


 Restoring the web of life

Tools for the Analysis of connectivity in Riverine landscapes



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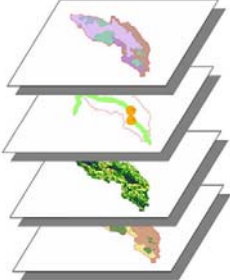


 Restoring the web of life

Tools for the Analysis of connectivity in Riverine landscapes


Overview

- definition of riverine landscapes
- quantifying fragmentation
- characterising barriers
- habitat connectivity
- Outlook

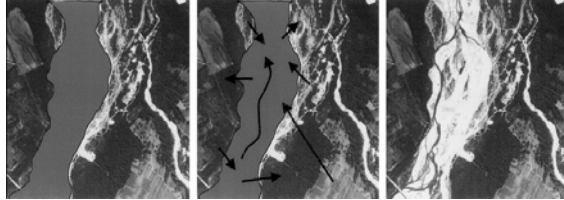


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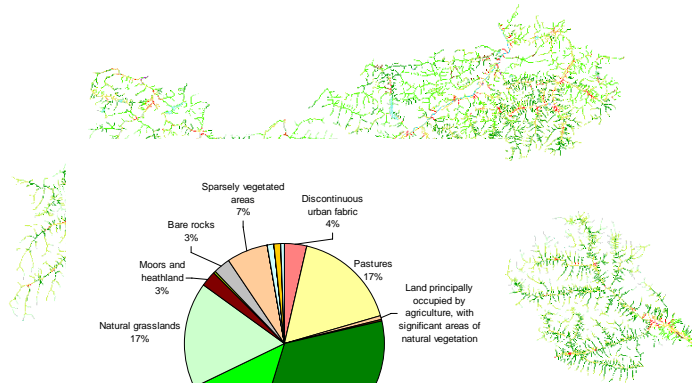
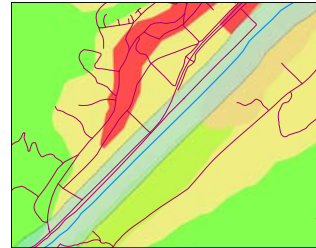
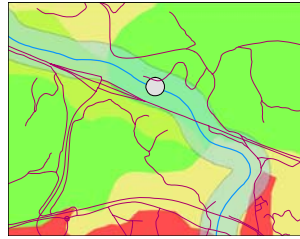
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Riverine landscapes



Wiens_2002

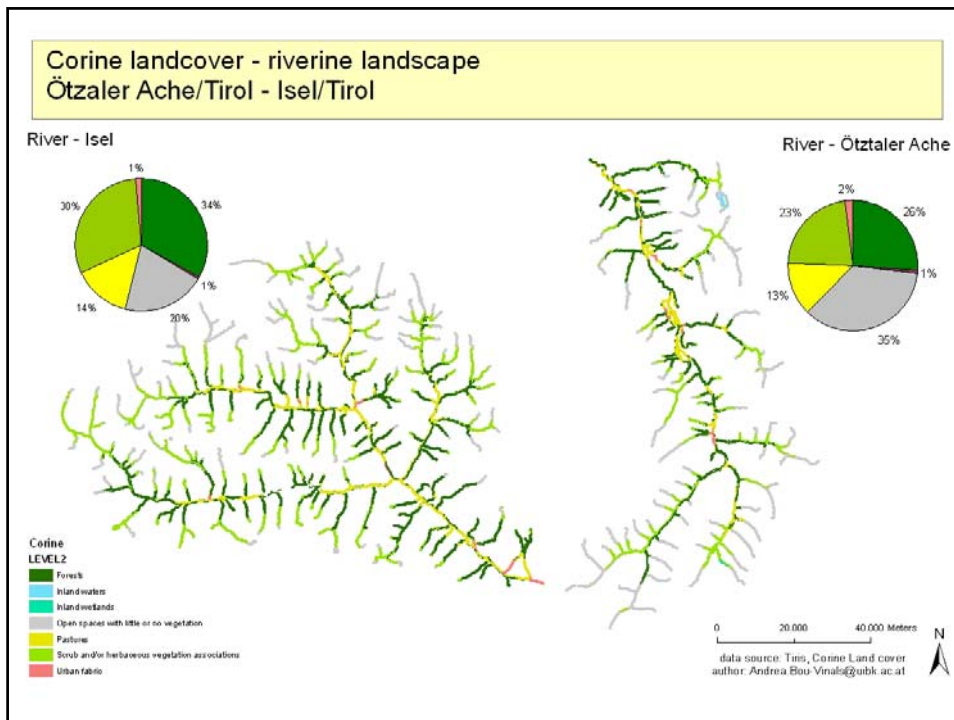


- Level3**
- Alports
 - Bare soils
 - Broad-leaved forest
 - Complex cultivation patterns
 - Coniferous forest
 - Continuous urban fabric
 - Discontinuous urban fabric
 - Glaciers and perpetual snow
 - Industrial or commercial units
 - Inland marshes
 - Land principally occupied by agriculture
 - Mineral extract on sites
 - Mixed forest
 - Moors and heathland
 - Natural grasslands
 - Non-irrigated arable land
 - Pastures
 - Peat bogs
 - Road and rail networks
 - Sparsely vegetated areas
 - Spots and sparse tree-fels
 - Transitional woodland-shrub
 - Water bodies
 - Water courses

0 10,000 20,000 Meter

data source: Tiris, Corine landcover Level3





Tools for the Analysis of connectivity in Riverine landscapes

Quantifying fragmentation - indices

effective mesh-size

Landscape division index

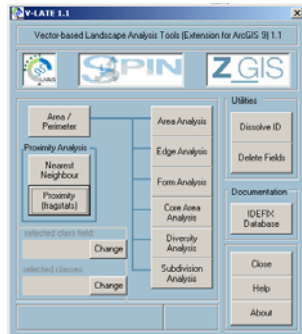
degree of coherence

indices landscape (river and riparian area) division		
splitting index S	$LDI = \frac{\sum_{i=1}^n p_i}{\sqrt{\sum_{i=1}^n A_i} \cdot \sum_{i=1}^n \frac{1}{A_i}}$	(1-∞) m²2 Jäger_2000, Lang_2007
Splitting density s	$s = \frac{1}{A_t} \sum_{i=1}^n A_i^2$	Jäger_2000
degree of coherence C	$c = \frac{\sum_{i=1}^n (A_i)^2}{\sum_{i=1}^n A_i^2}$	(0-1) % Jäger_2000, Lang_2007
degree of landscape division	$D = 1 - \frac{\sum_{i=1}^n (A_i)^2}{\sum_{i=1}^n A_i^2}$	(0-1) % Jäger_2000, Lang_2007
effective mesh size (meff)	$m = \frac{A_t}{S} = \frac{1}{A_t} \sum_{i=1}^n A_i^2$	(0-A) Jäger_2000
Net product N	$N = \sum_{i=1}^n A_i^2$	Jäger_2000
edge-effect (TE, ED)		Lang_2007

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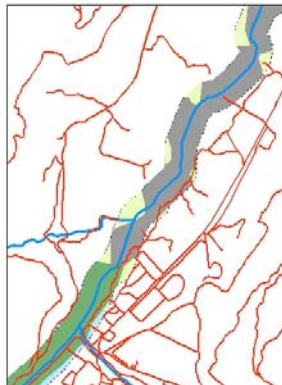
Software tool V-late (LANG, S., TIEDE, D., 2003) for calculation of Fragmentation-indices (Division index – eff.meshsize)



Class level	NP	CA	DIVISION	SPLIT	MESH
no class	6364	305751427.93	99.89	929.08	410775.89

Fragmentation of Riverine Landscapes - Lech, Ziller/Tyrol effective mesh-size (km²)

River Lech

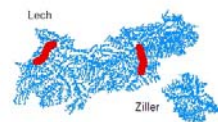


Lech	
Area riverine landscape (km ²)	6.24
Number of Habitat types	5
Number of Patches	13
Class Area	3.82
coverage (%)	57.95
Streets (km)	46
Division Index (%)	49
eff. Mesh-size (km ²)	1.85

River Ziller



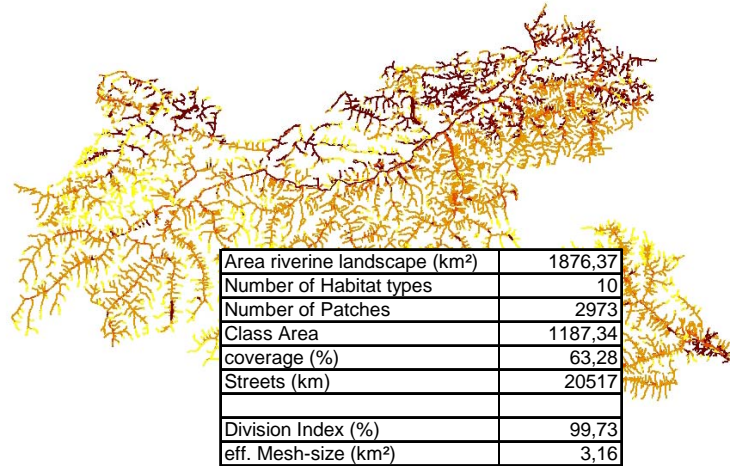
Ziller	
Area riverine landscape (km ²)	6.05
Number of Habitat types	3
Number of Patches	9
Class Area	0.15
coverage (%)	2.50
Streets (km)	94
Division Index (%)	82
eff. Mesh-size (km ²)	0.83



- Streets
- Rivers
- Corine landcover**
 - Bare rocks
 - Coniferous forest
 - Mixed forest
 - Moors and heathland
 - Transitional woodland-shrub
 - riverine landscape (Buffer 100m)

data source: Tiris, Corine landcover Level3





Characterising barriers

Tab. 1: Conjunction between the barrier value and their verbal description

Barrier value	Verbal description of the barrier
1.0	Absolute barrier, no traversing possibility
0.8	Hard conquerable barrier
0.6	Conquerable barrier (large agricultural field with low vegetation)
0.4	Easy conquerable barrier (agricultural fields with high vegetation)
0.2	Very easy conquerable barrier
0	Landscape element without barrier function

Woess_2001



Map 2: Spatial distribution of forests and barriers in Lower Austria (Vöck et al., 2001)

Define potential barriers

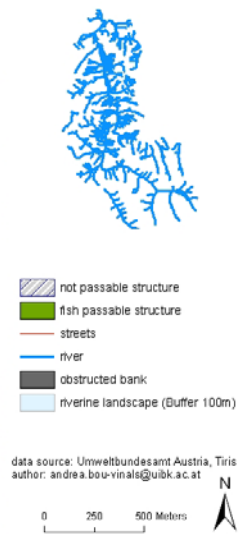
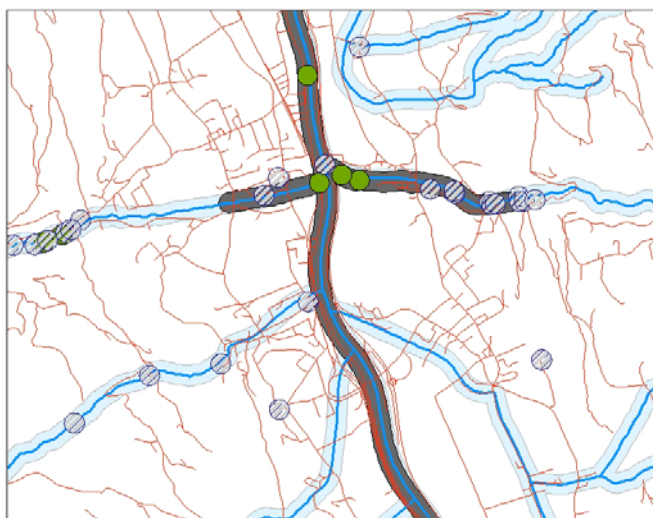
Classification of barriers have to be adapted for every key species / taxa

e.g. Fish – *Cottus gobio*

- o passable barriers (power station with fish pass)
- o non passable barriers (waterfalls, power station without a fish pass)
- o potential barriers (falls, streets, constructed bank)



Map of potential barriers River Ziller, Tyrol, Austria



Habitat connectivity

proximity index

class coincidence probability index

landscape coincidence probability

contagion

Indices - corridor - river-riparia					
Total number of links (L)				Partial	
Number of components (NC)				Partial	
Mean size of the components (MSC)				Partial	
Size of the largest component (SLC)				Partial	
Hairy index (HI)	$HI = \frac{1}{L} \sum_{i=1}^L \sum_{j=1}^L W_{ij}$			Partial	not connected patches are able to
Normalized hairy index (NHI)	$NHI = \frac{HI - \text{mean}}{\text{stdev}}$			Partial	allows comparison of habitats with different number of patches
Graph diameter (GD)		distance units		Partial	
Class coincidence probability (CCP)	$CCP = \sum_{i=1}^n (p_i)^2$		0.1	Partial	probability that two patches randomly placed within the habitat are able to find each other given the set of habitat classes as CCP, but within landscape (patches can be either in habitat or non-habitat areas); generalization of coherence
Landscape coincidence probability (LCCP)	$LCCP = \sum_{i=1}^n (p_i)^2$		0.1	Partial	increases with increased connectivity, in all patches are occupied by habitat, if patches are connected or not
Integral index of connectivity (IIC)			0.1	Partial	basic reach branching function, node size
number of patches	$\sum_{i=1}^n p_i$		Schumaker 199	Schumaker 199	total number of patches
patch area			Schumaker 199	Schumaker 199	total number of patches
core area (CA/TC/CA)			Schumaker 199	Schumaker 199	total number of patches
patch perimeter			Schumaker 199	Schumaker 199	total number of patches
contagion	$Contagion = 1 - \frac{P}{A} \cdot \frac{P}{A}$		Schumaker 199	Schumaker 199	total number of patches
patch area ratio	$\frac{P}{A}$		Schumaker 199	Schumaker 199	total number of patches
shape index - mean (MSI)	$MSI = \frac{P}{A}$		Schumaker 199	Schumaker 199	total number of patches
nearest neighbor distance	$\frac{P}{A}$		Schumaker 199	Schumaker 199	total number of patches
proximity index - PI	$\frac{P}{A}$		Schumaker 199	Schumaker 199	total number of patches
network connectivity - NCC			Schumaker 199	Schumaker 199	total number of patches
habitat network function			Schumaker 199	Schumaker 199	total number of patches



Define potential corridors

Literature research on potential habitats

e.g. Common Sandpiper - *Actitis hypoleucos*

- o Gravel
- o rocky bank
- o marshes

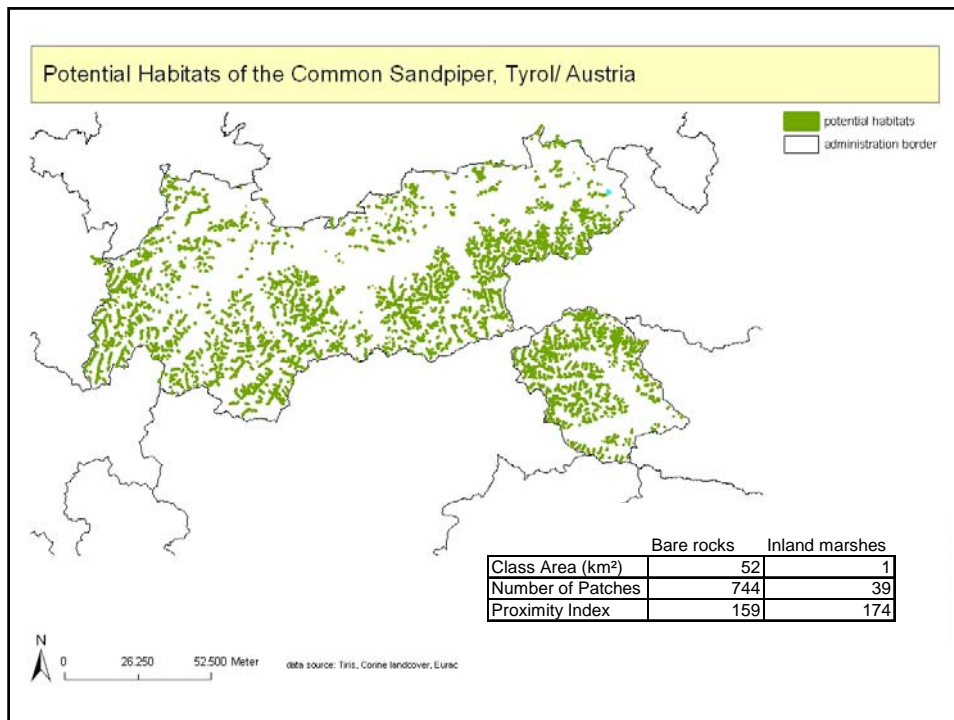
Define the habitats with Corine land cover types
selection of the types and clip it with riverine landscapes

Calculate proximity index (Buffer = dispersal distance species)



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Outlook

- Quantitative analysis of habitat connectivity by applying representative indices (e.g. class coincidence probability, proximity index, contagion index)
- Define habitats including Temperature, elevation,...
- Overlay/intersect results of fragmentation and barrier analysis as well as distribution maps and migration routes of focal species
- Definition of potential corridors for each focal species and/or taxon in the pilot regions
- Visualise the corridors – map in ArcGis



Thank you for your attention