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Natural Resource Impacts of Roads

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Outline

- Focus on natural resource impacts associated with roads in a forested landscape
- Overview of the 3 phases of road existence
- The different types of possible natural resource impacts associated with each phase of road existence.
- The types of species that can be impacted by road existence.
- Questions

Roads

- A road is a linear corridor for the conveyance of traffic.

Road Construction

What are the 3 phases of road existence? What environmental factors are impacted by roads during each phase?

1) Construction
2) Presence
3) Use

This phasing of road impacts is outlined in the literature review conducted by Robison et al. (2010) titled *"A conceptual framework for understanding, assessing, and mitigating ecological effects of forest roads"*

Road Construction

- NYS does not build new roads on Forest Preserve lands classified as Wild Forest.

Road Construction

- Direct loss of physical habitat, vegetation removal (new road construction & some road maintenance projects)
- Habitat fragmentation & connectivity
- Direct wildlife mortality
- Increased risk of sedimentation to aquatic resources
- Increased risk of pollution (contaminants, dust, petro-chemicals)
- Alteration of hydrology and adjacent ecological habitats
- Introduction of invasive species
- Noise

Road Construction

Habitat Fragmentation + Habitat connectivity

- Direct loss of habitat appears small from a landscape scale, taking up only 1% of the U.S. land, the ecological impact is much greater affecting 15-20% of the landscape (Forman and Alexander 1998).

roads bisecting large tracts of forested habitat

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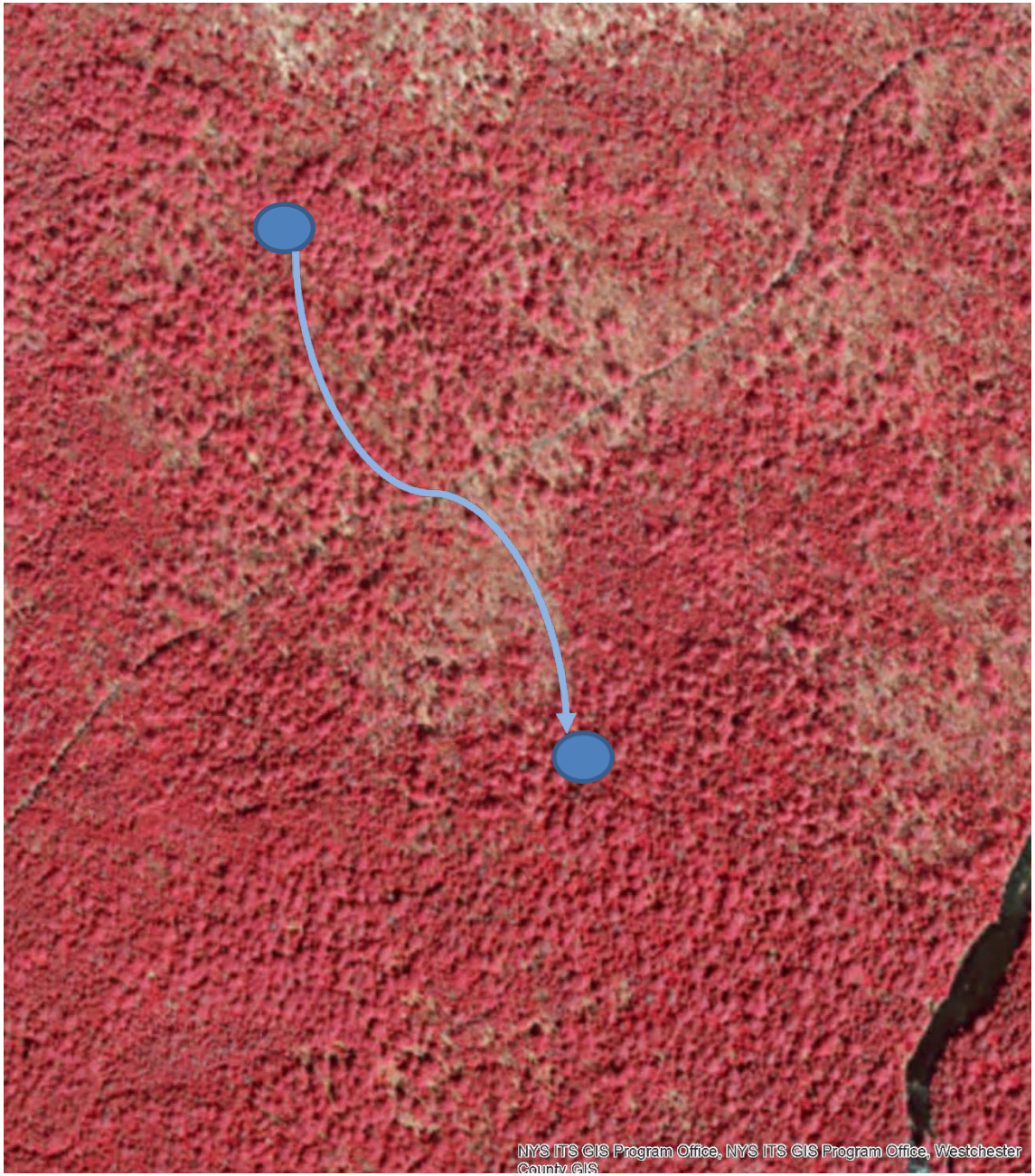
Road Construction

Habitat Connectivity (terrestrial)

State forest preserve road bisecting a large tract of forested habitat, still a visible break in habitat but at a much smaller scale. Note that some portions of this road are obscured by overhead tree canopy.



Road Construction

Habitat Connectivity & fragmentation (aquatic & semi-aquatic)

"road crossings can reduce the degree of connectivity in river systems, affecting habitat availability for fish and species dispersal. Moreover, at a population level, reduced fluvial connectivity causes partial or complete isolation of populations, a reduction in gene flow, and an increased risk of extirpation (Goerig et al. 2015; Letcher et al. 2007;Whiteley et al. 2013;Woffard et al. 2005)"

perched culvert crossing

Road Construction

Increased risk of sedimentation to aquatic resources

Photo courtesy of NYSDEC

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Road Construction

Alteration of wetland hydrology & adjacent habitats

“Hydrologic effects are likely to persist for as long as the road remains a physical feature altering flow routing- often long after abandonment and revegetation of the road surface. By altering surface and subsurface flow, roads can destroy and create wetlands. (Trombulak and Frissell 2000).”

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Road Construction

Introduction of invasive species

Noise

Road Presence

- Increased edge effects
- Reduced habitat connectivity
- Increased habitat fragmentation
- Effects of road density
- Potential species introductions
- Exploitation of natural resources
- Ongoing erosion and sedimentation to aquatic resources
- Alteration of hydrology and adjacent ecological habitats

Road Presence

Species most affected

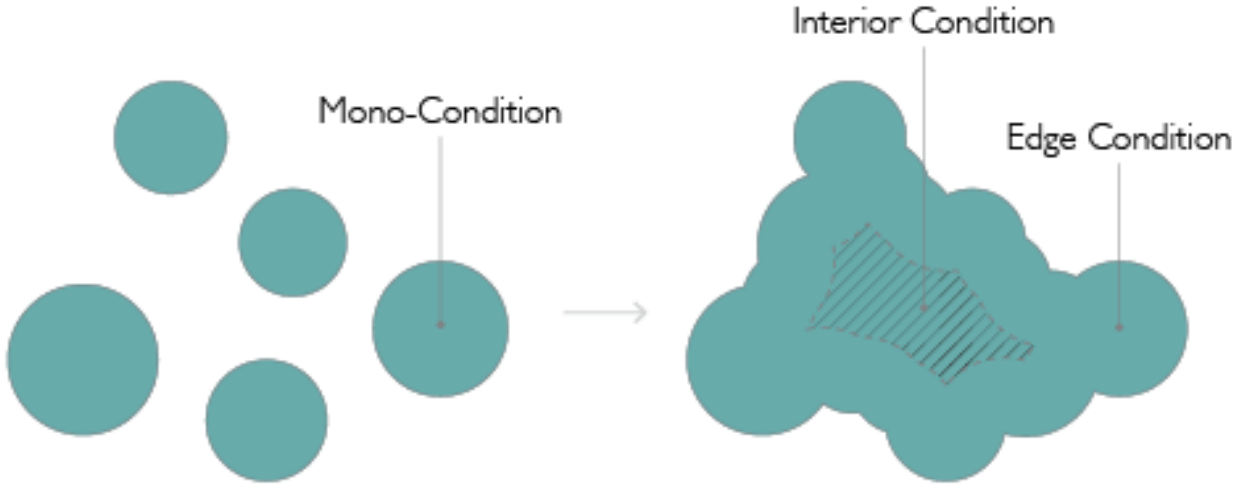
Types of species most affected by roads:

- Specialists requiring interior forest conditions, especially large-bodied animals with long lifespans and few offspring (marten)
- Species with lower population densities (moose)
- Species with large area requirements and/or needing different habitat types to access multiple resources (Northern leopard frog, carnivores, raptors, amphibians, turtles and waterfowl)
- Species with a behavioral attraction to roads for thermoregulation, forage or improved mobility (snakes, raptors, deer)
- Exhibiting behavioral avoidance or sensitivity (woodland birds, marten)

Road Presence

Edge effects

Edge effects are changes in population or community structures that occur at the boundary of two or more habitats



Graphic by Rhiannon Crain at TNC

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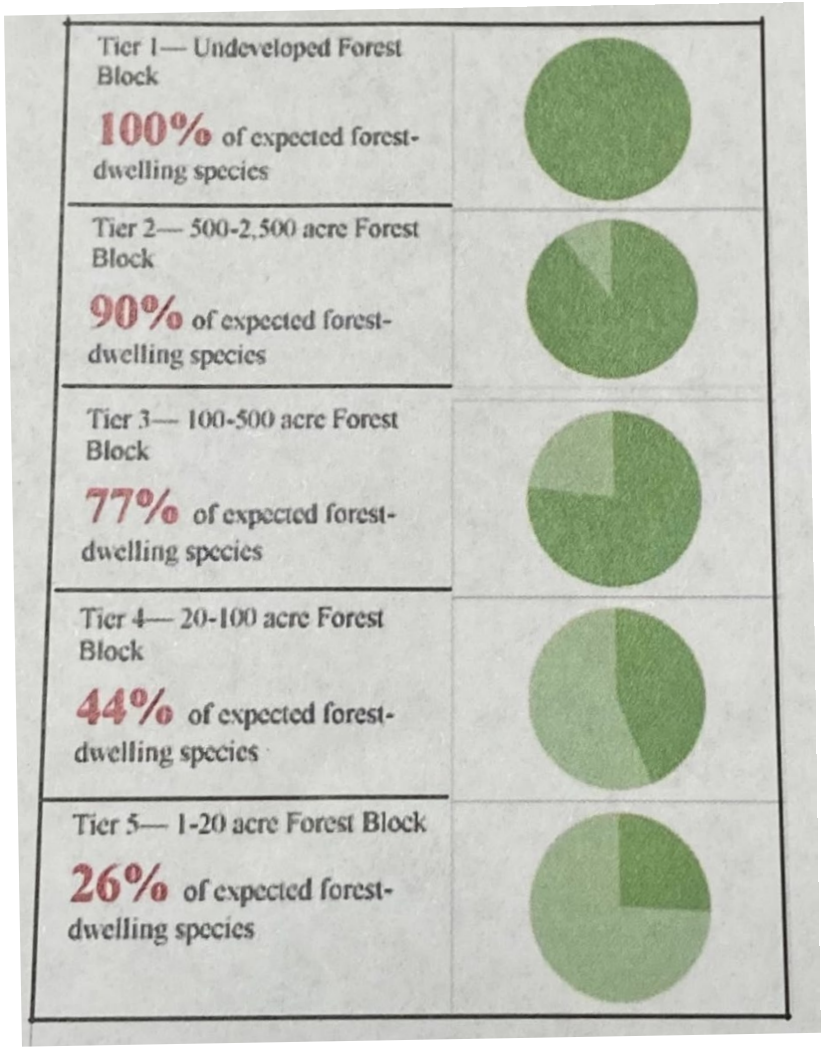
Road Presence

Habitat Fragmentation

Habitat fragmentation is a process by which large and contiguous habitats get divided into smaller isolated patches of habitat



Source: Staying Connected Initiative

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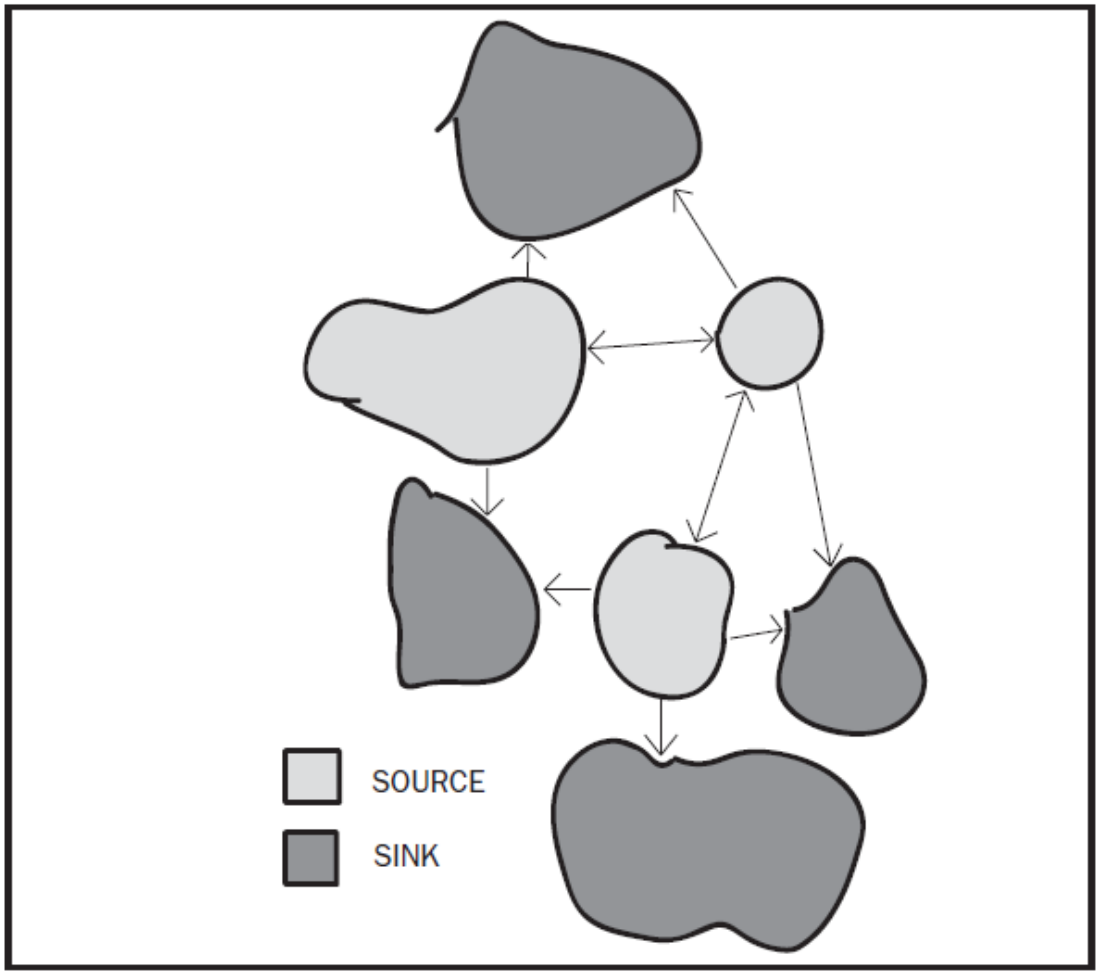

Road Presence

Habitat Fragmentation

Metapopulations and Source/Sink Dynamics

Modified from Meffe and Carroll (1994), Principles of Conservation Biology, p 188.

Road Presence

Road Density

The most common indicator used to measure landscape-level road influence appears to be **road density**. (Average total road length per unit area of landscape in km/km2). Road density can be used to infer ecological response to fragmentation, including individual species persistence, overall biodiversity and hydrologic function of a landscape.

Road Presence

Invasives

Roads provide dispersal of exotic species via 3 mechanisms:

- Providing habitat by altering conditions
- Making invasion more likely by stressing or removing native species
- Allowing easier movement by wild or human vectors

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Road Use

- Wildlife mortality
- Habitat fragmentation exacerbated
- Noise
- Pollution
- Potential species introductions
- Exploitation of natural resources
- Increased human disturbance on road and surrounding lands and waters

Road Use

Sedimentation
and trash

Road Use

Wildlife Mortality

Highly influenced by traffic volume, road width & speed.

In general, narrower roads and roads with lower traffic speed have fewer impacts than wider roads or roads with higher traffic speed (Forman et al. 2003, Jaeger et al. 2005).”

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Road Use

Traffic

Local populations of reptiles and amphibians can have substantial impacts from roads even with low daily traffic volumes.

Road Use

Species Introductions

"Introduced non-native aquatic species could cause shifts in distribution, abundance, and size of native species (Angermeier et al. 2004)."

Photo courtesy of NYSDEC

Road Use

Exploitation of Natural Resources

“More access promotes greater incidence of inadvertent and intentional wildlife harassment by people and their machines. (Robinson et al. 2010)”

In Summary

Roads can have a wide range of ecological impacts on both terrestrial and aquatic ecosystems. Interior forest habitats are increasingly rare across the nation and the impacts to these forested habitat can occur throughout all 3 phases of road existence on the landscape.

Conclusion

This is an evolving science…

"preserving interior forest species and environments sensitive to human presence and development requires that road planners and builders understand the impacts of their work."
"Roads penetrating remote and otherwise intact forested landscapes have been correlated with subtle and extensive changes in species population density and diversity. (Robinson et al. 2010)"
"Forests fragmented by roads will likely demonstrate less resistance and resilience to stressors, like those associated with climate change (Noss 2001)."

Photo courtesy of NYSDEC

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Questions?

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