Condatis connectivity analysis to plan resilient habitat networks: training workshop introduction:

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Major acknowledgements to:
Claudia Gutierrez-Arellano, John Heap, Lydia Cole, Sarah Scriven, Tom Travers, Jamie Alison,

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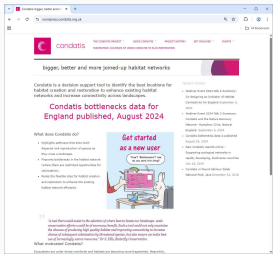
Condatis is a web application and a science-practice partnership

- Project started 2013
- Thanks to many partners!
- In this talk: why was Condatis needed?
- How can Condatis support landscape decisions?

Find out more: www.condatis.org.uk
Get started with today's exercises:
https://condatis.github.io/Ctraining_InR_25/



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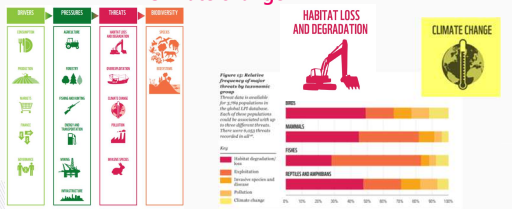
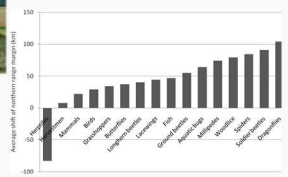
Why needed? For nature recovery with Climate change



WWF. 2018. Living Planet Report - 2018: Aiming Higher. Grooten M, Almond R (Eds.) WWF, Gland, Switzerland

3

Range-shifting through fragmented landscapes is a challenge



Pateman and Hodgson (2015) The effects of climate change on the distribution of species in the UK. Biodiversity climate change impacts report card technical papers. LWEC partnership

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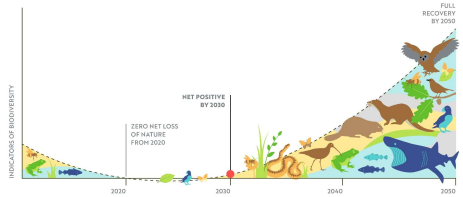
'Nature-positive 2030' a great ambition, but how to get there?



- https://www.wcl.org.uk/a-world-richer-in-nature.asp

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One solution is better connected networks

Designed by Mandee Hoffin. Hilty et al. (2020). Guidelines for conserving connectivity through ecological networks and corridors. Best Practice Protected Area Guidelines Series No. 30. Gland, Switzerland: IUCN.

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Policies are already aiming for large-scale restoration, e.g.

The Nature Recovery *Network* includes:
- Protected sites (recovery actions)
- Other wildlife-rich habitat (500,000 hectares created or restored by 2042) of outside the protected site network
- Woodland planting (180,000 hectares in England)

Defra. (2018). A Green Future: Our 25 Year Plan to Improve the Environment. https://www.gov.uk/government/publications/25-year-environment-plan

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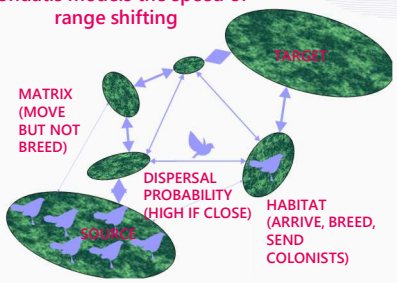
Condatis models the speed of range shifting



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Thanks to this underlying range-shift model, we can:

- Highlight pathways across a landscape that allow both dispersal and reproduction of species;
- Pinpoint bottlenecks in the habitat network, where there are restricted opportunities for colonisation, and where restoration would be most impactful;
- Rank any feasible sites for habitat restoration, to efficiently enhance the existing habitat network

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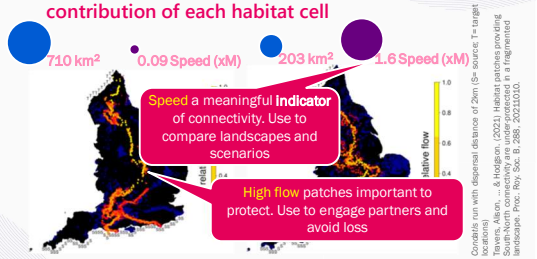
Speed scores the whole network, flow shows contribution of each habitat cell



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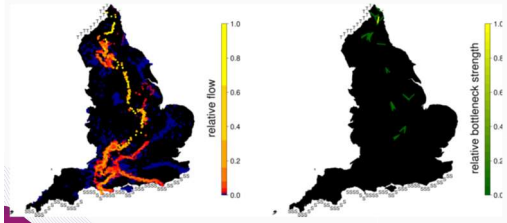
Bottlenecks are 'difficult jumps' where flow is restricted: target restoration here



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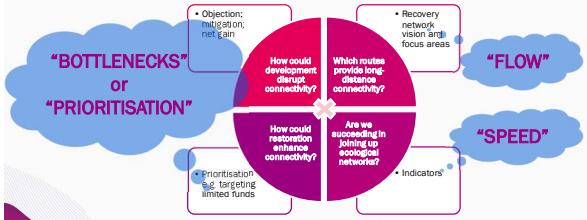
Several ways Condatis can support landscape decisions



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Objectives for today

A. Learn how to use the Condatis web app, with an example about protecting additional rainforest in Sabah, Borneo
B. Learn how to use Condatis in R
C. The R example comes from our 2023-24 work with Natural England, trying to give national strategic guidance to improve the connectivity of semi-natural habitats; we developed some additional functions that aren't available in the web app yet (see Claudia's talk)

- **Session 1**
- 11:20 — now Introduction to Condatis
- now — 12:00 Web App tour and explaining the Sabah exercise
- 12:00 — 12:40 Sabah exercise running, viewing outputs in GIS, with help as needed
- 12:40 — 12:50 Condatis Bottlenecks introductory presentation
- **Session 2**
- 14:50 — 15:50 Condatis Bottlenecks Eastern England exercise in R
- 15:50 — 16:10 Recap, Q&A and requests
- 16:10 — 16:20 According to requests, either explore Condatis outputs further in GIS, or discuss applications for your own work

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Get started with today's exercises:
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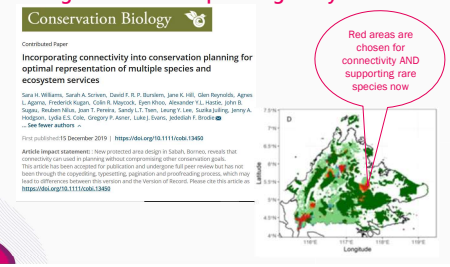
Our first example – Sabah, Borneo – based on a large conservation planning study



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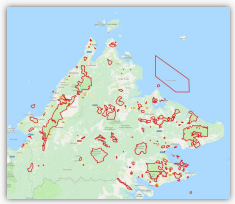
Enhancing Sabah's PA Network - Conservation & Management Qs

- As the climate gets hotter, which forested routes will populations take to move from lowland Protected Areas to suitable habitats on Mount Kinabalu?
- Given plans to protect more of Sabah's forest, which are the currently unprotected forest habitats that are a priority for long-term connectivity between lowland PAs and Mount Kinabalu?



Sabah's Protected Areas

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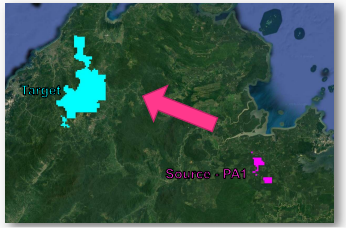
We take one case study Protected Area

- Lowland *source* to cooler, highland *target*, predicted to provide a refuge in 2080



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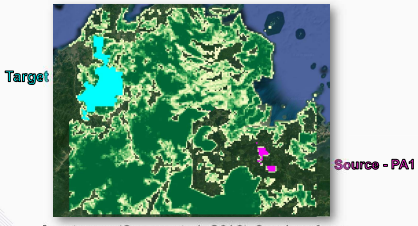
Habitat = Forest cover– mostly unprotected



forest cover (Gaveau *et al.*, 2016). Species of conservation concern assumed to move through forest habitat

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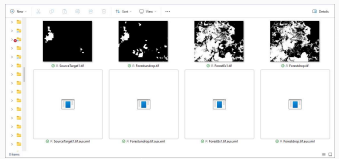
Two analyses – with provided data

- **Flow/bottlenecks analysis** asks: How easy is it currently for forest species to travel from lowlands to mountains in Sabah? Where are the bottlenecks?
  - A simple introduction to the web app - learning how to analyse flow with bottlenecks
- **Prioritisation** analysis asks: Which currently unprotected forest habitats are a priority for long-term connectivity between lowland protected areas and Mount Kinabalu?
  - We'll learn what 'Prioritisation by Dropping' does
- Find sabah_data folder



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Note that in your own analyses, data preparation needs time and thought!

- https://condatis.github.io/Ctraining_inR_25/CondatisDataRequirements.pdf PDF helps you to understand the data requirements
- https://webapp.condatis.org.uk/help/help.html#_Toc113618972 The flow chart helps to decide which analysis answers your ecological question

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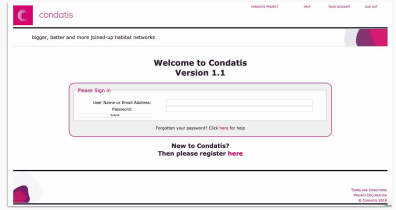
Running Condatis analysis – Log in to web app



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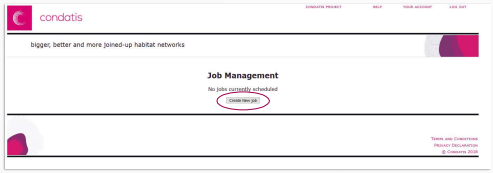
Running Condatis analysis – Create a new job



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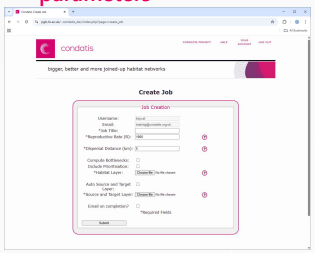
Running Condatis analysis – setting parameters



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Inputs for simple flow/bottlenecks analysis

- The 'job name' will be used to name your downloaded files, so make it informative, but not too long

Data/files	Name
Folder	**sabah_data**
Habitat layer	**ForestEx1.tif**
Source/target layer	**SourceTarget**1.tif
Reproductive rate	**2000 individ**uals per km^2
Dispersal distance	**1.5km**
Bottlenecks	**Yes (up to 20**0)

This is the 'forest example', and includes both protected and unprotected forest

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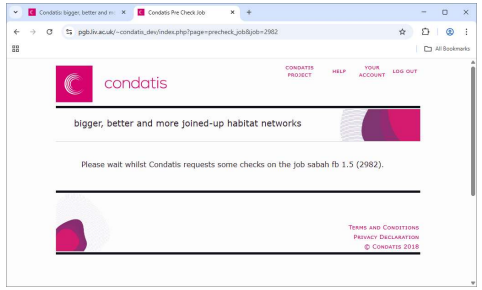

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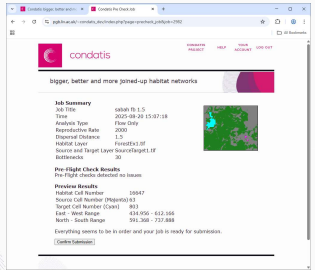
Confirm submission after pre-flight checks



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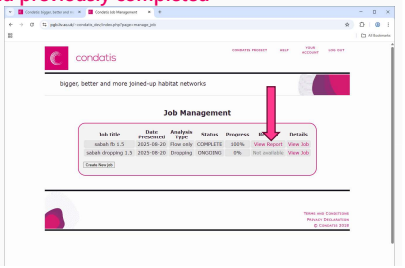
Job management page shows everything in progress and previously completed

- Click 'View Report' to get your results



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Open Results html page & download zip files

- Overview maps are shown in the html summary, but the colour scheme isn't always the clearest
- Look at the interpretation legends to help understand the data
- The connectivity of this landscape is high (7), is this a surprise?

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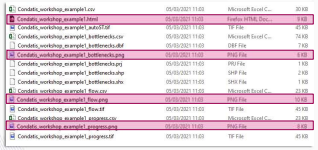
Exploring the downloaded results



- .html file is the same as the summary shown on the website
- .png files are the images displayed in the summary

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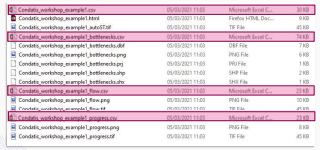
Exploring the downloaded results



- .csv files are the raw data underlying the spatial outputs
- Provided for statistical analysis should you want to

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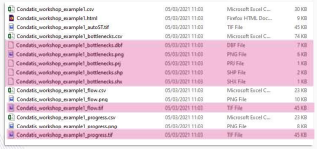
Exploring the downloaded results



- .tif files and the bottlenecks shapefile can be opened in GIS

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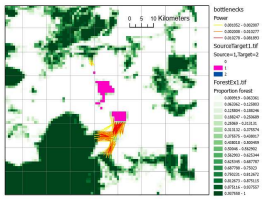
Bottlenecks and flow viewed in GIS



Notice all the bottlenecks are close to the source

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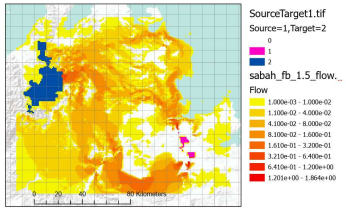
Bottlenecks and flow viewed in GIS



Notice flow is highest when there is little 'choice' about route to take. Where there is plenty of forest, flow spreads out and takes all routes

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Condatis Web app analysis summary

- Follow along with https://condatis.github.io/Ctraining_inR_25/Web_app_quick_reference.pdf
- To be able to use the web app you will need to register with the website
- Once logged in you will be able to
  - Create a job
  - Fill in the relevant parameters
- Remember to select "bottlenecks" if you require the major barriers to dispersal to be reported
- Condatis will give you a position in queue and a progress % on analysis
- A summary will be provided when analysis is finished
- Data can then be downloaded and imported to GIS and/or statistical packages for exploration

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Prioritisation – questions that can be addressed

- Conservation:
  - Of unprotected habitat that the population could move through, which areas are a conservation priority? i.e. we need to avoid losing them.
- Restoration:
  - In which areas would restoration be most beneficial to connectivity, out of identified feasible areas?
- Today, we're prioritising the unprotected rainforest in this area of Sabah. We're investigating 'worst case' future scenarios where unprotected forest is lost. Not because we expect it to happen, but in order to advise on efficient additional protection of corridors or 'climate change escape routes'.

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Inputs for Condatis – *Prioritisation* analysis

- We suggest some in the class choose 50 dropping stages (slower), and some choose 10

Data/files	Name
File package	**sabah_data**
Source/target layer	**SourceTarget1**.tif
Habitat layer	**Forestundrop.tif**
Prioritisation layer	**Forestdrop.tif**
Reproductive rate	**2000 individuals per km²**
Dispersal distance	**1.5 km**
Bottlenecks	**No**
Number of stages for dropping	**10 (rough guide) or 50**
Dropping stage Type	**Flow based**

We have separated protected and unprotected forest into two layers for you

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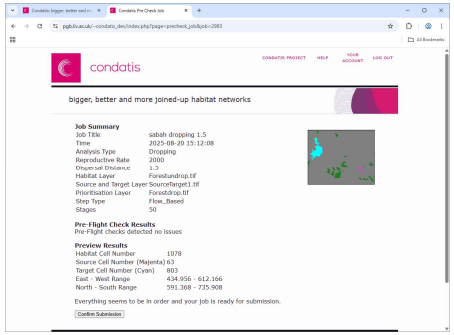

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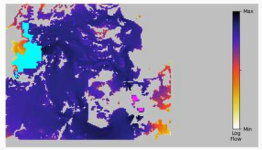
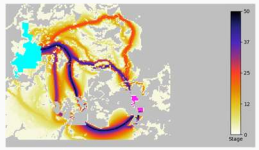
Overview of your results in html report



Start flow



Dropping rank – shows which 'climate change escape routes' are most efficient to conserve

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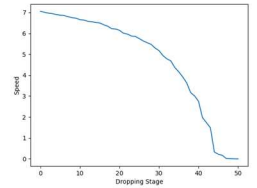
View the speed loss trajectory

- What impact does loss of habitat, i.e. dropping, have on speed of movement?
- How does speed change with each stage of dropping?



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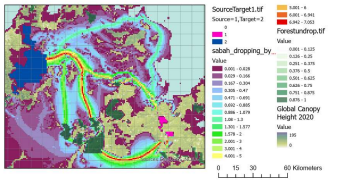
Trajectory on a map – how much of the original speed has been lost by stage x?



E.G. By retaining the yellow, orange and red areas we can keep speed loss no more than 4 (i.e. keep it above ~3 when it was originally ~7)

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Synthesis

- **Flow/bottlenecks analysis** asks: How easy is it currently for forest species to travel from lowlands to mountains in Sabah? Where are the bottlenecks?
  - We learnt how to analyse flow with bottlenecks
  - We saw some obvious features bottlenecks tend to have – bridging the worst gaps along a route that species are 'forced' to take if they are to reach the target
  - We noted that the bottlenecks in this particular landscape are difficult in practice to bridge
- **Prioritisation** analysis asks: Which currently unprotected forest habitats are a priority for long-term connectivity between lowland protected areas and Mount Kinabalu?
  - We learnt what 'Prioritisation by Dropping' does
  - The landscape starts with a high connectivity ("speed"), and it would be possible to preserve much of this with a small amount of conserved corridor forest
    - Just looking at flow alone in these landscapes would not have given such clear priorities of areas to save from logging
    - The end speed is virtually zero, because there are large distances between the existing protected areas

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Of course, analyses like these are only the beginning of your travels

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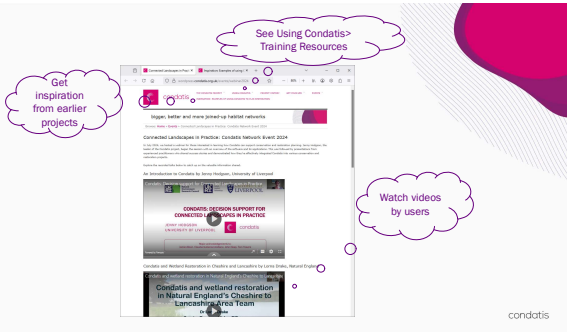

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Thanks! Feedback welcome

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Thanks to many conservation partners and users who have helped make Condatis fit for purpose

Our software developers include: David Wallis, John Heap, Tony McCabe, Tom Travers and Claudia Gutierrez-Arellano

Find out more: www.condatis.org.uk

Natural Environment Research Council

Future Leaders Fellowships

University of Liverpool

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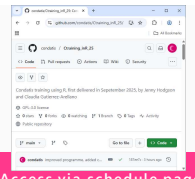
Download all today's materials: https://github.com/condatis/Ctraining_inR_25/



Access via schedule page: https://condatis.github.io/Ctraining_inR_25/

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