ENVEROS

ENVIRONMENTAL EDUCATION THROUGH ROADKILL OBSERVATION SYSTEMS

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Enviromental Education through Roadkills Observation Systems - EnVeROS

09. Planning and Design

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LEARNING OBJECTIVES

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

- Explain features of Bad/ Good roads and the importance of roadless areas.
- Relate the importance of biodiversity research on road planning, designing and operation.
- Critically assess the current capability of Environmental Impact Assessment to incorporate road ecology and WVCs issues.
- Design field methods and experimentation for road ecology and WVCs mitigation.

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Planning and Design: key concepts

1. Bad roads, Good roads and the importance of roadless areas.

2. Incorporating biodiversity issues into road design.

3. Improving EIA (Env. Impact Assess.) and road planning at landscape scale.

4. Ensuring that each road project is designed, built and operated as planned.

5. Good science, field methods and experimentation for road ecology and WVCs mitigation.

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1. Bad roads, Good roads… things to have in mind in road planning and management

- Roads in pristine areas are environmentally dangerous and they should be avoided. Protecting roadless areas is critical → Ecosystem Services and Biodiversity protection.
- Unnecessary and ecologically damaging roads should be reclaimed.
- Paved roads/ highways have especially large-scale impacts (than do unpaved roads; but consider also the first bullet point! Not an argument to "invade" into roadless areas).
- Roads could be (in certain contexts) environmentally (and socially) beneficial (e.g. for waste management; increased agricultural productivity → less deforestation; see Laurence et al. 2014; Nature for the "good aspect of roads")
- Global road mapping is a "first-class" tool for planning and designing (and it is a relatively recent achievement).

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Road planning near roadless or low-traffic areas.

Is the road crossing a roadless or low-traffic area?

↓ Yes

Is the road really necessary?

No → Maintain the area road-free
Reduce future demand for a new road in the area
Transport planning directs the traffic to other areas

↓ Yes

Can the dissection of the area be avoided?

Yes → Re-route the road to minimise impacts on the area
Bundle to existing transport networks

↓ No

Can fragmentation be minimised?

Yes → Assessment of alternative routes across the area
Prioritize route leaving largest patches unfragmented and maintaining functionality of the ecosystem

↓ No

Apply compensation measure: no net loss of roadless area, road reclamation
Apply mitigation measures, e.g. limit traffic volume, access or speed.
Avoid contagious development effects by strictly regulating it
Implement sustainable development schemes
Promote railroads or other ways of transport

(Source: Van der Ree et al. Handbook of Road Ecology, Wiley, page 24.)

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Consideration of road design features (indicative examples)

- At locations where the roadway crosses drainages, known migration corridors, or known animal habitat, the designer should take extra caution to make animals visible to drivers. At these locations **avoid curves**, **steep side slopes**, and **narrow clear zones**.
- When designing drainage consider the impact on wildlife movement and attraction. **Avoid creating pooled water** in the right of way which can create attractive vegetation. Some wildlife will avoid crossing rip-rap. If rip-rap funnels animals to an undesirable crossing location, **consider filling gaps in the rip-rap with sand and gravel** (which may make it more conducive for animals to cross) or extend the rip-rap to a more suitable crossing location.

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2. Incorporating biodiversity issues into road design

Stage in road project	Type and detail of ecological input required
Strategic planning	Focus on options that avoid or improve ecological outcomes based on strategic environmental assessment. Examples of key questions include: Can the impact on important wildlife migration routes be avoided? Can the project enhance wildlife connectivity by restoring connections? Can areas without roads be avoided?
Physical planning	Focus on road designs that minimise, mitigate or offset impacts based on detailed ecological analysis. Examples of key questions include: Where should fauna crossings be located? Can the road design be modified to minimise impact on important habitat?
Construction	Ensure that ecologically sensitive designs are easily translated to construction. Examples of key questions include: Has the design of wildlife crossing structures met the required standards for the target species? Has the detailed drainage design considered the impact on adjacent important habitat?
Operation	Ongoing ecological management, maintenance of mitigation measures, review and adaptive management. Examples of key questions include: Is there a plan for monitoring and maintenance in place to ensure crossing structures remain effective over time? Are areas of important habitat adjacent to the road project being managed to ensure that they are not degraded by indirect impacts of the operation of the road?

(Source: Van der Ree et al. Handbook of Road Ecology, Wiley, page 31)

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Tradeoffs… are always there

- Construction of a wildlife overpass (left) may require greater clearing of habitat during construction than a modified culvert (right), but in the long-run will provide connectivity for a wider array of species (Mata et al. Handbook of road ecology, Wiley).

(Source: Image via reddit, Belgium)

(Source: Photo by Joaquim Pedro Ferreira)

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3. "EIAs (Env. Impact Assess.) of road projects are generally poor"

Researched in these papers: Atkinson et al. 2000; Impact Assessment and Project Appraisal; Byron et al. 2000; Journal of Environmental Planning and Management; Söderman 2005; Impact Assessment and Project Appraisal; Gontier et al. 2006; Environmental Impact Assessment Review; Tennøy et al. 2006; Impact Assessment and Project Appraisal; Karlson et al. 2014; Environmental Impact Assessment Review.

Deficiencies (examples of what was observed in the above papers):

- Not enough (if any!) research on the effects of roads on rare or protected species.
- Gap between EIA and state of the art GIS-based modelling.
- Fragmentation effects? Barrier effects? Seldom considered.
- EIAs were generally descriptive (we need analysis and predictions!)
- Indirect impacts not considered; even information on biodiversity was absent in some cases.
- EIAs focus on the local scale (but what about the scale of ecological processes?)

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4. Built and operation as planned

- **Road planning, design, construction and operation: a collaborative process.**
- **Engage ecologists and biologists** with expertise on the ecosystems or species of concern at the earliest planning stages to ensure the best outcome for biodiversity.

- Accommodating wildlife and habitat is not likely to be considered unless mandated by regulation or formal agreement which is a result of public sentiment and government policy.

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4. Built and operation as planned

- **Clearly define the ecological goals**.

- Mitigation measures (i) an existing road negatively impacts wildlife or (ii) an assessment for a proposed road has identified that it will likely have a negative impact on wildlife.

- **Mitigation measures need to be identified** during the planning or early design stages to prevent unnecessary costs (cost-benefit analysis).

- … but changes are always possible! E.g. movement of features (e.g. a culvert) from their initial location (Effects?).

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5. Good science …

- **Effective monitoring is an essential tool in road planning/ operating and <u>WVCs mitigation</u>.**

➢ After the road has been built; Identifying and Prioritizing WVC problem areas.

➢ Crash and carcass data can be used to identify “Hot spots” areas, to develop an understanding of the root causes of WVCs.

This approach is multidisciplinary in nature and involves:

- **Landscape ecology**: a discipline that stresses understanding of the interactions of physical and biological phenomena at multiple spatial and temporal scales
- **Conservation biology:** a discipline that integrates biological, social and physical sciences to develop a sound basis for the conservation, management, and restoration of biological resources.

These scientific fields of study can lend understanding to the effects of **spatial patterns**, **ecological processes**, **animal behavior** and **related factors**.

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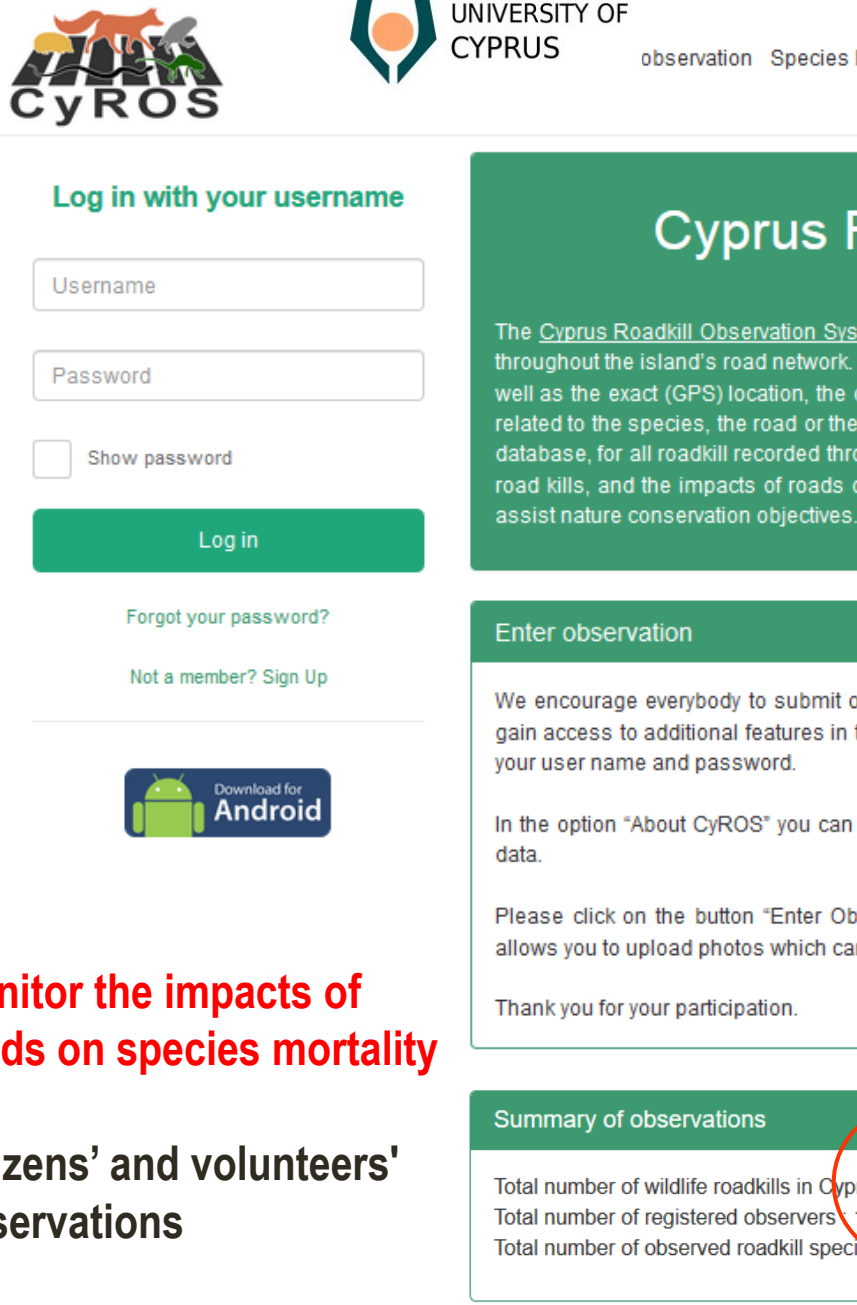
observation Species li

CASE study: www.cyroadkills.org



Monitor the impacts of roads on species mortality

Citizens' and volunteers' observations

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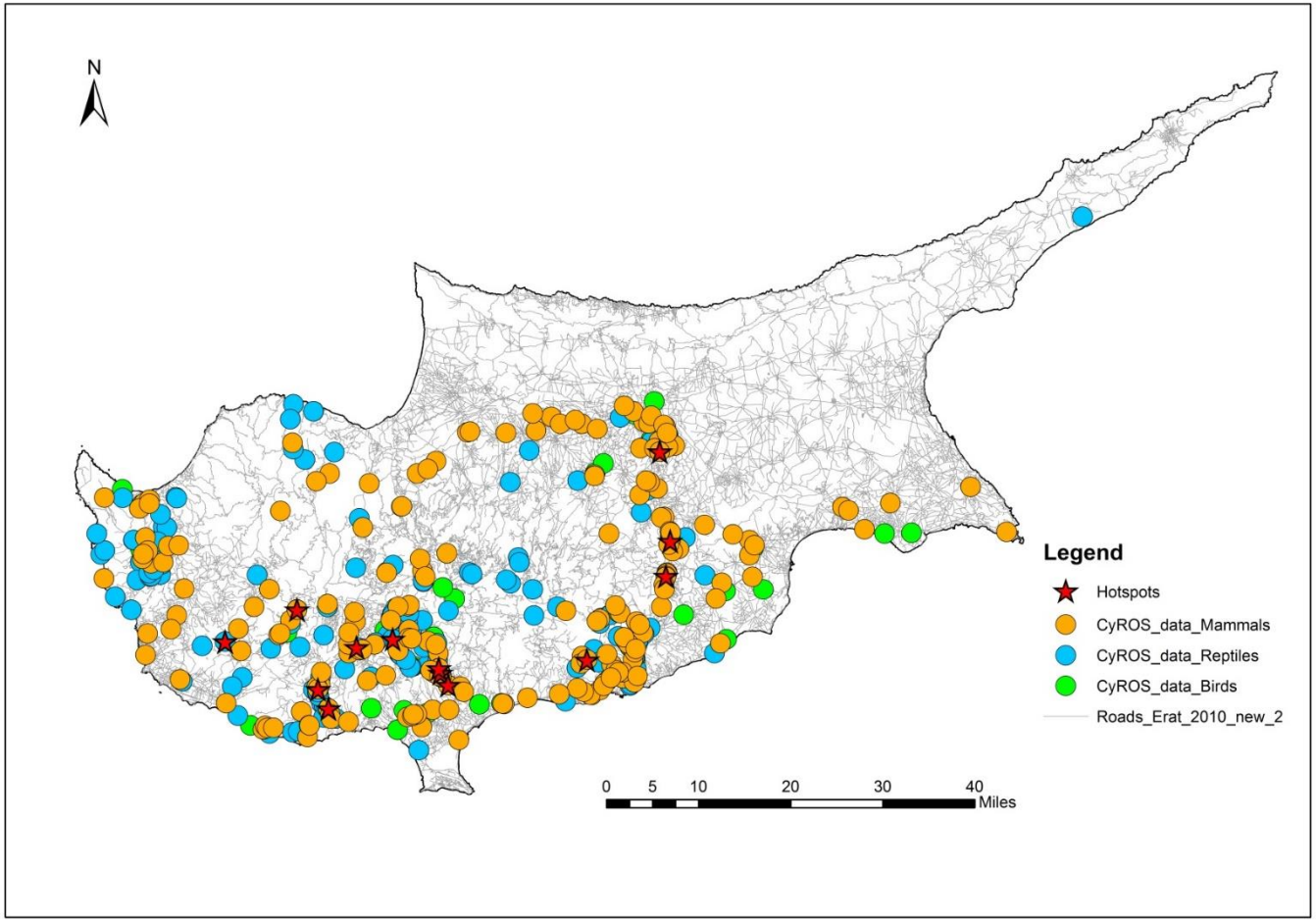

12 hotspots in asphalt road and rural roads in Cyprus
(Vogiatzakis; unpublished data from CyROS)

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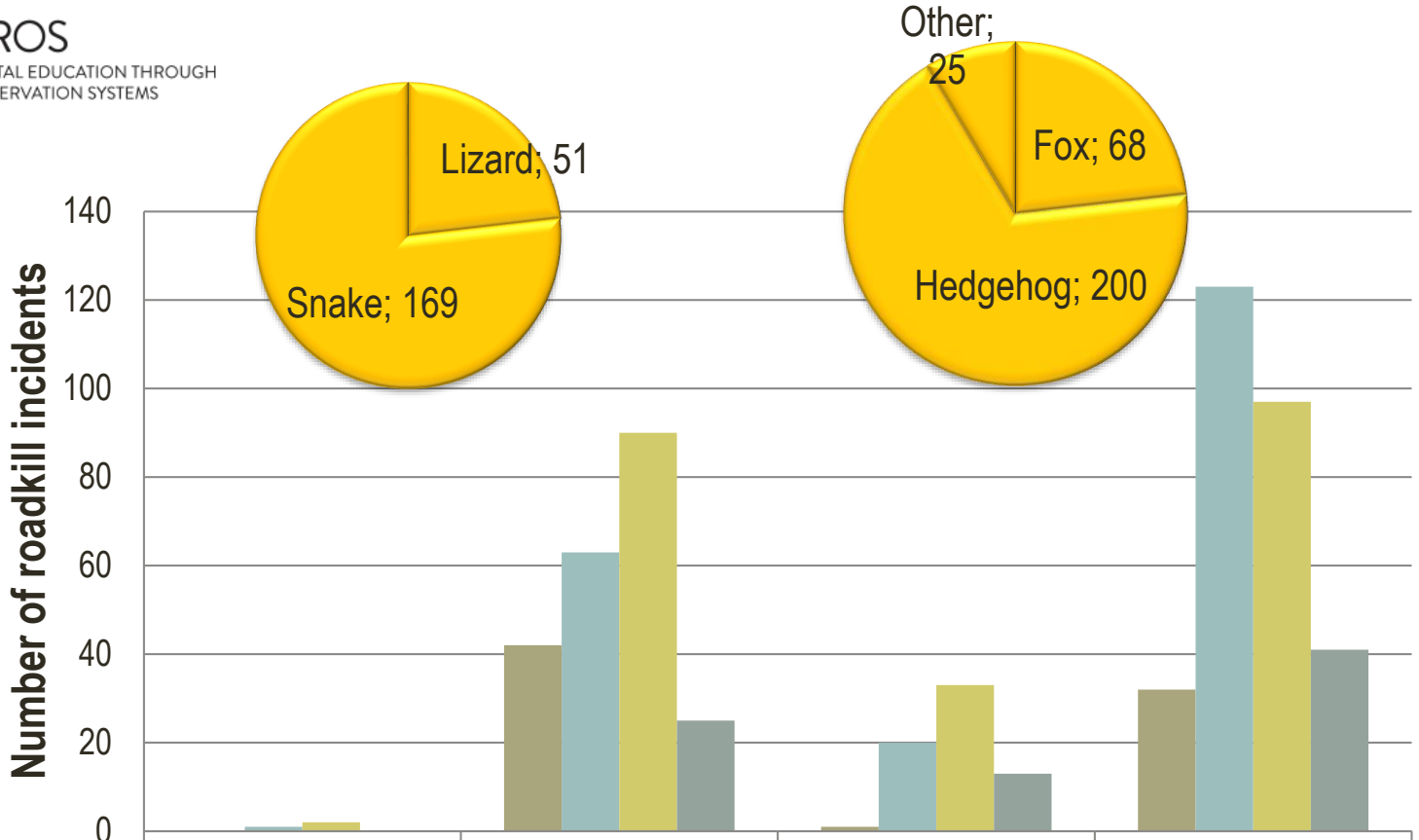

	Amphibian	Reptiles	Bird	Mammal
2016		42	1	32
2017	1	63	20	123
2018	2	90	33	97
2019		25	13	41

- **Reptiles are mostly affected** (Large whip snake - *Dolichophis jugularis*).
- **Hedgehogs** are the mostly affected mammal species.

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Summary

- There are features that distinguish Bad from Good roads
- Roadless or low traffic areas are crucial for WVCs mitigation and species protection.
- Incorporation of biodiversity issues for road planning and operating, including improvement of related EIAs (Env. Impact Assess.), is very important.
- Ensuring that each road project is designed, built and operated as planned is also fundamental.
- Good science, field methods and experimentation for road ecology and WVCs mitigation are also need to be involved in road management.

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- van der Ree, R., Jaeger, J. A., Rytwinski, T., & van der Grift, E. A. (2015). Good science and experimentation are needed in road ecology. *Handbook of road ecology*, 71-81.

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Activities & Self Assessment Exercises:

- Explain in two paragraphs the features of Bad/ Good roads and the importance of roadless areas.
- Suggest 3-4 tips to consider when designing roads in order to minimize WVC.
- Explain in paragraph: "How the better design features of roadways and better adjusting the road alignment can have an impact on reducing WVCs" (100 words).
- "For road planning and operating the incorporation of biodiversity issues is very important." Develop this quote and give your explanation (150 words).

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