



# Bat mitigation on roads - a review of effectiveness

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## Bats and roads

### Road effects

- Mortality
- Light, noise and chemical pollution
- Habitat loss and degradation (roosts & feeding sites)
- Barrier and fragmentation of habitats and populations

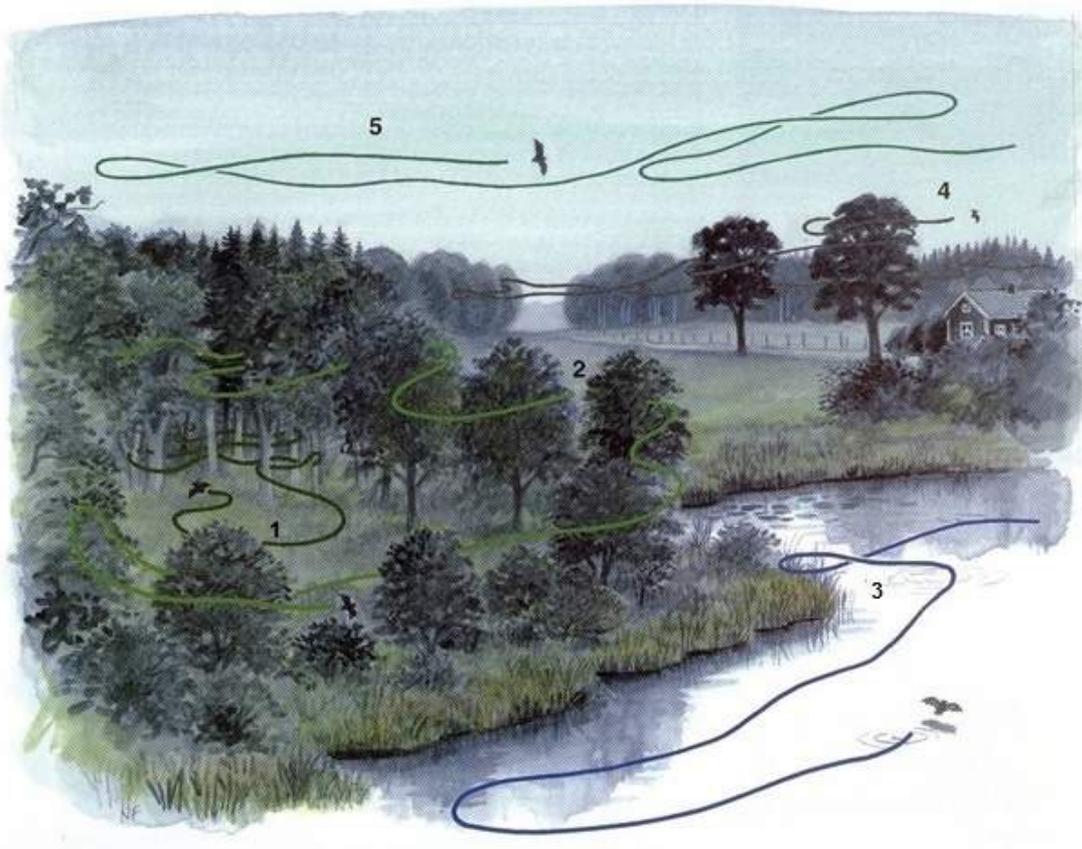
### Bat conservation

- National legislation
- EU Habitats Directive (92/43/EEC), Annex II & IV
- Bern Convention
- Bonn Convention / EUROBATS Agreement





# Species specific behaviour

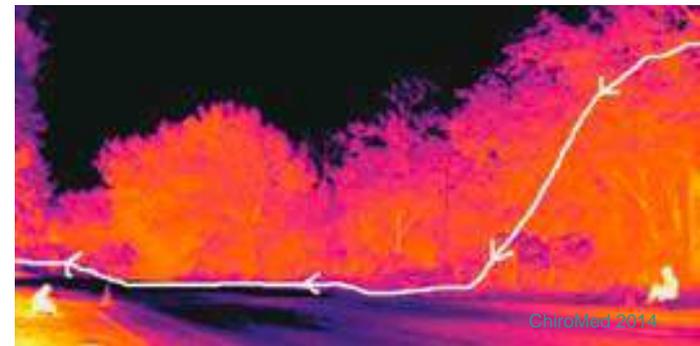


Open air / Aerial hawking



- 5/ Noctule
- 4/ Serotine
- 3/ Pond bat
- 2/ Common pipistrelle
- 1/ Long-eared bat

Clutter-adapted / Gleaning



© CEDR 2014



## Assessment of measures



>90%

& similar  
numbers as  
before

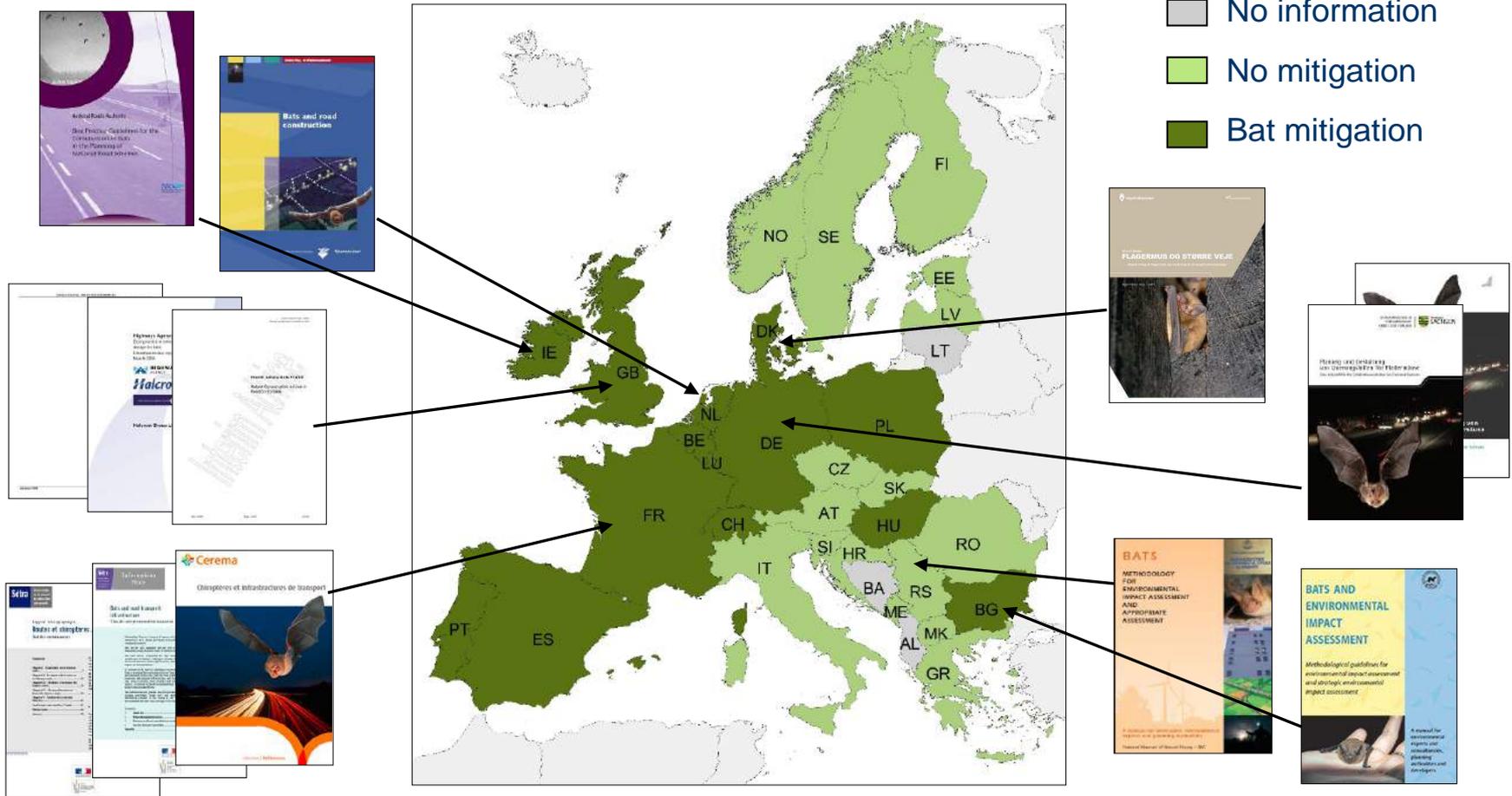


### Literature review :

>200 references, >50 studies on use or effectiveness



# Bat mitigation on roads & guidelines





## Mitigation & Compensation

<b>Function</b>	<b>Type</b>
<u>Passages</u>	Wildlife overpass Modified bridge Hop-overs Viaduct bridges Tunnels & Culverts
<u>Diversion &amp; deterrence</u>	Hedgerows Fences Artificial lighting Audible warning
<u>Habitat compensation</u>	Artificial roosts Roost site enhancement Habitat improvement



NACHTaktiv & SWILD



D. Almenar



U. Tegelhof



## Over-the-road-structures

### Wildlife overpasses

- Effectiveness for a wide range of functionally diverse group of species
- Recommended if constructed and located optimally
- Planted with dens woody vegetation of native species
- Connect with hedgerows and trees to bat habitats in the surrounding landscape
- Planting of 2-4m high trees and fast-growing species
- Noise and light deflecting screens should be installed along each side of the overpass





## Over-the-road-structures

### Modified bridges

- Green verges
- Little documentation of effectiveness, but promising
  - Vegetation on bridge must be well-connected to existing commuting routes.
  - Minimal night time traffic intensity on modified bridges
  - The road must be unlit

- Panels & railing
- Successful experiments for horseshoe bats
  - Panels sufficiently high to provide good cover for the bats (>2 m)





## Over-the-road-structures

### Bat gantries / overpasses

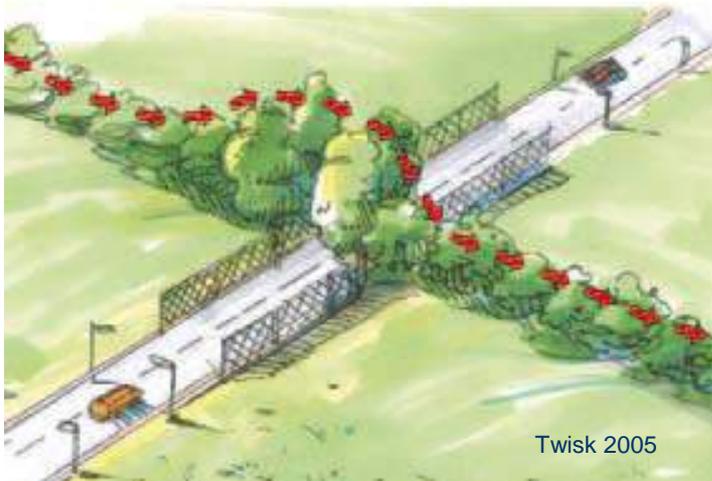
- Open structures
- Wire gantries documented ineffective
  - Wires with large acoustic reflectors ?
- Closed structures
- Used, but effective?
  - Must be located on existing well-defined flight path
  - Height and alignment of existing flight paths
  - The gantry and adjacent areas should not be lit
  - Should be well connected to bat commuting routes hedgerows and habitats





# Over-the-road-structures

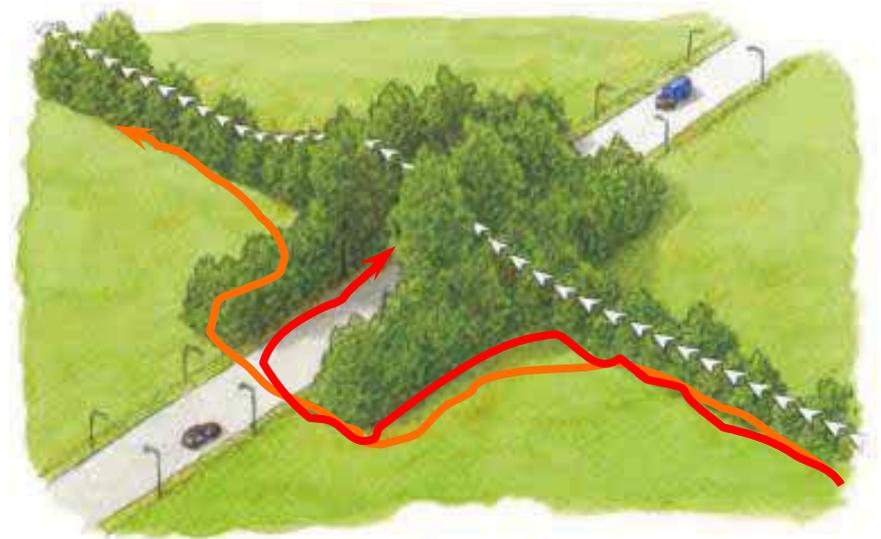
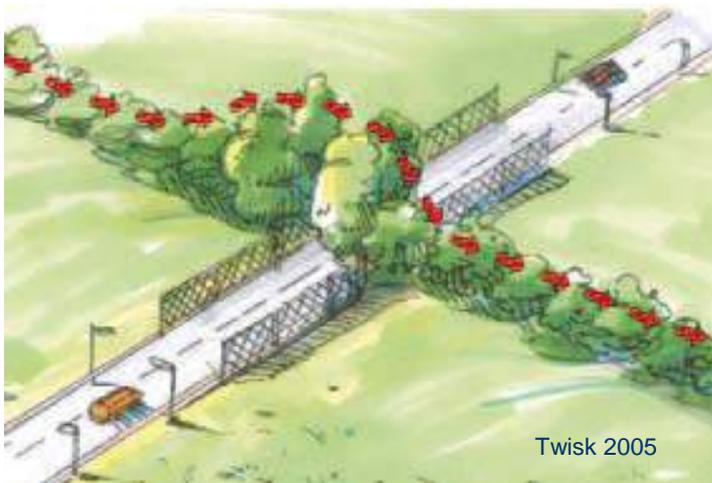
## Hop-overs & Screens





# Over-the-road-structures

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# Over-the-road-structures

## Hop-overs & Screens



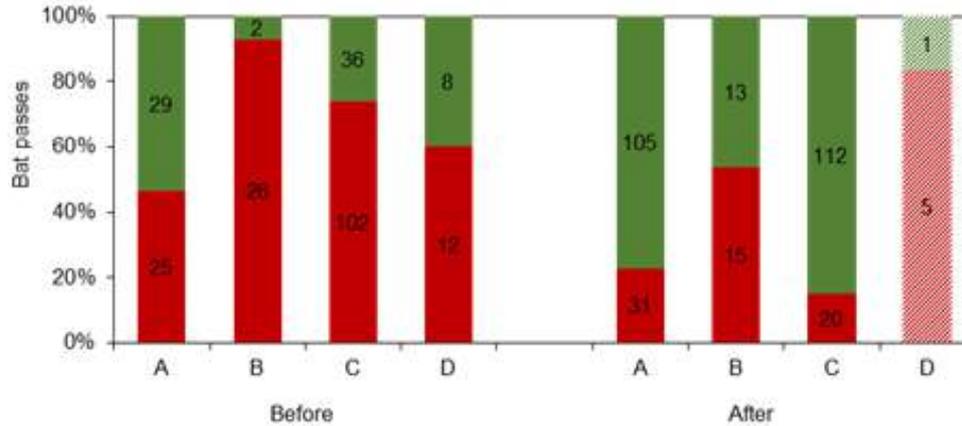
E. Ransmayr



J. Pickard



*Myotis daubentonii*



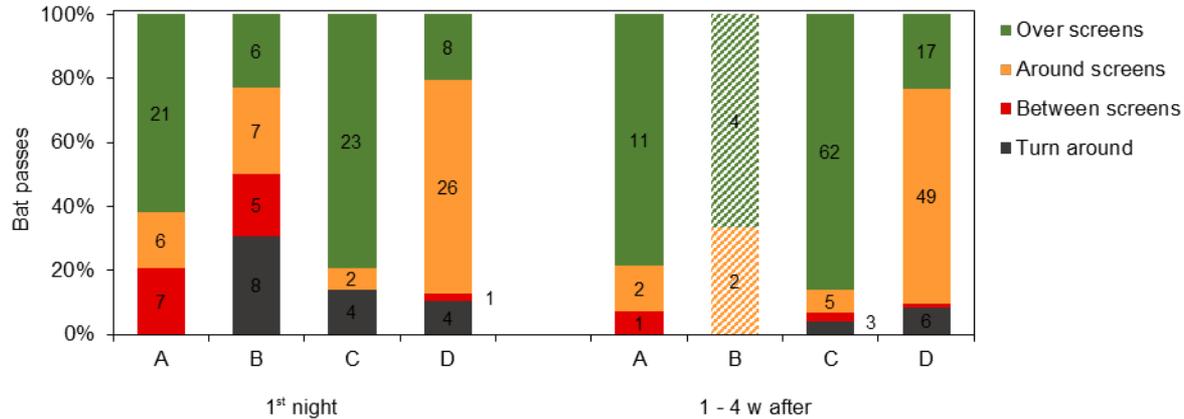
- Above 4 m
- Below 4 m





## Over-the-road-structures

### Hop-overs & Screens

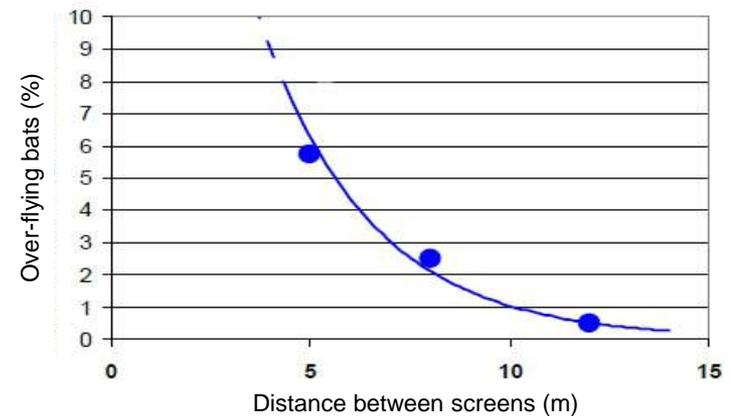




## Over-the-road-structures

### Hop-overs & Screens

- Lesser horseshoe bat commuting routes
- 3 sites – 4m height screens, 5-12 between
  
- 5% bats flew over the screen
- >50% of these dropped between screens
- 95% circumvented the screens



SWILD & NACHTaktiv, 2007



## Over-the-road-structures

### Hop-overs

- Many observation of use, mixed results in experiments
- Potentially effective for some species
- Must be placed exactly on an existing bat flight path
- Local deciduous trees and shrubs should be used.
- The hedgerow and treeline should encourage the bats to gradually increase their flight height as they approach the hop-over





## Under-the-road-structures

### Tunnels & culverts

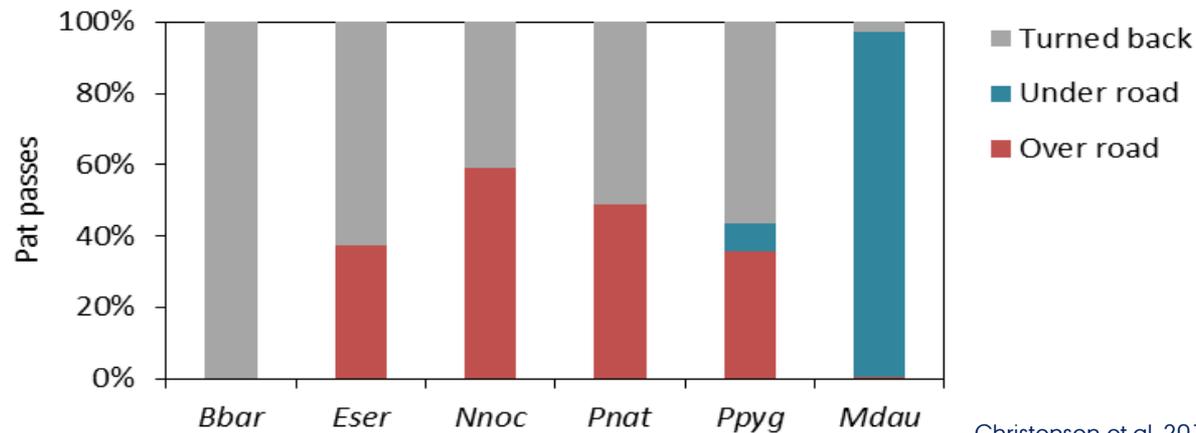
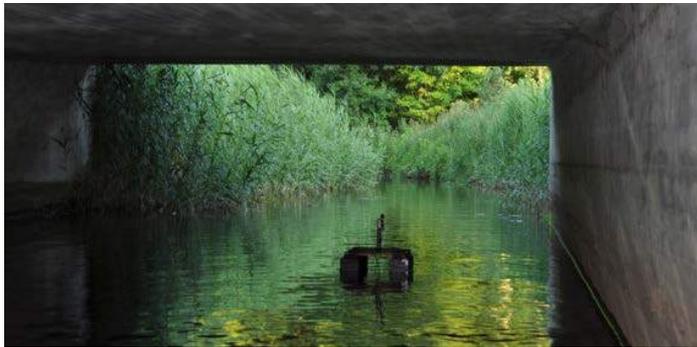
- Suitable for clutter-adapted species
- The bigger, the better
- Must be located on existing commuting routes and well connected to existing vegetation
- Barrier screens should be installed on the road to reduce noise and light pollution
- Joint-use underpasses should be unlit. If lit, light intensity and light spillages away from the road surface should be restricted.
- The water surface should never be lit





## Under-the-road-structures

Box culvert at highway crossing of stream

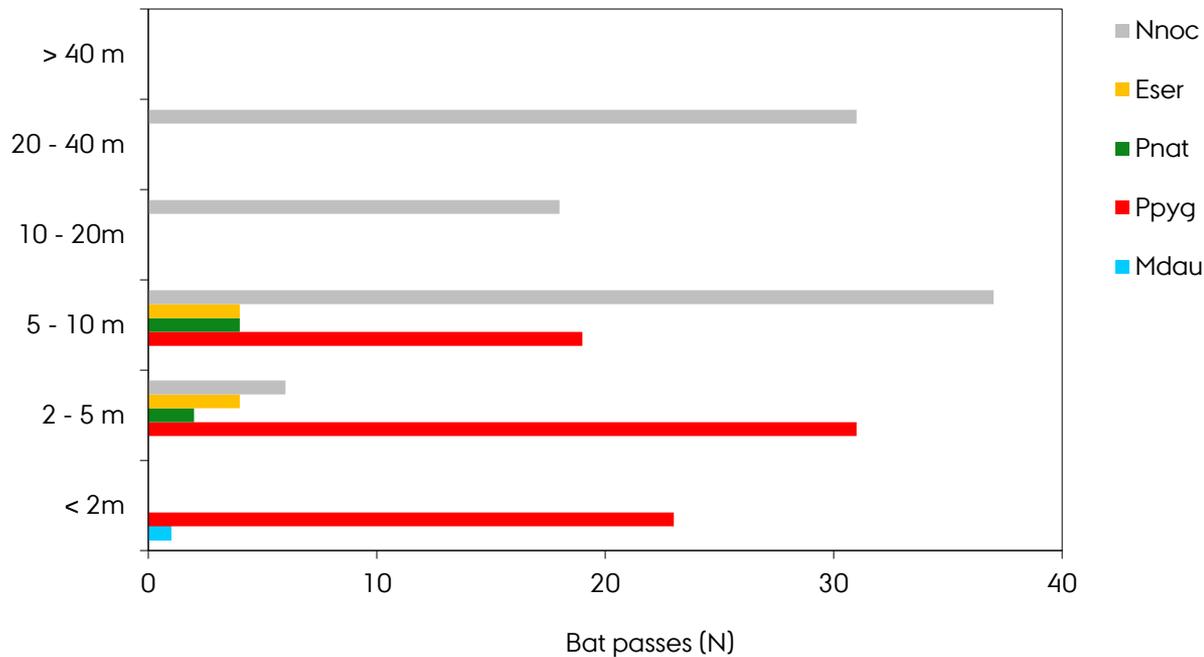
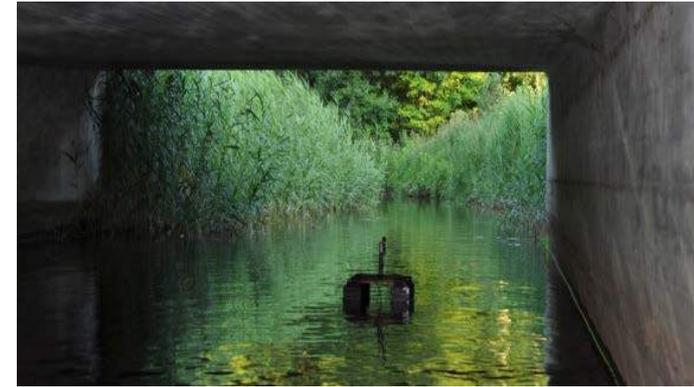


Christensen et al. 2013



# Under-the-road-structures

## Box culvert at highway crossing of stream



Christensen et al. 2013





## Under-the-road-structures

### Viaduct bridges

- Potentially effective for a wide range functionally diverse bat species
- Recommended structure to valley crossings
- Preserves habitat and commuting routes under the bridge, e.g. river corridors and hedgerows
- The tree canopies of hedgerows and woods should not extend above the level of the road.
- Barrier or noise screens should be considered
- Access to the viaduct should not be hindered by areas with artificial lighting, e.g. other roads and buildings





## Light deterrence & adaptations

### Deterrence

- Artificial light deterrence for some species
- Prevent crossing or guidance

### Light spectrum

- Amber street light more 'bat-friendly'
- Non-UV street light reduce insect aggregations

### Light restriction

- Restrict lightings near passageways
- Restrict lightings in multi-use passes
- Motion sensor controlled street lighting
- Part-night street lighting



L. Wyatt



V. Loehr



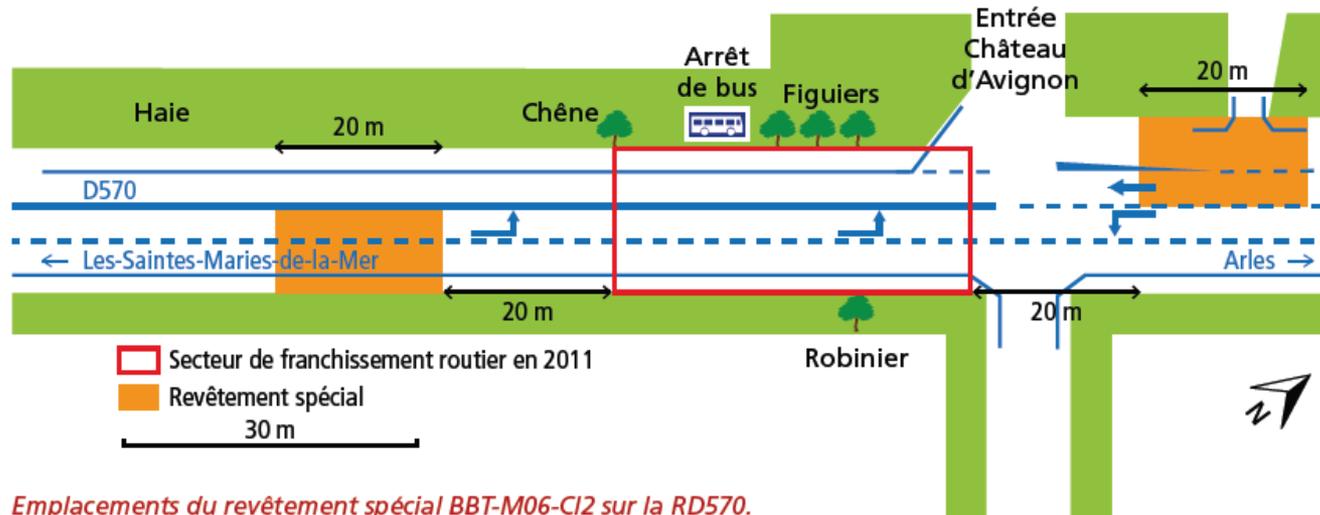
V. Loehr



## Audible warning

### Deterrence

- Patches with special asphalt
- One study showing some potential
- Habituation?



*Emplacements du revêtement spécial BBT-M06-CI2 sur la RD570.*



## Hedgerows & fences

- Guidance for clutter-adapted species commuting at low to medium heights
- Hedgerows should be planted as early in the construction phase as possible
- Planting of 2-4 m high trees and fast-growing native species
- Fences/screens to prevent crossings functioning as hop-overs should be minimum 4-5 m high
- Fences/screens should lead to safe crossing points
- Fences/screens must be tightly connected to vegetation and passages

2007



NACHTaktiv & SWILD

2013



NACHTaktiv & SWILD



NACHTaktiv & SWILD



## Artificial roost sites

### Bat boxes

- Not recommendable as compensation measure

### Tree trunk relocation

- Relocated tree trunk should be reinstated on the nearest suitable tree.
- Should be positioned so that the access point has the same height and orientation as the originally.
- Use protective rubber straps to reduce the impact on the live tree

### Artificial holes in trees

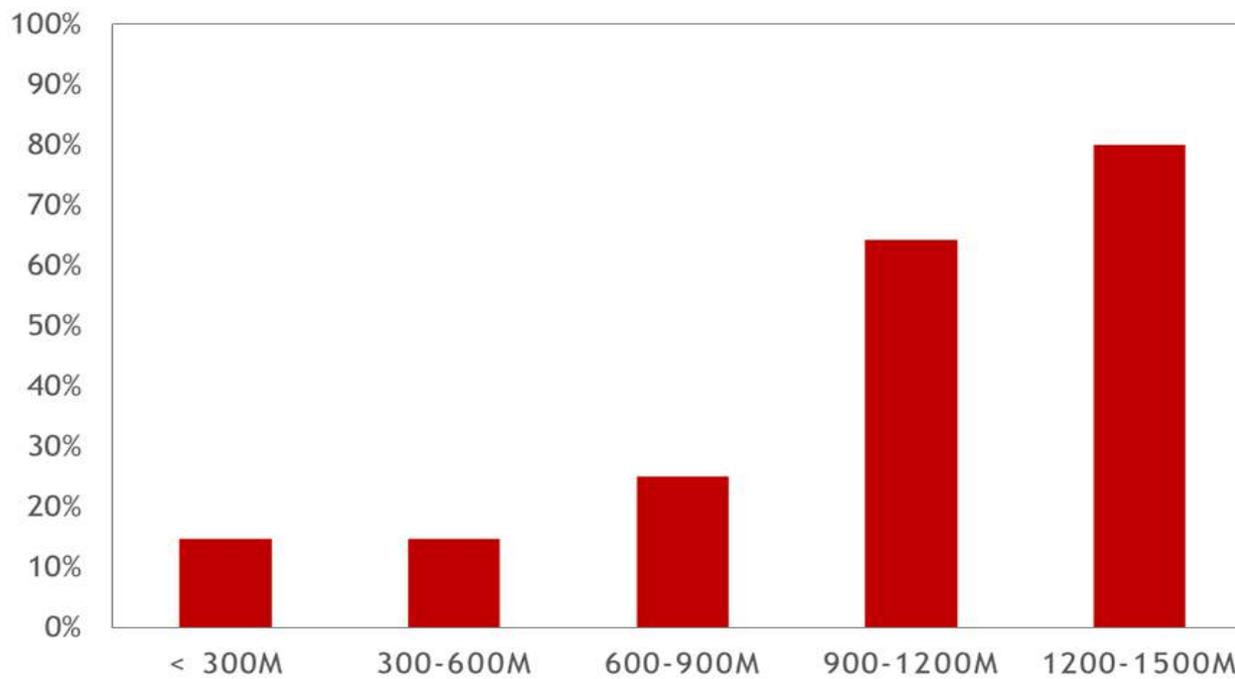
- Accelerate development of natural cavities ?





## Bat boxes

Occupancy rates in 150 boxes relation to distance to a highway



Christensen & Ujvári 2015





## Other roost facilities

### Bat houses & underground sites

- The larger structure the better to stabilize interior microclimatic conditions

### Enhancing existing roosts

- Manage access ways (light, noise, predation risk, etc.)
- Install heaters
- Manage humidity
- Rough surfaces of walls in chambers





# Bats and infrastructures

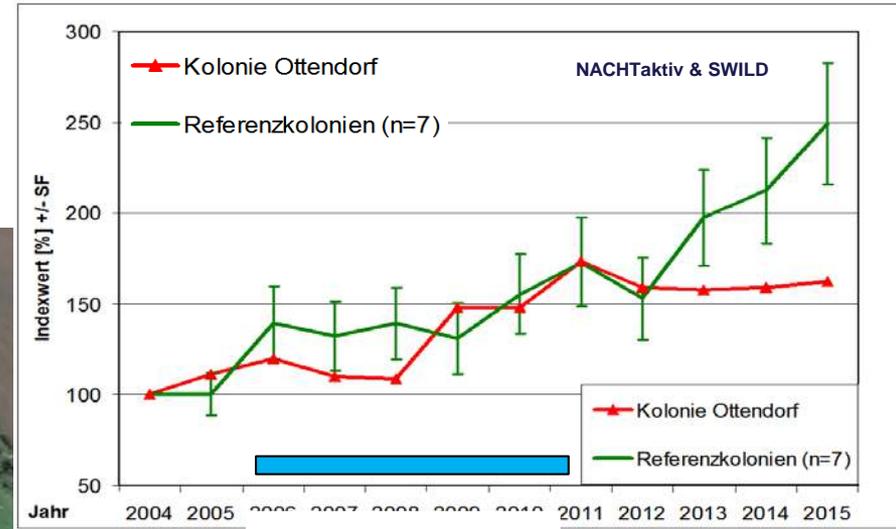
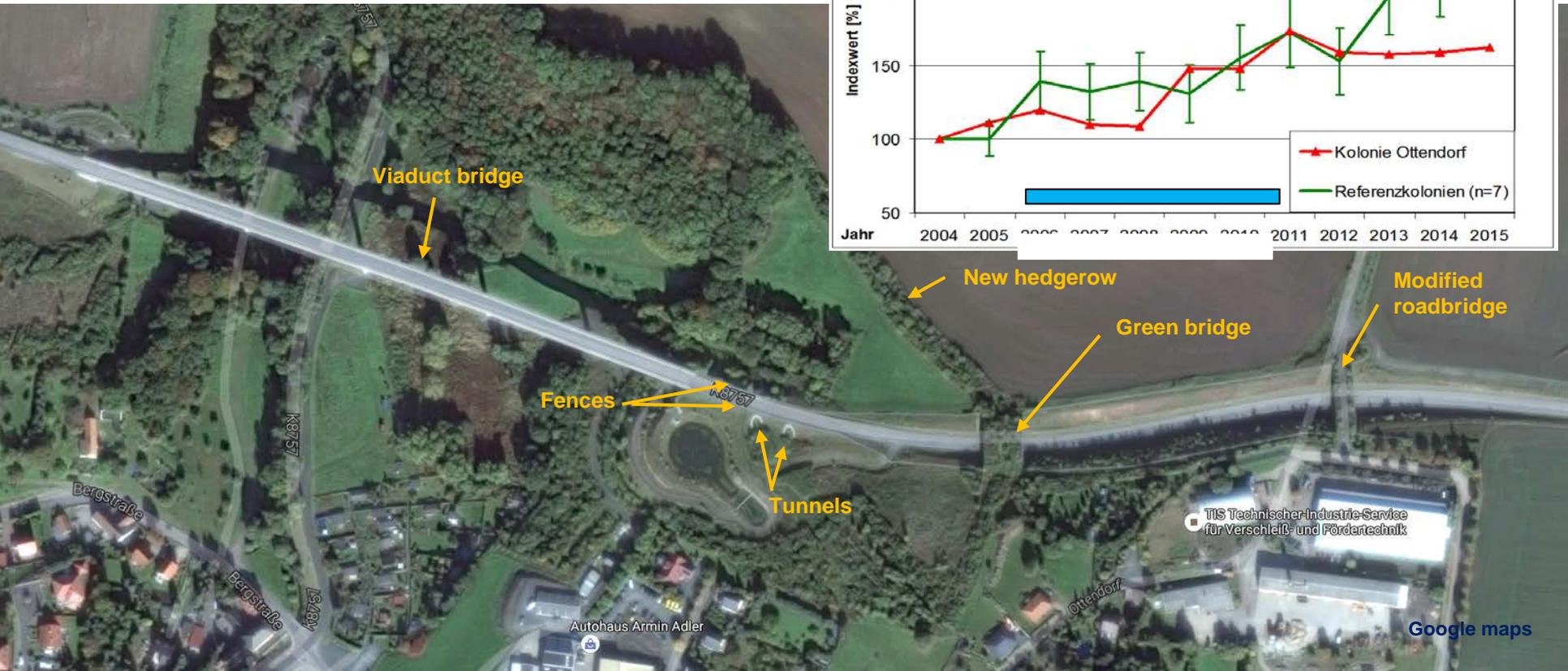


Function	Type	Clutter-species	Aerial hawking
<u>Passageways</u>	Green bridges		
	Adapted bridges	Green verges	
		Panels	n/a
	Bat gantries	Open structures	
		Closed structures	
	Hop-overs		
	Viaduct bridges		
<u>Diversion &amp; deterrence</u>	Tunnels & Culverts		
	Hedgerows		
	Barrier screens		
	Light	Deterrence	
		Adaptation	
		Restriction	
		Audible warning	
<u>Habitat compensation</u>	Bat boxes		
	Bat houses		
	Translocate trees w/cavities		
	Artificial holes in trees		
	Habitat improvement		





## How much is needed?





**Thanks for your attention**



**Thanks to:  
Jasja Dekker, Julie D. Møller, Morten  
Christensen, Esben T. Fjederholt, Hans J.  
Baagøe, Inazio Garin and photographers**



## References and links

CEDR Road and Wildlife Manual

<http://www.cedr.eu/wpfb-file/cr-2018-3-call-2013-roads-and-wildlife-manual-pdf/>

Safe-Bat-Paths reports and documents:

<http://bios.au.dk/om-instituttet/organisation/faunaoekologi/projekter/safe-bat-paths/documents/>