The new road and highway megaprojects changing the face of our planet

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Last November, a remarkable new species was added to life's catalogue. The Tapanuli orangutan lives in a small patch of rainforest on the Indonesian island of Sumatra, a biodiversity hotspot known as the Batang Toru ecosystem. It is just the eighth living species of great ape to be described, besides two previously known orangutans, two gorillas, chimps, bonobos – and us.

But triumph is tinged with tragedy. The entire population of Tapanuli orangutans is thought to be fewer than 800. It instantly became the world's most endangered great ape. Soon it won't be endangered any more. It will be extinct.

Right now, bulldozers and chainsaws are tearing into its habitat. By 2022, if things go to plan, the Batang Toru hydroelectric dam will have destroyed 3.6 square kilometres of prime habitat in the middle of the orang's home. A 13.5-kilometre tunnel will be dug to carry water from the dam. Access roads will be built, power lines laid and part of the valley flooded. "The associated infrastructure will destroy key habitat with the highest density of orangutans," says Gabriella Fredriksson, founder of the Pro Natura Foundation, a local conservation charity. The dam will send the orangs "spinning towards extinction", says her colleague Matt Nowak.

The orangutan's demise is not unstoppable, but the forces that threaten it probably are. The dam is one small piece of a global infrastructure boom that promises to reshape our world over the next decade. This will bring much-needed roads, energy and jobs to some of the world's poorest people. But it will come at a shocking expense to nature. The question is: can we do things better?

When conservation biologists hear the word "infrastructure", they shudder. "It's the primary force that is peeling back nature and opening the last remaining wild areas like a flayed fish," says Bill Laurance of James Cook University in Australia. "If you look at everything that is going on environmentally – dwindling wildlife populations, habitat fragmentation, shrinking wilderness areas, protected areas being isolated, poaching and encroaching of biodiversity hotspots – you find that infrastructure is the proximate cause, the first step, in those processes."

Gouged strips

And its effects are profound. According to the International Union for Conservation of Nature, which maintains the Red List of Threatened Species, of 13,761 endangered or critically endangered species, 4383 are directly threatened by infrastructure projects of one kind or another. These include residential and commercial development, extractive industries, energy projects and road building.

A further 7500 or so species are at risk from farming, logging, hunting, gathering, trapping and fishing. These are not infrastructure projects per se, but they are enabled by them – especially road building. Cutting a road through a wilderness is like gouging a strip of paint off the surface of a piece of wood: rot gets in and diffuses outwards.

"Roads are the most damaging sort of infrastructure," says Laurance. "They are the common denominator: you can't put in a new mine or a hydro project or fossil fuels without roads." They also open frontiers for logging, land clearance, poaching, hunting and illicit drug production. In the Brazilian Amazon, 95 per cent of forest destruction occurs within 5.5 kilometres of a road. Similar levels have been seen in Cambodia, Sumatra, Thailand and Panama. Around 70 per cent of the world's forests are now less than 1 kilometre from a forest edge.

That creates lots of "edge habitat", which has different light levels and exposure to the elements from the forest interior, and often ends up with different plant and animal species. Roads also affect biodiversity directly. They restrict the movement of animals, fragment their habitats, expose them to new diseases and chemical and noise pollution, and convert them into road kill. To add insult to injury, they also facilitate the spread of invasive species and clamp the world ever tighter into the vice of fossil fuels.

- 12 million km is the estimated length of road built worldwide since 2000. Source: *Current Biology*, vol 27, page PR1130
- 25 million km is the projected extra length of road to be built worldwide by 2050. Source: *Current Biology*, vol 27, page PR1130

A recent paper on the risk of road building, co-authored by Laurance, reported that "we are currently witnessing the most dramatic era of road expansion in human history". The researchers calculated that since 2000, the world's legal road network has lengthened by 12 million kilometres, enough to encircle the globe 300 times – not including wildcat road building for illegal logging, farming and hunting. Most new roads are in the tropics, where the bulk of the world's wildlife resides.

For these reasons, conservation biologists regard infrastructure development as the principal agent of biodiversity decline. An analysis of 35 years of research on habitat fragmentation caused by such development concluded that it reduces biodiversity by anything from 13 to 75 per cent.

But still we build. The Batang Toru dam is part of probably the largest infrastructure programme the world has ever seen: the Chinese-led Belt and Road Initiative, which since it began in 2013 has grown to encompass around 7000 individual projects across 70 countries (see "Biodiversity in crisis: Earth's giant construction projects mapped out").

That is not the only gigantic infrastructure project in the pipeline, just the biggest of a bad bunch. More than 30 development corridors are planned or being built across Africa, requiring 53,000 kilometres of new road, much of it in protected areas. South America has its Initiative for the Integration of Regional Infrastructure, which will build roads, pipelines and dams across the Amazon and beyond. Reforms to the US Endangered Species Act will make it easier to build roads in wilderness areas there.

Over the next 30 years, it is estimated that a further 25 million kilometres of road will be built across the world, mostly in the tropics. If these highways all go ahead, the prospects for biodiversity are poor. The tropics will end up looking a bit like Western Europe, with heavily fragmented ecosystems stripped of wildlife.

The story of the Tapanuli orangutan is a case study of development flying in the face of conservation. An environmental impact assessment carried out on the Batang Toru dam project in 2014, before the orangutan was recognised as a unique species, flagged up some major hazards, including habitat destruction. The following year, a biodiversity survey led by Fredriksson for the dam's lead construction company, North Sumatra Hydro Energy, recorded numerous critically endangered and legally protected species on the site, including Sumatran tigers, Malayan pangolins and the orangutans. It warned that the area earmarked for the dam was "an integral part of the Batang Toru Ecosystem" and that "the construction of any infrastructure in this fragile ecosystem will have significant impacts on the highly biodiverse and unique Batang Toru forests".

The orangs in particular will be hit hard. The area that will be cleared and flooded contains the highest density of the apes, with 41 individuals, 5 per cent of the entire global population. But worse, the dam and associated infrastructure will destroy already fragile corridors between the orang's strongholds, creating three isolated populations that have no hope of interbreeding (see "map"). Two of these are too small to be considered viable. The largest one contains 531 orangs, which is just about viable.

Sound of chainsaws

"It's crazy," says Laurance. "It's the world's most critically endangered great ape, for God's sake." Further losses caused by encroachment on the forest will probably condemn the species to the grave. Fredriksson's biodiversity survey found that the site is already being assaulted by illegal land clearance, catalysed by the prospect of development and facilitated by temporary river crossings installed to get equipment to the site. The survey was carried out to the sound of chainsaws.

According to a coalition of local NGOs, the project is not even necessary. North Sumatra does not have an energy shortage and even if it did, there are other sites that could be developed without destroying a globally important habitat.

And yet the project ploughs on. "[The hydro company] has gone full steam ahead, especially after the orangutan was declared a separate species," says Fredriksson. In May, the company announced that the dam would open in 2022. A spokesperson told the Jakarta Globe: "We understand that the forest ecosystem plays an important role… We are not going to sacrifice it. This has been our commitment from the very beginning."

Ultimately, according to an investigation by the NGOs, the project is controlled by Chinese companies and money. *New Scientist* asked Sinohydro, the Chinese state hydropower company that is a major stakeholder in the project, for comment. It did not respond, but its website says that one of its priorities is "preserving biodiversity".

It is possible to build infrastructure without destroying vital habitats and the biodiversity that depends on them. Conservation biologists and even pressure groups like WWF accept that development can coexist with environmental protection, bringing enormous benefits to people without trashing nature. “We’re not anti-development, we’re anti-stupid development,” says Laurance.

In Russia’s wild east, for example, a precious habitat for endangered Siberian tigers and even more endangered Amur leopards was recently saved from being sliced in two by a four-lane highway, part of the Belt and Road Initiative linking Russia to China and North Korea.

“During improvement and widening of this road, we have two or three places where leopards were killed in car accidents,” says Evgeny Shvarts of WWF Russia. Losing that many leopards was a huge blow. At one point, the entire population was down to 29.

He and other conservationists persuaded the Far Eastern Leopards Federal Conservation Program, which is overseen by Sergei Ivanov, Vladimir Putin’s special representative for the environment, to create a wildlife corridor by funding a 530-metre tunnel for the road. “It was a really important case,” says Shvarts. “We really believe it is possible to save habitat if we convince very high-level persons to make the right decisions.” The Narvinskiy Pass tunnel opened in 2016. Tigers and leopards are using the overpass and populations of both are increasing, says Shvarts.

There are other examples. In Nigeria, the government of Cross River state recently agreed to reroute a planned major highway to avoid slicing through a national park that hosts a population of gorillas. In Bangladesh, the state-owned rail company is building overpasses to allow wild elephants to cross a high-speed line now under construction.

And planned infrastructure projects sometimes don’t happen at all. In June, the new Malaysian government abruptly and unexpectedly cancelled four major Belt and Road projects. At the same time, millions of square kilometres of farmland, mostly in developed countries, are being abandoned. This is creating what conservation biologists see as a potential bonanza of ecological restoration, known as “rewilding”, which could be the saviour of biodiversity. But that is another story.

This is the second in Graham Lawton’s series of articles about biodiversity. The third will be on rewilding. Send your suggestions for topics to cover to biodiversity@newscientist.com

Map feature accompanying this article in *New Scientist*: Biodiversity in crisis – Earth’s giant construction projects mapped out (subscriber only)