Infrastructure Tsunami and the Fate of Nature

> William F. Laurance FAA, FAAAS, FRSQ Distinguished Professor Director of Centre for Tropical Environmental and Sustainability Science James Cook University Australia & Singapore

International Energy Agency (2013) 25 million km new roads by 2050

5 times

Nine-tenths of new infrastructure in developing hations

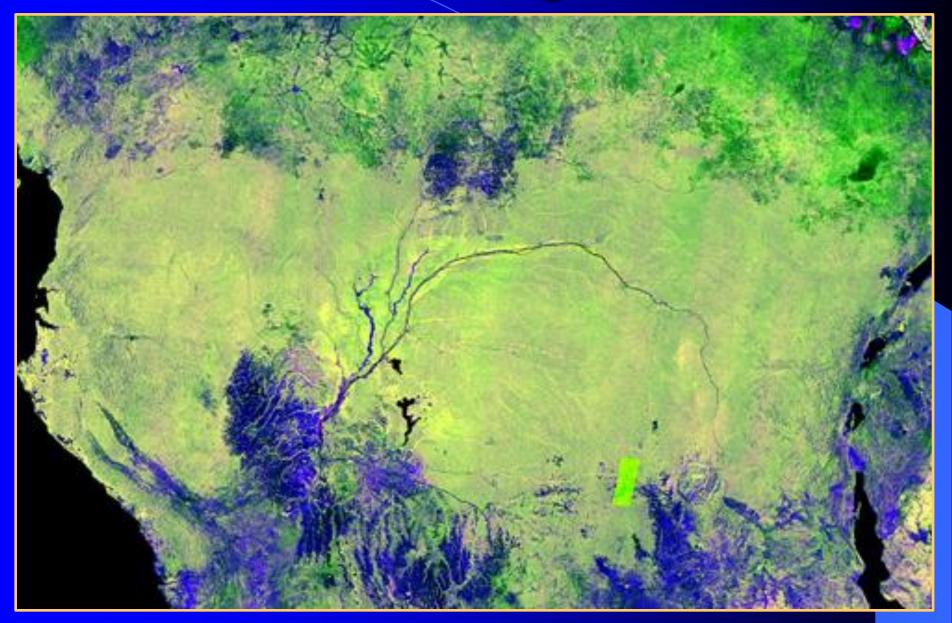
Laurance et al. (2009) Trends in Ecology & Evolution Laurance (2012) Yale Environment 360 Laurance et al. (2014) Nature Laurance & Burgues (2017) Science 7,500 km of new highways in Brazilian Amazon

Triad of highways from Amazon to Pacific Ocean

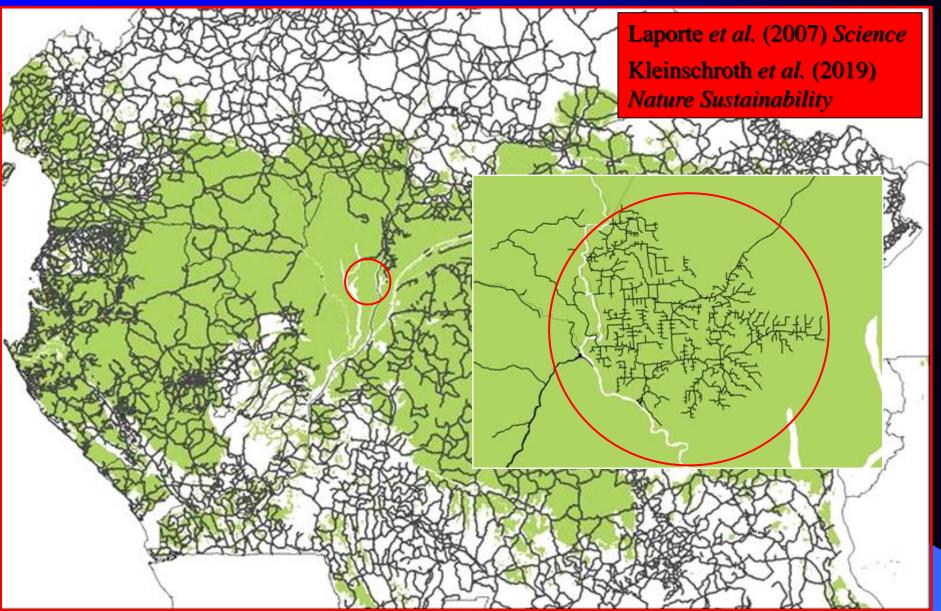
- >100,000 km of new logging roads in Congo Basin
- New roads opening up last intact forests in Sumatra
- Panama-Colombia Highway would threaten Darién wilderness

 Many roads bisecting protected areas

Greater Congo Basin



Major Roads Today



Direct Environmental Effects

Habitat Loss

Edge parameter	altered he lower relative reduced soil moi lower canopy-foliage increased 13C in un increased air temperatur reduced understory-bir elevated litterfall (14) increased photosynthe lower relative humidity (12) increased number of treef increased 13C in underst higher understory-foliage d increased seedling growth (13 invasion of disturbance-adap lower leaf relative-water conter lower soil-moisture content (12 higher vapor pressure deficit (1 higher leaf conductance (12) increased phosphorus content invasion of disturbance-adapted increased recruitment of Cecrop reduced density of fungal fruiting	invasion altered bundance & diversity of ight of greatest foliage of e humidity (3) ruitment of disturbance hopy height (9) sture (7) density (10) derstory leaves (11) ature (12) e & vapor pressure define d abundance (3) tically active radiation in all gaps (11) ory air (11) ensity (10) i) ted plants (3) ts (12)) 2) of falling leaves (14) plants (14) ia spp. (13) bodies (15)	invasion of disturband pp. composition of leaf-lift of disturbance-adapted b spp. composition of leaf-lift f leaf-litter invertebrates (6 density (7) -adapted trees (8) cit (13) n understory (12) Laura <i>Conse</i>	eetles (5) iitter invertebrates (5) s) ance <i>et al.</i> (20 <i>rvation Biolo</i>	0 2) gy
0	100 E	200 dge penetra	300 ation distan	400 ce (m)	500
Edge parameter	altered he lower relative faster reduced car reduced soil moi lower canopy-foliage increased 13C in un increased air temperatur reduced understory-bin elevated litterfall (14) increased photosynthe lower relative humidity (12) increased number of treed increased 13C in underst higher understory-foliage d increased seedling growth (13 invasion of disturbance-adap lower leaf relative-water conter lower soil-moisture content (12 higher vapor pressure deficit (1 higher leaf conductance (12) increased phosphorus content invasion of disturbance-adapted increased recruitment of Cecrop reduced density of fungal fruiting 100	invasion altered bundance & diversity of ight of greatest foliage of e humidity (3) ruitment of disturbance hopy height (9) sture (7) density (10) derstory leaves (11) ature (12) e & vapor pressure define d abundance (3) tically active radiation in all gaps (11) ory air (11) ensity (10)) ted plants (3) ts (12)) 2) of falling leaves (14) plants (14) ia spp. (13) bodies (15)	of disturbance-adapted b spp. composition of leaf-I f leaf-litter invertebrates (6 density (7) -adapted trees (8) cit (13) n understory (12) Laura <i>Conse</i>	eetles (5) litter invertebrates (5) s) ence <i>et al.</i> (20 <i>rvation Biolo</i> 400	<i>gy</i>





Vulnerable species
slow-moving
poor eyesight
freeze response
forage along roads
basking species
mass migrators

Secondary Effects Incursions of hunters



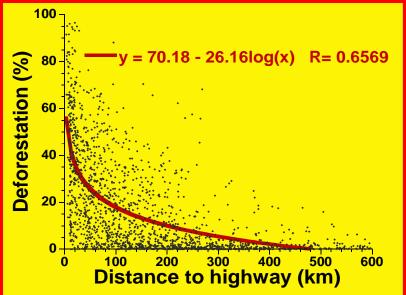
Laurance et al. (2006) Conservation Biology Laurance et al. (2008) Conservation Biology Laurance (2010) Africa Geographic Magazine Mahmoud et al. (2018) Tropical Conservation Science





Deforestation





Laurance et al. (2002) Journal of Biogeography Barber et al. (2014) Biological Conservation

Fires & Greenhouse Gas Emissions



China's Belt & Road Initiative

- **Spanning 138 nations**
- Some 7,000 infrastructure & extractive-industry projects
- Up to \$8 trillion projected

Ascensão *et al.* (2018) *Nature Sustainability* Laurance (2019) *The Ecological Citizen*

в



Target a broad audience

Alamgir *et al.* (2017) *Current Biology* Laurance & Burgues (2017) *Science* Laurance (2018) *Trends in Ecology & Evolution*

Laurance (2018) Yale Environment 360



Highlight exaggerated economic benefits are

Project benefits are highly variable and

context-dependent

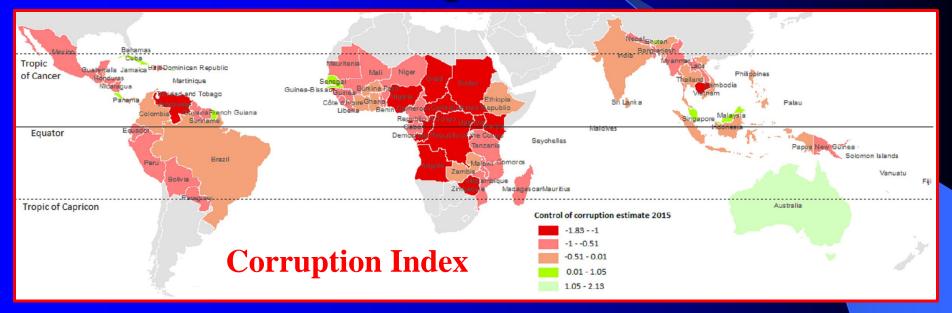
Many projects have

highly inequitable

benefits

Alamgir et al. (2017) Current Biology

Decry heavy toll of corruption...



- Many ill-advised projects approved

15-60% of project funding lost to corruption (World Bank 2011)

And massive maintenance costs...



It *is extremely* expensive to engineer and maintain roads in high-rainfall environments



...and serious impacts of pollution on people





Conserving ecosystems















A Few Things I've Noticed

- Once completed, Chalumbin windfarm could be sold to 'anyone', including China
- Roadworks could be up to 75 metres wide
- Roads and wind-tower clearings would predispose ecosystems to invasions of cane toads, feral cats, exotic insects, many weeds, myriad edge effects, and sharp spikes in fire intensity
- Project area contains many patches of wet sclerophyll (rose gum) forest
- EIA or quick surveys are unlikely to provide anything close to a full list of rare or endangered species in area







alert-conservation.org global-roadmap.org