Amphibian and reptile mitigation measures over roads
On Thursday, May 27, 2010, for a second day, near the town of Langadas, some 12 miles east of Thessaloniki, Greece, as the frogs migrate from a nearby lake probably looking for food. Greek officials say the colony of frogs has forced the closure of a key northern highway for two hours after three car drivers skidded off the road while trying to dodge the frogs. No human injuries were reported.
Effect of road kills on amphibians

basically determines distribution (Vos et al. 2001),

avoidance (Fahrig et al. 1995, Vos & Chardon 1998),

extremely unequal sex ratio (Csapó et al. 1989),

low density in the vicinity of sections with high traffic (Fahrig et al. 1995, Vos et al. 2001),


local extinction (Cooke 1995).
Effect of road kills on reptiles

much less is known

more frequent nearer to the Equator (see e.g. Smith and Dodd, 2003 for snakes, Kline and Swan, 1998 for turtles)

everely unequal sex ratio (Aresco, 2005, Gibbs and Steen, 2005),

lower density in the vicinity of roads than further away (Boarman and Sazaki, 2004)

local decline (?) (Haxton, 2000) but Steen et al., 2004
MAAILMAN LUONTO
majoittuu museoon
23.4.2010
Tervetuloa!
Relative frequency of amphibian road kills

12-16 times more vertebrates are killed on roads than what can be found, many amphibians are removed by scavengers (Slater, 2002).

4.9 – 92.1%

on foot – by bicycle  by car  (increasing speed)
Relative frequency of reptile road kills

Desert

0 – 30.3%

on foot – by bicycle by car (increasing speed)
POSSIBLE SOLUTIONS

Road signs 😞

Temporary drift fences 😊

Close road to traffic temporarily 😊

Road demolishing 😊

Permanent technical solution 😊

Mitigation pond 😊 (Newts)

Reduced speed 😊?

Rescue measures 😊
POSSIBLE SOLUTIONS

Swiss Standard SN 640 669

Rescue measures 😊
POSSIBLE SOLUTIONS

Road signs 😕

Temporary drift fences 😊

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Rescue measures 😊

Schelbert-Jungo 1999
Permanent technical solutions

First amphibian tunnels

In Europe

1969: near Zürich, Switzerland

Schmidt & Zumbach, 2008
TUNNELS
mainly from concrete
great diversity but no one-way system any more
diameter increases

Amphibian tunnel diameter in Lower Saxony and in Central-Europe
Bigger is better.

Special material (polymer concrete) developed.

Humidity, light, size, pollution, cleaning.

TUNNELS
Most favourable tunnels have large diameter (1 m x 1 m, if the road is very wide 2 m x 2 m), moist microclimate (permanent or temporal stream),
Most favourable tunnels have
large diameter (1 m x 1 m, if the road is very wide 2 m x 2 m),
moist microclimate (permanent or temporal stream),
rectangular shape,
natural soil in them,
smooth tunnel barrier wall connection.

There is no standard solution!!!
spatial pattern of the migration,
species composition,
local topography
are decisive.
Case study 1.
Main problem: high water table
Target species: European spadefoot toad
ACO tunnels:
**Pros**: humid microclimate, near the surface
**Cons**: pollution (e.g. road salt) enters easily, air pressure changes caused by cars
A little alteration to change movement direction
BundesMinisterium für Verkehr, Bau- und Wohnungswesen, 2000
Case study 2.
Main problem: fluctuating water table
Target species: amphibians and mammals

Large tunnels deeper under the road:
**Pros**: size, allows crossings of both groups
**Cons**: overflooded occasionally, counter-balanced by floating wooden structures inside allowing mammals to cross with dry feet
Besides a large number of amphibians, *Natrix natrix* crossed (juveniles were trapped inside).
Besides amphibians, *Natrix natrix* crossed (trapped inside).
Lacerta agilis crossed and lived on the mitigation measure (several individuals were seen).
FENCES
from concrete, plastic mesh or polythene
often problems due to inadequate building or maintenance

Relative frequency of different fences
in Central-European mitigation measures
Auckland, New Zealand

Photo courtesy: Phil Bishop, Otago Univ.
Barrier walls and fences should prevent road kills, direct animals into the tunnels.

Favourably they have zigzag arrangement, If from concrete e.g. L-shape elements, overhanging upper end.

Unlike fences, barrier wall top should be ground level with the surface of the road (to provide escape routes). Alternatively, escape ramps can help amphibians leaving the road as with fences.
A fence that directs e.g. common toads well, can be inappropriate for other species.
Western toadlet, Vancouver Island, BC, Kanada (Photo: Leonard Sielecki)
TUNNEL – FENCE CONNECTIONS, SYSTEMS

Distance between tunnels: usually 80-100 m (lowest in Kudowa Zdrój, Poland), optimally appr. 50 m-s

Some systems did not work because there is no connection between system elements

Non-herp specific mitigation measures or viaducts have a great conservation potential as it is already utilised in Domzale, Slovenia
The fate of a mitigation measure

Maintenance is a must!
The fate of a mitigation measure  

Henley-on-Thames, England
MULTI-SPECIES APPROACH

• In Europe, most mitigation measures were constructed according to the requirements of large, common species with a considerable migration distance, namely the common toad (*Bufo bufo*) and the common frog (*Rana temporaria*), which are abundant and play an important role in the local ecosystems.

• At most sections, however, several species cross roads or railways together due to their similar habitat needs. Their relative abundance may vary from site to site according to their local population sizes.
Effectiveness

Does the system prevent road kills?
The barrier function of the fences are investigated.

Does the system facilitate amphibian crossing?
  life stages (adults, juveniles)
  seasonality

The number/ratio of crossing individuals/species
  (use of the passage) is surveyed.

How does the system affect population viability?
Populations living in the vicinity of the road are studied
  if their viability is enhanced.

Rarely measured, definitely need long-term data.
Efficiency

Does the system prevent road kills?

Does the system facilitate amphibian crossing?
   life stages (adults, juveniles)
   seasonality

How does the system affect population viability?
   Rarely measured, definitely need long-term data.

Missing links

Juveniles
Newts

What percentage of the populations ought to use the tunnels?

Technical details
e.g. metal tunnels – magnetoreception by amphibians
CONCLUSION

The long-term survival of the local herpetofauna may require different measures to cross linear infrastructure elements the most efficiently. As such, the actual mitigation measure design should not only meet general standards but also reflect to the composition and relative abundance as well as the vulnerability of the individual species of the local amphibian fauna to function as the most effective conservation corridor. Without efficiency studies, however, the functioning of mitigation measures can not be evaluated.
Thank you for your attention!

St. Hélier, Jersey, UK.

Photo courtesy: John W. Wilkinson

Torun, Poland