Waka Kotahi research summary

August 2022

Road edge-effects on ecosystems

New Zealand roads transport people and goods, but they can also harm our unique native plants and animals. Further research and good management could reduce this harm and even enhance our unique biodiversity.

As new roads are built and upgraded and vehicle numbers increase, the ecological impacts of roads (known as 'road edge-effects') also increase unless they are addressed. Many of New Zealand's unique plants and animals are highly vulnerable to environmental pressures. So how can we better predict, assess, monitor and manage the edge-effects of roads on New Zealand ecosystems?

Manaaki Whenua researchers devised this study in response to the National Environmental Standards for Freshwater (wetland protection) and in preparation for the National Policy Statement for Indigenous Biodiversity. The research covered terrestrial ecology and wetlands, but excluded rivers, streams and drains.

Literature review

The researchers first reviewed overseas literature on road edge-effects, and the limited literature from New Zealand. They grouped road edge-effects into seven categories:

- noise and vibration
- artificial light at night
- road runoff
- air emissions
- hydrological effects
- habitat modification, fragmentation and impacts of road users
- roadkill.

Most New Zealand state highways have low vehicle numbers by international standards, which reduces road edge-effects like stormwater contaminants, air emissions and noise.

However, the centreline of over 2,000 km of state highway is within 100 m of land managed for biodiversity. State highways also pass within 50 m of wetlands along at least 163 linear kilometres of road.

Overall, the researchers concluded that impacts of roads through highly biodiverse areas are very negative. At first, ecosystems are strongly impacted when soils and plants are removed for road construction. New vegetation-clear edges are created, which are then maintained for the life of the road. Ongoing road noise, artificial light,

and stormwater discharges may ripple out for hundreds to thousands of metres. The amount of pressure on the ecosystem depends on the type of road, its vehicles, and the type of ecosystem and species in the wider landscape. We don't yet know when to begin managing most road effects to reduce a moderate level of effects for most native ecosystems.

Road edge-effects on plants

Most road edge environments are very different from the humid, shaded native forests that dominated New Zealand before deforestation. Some aggressive roadside weeds also spread into and smother native ecosystems. Some non-native insects prefer them, which again increases weeds' pollination, seed production and spread.

However, in suburban and intensively farmed areas of Europe and North America, road verges are hotspots of meadow flowers and pollinators. Some roadsides are managed to benefit these pollinators and other invertebrates.

Road edge-effects on animals

Many of New Zealand's native animals are forest dwellers. Their habitat quality is degraded by road noise, artificial light, changes in plant structure and species, removal of tree canopy and reduced connection to other natural areas (connectivity).

The new 'edge ecosystems' created by roads tolerate high exposure to edge effects and disturbance from roadside maintenance, which can be permanent and amplify over time. There are no data about the impact of traffic noise on New Zealand land birds. However, we do know that many native birds are flightless and willing to cross roads, so both habitat and connectivity effects increase roadkill.

Meanwhile, in areas where little habitat remains, dense roadside habitat supports native animals such as weka and kiwi, although it also increases their vulnerability to becoming roadkill.

Desktop analysis of road environments

The researchers analysed and compared New Zealand's roads and unique ecology to those overseas to determine what edge-effects matter most in the New Zealand context.

They identified:

- native-dominated land covers
- New Zealand highway data on vehicle numbers, noise, streetlights, bridges and culverts
- where road edge-effects were likely to be most positive or negative.

Their maps and infographics show that:

- highway traffic volumes and road density across New Zealand are unevenly distributed
- negative road edge-effects on biodiversity are greatest where highways cross wetlands and conservation areas or follow the coast
- highway corridors may be wildlife refuges in landscapes where little native habitat remains.

A method for assessing road edge-effects

The researchers developed a four-step method for assessing road edge-effects using New Zealand data. The desktop analysis was supplemented with regional information and field assessments and was tested with two contrasting case studies:

State highways 16 and 18 on the outskirts of north-west Auckland, carrying 30,000–60,000 vehicles per day. They are dual-lane, separated highways. Road runoff is treated in wetlands, and they have extensive buffer plantings of native species.

State Highway 73 through the Waimakariri Basin, carrying up to 5,000 vehicles per day. It's a narrow state highway through both agricultural and conservation lands, including Arthur's Pass National Park, with no formal stormwater treatment.

The researchers mapped general road edge pressures and pressure points for the case studies. The largest edge-effects were habitat modification/fragmentation, stormwater, noise, and light. Roadkill couldn't be assessed.

Conclusions and recommendations

New Zealand land transport projects likely underestimate the size of the road-affected zone, the long-term effects of road edges, and the cumulative effects of road density.

A range of effects management strategies are proven. However, reducing the spread of pest plants requires changing highway management contracts.

Road edge-effects should be assessed at early stages of capital projects and should avoid:

- building roads through wetlands or remnants in areas with low biodiversity
- new artificial lights in 'dark' areas and within habitats or flight paths of vulnerable species
- new roads through areas managed for conservation
- untreated stormwater discharges to surface waters.

Other solutions to reduce road edge-effects include constructing bridges, tunnels, barriers and retaining walls to reduce road footprints. The increase in weed diversity and density along roads through New Zealand's natural areas also needs to be mitigated and prevented.

The researchers' assessment method helps identify areas of New Zealand where road corridors could enhance native habitat by:

- increasing the quality of remnant habitats in areas where little remains (eg using buffers to reduce effects from disturbance, noise, light, hydrology/stormwater, grazing, and weeds)
- increasing areas of habitat for common native birds and insects
- reducing roadkill and other animal deaths.

All capital projects should report the width and area of:

- impervious (non-porous) surface to the outer edge of the road seal
- the 'construction zone' width from which original vegetation and soils are stripped or filled
- the clear zone (road edge) that is managed by herbicide, pruning or mowing.

Further research

Current knowledge gaps may mean ineffective management and lost opportunities for Waka Kotahi commitments to biodiversity. Further research is needed on:

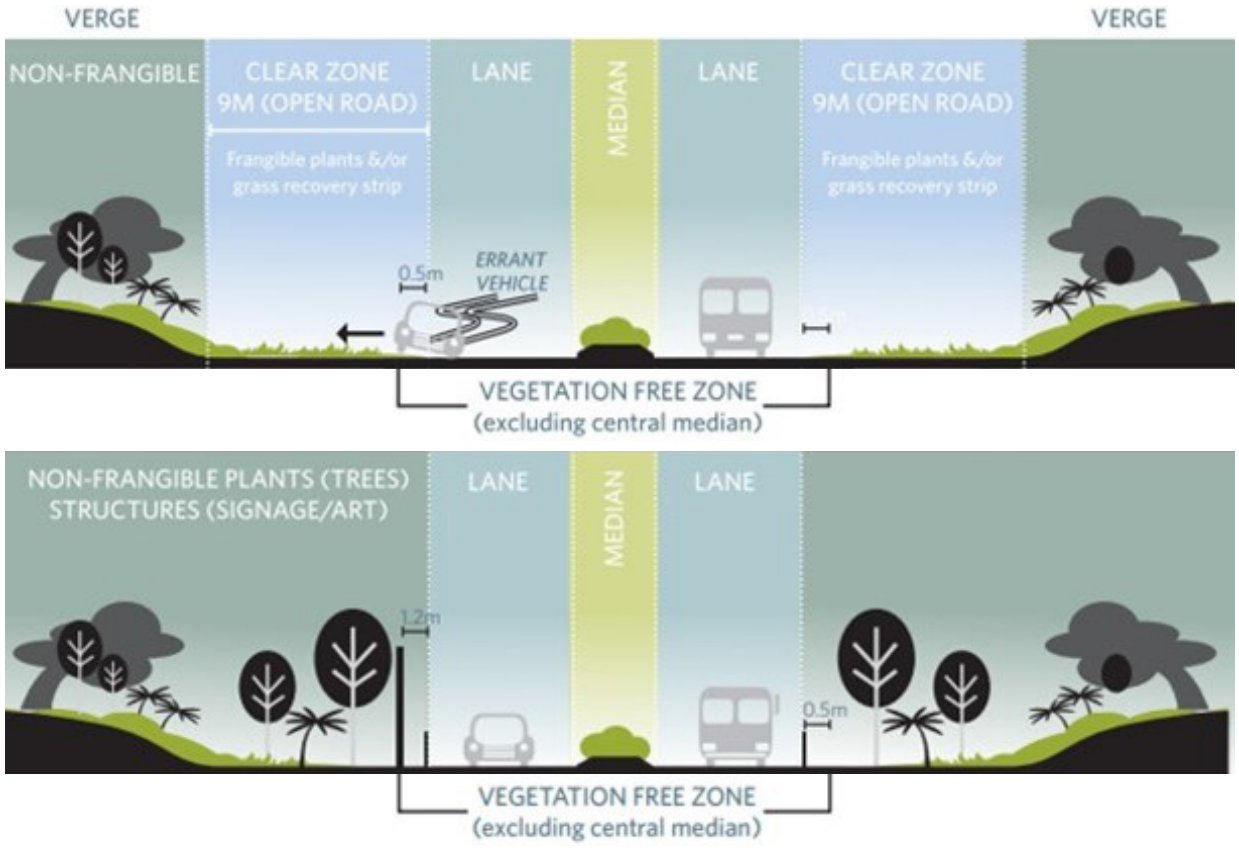
- the effects of road noise and artificial light on native birds and other animals most likely to be affected
- the size of the 'road-effect zone' that extends into surrounding landscapes
- where roadkill may threaten nationally vulnerable species.

Strategies (such as alternative designs for capital projects) need to protect our native species, and if well planned could even improve biodiversity in some areas.

Clear zone requirements along state highways

Maintaining 'clear zones' along state highways prevents trees more than 100 mm trunk diameter at 400 mm height and flax within ~9 m from the edge of seal (top graphic) or overhanging below 6 m height. Clear zones can be narrower if barriers are present (lower graphic) and in areas with high ecological values.

Frangible ('bendable' or 'breakable') plants don't damage cars.



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