for their help with providing the data for these case studies.

9. Copyright & Citation

The html file reporting the results of your Condatis analysis has more information on copyright for the inputs and outputs from running a job. It also contains information on how to cite the software; please include a reference to Condatis in your work wherever it is appropriate. We would appreciate it if you could let us know how you are using Condatis so that we can report on its application in future grant applications and impact reporting. Please email us, and ideally send a copy of any publications to contact@condatis.org.uk.

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