Incorporating experiments into road mitigation and monitoring

Rodney van der Ree
(rvdr@unimelb.edu.au)

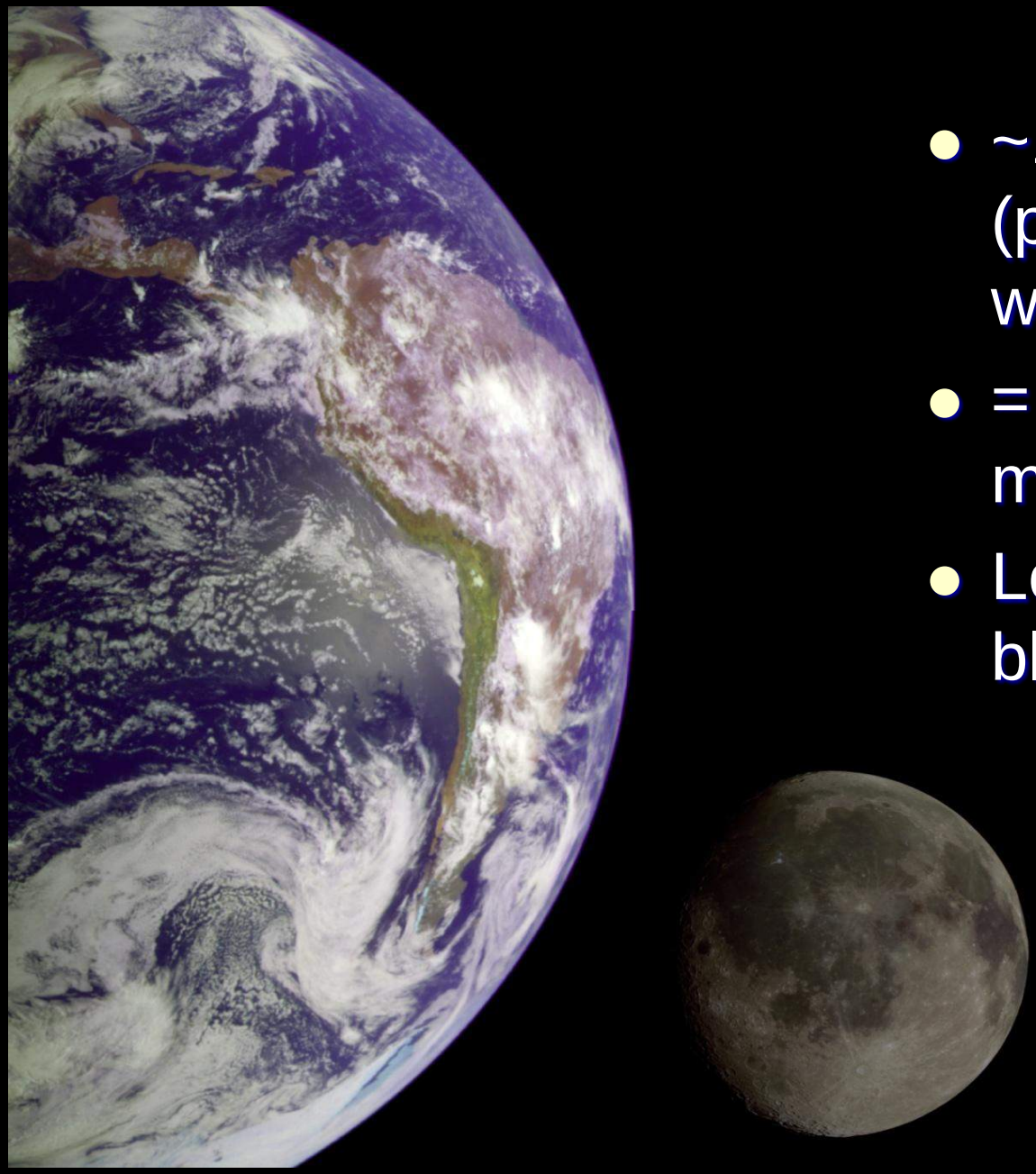
Most monitoring is, but need not be, a waste of time

- *"Results from inadequate monitoring are: misleading for their information quality and are dangerous because the give the illusion that something useful has been done"*

Legg and Nagy (2006), Jnl Env Mgt)

Research or monitoring?

- Research: the systematic collection & analysis of information to increase understanding of a topic or issue
- Monitoring: specific form of research, involving the repeated measuring of certain variables, usually over extended time period
- Experiments: (in research & monitoring) uses manipulation and testing under controlled conditions to understand causal relationship between 2 or more variables

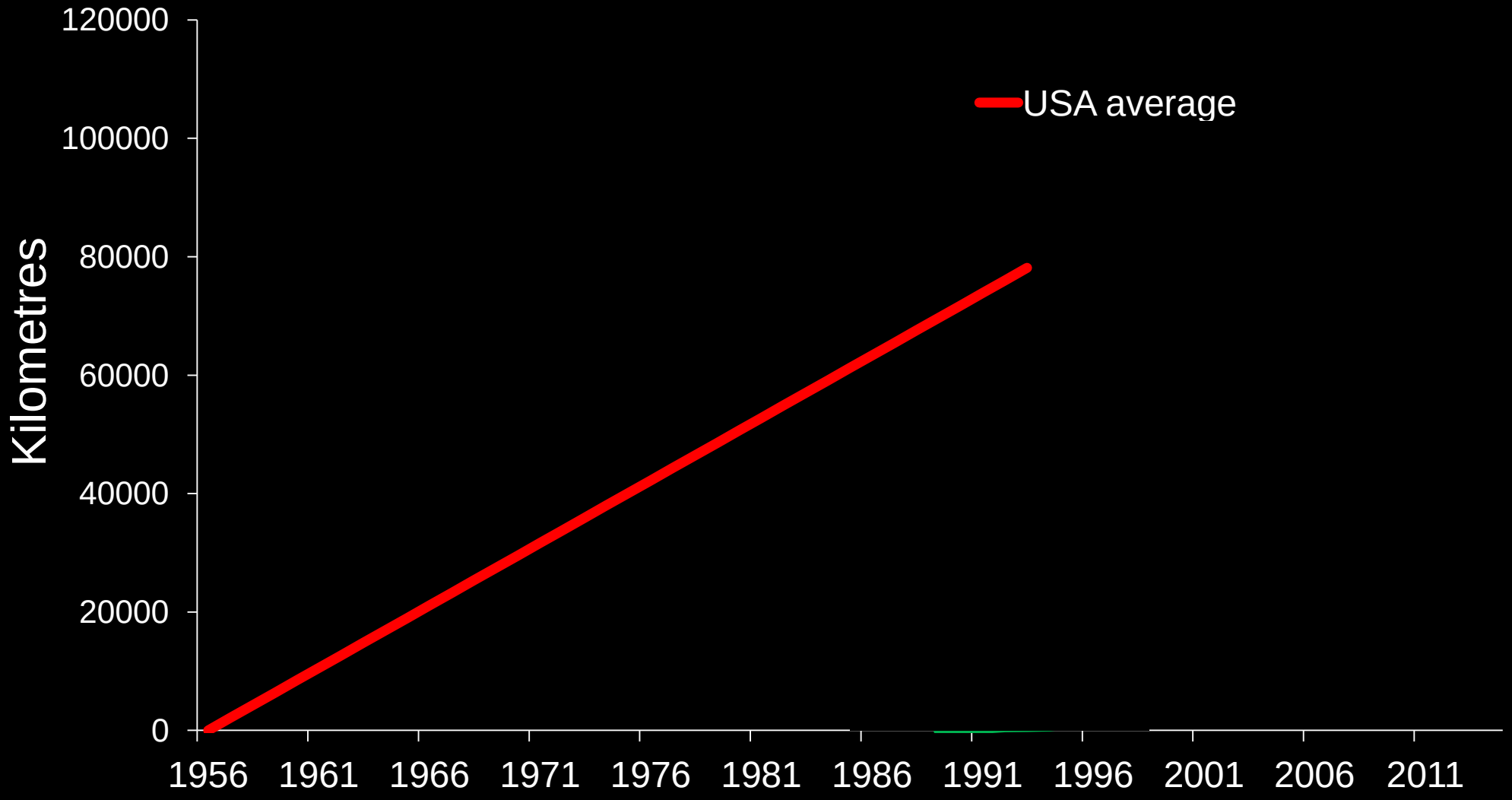


- ~102 million km of road (paved and upaved) worldwide
- = 130 return trips to the moon!
- Lots of impacts blah blah blah…

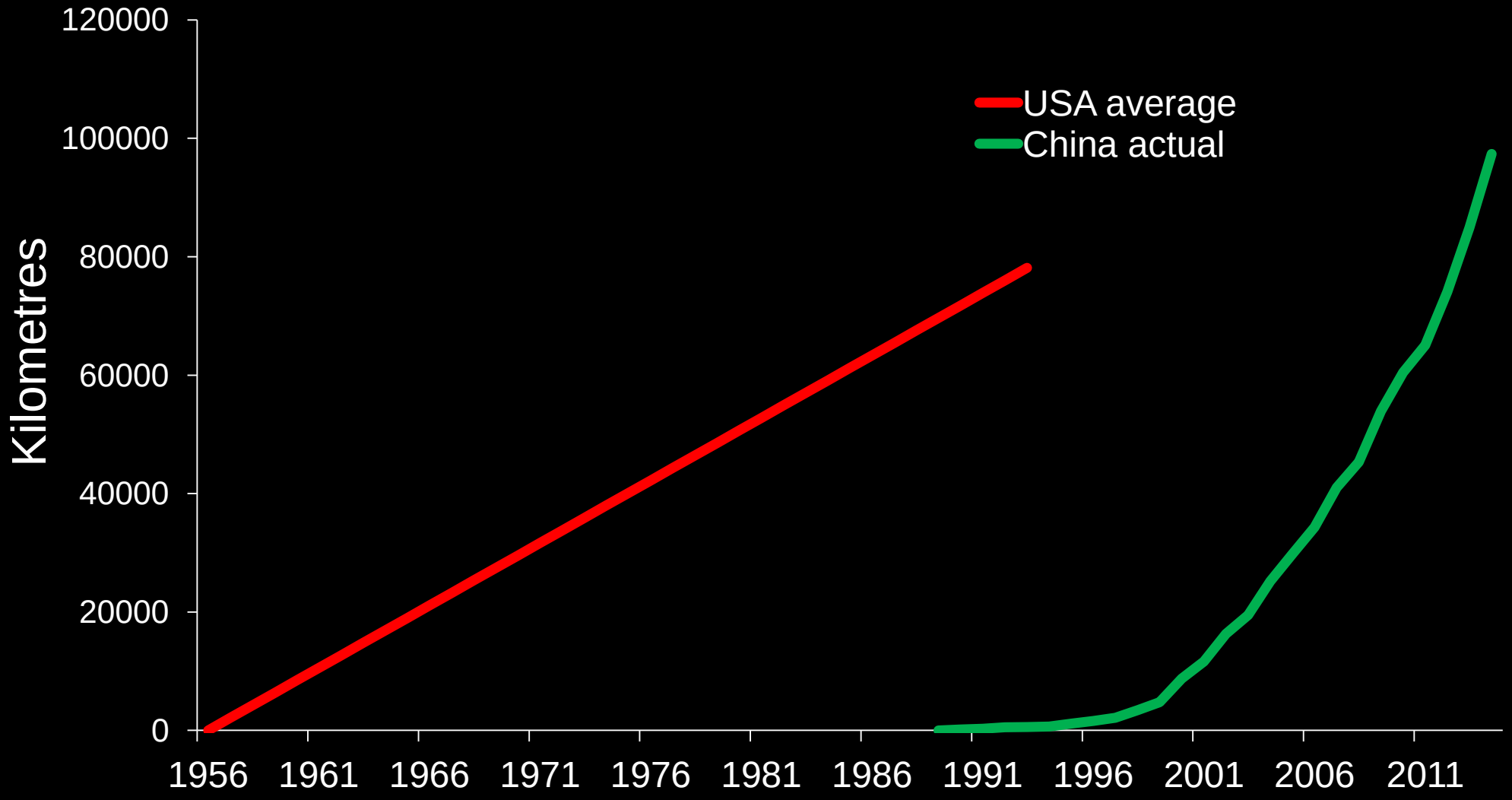
Globally by 2050….

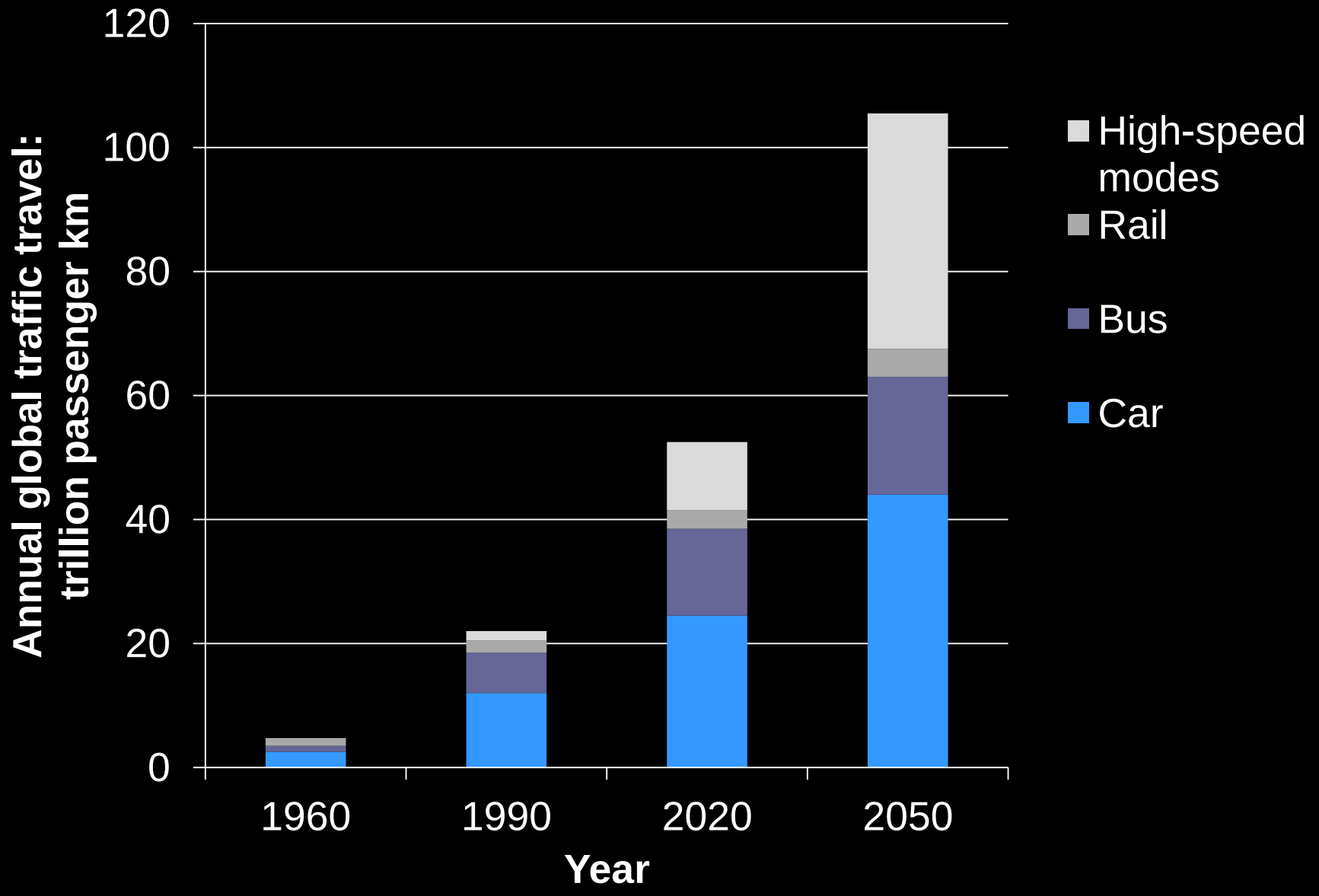
- Additional 25 million lane-km
- 90 % in non-OECD countries
- 1.7 to 2.8 billion vehicles (0.9b in 2009)
- 5-fold increase in vehicles in non-OECD
- Individual travel increasing

Development of expressway (China) & Interstate Highway (USA)



Development of expressway (China) & Interstate Highway (USA)





(nb Excludes freight travel)

Source: Schafer and Victor 2000

Tony Abbott: Australia's "Infrastructure Prime Minister"

Credit: Goois Natuurreservaat, The Netherlands/Photo: W. Metz)

Hilversum, NL – an 800 m long wildlife overpass


16 23:16

Goals of mitigation

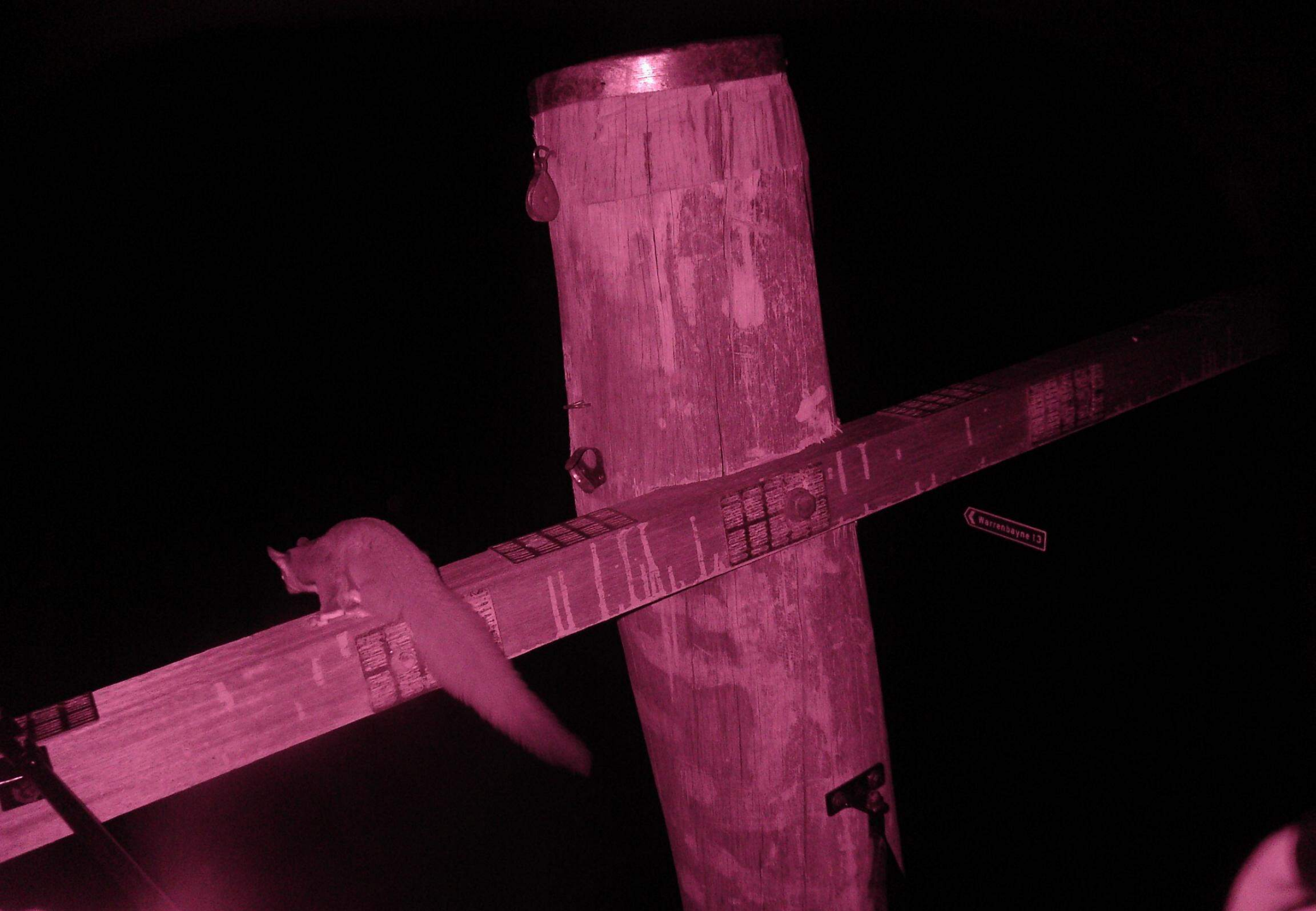
1. Reduce rates of mortality
2. Maintain habitat connectivity
3. Maintain genetic interchange
4. Ensure biological requirements are met
5. Allow for dispersal and recolonisation
6. Maintain metapopulation processes and ecosystem services
7. **Restore and maintain viable populations**

- 25 glider poles & 5 rope bridges
- Hume Fwy, NSW & Vic
- Monitoring since 2007
  - Rates of use
  - Population size / density
  - Survival
  - Gene flow
  - Reproductive output
  - Recruitment


17 19:53

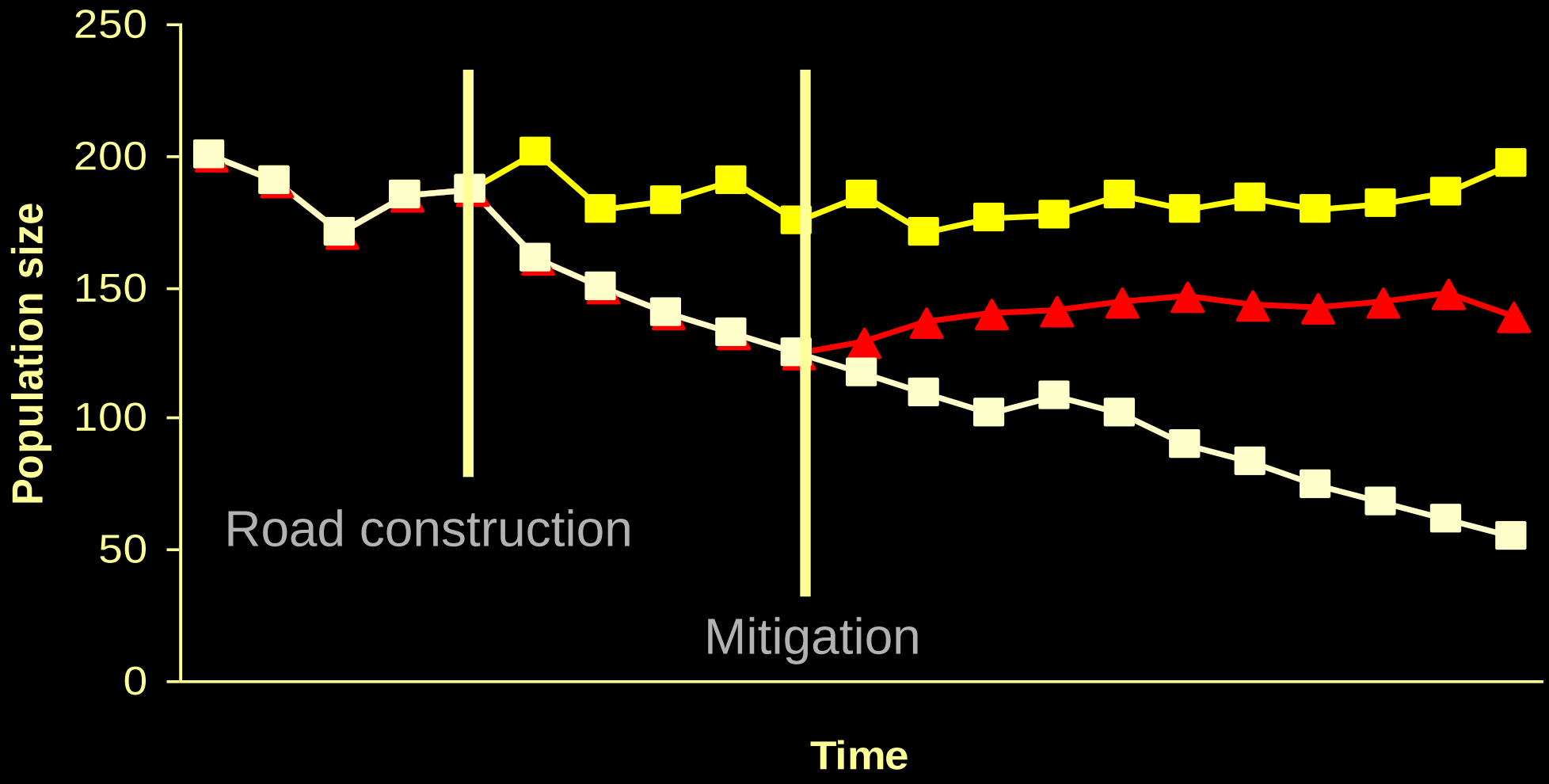

9 3:50


8 4:35


Warrenbayne 13

- Mitigation is successful

Predicting population viability



- Mitigation is successful, but not successful enough
- Something is not good enough
- What do we do next?

Install more poles or poles closer together

Make poles wider at base

Remove poles and install rope bridges

Get another job

Install more glider poles

Make poles wider

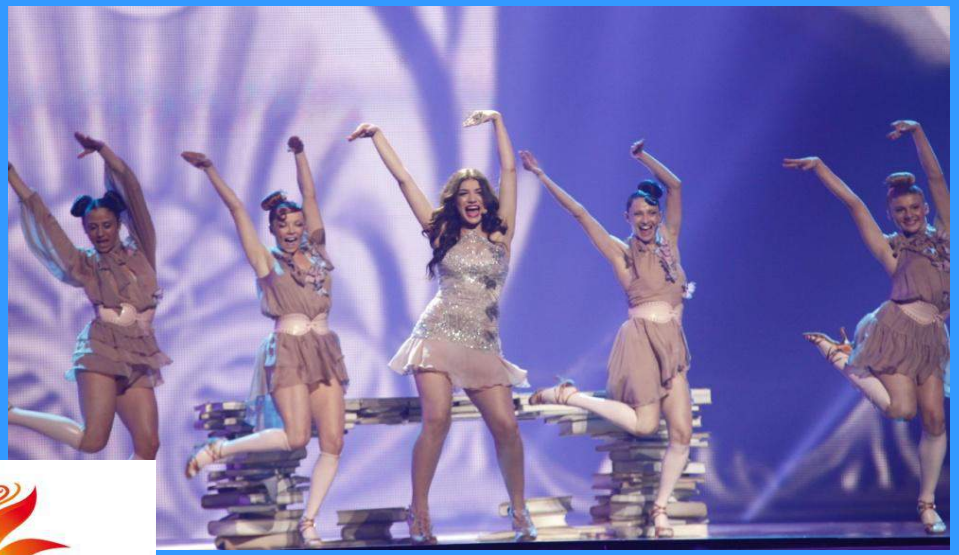
Seriously….how to decide what to do, and how much to do?

Install rope bridges

Get another job

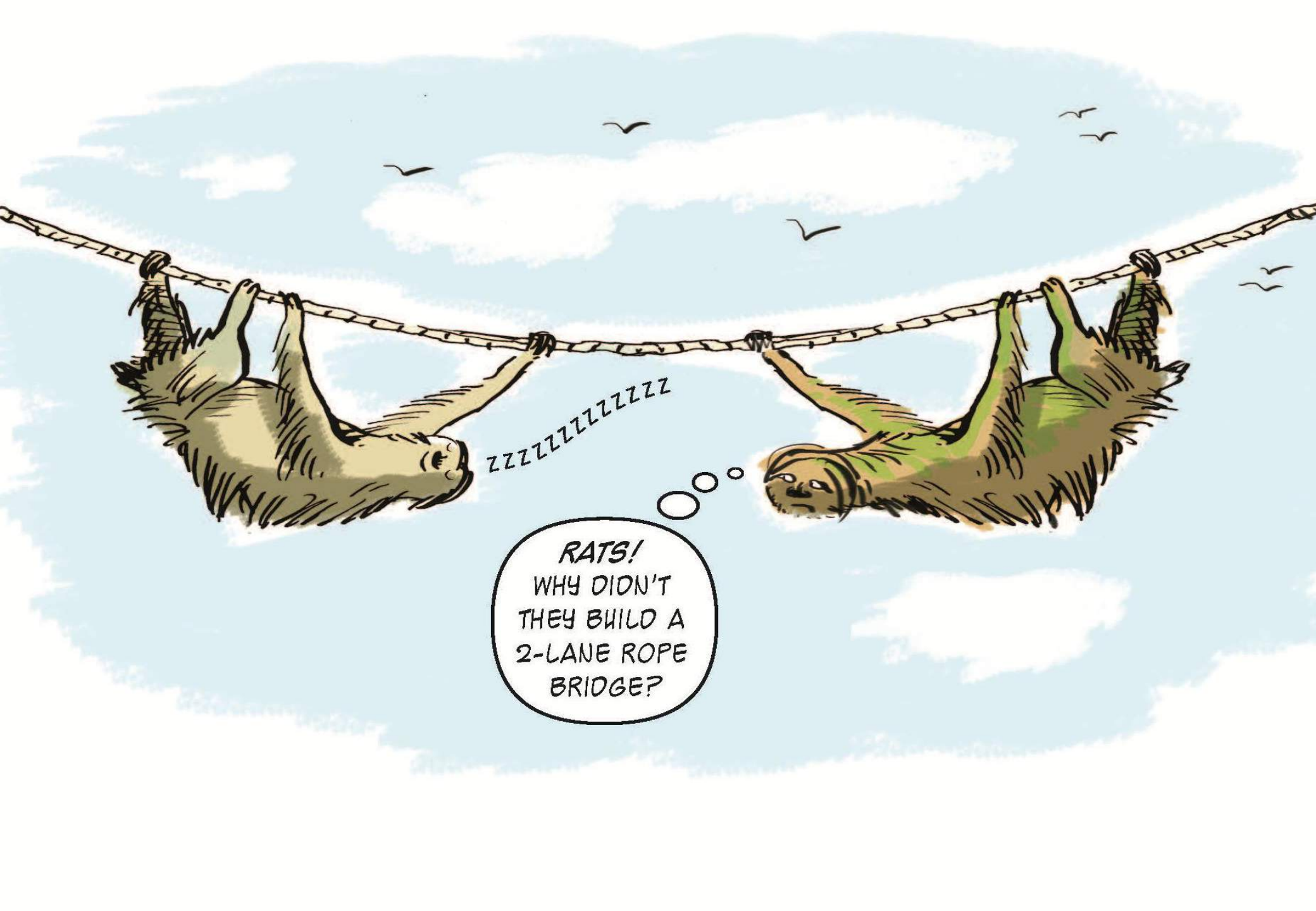
Install more glider poles

Make poles wider

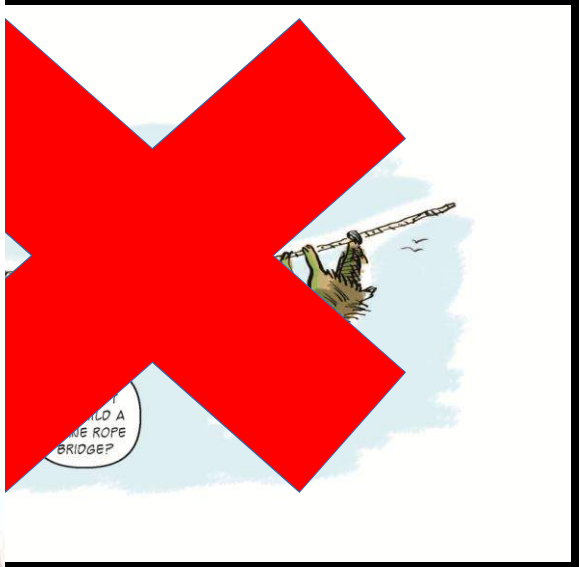


Install rope bridges

Get another job


ZZZZZZZZZZZZ
RATS! WHY DIDN'T THEY BUILD A 2-LANE ROPE BRIDGE?

Our options?

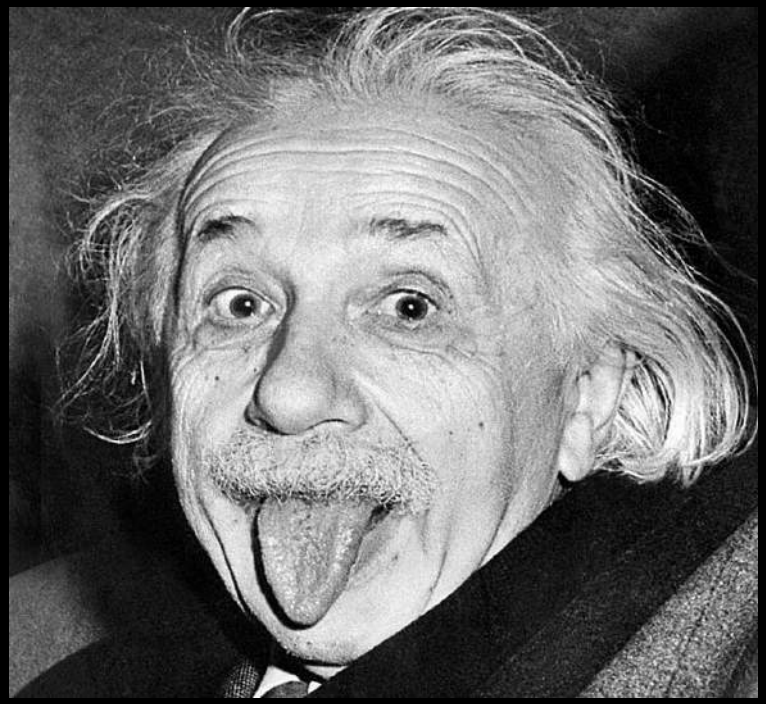


Our “current practise”...

- Conserve biodiversity/environmental protection
- Install the “best-practise” mitigation solution
- Mitigate the highest priority locations
- Most cost-effective manner
- Generally – monitor to confirm use
- Our mitigation is not designed for “learning”
- PROBLEM: Mitigate without explicitly incorporating the need for new information

Need SMART goals to evaluate effectiveness

S: Specific
M: Measurable
A: Achievable
R: Relevant
T: Timeframed



“Enhance connectivity”, “reduce mortality” are NOT SMART goals.

Need more & better “experiments”

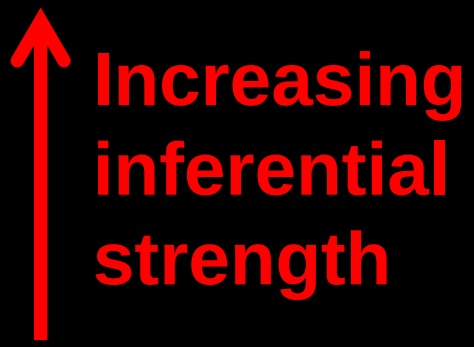
- EXPERIMENTS: “...a scientific approach or method that tests a hypothesis or competing ideas & confounding variables are held constant”

- Monitoring is not usually capable of holding confounding variables constant
- Most monitoring projects are not very helpful in the long-term or for generating generalities
- Still need monitoring for new species, confirm use

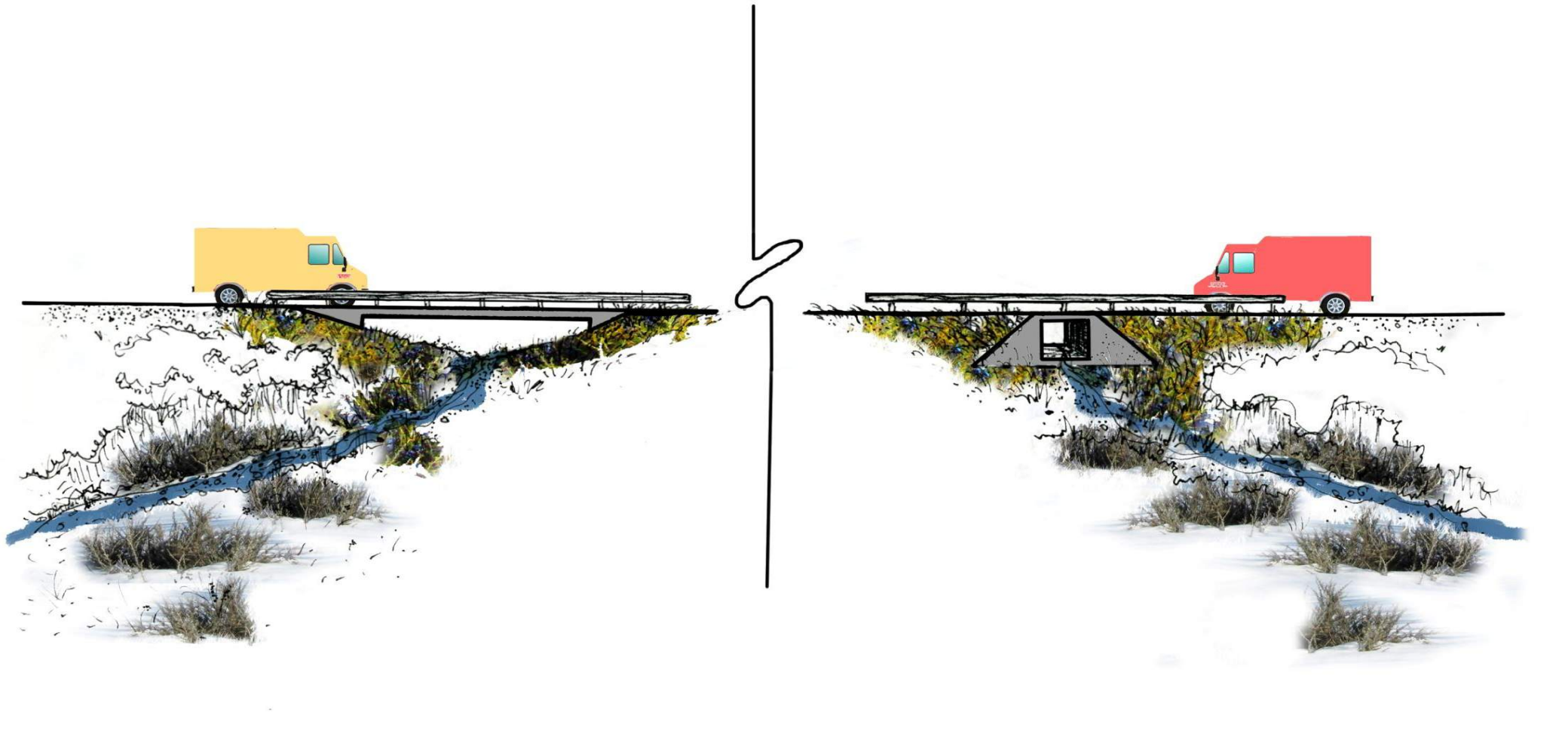
Experimental design

- The goal
  - Answer a question
  - Be as confident as possible in the outcome (inferential strength)
  - Make generalisations that are transferable
- Before, After, Control, Impact (BACI)
- Before and After
- After only

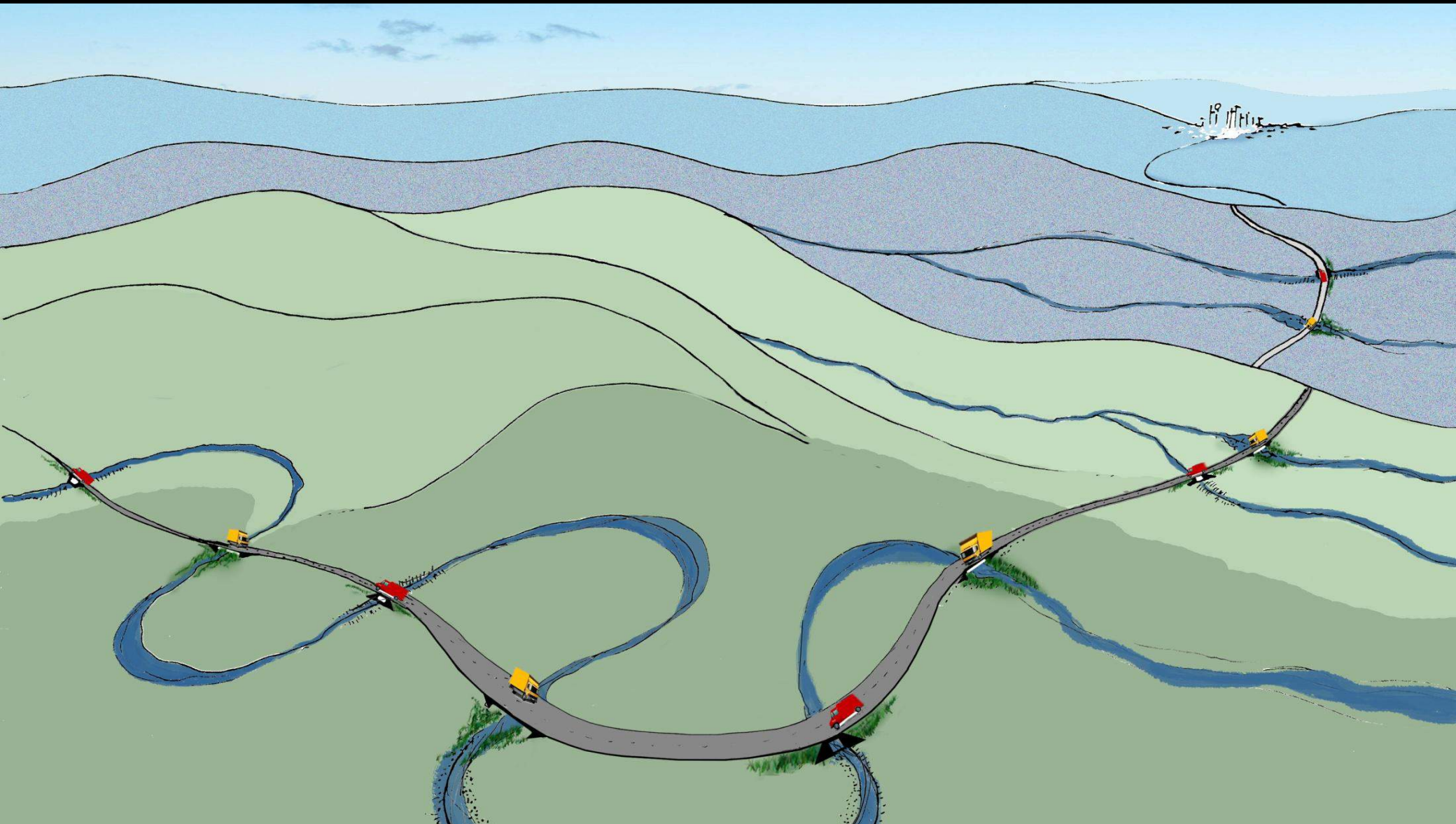
(Roedenbeck et al 2007, Ecology and Society)



Simple questions...



Simple question, well-designed experiment



Crossing structures as prey traps

- Classic experiment
- Treatment: Predator control / no control
- Replication
- Comparison:
  - Before / After
  - Control / no control

Improve rate of crossing for small mammals

- Add furniture/remove rocks
- Current practise: Fix every culvert
- Experimental approach:
  - Add 5 logs to 5 culverts
  - Add 10 logs to 5 culverts
  - Add 5 logs and remove rocks at 5 culverts
  - Add 10 logs and remove rocks at 5 culverts
  - Leave 5 culverts untreated

Even simpler questions...

Austral ECOLOGY A Journal of ecology in the Southern Hemisphere

Austral Ecology (2012) 37, 629–632

Do drivers intentionally target wildlife on roads?

CHRISTA BECKMANN* AND RICHARD SHINE
School of Biological Sciences, University of Sydney, Sydney, New South Wales, Australia

Many reasons we don't do experiments

- Before and After “traditionally” difficult
- Lack of money / agency support
- Projects often small in scale / crossing structures small in number
- Install the best mitigation
- Experiments are an admission it may not work?
- Road agencies want solutions, not experiments
- .....

Projects often small-scale

- Mitigation often small number of structures

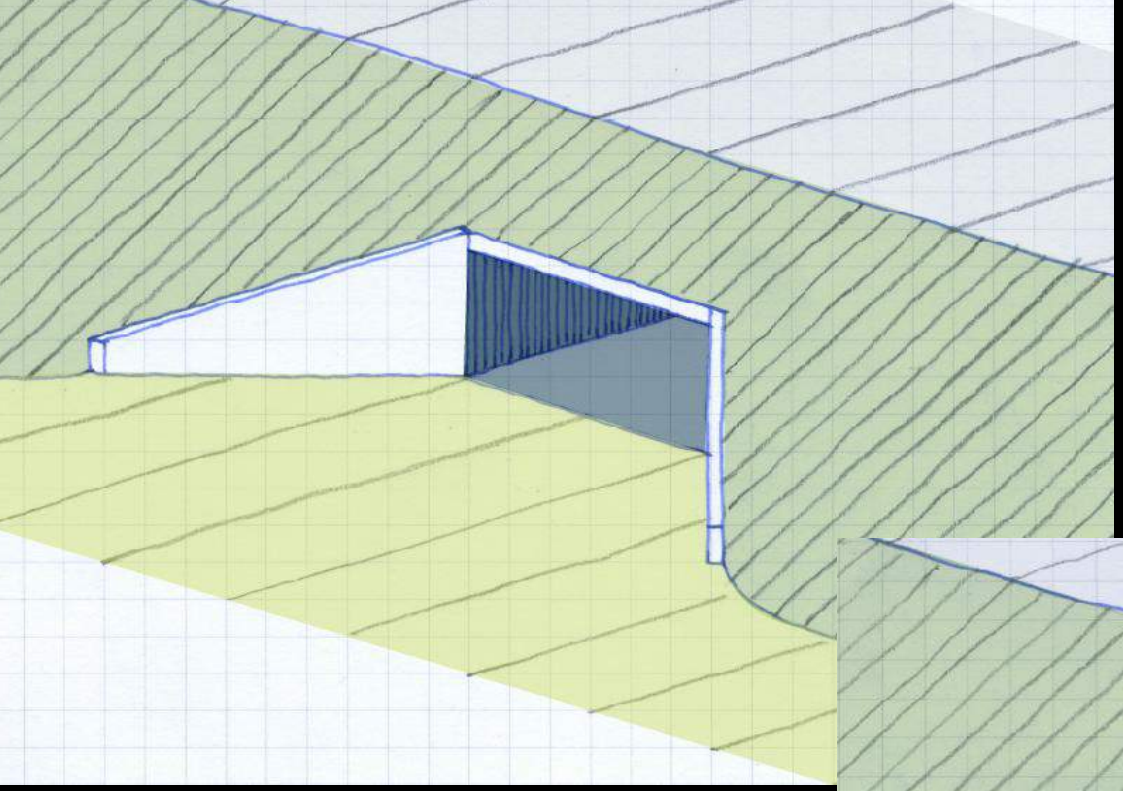
- Meta analyses / systematic reviews
- Similar questions and collect standardised data, data published and made available
- International network of nationally/regionally managed databases of mitigation projects
  - Use database to design studies across borders

Accept mitigation is experimental

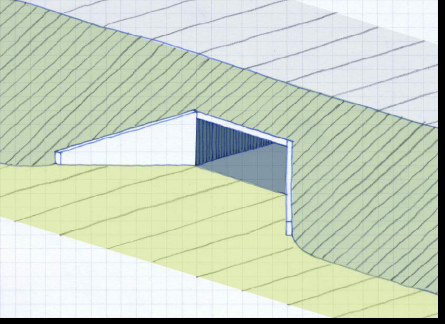
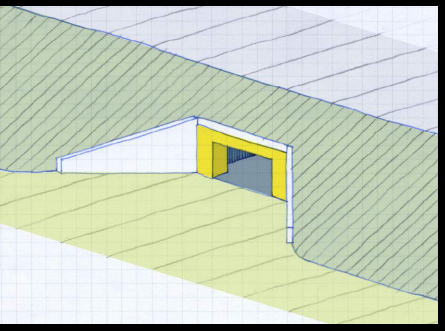
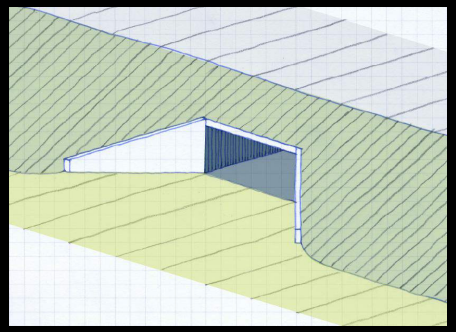
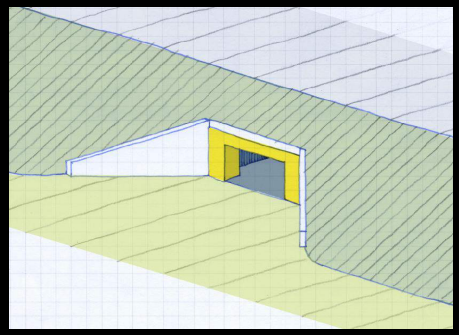
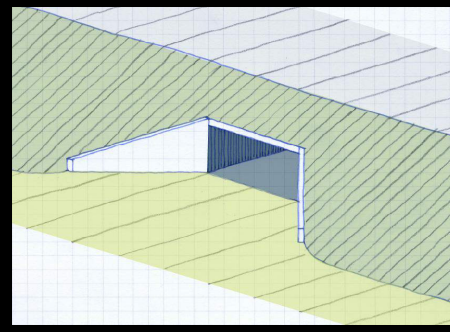
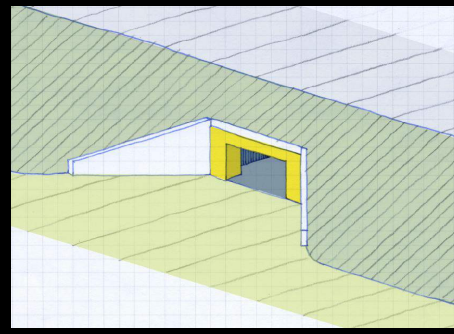
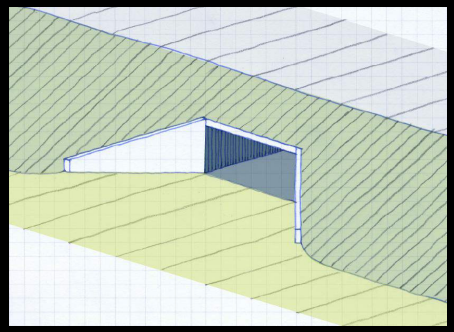
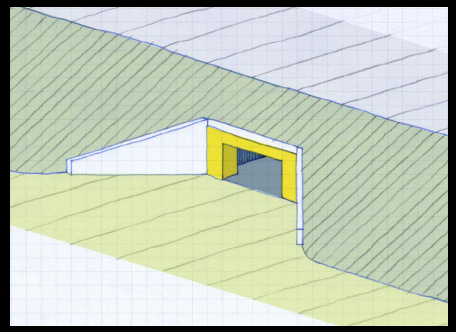
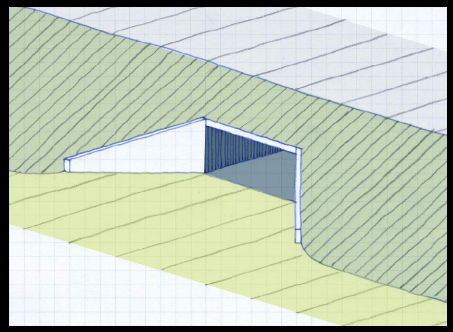
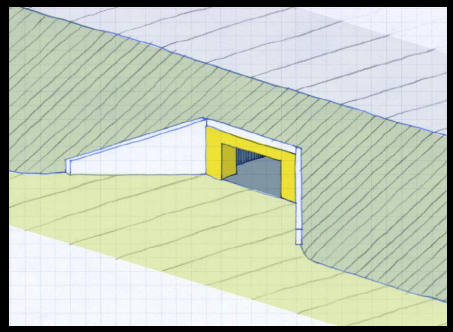
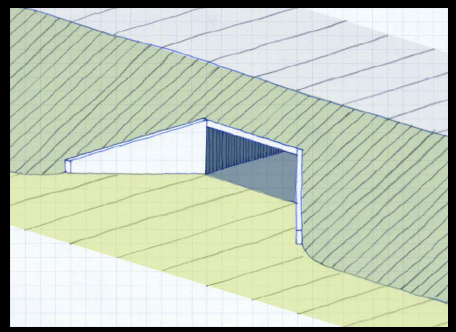
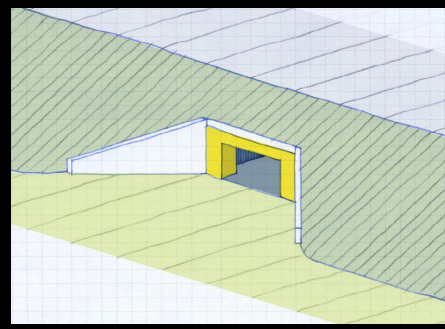
- Approval agencies demand monitoring as a condition of approval (implicitly agree mitigation is an experiment)
- Approval agencies should demand better monitoring
- Accept that we are doing our best, it may (may not) be good enough, and need to thoroughly evaluate mitigation

Evaluation should begin in planning stage, not after construction

- Most powerful experiments collect data “BEFORE” the impact occurs
- Road planning and design takes years – time to collect invaluable “BEFORE” data
- Modify design of road or mitigation to experimentally test something (eg culvert size)
- Identify important parameters during the design that we experimentally manipulate



Replication!

Agencies must support good science

- Agencies must accept good-science is part of best-practise mitigation
- Designers expect detail on the specifications of mitigation
- Can’t give detail without good science
- BACI experiments = good science

- Road Ecology is an evidence-based discipline
- Ensure monitoring examines the most important questions
- Obtain the most reliable information
- Use the best available scientific methods
- Learning is part of best practise (test a hypothesis / develop generalisations)
- Experiments (more with BACI) critical


ANY QUESTIONS?