Wildlife passages
De-Fragmentation in the Netherlands
How to evaluate their effectiveness?

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De-fragmentation in the Netherlands

• Long history in de-fragmentation processes
  – First badger tunnel in 1974
  – Now more then 500 tunnels for small fauna under and 10 ecoducts over motorways
  – Badger population increases 4x between 1980 - 2008

Netherlands = worst case
1990: Two important policy-plans

Nature Policy Plan and Transport Policy Plan

In both fragmentation of habitats was recognised

In Transport Policy Plan:
- no further fragmentation (new motorways)
- decrease existing fragmentation

1990: Nature Policy Plan
introduction of National Ecological Network

Goal: biodiversity

2002: Robust Corridors added
Long Term De-Fragmentation Program

Existing national infrastructure

National government
Infra authorities
Provincial governments
NGO’s
Water boards

Rail
Waterways (canals)
Roads

Long Term De-Fragmentation program

Three ministers signed, accepted by parliament and now part of the policy plans of the 3 ministries ➔ integration of policies

Area oriented
provinces has an important role to realise nature policy
all kind of road levels
incorporating other interests (water management, drinking water, recreation, forestry, hiking,……)

208 MJPO-points identified; all in the NEN, Program ready 2018

410 M€ from 2 ministries (Transport and Nature)
Identification in ‘80 and ‘90: by road victims

And strong lobby by pressure group

Identification first two ecoducts:

Historic data about use of corridors by red deer and wild boar
Identification ecoduct:
vision around connectivity at regional scale
Identification underpass: passing existing provincial road connected with ecoduct over highway

Identification adapted existing bridge: Existing situation, vision about strong connectivity of nature reserve and active lobby
Identification adapted existing viaduct availability with low traffic volume

Badger proof fence
Discussion: co use ecoduct with recreation

- Impact use
- Species
- Extra provisions
- Dogs / horses
Co use with water

Worldwide many wildlife passages in all forms/sizes, but….
...do they work?

Knowledge gap

Literature study van der Grift, van der Ree, et all

Most studies address use
Some studies address effectiveness…

But in most of them the effectiveness of wildlife passages on population persistence remains unclear!
Wildlife passage use

Studying use is not useless!

However:

• Use ≠ Effectiveness

• Use does not provide evidence for effects of wildlife passages on population persistence!

Use ≠ Effectiveness

Research:

3 crossings of badger per time period T

But: what does it mean?

3 x 1 badger?

1 x 3 badgers?
Use ≠ Effectiveness

**Before road construction:**
- Usually no monitoring “before”

**After road construction:**
- 1 x 3 badgers
- 3 x 3 badgers

Wildlife passage effectiveness

Definition effectiveness:
The extent to which the objectives (= desired effect) for a wildlife passage are reached

**no objective = no effectiveness**

(And: no problem = no objective)
Working out a monitoring approach

- What are suitable research species?
- What are suitable research sites?
- What is the best study design (options)?
- Which research methods (surveys/analyses) are most promising?
- What measurement schemes should be used?
- What are the estimated costs?

Complex problem: time for collaboration...!

This badger gate is for 94.68% effective!
Choose appropriate research species

- Species is (highly) vulnerable for road impacts
- Proven use of wildlife passages
- Road impact is measurable
- Species allows for study design with high inferential strength (= high probability and low uncertainty that research result is true)

Choose appropriate research sites

Species X:
- not viable
- viable
- highly viable

Select locations where wildlife passages are expected to make a large difference (e.g. by modelling population viability)
Choose appropriate study design:

(B)BACI, BA or CI
(Roedenbeck et al., 2007)

<table>
<thead>
<tr>
<th>Impact</th>
<th>Before road construction</th>
<th>Before mitigation</th>
<th>After mitigation</th>
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<tbody>
<tr>
<td>Control 1</td>
<td></td>
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<tr>
<td>Control 2</td>
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Study design in literature review (n=123 studies):

- Before-After (BA) comparison approach: n=15
- Use of controls in <10 studies
- Most studies only survey of crossing structures after construction

In practice: trade-offs between perfect study design and reality!
- “Before” situation already in the past
- No controls, no replication
- Randomisation not feasible
- Limited budget
- ….
Do not only include the wildlife passage in your study design!

- Not measuring the population adjacent to road may result in wrong conclusions about wildlife passage performance

Example:
- Reduction in road kill does not necessarily mean the crossing structure is effective

### Importance of population surveys

<table>
<thead>
<tr>
<th>Effect</th>
<th>BEFORE</th>
<th>AFTER</th>
<th>Change</th>
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<tbody>
<tr>
<td><strong>Example 1:</strong></td>
<td></td>
<td></td>
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<tr>
<td>Roadkill</td>
<td>10</td>
<td>5</td>
<td>50% ↓</td>
</tr>
<tr>
<td>Population size</td>
<td>100</td>
<td>20</td>
<td>15% ↑</td>
</tr>
<tr>
<td><strong>Example 2:</strong></td>
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<tr>
<td>Roadkill</td>
<td>10</td>
<td>10</td>
<td>0%</td>
</tr>
<tr>
<td>Population size</td>
<td>100</td>
<td>200</td>
<td>50% ↓</td>
</tr>
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</table>
Appropriate measurement scheme

- Appropriate monitoring period
  (review: 4 nights – 8 yrs)

- Appropriate frequency of measurements within period
  (review: 1/day – 1/week)

- Appropriate number of impact and control sites

Monitoring changes in populations

Survey: 26 years

Survey: 12 years
Example study design
Slabroek
Relate to abundance of animals in adjacent habitat

**Wildlife overpass: August-December 2007**

Select appropriate research methods
Review research literature:

- Tracking pads (n=74)
- Video / infra-red still cameras (n=36)
- Collection/identification scats (n=16)
- Direct observations (n=13)
- Trapping (n=12)
- Collection/identification hair (n=8)
- Radio-tracking (n=7)
- Trail monitors/wildlife counters (n=6)
- Other (including dusting with fluorescent pigment)

Select appropriate research methods

Go (sometimes) off the beaten track! EXPLORE!

Large species over-represented in existing studies, partly because of chosen research methods

New techniques in development: e.g. PIT tags, GPS, genetic information (DNA), digital equipment, chips,…. 

Two examples:
1. monitoring amphibian at ecoduct Groene Woud
2. badger population, road victims and fauna passages
Example 1: Wildlife overpass “Groene Woud”
Distribution amphibians across overpass

Number of observations 2006-2007 adults/juveniles (n=968)

- Common toad
- Common frog
- Smooth newt
- Crested newt
- Green frog

Wildlife overpass
Significant more amphibians in wetland zone

Efficiency method “artificial refugia”
Crested newts: Belly patterns

Identification of individuals and individual movements across the overpass.
Crested newts: Belly patterns

Identification of individuals and individual movements across the overpass

Example 2: Road kill badgers

Highways, county and local roads

Data: 1990-2006

contract
Victim numbers (direct and indirect)

Victim distribution

Yellow: setts from census, black: victims

1990 2000
Road type

Are they "effective"?

Are the number of victims lower after realization than before placement?

Tunnels & fences
Tricky to get conclusions

- Victims
- Mobility
- Occupied km-squares
- Measures

Percentage of population

- Victims as percentage of population
- Each populated km² square houses 3 badgers
Conclusions

• Victim number stabilized or even decline;
• Most victims reported from provincial roads;
• Mitigation measures seem to have positive effect at population;
• Studies at regional scale are needed for better understanding of effects of mitigation measures.

Thanks to Síl Westra for GIS analyses!

Increase from Einde Gooi

Badger Reproduction (observed juveniles)
Thanks for your attention