One size does not fit all: How to manage frogs and other semi-aquatic wildlife

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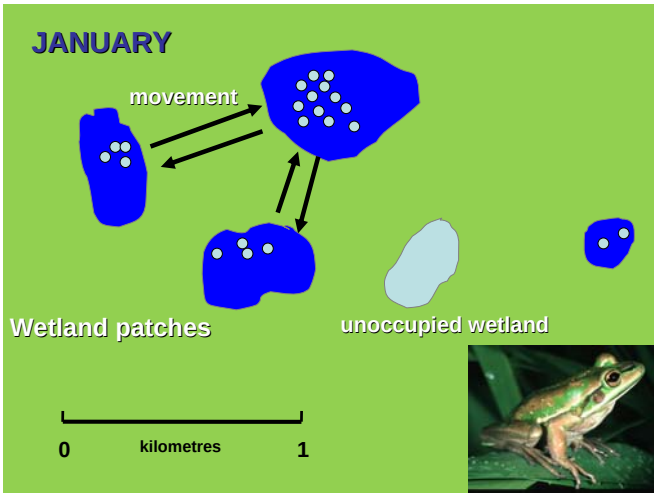
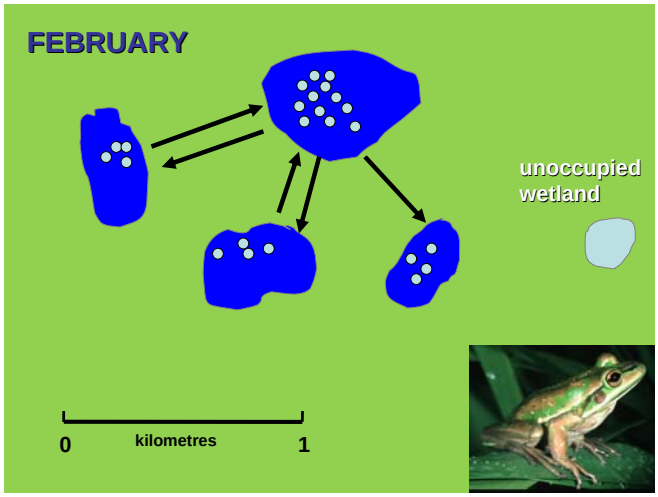
Scope of Presentation

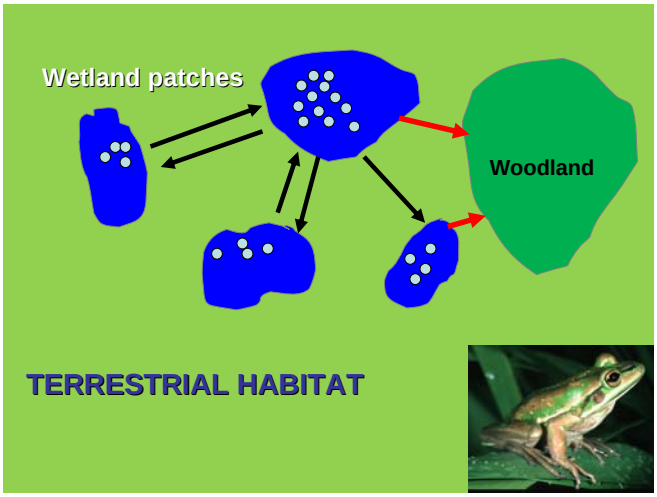
- Population dynamics of frogs and semi-aquatic species
- Effects of roads on frogs and semi-aquatic species
- Mitigating adverse impacts
- Case study: Pakenham Bypass, Victoria
- Effectiveness of mitigation and future directions

Population Dynamics of Frogs and Semi-aquatic Species

- Location of habitats in the landscape
- Landscape permeability and maintenance of movement corridors
- Terrestrial habitat adjacent to wetlands and links to other wetlands





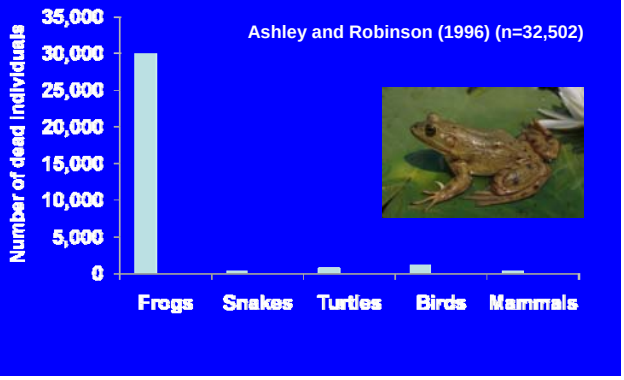


Direct effects of roads on frogs and semi-aquatic species

MORTALITY

Road construction — Road operation

Number of vertebrate animals killed along a 3.6 km survey route in Ontario (2,549 total km travelled)



Frogs, toads and hatchling turtles killed in one day on U.S. Highway 27, Florida

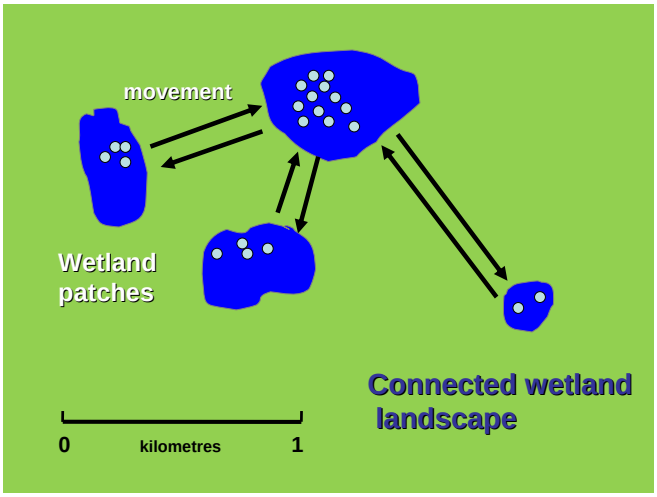
Large turtles on roads are a dangerous obstacle for motorists

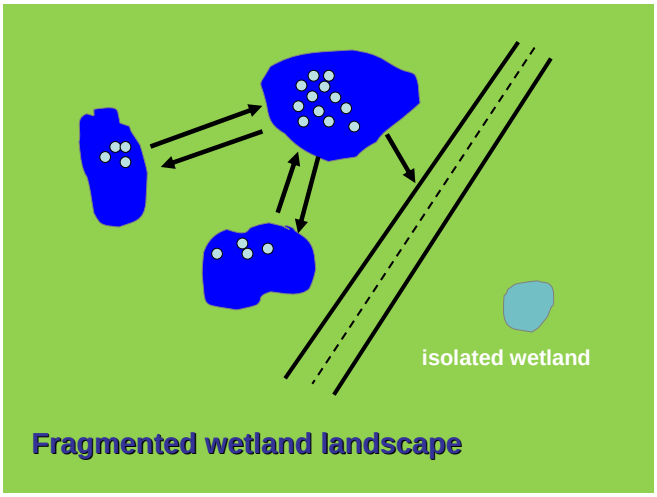
Road Mortality

- Highest rates occur where roads are located in vicinity of a wetland
- Highest rates occur on rainy nights in breeding or nesting season
- Can threaten the sustainability of populations

Indirect effects of roads on amphibians and semi-aquatic species

- Habitat fragmentation
- Altered wetland hydrology
- Pollution/sedimentation
- Noise
- Light
- Invasive species





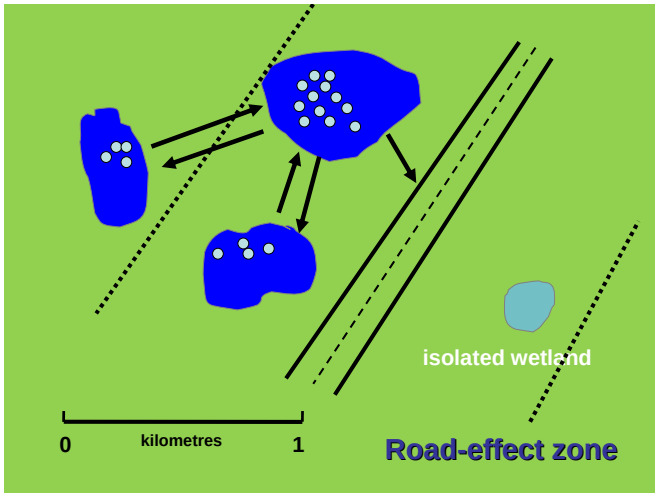
Indirect effects of roads on amphibians and semi-aquatic species

- Habitat fragmentation
- Altered wetland hydrology
- Pollution/sedimentation
- Noise
- Light
- Invasive species

Effects of roads on amphibians

- Combined environmental effects of roads = 'road-effect zone':
  - Road mortality
  - Hydrological
  - Pollutants
  - Noise
  - Light
  - Invasive species
  - Human access

100 – 800 m



Why are Frogs and Semi-aquatic Species Sensitive to Road Impacts?

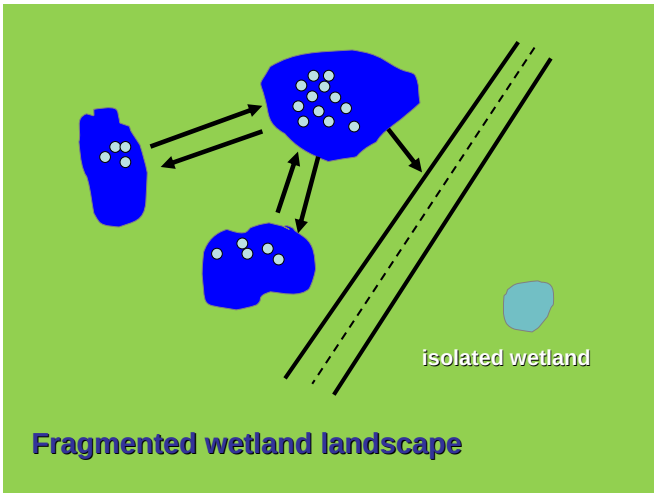
- Depend on a non-fragmented landscape to complete their life cycle
- Breeding habitats often concentrated in specific areas at specific times
- Species with higher dispersal requirements more at risk of road mortality
- High skin permeability of amphibians
- Slow moving

Implications of Road Effects for Frogs and Semi-aquatic Species

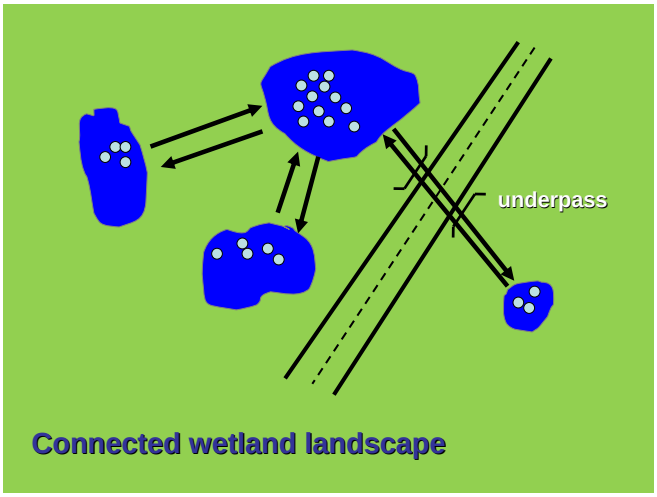
- Reduced species richness, abundance, occurrence
- Declines in population size
- Long-term impacts on populations
- Reduced population genetic diversity

Mitigating Adverse Impacts

- Road placement most important factor in determining severity of road impacts
- Crossing structures to allow safe movement
- Common solution: installation of culverts (i.e. Underpasses) coupled with barrier fences
- Warning signs to motorists in movement areas

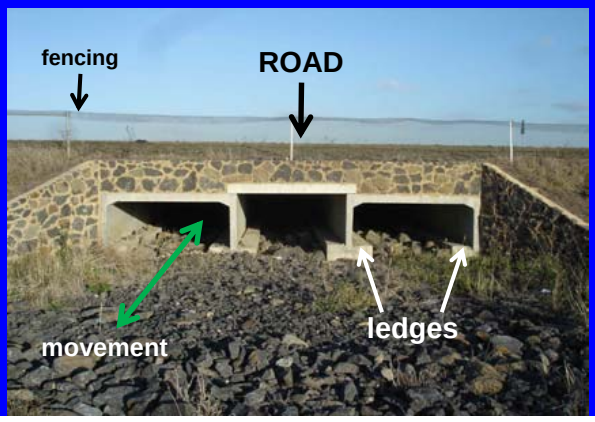


Fragmented wetland landscape



Connected wetland landscape

Underpass with barrier fencing

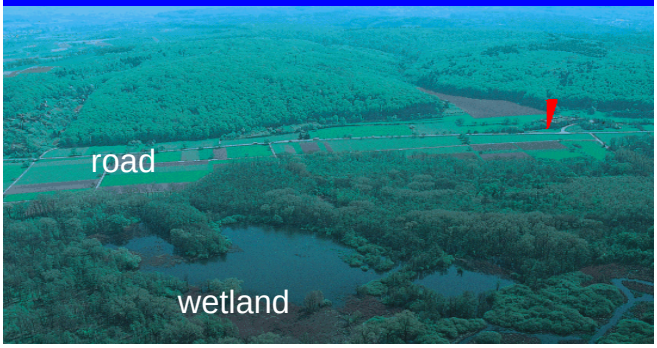


Frog and toad movement through underpass

http://www.xfaweb.baden-wuerttemberg.de/nafaweb/berichte/pas_03/pas3.html

Bridge crossing over a creek

Position of underpass to connect two forest fragments in Germany



Location where U.S. Highway 27 crosses Lake Jackson, Florida (Aresco 2005)

http://www.lakejacksonturtles.org/

Temporary fence to direct turtles through a culvert under U.S. Highway 27

http://www.lakejacksonturtles.org/

Mitigating Adverse Impacts

- Road placement most important factor in determining severity of road impacts
- Crossing structures to allow safe movement
- Common solution: installation of culverts (i.e. Underpasses) coupled with barrier fences
- Warning signs to motorists in movement areas

Warning signs to motorists in areas where roads bisect movement corridors

Permanent sign

Temporary sign during spawning season

Road Underpasses and Mitigation

- First amphibian tunnel built in 1969 near Zurich, Switzerland
- Reduce road mortality and provide safe passage across road
- Destruction of wetlands during road construction may be “offset” by habitat creation
- Amphibians less likely to use underpasses without barrier fencing

Barrier Fencing

- Barrier fencing:

1. Prevents access to the road
2. Directs (funnels) individuals towards the underpasses

- Underpasses may only work for ground frogs as tree frogs can climb over barrier fences

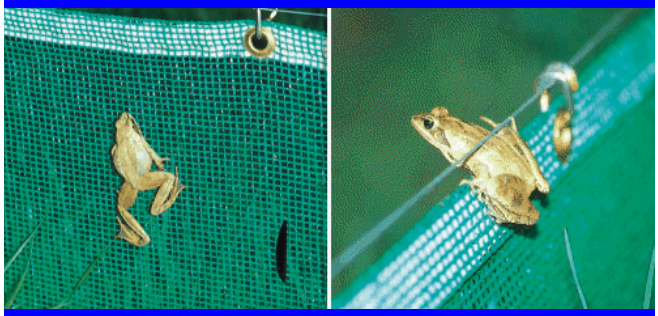
Barrier fences used in Germany

http://www.xfaweb.baden-wuerttemberg.de/nafaweb/berichte/pas_03/pas3.html

Barrier fences direct animals to underpasses

http://www.xfaweb.baden-wuerttemberg.de/nafaweb/berichte/pas_03/pas3.html

Frog trespass over barrier fence



http://www.xfaweb.baden-wuerttemberg.de/nafaweb/berichte/pas_03/pas3.html

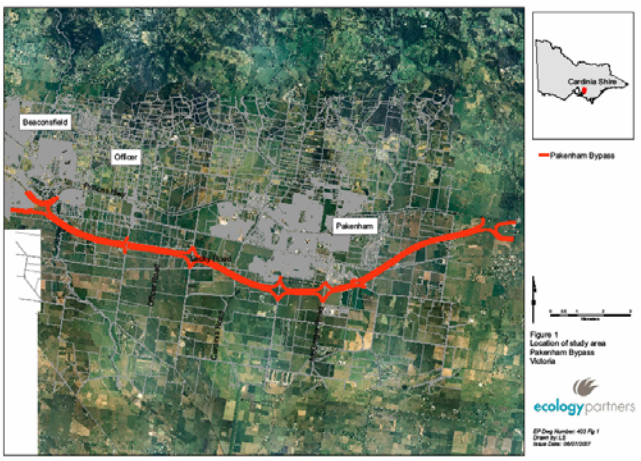
Overlapping sections of fence may enable animals to climb up and over

http://www.xfaweb.baden-wuerttemberg.de/nafaweb/berichte/pas_03/pas3.html

Case Study:
Monitoring the Growling Grass Frog (*Litoria raniformis*) along the Pakenham Bypass

- 20 km six-lane road between Beaconsfield and Nar Nar Goon, southern Victoria
- Ten frog underpasses and 32 ponds were created
- *Environmental Protection and Biodiversity Conservation Act 1999*
- Conservation Management Plan

Growling Grass Frog (*Litoria raniformis*)



Underpasses with barrier fences

Culvert at drainage line

Frog habitat at underpass entrances

Permanent pond

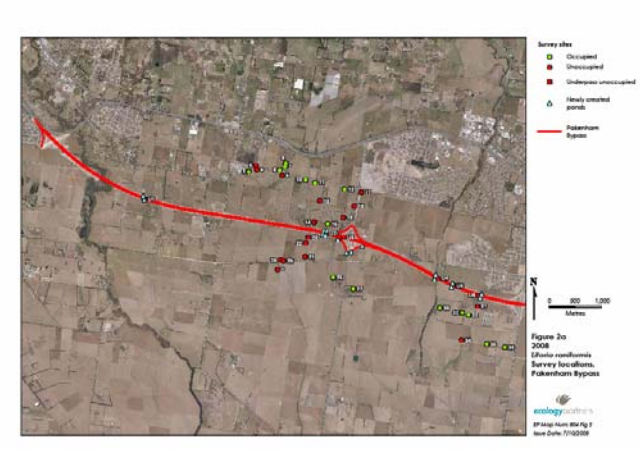
Rock piles

Mitigation wetlands for growling grass frog

Pakenham Bypass road reserve

Growling Grass Frog Monitoring

- Frog monitoring along the Pakenham Bypass from 2003 – 2009
- Monitoring aims:
- Occupancy
- Population size;
- Habitat conditions
- Breeding
- Before-during-after construction



Wetlands monitored away from the Pakenham Bypass

Farm dams

Frog Monitoring Methods

- Nocturnal searches at 50 – 60 ponds from 2003 – 2009
- Mark-recapture methods at 6 ponds within 2 km of the Bypass (3 south, 3 north of Bypass) from 2006 to 2009
- Habitat assessment – vegetation, water quality



Frog Monitoring Results

- Frogs detected at 20 ponds out of 50 in 2007 breeding season
- Frogs colonised and used created ponds for breeding
- Individuals recaptured in 2007 at sites they were initially marked in 2005 and 2006
- No movement detected across the Bypass

Effectiveness of Mitigation for Frogs and Semi-aquatic Species

North American and European studies...

- Underpasses prevent road mortality
- Frogs and turtles move through underpasses
- Frogs use created mitigation ponds

http://www.xfaweb.baden-wuerttemberg.de/nafaweb/berichte/pas_03/pas3.htm

Australian Studies

©frogs.org.au

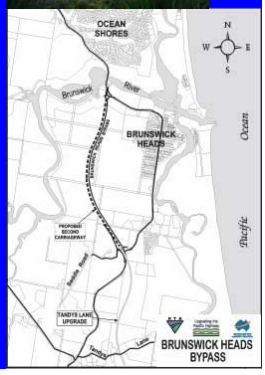
However...

- Studies conducted for the NSW RTA recorded few frogs and one turtle moving through box culverts along the Pacific Highway

- No evidence to support use of constructed ponds and underpasses by the green-thighed frog along Pacific Highway upgrade

Australian Studies

- Taylor and Goldingay (2003) assessed frog populations along Brunswick Heads Bypass
- Cane Toad was the only amphibian observed inside culverts
- Conclusion: relative lack of use of culverts by frogs and high road mortality



Effectiveness of Mitigation for Frogs and Semi-aquatic Species

The Unknown...

- Short-term and long-term use of frog underpasses
- Long-term use of mitigation ponds and wetlands
- Impact of indirect effects on populations

Future Directions

- Studies to assess mortality and barrier effects:
- Annual roadkill across Australia of 4.45 million frogs (Ehmann and Cogger 1995)
- Goldingay and Taylor (2006) counted >1000 dead frogs over 13 mornings including threatened species
- Greater interaction between ecologists and engineers at the planning and design phase of a project
- Applied research and long-term monitoring

Permanent underpass (“ecopassage”) at Paynes Prairie on US Highway 441 south of Gainesville

http://www.lakejacksonturtles.org/

Toad Tunnel Conference, Rendsburg, Germany January 1989

ACO Polymer Products

FAUNA & FLORA International
Conserving wildlife since 1903

WWF

Proceedings: tunnels and drift fences to mitigate amphibian mortality on roads (ed. T.E.S. Langton)

Frog Monitoring Results

- Consistent habitat conditions, but low water levels
- Population size estimates at a farm dam:

2005 = 56 frogs
2006 = 128 frogs
2007 = 89 frogs

- Declines in occupancy at smaller waterbodies – pond drying/drought

Future Directions

- Long-term monitoring needed to:
- Assess underpass/created pond use over time
- Establish the time lag between underpass construction and species use
- Assess long-term persistence of populations in vicinity
- Assess indirect impacts on populations
  - quantifying the road-effect zone
  - genetic studies