ENVEROS
ENVIROMENTAL EDUCATION THROUGH
ROADKILL OBSERVATION SYSTEMS

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Enviromental Education through Roadkills Observation Systems - EnVeROS

01. INTRODUCTION TO ROAD AND LANDSCAPE ECOLOGY

LEARNING OBJECTIVES

At the end of this topic students should be able to:

- Identify terms and principles related to landscape ecology and habitat fragmentation/ loss.

- Explain the differences/ similarities between road and landscape ecology.

- Describe the role of roads in shaping the environment.

- Summarize the threat for biodiversity by habitat fragmentation/ loss due to transport infrastructures.

Terminology & Overview

- **Ecosystem** is the complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space.

- **Landscape** is a mosaic in which the local ecosystems are repeating themselves.

- **Habitat** is the type of natural environment in which a particular species lives. It is characterized by both physical and biological features.

- **Roads** play a significant part in shaping the environment. Natural areas are being increasingly fragmented by a fast growing transport system.

- **Road effects** include biodiversity decline, environmental degradation, shifts in ecological processes and ecosystem services, higher extinction and outbreak probabilities.
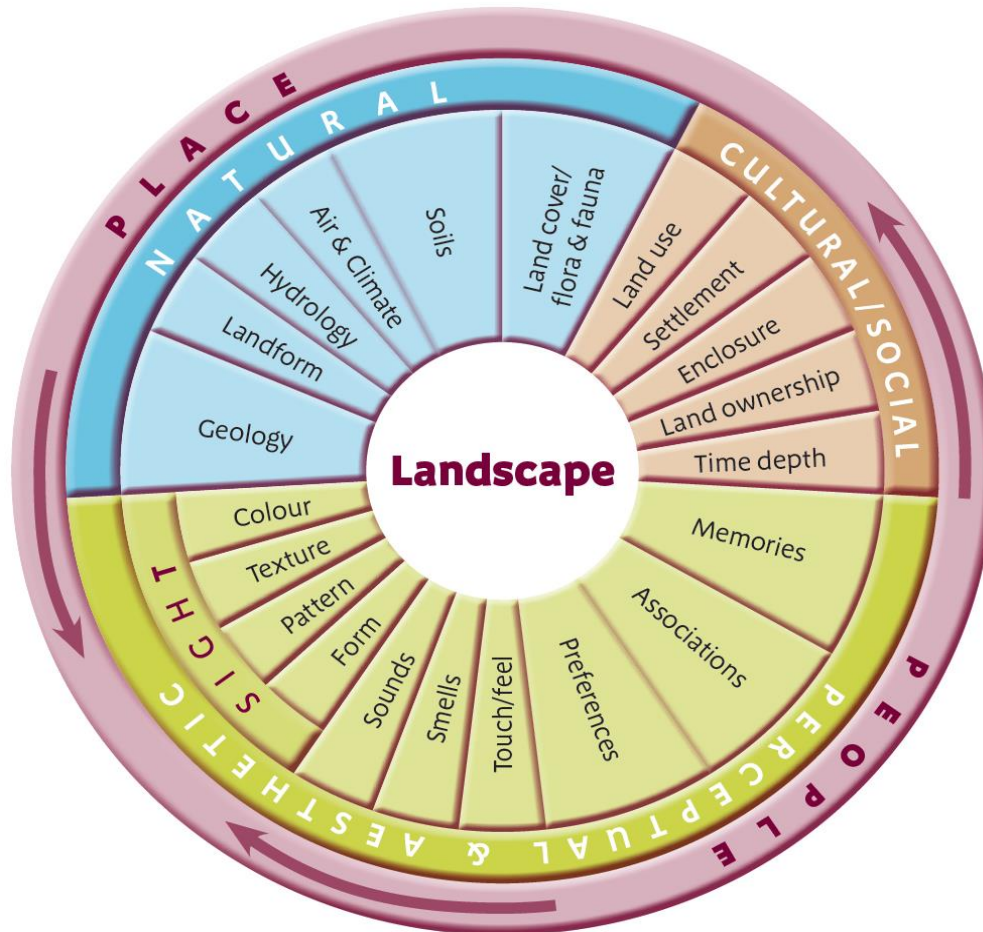
Landscape

THE CONCEPT OF LANDSCAPE

The concept of landscape is expressed through the relationship between human and its place and consists of natural, aesthetic, social and perceptual elements

(Source: Natural England, 2014)

Landscape as patch mosaic

- Landscapes are formed by a mosaic of patches.

- patch: a homogeneous area which differs from surrounding areas.

- Patches are homogeneous within their boundaries but heterogeneous compared to the rest of the patches in a landscape.

(Source: Barnes, J. I.,2001; South African Journal of Wildlife Research)
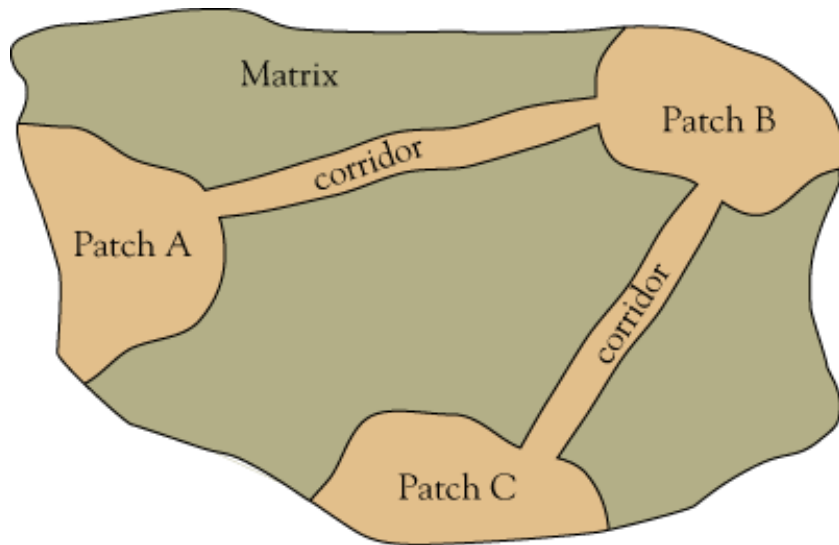
Patches in Ontario's southern boreal forest.
(Photo: Per Breiehagen)

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Matrix

Matrix: The most extensive and most connected landscape element type, and therefore plays the dominant role in the functioning of the landscape (Forman and Godron 1986; Landscape ecology; Willey). In most landscapes, the matrix type is obvious to the investigator /observer.
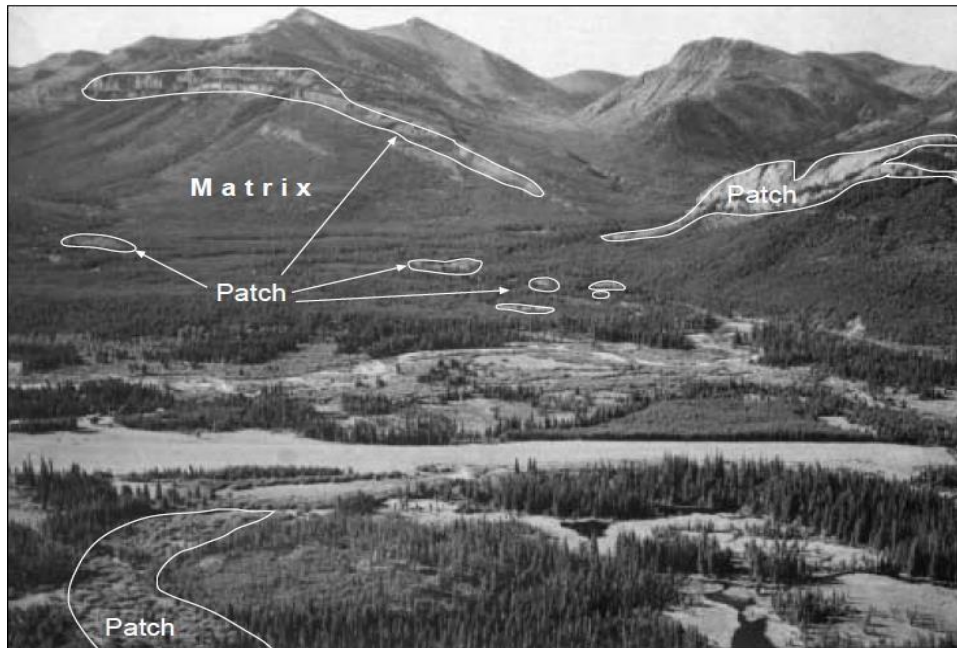
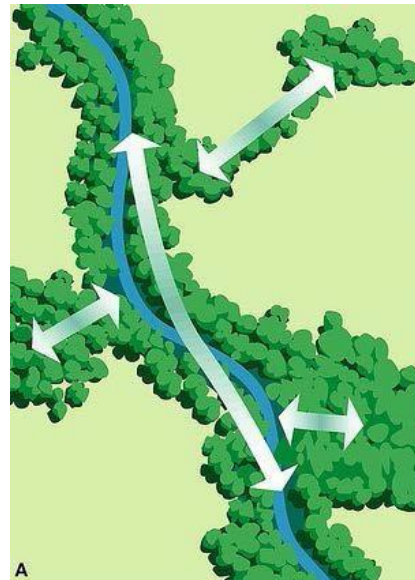
(adapted from U.S. Forest Service 1993)

Corridors

Linear features in a landscape which differ from the matrix.

They can be defined on the basis of their function or structure.

They can be isolated strips although usually they are connected with a patch of similar vegetation type.

(Source: Conservation Corridor)

Patches – habitat fragmentation/ loss

Infrastructure development is happening fast in Gabon, Africa. New roads pose an increased threat to wildlife.

(Source: © WWF-Canon / James Morgan)
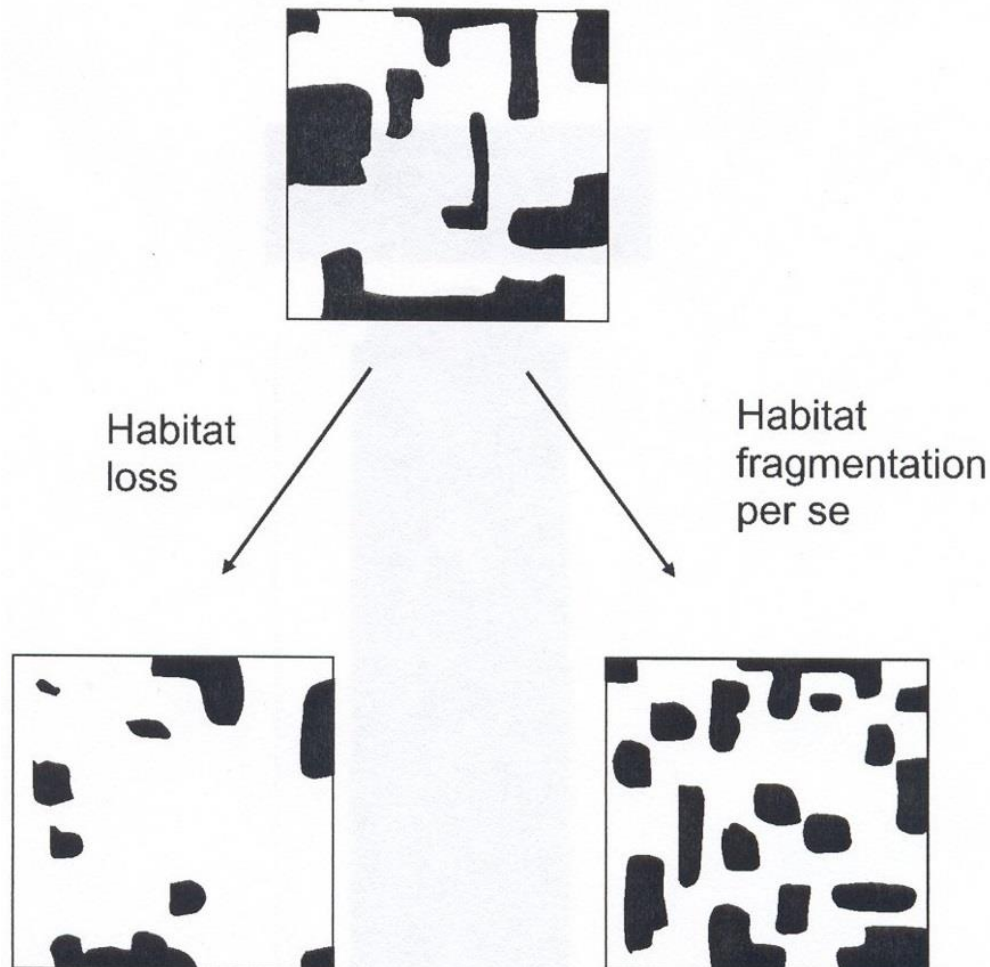
(Photograph by Georg Gerster / Panos)

Habitat loss can be distinguished from fragmentation…

(Adopted from Fahrig 2003; Annual review of ecology, evolution, and systematics.)
https://www.annualreviews.org/doi/pdf/10.1146/annurev.ecolsys.34.011802.132419

Roads (and roadless areas)

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➤ Roads have dissected the earth's surface in > 600.000 fragments. Although 80% of the earth's surface is roadless, half of the roadless areas are < 1km^2
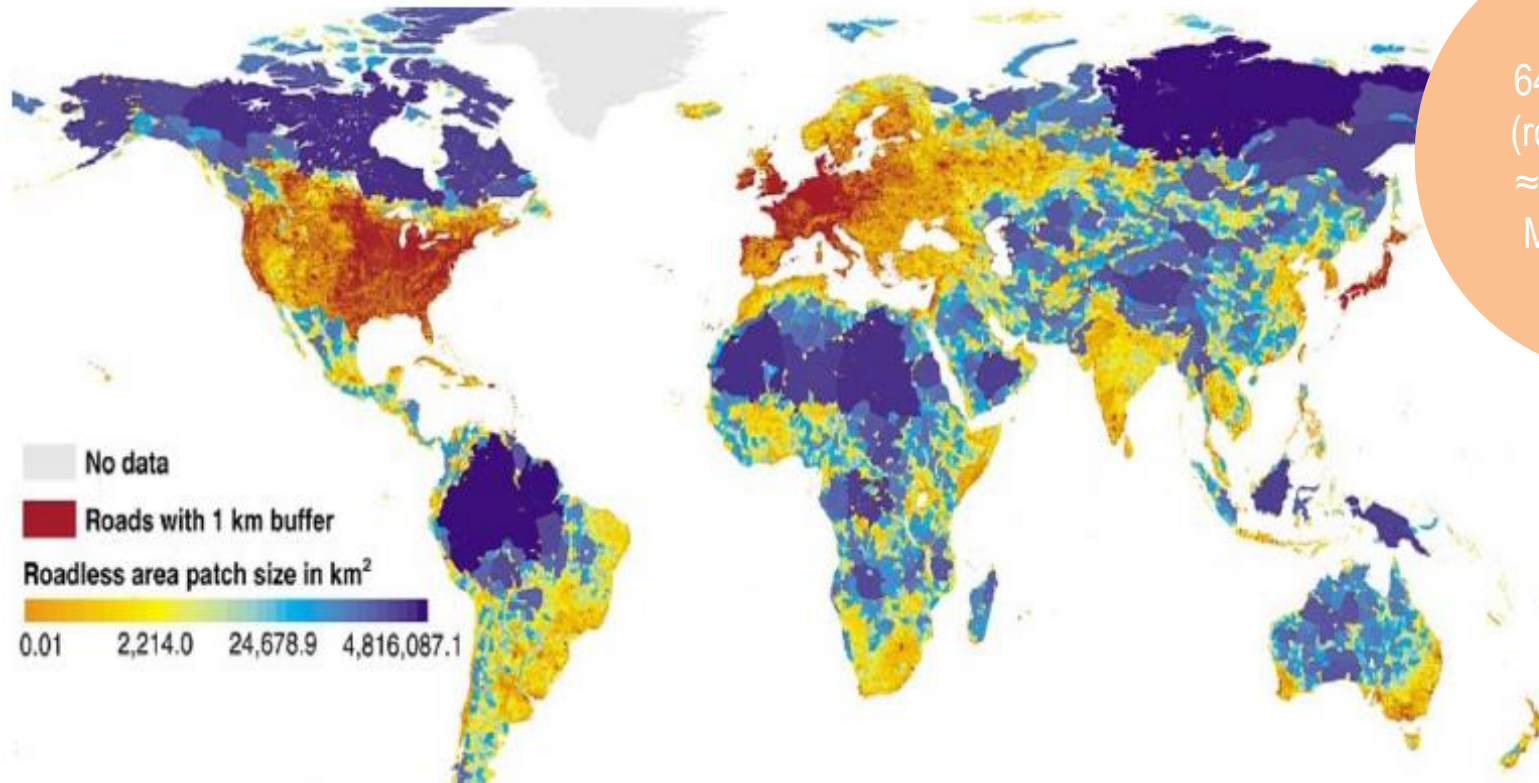
64,000.000 Km (road networks) ≈ 166 x Earth - Moon distance

No data

Roads with 1 km buffer

Roadless area patch size in km^2

0.01   2,214.0   24,678.9   4,816,087.1

(Source: Ibisch P., et al 2016;A global map of roadless areas and their conservation status, Science Vol.354, Issue 6318)

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- Roadless areas (areas with no roads) and low-traffic areas (larger than 100km^2, not dissected by roads with more than 1000 vehicles per day (BfN 2008) represent relatively undisturbed natural habitats and functioning ecosystems in Europe.

- They play a crucial role in maintaining biodiversity, ecosystem processes, connectivity and overall ecosystem integrity (Strittholt & DellaSala 2001;*Conservation Biology;* Angelstam et al. 2004; *Ecological Bulletins*; Crist et al. 2005;*Journal of Applied Ecology*).

- They are of special bearing for Europe because of their rarity and, in the context of climate change, due to higher resilience and their vast buffering capacity (MacGarigal et al. 2001; *Landscape Ecology*).

- Sadly roadless and low traffic areas are widely neglected as a legal target (Selva et al. 2011; *Environmental management*).

- The Habitats & Birds Directives oblige Member States to take appropriate measures to maintain the integrity of N2K sites in practice they face enormous difficulties in avoiding habitat fragmentation. In fact a high proportion of N2K sites is already in close proximity to roads.

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Road network in central Europe areas.
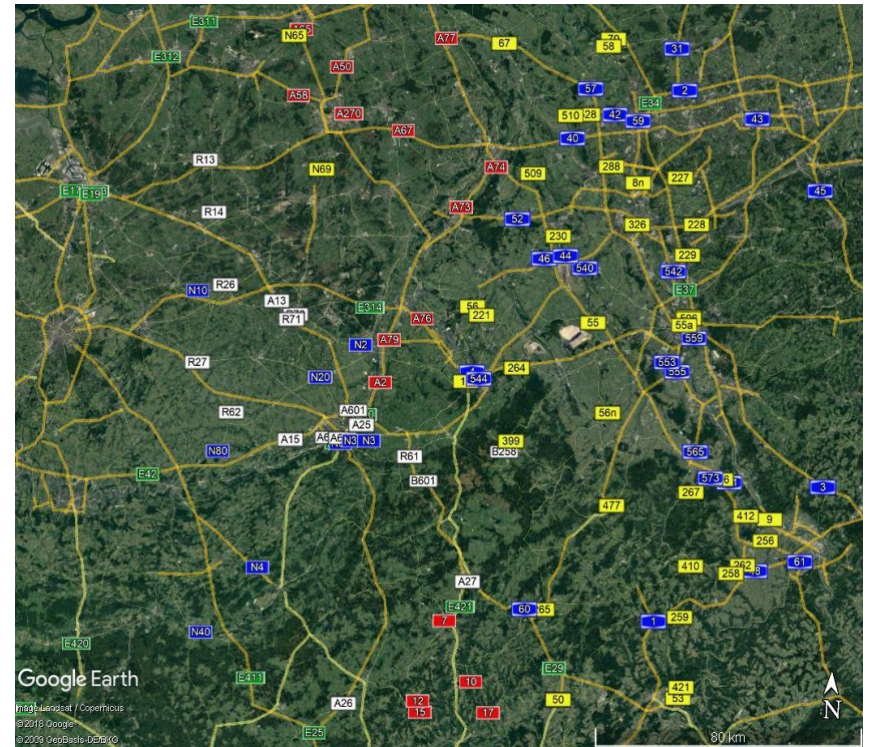
Source: Google Earth pro.

Road vs. Landscape Ecology

Road Ecology: the study of the ecological impacts of roads and highways.

Landscape Ecology: spatial heterogeneity, coarse spatial scales, the role of human on landscape pattern.
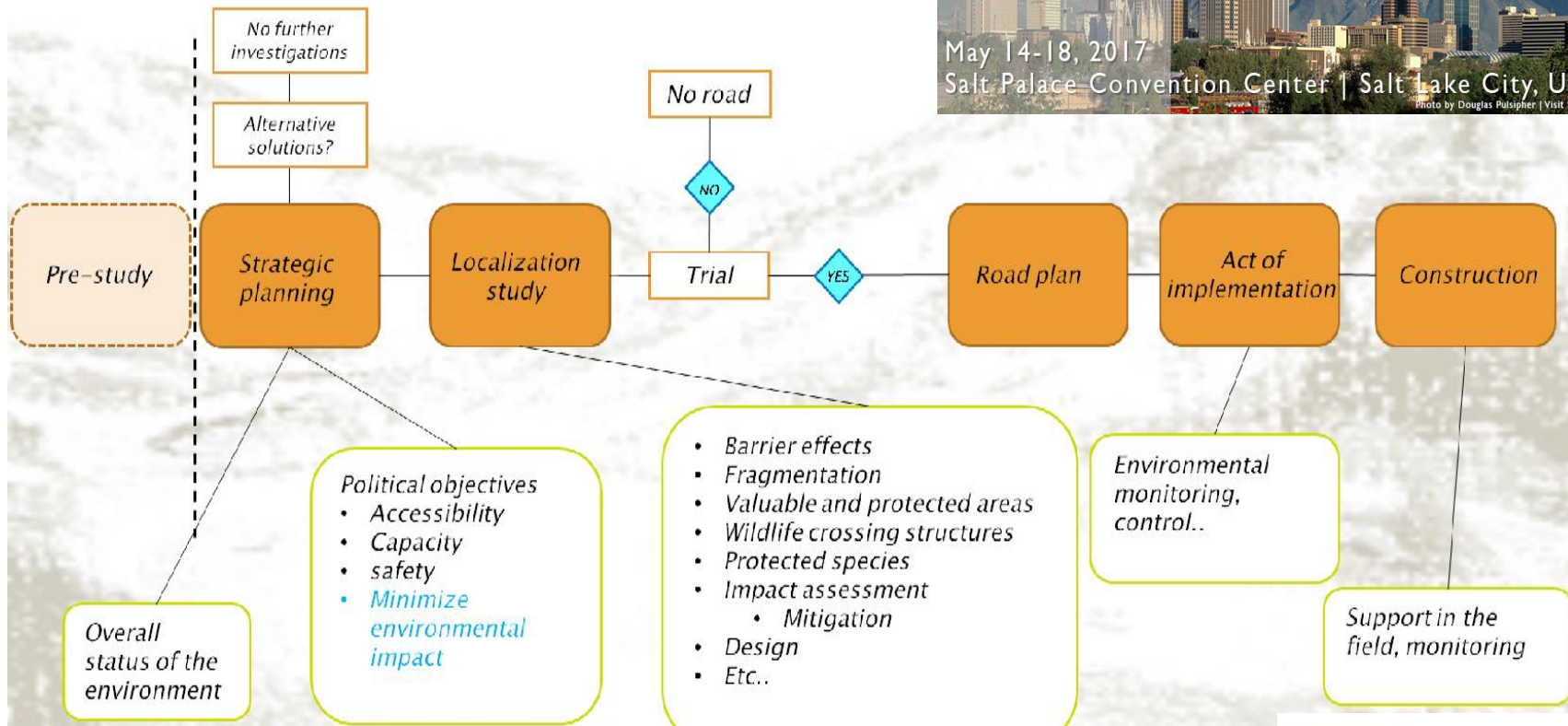
Road Ecology in Action

(Source: Mårten Karlson, 2016, TYRÉNS; Road Ecology)

Road Ecology in Action

® ICOSTASY

(a) Jersey barrier with "wildlife scupper"
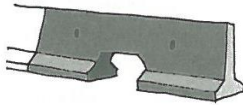
(b) Stump line for small and midsized animal movement
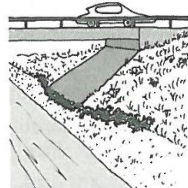
(c) Wildlife culvert

(d) Canopy connection for arboreal animals

(e) Hourglass wildlife overpass

Highway

2 m (6.5 ft) high berm with shrubs and small trees
Fence

Small pond/wetland receiving drainage from overpass

Wildlife line of vision

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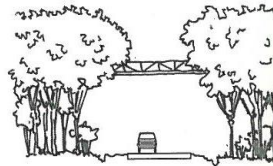
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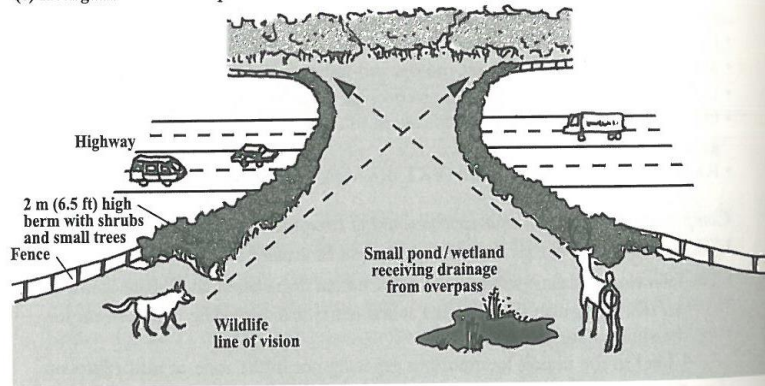
Summary

- Road ecology and landscape ecology terms are required for the study of WVCs.

- Road construction is one of the principal cause of habitat loss and/or fragmentation.

- Roadless areas are very important for species conservation.

- Many factors should be considered for road design in order to preserve species and habitats.

Selected references

- Crist MR, Wilmer B, Aplet GH (2005) Assessing the value of roadless areas in a conservation reserve strategy: biodiversity and landscape connectivity in the Northern Rockies. Journal of Applied Ecology 42:181–191

- Fahrig L, Rytwinski T (2009) Effects of roads on animal abundance: an empirical review and synthesis. Ecology and Society 14:21

- Forman RTT, Alexander LE (1998) Roads and their major ecological effects. Annual Review of Ecology and Systematics 29:207–231

- Forman RT, Sperling D, Bissonette JA, Clevenger AP, Cutshall CD, Dale VH, Fahrig L, France R, Goldman CR, Heanue K, Jones JA, Swanson FJ, Turrentine T, Winter TC (2003) Road ecology: science and solutions. Island Press, Washington, p 481

- Selva N, Kreft S, Kati V, Schluck M, Jonsson BG, Mihok B, Okarma H, Ibisch PL (2011) Roadless and Low-Traffic Areas as Conservation Targets in Europe. Environmental Management 48(5):865-77

Activities & Self Assessment Exercises:

- See the map of Hofmann et al. in page 10 of this presentation and list the 5 most important roadless areas in the planet as well as the 5 most impacted in terms of habitat fragmentation by roads.

- Explain the terms "patch" and "connectivity" giving specific examples.

- Present using 150 words the Figure presented in page 14, on road design.

- Create 4 PPT slights to present one example of habitat loss and another one for habitat fragmentation in an area/ country of your interest.