GTB-tools in container: Image Analysis → Restoration Planner
Task: assess restoration status and restoration scenarios

In graph-theory, a network is defined as a set of components, and a component is defined as a set of nodes connected via area-free links. In contrast to graph-theory, all tools in this container examine the entire area of the existing network, where the network is defined as a set of individual interconnected objects or put simply, the set of all foreground patches. For example, a forest network is defined as the set of all forest patches, also called forest objects. **Coherence** is defined as the normalized degree of connectedness of the area of all network objects. Coherence is measured in percent and is maximum (100%) if the entire foreground area is interconnected in a single foreground object. **Restoration** is defined as the process of adding area to an existing network aimed at increasing network coherence. The impact of any restoration measure can then be quantified by measuring the increase in percent points of coherence before and after the restoration event. With this setup, the restoration event is defined as the process of converting a series of background pixels into foreground pixel, which then become part of the new network. The effort needed to conduct the restoration event is directly related to the per-pixel **resistance** to conduct the conversion from background to foreground pixels:

- A restoration status assessment measures the coherence of the existing foreground network.
- A restoration assessment quantifies the change in coherence before and after the restoration event.
- The effort to conduct a restoration is related to the background resistance.

It is strongly recommended to read the Restoration Planner product sheet. This document provides further details and application examples for both, the network status assessment, and the restoration assessment.

Setup Tools (← click for product sheet)

Question: how can I define or customize the resistance map?

Restoration entails the conversion of background to foreground pixels and the effort to conduct this process is driven by the specific resistance value of the pixels that will be converted. Within GuidosToolbox the following notation is used for the **input resistance map**:

- 2 byte – Foreground: pixel of interest/habitat having the lowest resistance = easiest to traverse
- [3, 100] byte – Background (outside of network): a pixel having a larger resistance than foreground of at least 3 and up to a maximum of 100.
- 0 byte – Missing: a pixel with infinite resistance = impossible to traverse

The options in the menu *Setup Tools* can be used to assign resistance values, choosing either:

- Fixed BG: all background pixels will get the same resistance value.
- Land Cover: assign a resistance value to a specific land cover class.
- Distance: resistance value will increase with increasing distance away from the foreground boundary.
- Pixel: insert the resistance value for a specific x/y-coordinate.
- Line: draw a line and assign the resistance value to the line pixels.
- Region Of Interest: select or insert a new region of interest and assign the resistance value.
- Isochrone Map Marker Image: setup a marker image, specifying the start object (mandatory) and the optional target object for travel time analysis.

Further instructions are summarized in the Restoration Planner section of the GTB Manual.

How: load a map and apply a suitable option from the list above.

Result: the customized input map for a restoration status assessment.

Assessment (← click for product sheet)

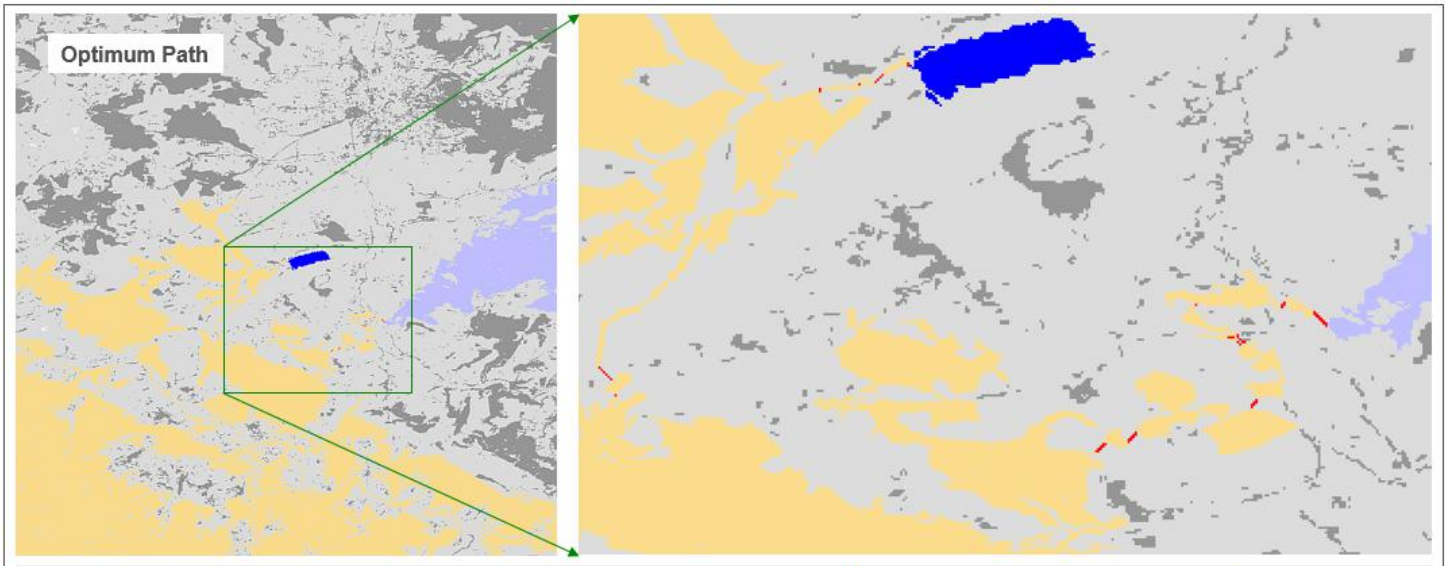
Question: what is the restoration status? What is the impact of a specific restoration event? Where is restoration most efficient and at what price?

The options in the menu *Assessment* are designed to conduct a restoration status-, change-, planning-, or travel time analysis, each summarized with a set of restoration status and restoration planning indicators. Please consult the Restoration Planner section of the GTB Manual and/or the Restoration Planner product sheet.

- *Status Summary*: restoration status summary overview.
- *Change Summary*: changes in restoration status over time or after a restoration event.
- *Add Custom Path*: insert a restoration path; assess its cost and impact on the current network.
- *Find Optimum Path*: detect the optimum restoration pathway between a user-specified start and target object; assess its cost and impact on the current network.
- *Show Optimum Big 5*: automatically detect the pairwise optimum restoration pathways between the five largest network objects; assess the cost and impact on the current network for each of them.
- *Isochrone Map A*: show the travel time distance from a user-selected object.
- *Isochrone Map AB*: show the travel time surface between two user-selected objects.

How: load or setup a resistance map and apply a suitable option from the list above.

Result: statistics and maps, see the Restoration Planner product sheet for details.



	A	B	C	D	E	F	G	H	I	J	K	L
1	SIZE_A	SIZE_B	REST_PIX	AVDIST_RP	EXP_30	EFFIC	ECA_ORIG	ECA_NEW	DELTA_ECA	COH_ORIG	COH_NEW	DELTA_COH
2	1451	33508	65	1.80456	1950	24.151311	221292.76	268387.81	47095.056	51.644789	62.626224	10.981435

The chart above shows an example for the option *Find Optimum Path* including statistics for the optimum restoration pathway (red) between a start object (dark blue) and target object (light blue). In this example, the automatically detected optimum restoration pathway will increase the network coherence by ~ 11 percent points from the previous degree in network coherence of 51.6% to the new degree in network coherence of 62.6% (see the three last columns). The selected starting object (dark blue) is of size 1,451 pixels, the target object (light blue) is of size 33,508 pixels; by taking maximum advantage of intermediate existing objects, only 65 restoration pixels (red) are needed to establish a connection between start- and target object.