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Re-Imagining Urban Movement in Singapore: At the Intersection Between a Nature Reserve, an Underground Railway and an Eco-Bridge

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Abstract

In 2013, the Singapore government announced a plan to build the Cross Island Line (CRL), the country's eighth Mass Rapid Transit train line. Since its release, the proposal has caused ongoing heated debate as it involves going underneath Singapore's largest remaining reserve: the Central Catchment Nature Reserve. Following extended discussions with environmental groups, the transport authority later stated that they would now consider two route options: a direct alignment running underneath the Central Reserve, and an alternative route that skirts the reserve boundary. The authority warned that the skirting option could increase the construction cost significantly and cost commuters an extra few minutes of travel time. Intriguingly, in contrast to the underground rail project that threatens to further fragment the Central Reserve, another, more visible, repair work is taking place at the edge of the same reserve, aiming to reconnect fragmented habitat through an eco-bridge. Through these two seemingly contrasting yet intimately related case studies in a highly developed city-state, this article explores the complexity and ambivalence of urban movement and its entanglement with development, techonology and urban natures. How are the discourses of urban mobility directed by the desire for 'velocity', the politics of invisibility, and a fixation on certainty? What might it mean to reconfigure contemporary practices and ethics towards multispecies movements in an increasingly urbanised environment? Amid the growing expansions of infrastructure and public transportation in Singapore and around the world, often in the name of sustainability and liveability, this article unsettles some taken-for-granted, velocity-charged

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and human-centred approaches to urban movement and explores the serious need to craft new possibilities for a more inclusive and flourishing urban movement.

Keywords:

mobility, urban transportation, urban nature, more-than-human mobilities, Singapore, conservation technology, invisibility

'In Singapore, there are no traffic jams, the worst we experience is slow traffic'. We started our tour of the LTA gallery with this statement from the delegate of the Singapore Land Transport Authority (LTA), a statutory board under the Ministry of Transport. I had come to the gallery to learn more about the history and future of Singapore's urban mobility. The audience consisted of about twenty people from various countries. Over the course of the next hour, we were introduced to a range of mechanisms used by the city-state to ensure that traffic moved at its optimal speed and maximum efficiency. These mechanisms included Electronic Road Pricing, a pay-as-you-drive system designed to manage road congestion, and hefty vehicle taxes to curb car ownership. As we were guided through the trajectory of Singapore's transport development, we were repeatedly reminded that transportation infrastructure had been the cornerstone of the island's nation building, and that its continuous expansion was crucial to further enhance connectivity and liveability in the country.

At the conclusion of the visitors' program, we watched two animated videos featuring aspects of the island's future mobility planning. These stories, narrated from the perspective of a family of three generations, focused on a debate as to whether the construction of a new Mass Rapid Transit train line should be close to homes, which would bring noise and other issues, or away from homes, which would involve longer journeys for commuters. The family also had to decide between taking public transport or driving, each with its own merits and disadvantages. After watching the videos, we too were invited to choose between the two sets of decisions on these issues by pressing the buttons installed on our chairs.

In this imagined, imminent future, the seemingly complicated challenges offered to participants did not mention how the construction of new train lines might disturb the natural environment or involve relocating existing inhabitants, both human and non-human. Transport infrastructure with its attendant issues of *whose* mobility is enabled, and how, is entangled in a range of ways with a cluster of social-cultural, political, economic and environmental issues. Yet, in this admittedly simplified context, all these complexities were reduced to a simple set of yes or no questions centred on the trade-offs in terms of personal convenience and amenities. This experience of encountering a framing of urban mobility planning confined to a narrowed set of stakeholders and options impelled me to ask more questions.

In this article, I explore urban movement paying specific attention to transportation in the urban context of Singapore. In Singapore's effort to build a sustainable and liveable city, the framework for understanding liveability is comprised of three core aspects: a competitive economy, a sustainable environment in which the city has to survive with limited space and natural resources, and a high quality of life.[1] In line with this vision, the State outlines its goal to develop a people-centred land transport system where 'all can get to more places faster and in greater comfort'.[2] Yet, as geographer Tim Cresswell notes, creating models of mechanically aided physical movement to make transport more efficient, or less environmentally harmful, 'says next to nothing about what these mobilities are made to mean or how they are

practised'.[3] Further, he points out the need to place 'human mobilities in an entangled web of "other" mobilities that have sometimes been demoted in mobilities research'.[4] Cresswell's concern for the 'other' mobilities, namely animal movement, in an urban context has become increasingly pertinent to researchers. For example, cultural geographers Timothy Hodgetts and Jamie Lorimer explore how animals' mobilities are governed and shaped by human actions, and their complex social and political implications.[5] Philosopher Clare Palmer, in the context of urban environment ethics, posits a causal and moral responsibility towards displaced wild animals in densely human-populated environments as animal territory is encroached upon by development.[6] From an urban planning perspective, Aidan Davison and Ben Ridder meditate on the 'possibilities for understanding cities as sites for on-going dialogue between humans, non-humans and living systems'.[7]

With these approaches in mind, my inquiry aims to tease out the complexity of mobility and its entanglement with technology, development and urban natures. I focus on two seemingly contrasting yet intimately related case studies: a proposed cross-island underground train line earmarked to cut beneath a nature reserve; and an ecological bridge spanning a six-lane highway in the hope of restoring animal movement within the same reserve. In tracing the design of the train line, I am interested in how the discourses of urban mobility are directed by the desire for 'velocity', inspired by philosopher Paul Virilio; the politics of (underground) invisibility; and a fixation on certainty. As I navigate the wildlife overpass, I investigate the way in which the technology of restoring animal mobility may open another way of world-making, and conversely, how it may further enable automobility, serving as an 'ethical bypass' for particular development projects.[8] Through the interplay of these two cases, I ask which forms of movement are rendered desirable, and which are cast into the background to become the kind of 'shadow places' that Val Plumwood describes as in need of greater attention.[9]

In addressing these questions, this article unsettles some taken-for-granted approaches to urban transportation planning underpinned by the pursuit of a measurable, singular imagining of the future. Thinking with and responding to the intersection of work on transportation, urban nature and more-than-human mobilities, it seeks to offer a new mode of enquiry into urban movement by exploring, in a highly developed city-state, the development of human-centric and supposedly sustainable infrastructure projects, along with emergent social, economic, political and environmental issues from various types of movements. Amid the growing expansion of infrastructure and public transportation in Singapore and around the world, often in the name of sustainability and liveability, reimagining urban movement is essential and urgent ethical work that may open up spaces to rethink possibilities to create a more inclusive and flourishing urban movement.

Interconnected Mobilities: A Glimpse Into the Past

Although Singapore was not heavily transformed by its own desires for internal mobility until its independence in 1965, others' aspirations and distant mobilities became central to its shaping much earlier. Originally established as a trading post for the British East India Company in 1819, the island soon became an international port. The bustling trade movement would later cause severe damage to its coastal environment. Meanwhile, its landscape was also completely transformed. In less than a century of British colonial rule, almost all the primary lowland tropical rainforests of the island were cleared to make way for plantations.[10] Initially, the plantations consisted mainly of gambier for the British colonial dyeing and tanning industry, but by the end of the nineteenth century, fuelled by the invention of pneumatic tyres,

Singapore had become central to the rubber growing industry in order to meet the explosive demand for automobiles that was at this time transforming mobility in other parts of the world.[11]

Since its independence, Singapore has joined the forces of global capitalism and modernisation, shifting from a reluctant enabler of others' mobilities to a determined proponent of frictionless movement. In Singapore, transportation has become more than its apparent function of meeting travel demands, and has developed in 'a nation building project aimed at realizing the state's vision of a business-friendly, smoothly flowing urban economic unit'.[12] A dense network of six lane arterial roads was created, with semi-expressways equipped with flyovers or underpasses to further reduce traffic delays.[13] In 1987, the first Mass Rapid Transit train line was opened and was soon positioned as the backbone of Singapore's transport for its speed and ability to maintain a less disrupted service.

With about 5.6 million inhabitants as of 2018 living across approximately 720 square kilometres, Singapore is one of the most densely populated countries in the world.[14] To maintain its forward momentum, the state has placed a high premium on enhancing its transportation network, often at considerable cost to other kinds of land use and the environment. A program of island-wide urbanisation along with the aggressive expansion of transport infrastructure gave rise to both deforestation and the demolition of most *Kampongs* (villages in Malay) and heritage sites. The highways and traffic tunnels that were constructed, 'devoid of meaning and history', replaced the beloved national library, national theatre and cemeteries that carried generations of local people's memories.[15] At the same time, the country has grown in physical land mass by more than twenty-one per cent since the 1960s through aggressive land reclamation from the sea. As a result, any sign of the 'natural' shoreline has disappeared.

This brief glimpse into the past suggests some of the ways in which mobility has shaped this island-nation and the futures it imagines and pursues. In the discussion of urban planning, it is important to remember that mobility and immobility, including their impact and consequences, are never singular but inter-related events. As the young country of Singapore tries to negotiate pathways out of its past, an ethos of velocity and economic progress has arisen which to date continuously underpins its policies in urban development. As a result, certain kinds of movements that are enlisted to press forward this development regime tend to be given preference over both other movements and over efforts to stay in place.

Debating the Cross Island Line

In 2013, the LTA published the updated Land Transport Master Plan (Masterplan), in which the construction of the Cross Island Line (CRL) was proposed as the eighth Mass Rapid Transit (MRT) rail line in Singapore, and is set to play a key role as part of the liveability goal. Targeted for completion by 2030, the CRL is to run from the suburb of Changi to Jurong, connecting the east to the west. Besides relieving the load on the existing MRT lines, the CRL claims to provide commuters with greater comfort and shorter journey times. Since the proposal was first released, the CRL has caused ongoing heated debate, in part because it involves going underneath Singapore's largest remaining reserve: the Central Catchment Nature Reserve (Central Reserve). Occupying over two thousand hectares, the Central Reserve has some of the country's richest forests in terms of biodiversity and is home to most of its very few remaining pristine freshwater streams.[16] In light of the island-nation's already precarious ecological situation as a result of its long privileging of development including

transportation networks, it becomes clear why the proposed rail link is being challenged by environmental groups. One outspoken critic of the proposal is the Nature Society of Singapore (NSS), a long-term protector of the environment of the island. NSS have highlighted the fact that the Central Reserve has already been broken up by reservoirs, pipelines, sealed roads, military facilities and security fences, and that any further fragmentation and disturbance would have a serious detrimental effect on its ecological condition.[17] It further proposed an alternative route for the CRL that runs around the reserve, a route that may even allow the train line to serve more residents and commuters in that vicinity. Some local Singaporean residents felt equally strongly about the potential environmental impacts and organised campaigns to resist the building of the CRL. In some campaigners' words: 'Transport may be a key issue for the country but in this case, there is an alternative. If we don't take it, the damage to our national natural heritage could be irreversible'.[18]

Following extended discussions with environmental groups, the transport authority announced that they would now consider two route options for the CRL: a direct four kilometer alignment with two kilometers of the tunnel running underneath the Central Reserve, and an alternative nine kilometer route that skirts the reserve boundary in which sections of the line may go underneath existing homes and businesses.[19] The authority warned that the skirting option could increase the construction cost by two billion dollars and cost commuters six minutes of additional travel time. In this context, they noted that, 'for MRT commuters, (an) extra half a minute is terrible'.[20] The final alignment of the CRL is yet to be decided upon.

In a dynamic and compressed urban environment, the form of mobility that is preferred is often highly political and negotiated between contested forces. For example, due to land constraints in Singapore, space-efficient and affordable mass mobility is said to take priority while car ownership is strongly discouraged through hefty taxes. And yet, transport researcher Paul Barter points out that not only do cars in Singapore enjoy a large speed advantage over public transport arising from road designs, but what this situation seems to have inspired is a more desirable social effect and a strong sense of elitism for car ownership.[21] Despite these difficulties, public transport is central to Singapore's efforts to stimulate economic growth and increasing population, as well as to catch up and lead in the sustainability turn in urban mobility. The Masterplan states that by 2030 Singapore should double its rail network, with eighty per cent of households within a ten-minute walk from a train station.[22] In doing so, it is hoped that the nation will be able to increase its capacity in mass transit while reducing its reliance on cars and carbon emissions in the transport sector. The proposed CRL forms a critical component of this vision. So, how has a seemingly more sustainable form of transport sparked heated debates over its environmental consequences? Why have the LTA continued to insist on considering both routes, despite the fact that the skirting option would circumvent the reserve as well as serve more residents as the NSS and a member of the Parliament has argued?[23]

Velocity: The Unbearable Six Minutes

There is an inextricable connection between mobility, velocity, time and development at work in these debates over the CRL. French urbanist Paul Virilio proposes that dromology, defined as the 'science or the logic of speed', is now a central force that shapes social, political and cultural development in the modern and postmodern world.[24] For Virilio, the Cold War, 'whose end signified not so much the triumph of liberalism as the failure of a type of social experimentation, has been replaced by a global economic war based on speed'.[25] Indeed, both

modernisation and mobility share an insatiable appetite for harnessing velocity for its ability to compress distance, space and time. Singapore sociologist Chua Beng Huat maintains that modern Singapore's 'success as identity' is built on its hyper-accelerated miraculous transformation from third world to first, made possible by its transportation infrastructure, high-technology and the intense flow of capital.[26] As the ability to move fast is tied to economic competitiveness, the narrative of urban mobility is underscored by speed, efficiency and persistent growth.

In discussing the inter-relationship between capital, space, speed and time, Jason Moore quoting Marx, notes that '[Capital] incessantly drives towards the "annihilation of space by time"'.[27] He further writes that:

> **Capital seeks to create a world in which the speed of capital flows—its turnover time—constantly accelerates. The privileging of time over space in capital's project is not passive but active: every effort to accelerate turnover time implies a simultaneous restructuring of space.**[28]

As Singapore fully acknowledges its limited natural and human resources and intense space-scarcity, the focus of its urban development has been persistently on the *optimisation* of its land and sea space. It seems that the more the city-state centres on its spatial limitations, the more it attempts to compensate or overcome these with efficient transportation and communication networks. Locally, the expansion of the train network enables it to compress space and further the progression of urbanisation. Internationally, it allows the island-state to establish a social-economic model with a global hinterland. The Port of Singapore is, after all, the busiest port in the world in terms of shipping tonnage.[29] It is in this context that the CRL must be understood. As velocity continues to drive development, the additional six minutes arising from the proposed skirting alignment of the CRL is perceived as an unbearable disturbance to commuters, and a disruption to the forward momentum of transport and economic development. These are the logics that have become central to the state's position in defence of the direct route.

Furthermore, it is important to note that although much emphasised, velocity and efficiency are not evenly distributed. In other words, mobility is always hierarchised. In Tim Cresswell's work on the politics of mobility, he maintains that 'Being able to get somewhere quickly is increasingly associated with exclusivity'.[30] This is certainly the case in Singapore where, due to the high cost of car ownership, there is constant pressure on the state to provide 'a high level of service for private motorised traffic'.[31] Mobilities researcher Weiqiang Lin argues that as cars enjoy a large speed advantage over public transport, one of the greatest inefficiencies in travelling by public transport in Singapore is the disproportionate amount of time required to traverse relatively short distances. Furthermore, public transport is, in fact, entirely managed by private companies, an arrangement implying the least cost to the state subscribing to the logic of market allocation.[32] Indeed, during the tour at the LTA, we were informed that the government agency is not the service provider for trains or buses, but rather the regulator who monitors their service standards. According to Lin, the State is not taking a serious role in disciplining the public transport providers. Under these privatised arrangements he argues that travel time has been commodified and monetised through a series of strategic pricing mechanisms.[33] Thus, 'the temporal dimension of urban travel is differentiated and enhanced for some at the expense of others'.[34]

In 2011, the deteriorating condition of public transport services caused rare open public discontent, culminating in the early 'retirement' of the minister of transport.[35] Given the

conjunction of disappointing public bus services and an insistence on prioritising road usage for cars, the state has put more and more emphasis on expanding the underground rail link as perhaps the only alternative mode of transportation 'that can even remotely compete with the car on speed for long urban trips'.[36] When commenting on the route options of the CRL, the transport minister, Khaw Boo Wan said that even an extra one minute of travel time is a lot of time, let alone six minutes, in his words, 'when the train has a disruption and there's an extra one minute of delay, within that one minute (commuters) send out maybe 100 tweets to flame LTA or SMRT'.[37] The State's anxiety over speed is highlighted here, but so is its own contribution to the constant push for efficiency and speed. In this light, this tension over an extra few minutes of travel time seems to point less to the public's thirst for speed than it does to a growing resistance to the inherent inequality in Singapore's urban mobility planning and the underlying social injustice. It is as a result of these interwoven factors that shortening commute times becomes more a political necessity for the ruling party than merely a question of meeting travel demand.

Underground: The Politics of Invisibility

In his research on Singapore's urban mobility planning, Paul Barter suggests that the country's primary effort 'to improve the alternatives to cars has been rapid expansion of the rail system'… 'a "World City"-inspired strategy, looking to London, New York, Tokyo and Paris where large percentages of people, including affluent individuals, rely on urban rail for mobility'.[38] In contrast, the bus system, while remaining important, 'has been relatively neglected'.[39] In the Masterplan, walking and cycling are briefly mentioned. However, as they are positioned primarily as a means of transit from the train or bus station to home, it in a way further encourages the construction of more MRT stations throughout the small island.

In outlining the two possible alignments of the CRL, the transport authority stresses that though the direct route cuts through the Central Reserve, it will do so underground with a two kilometre tunnel that runs forty meters below the surface. There will be no construction at the surface level. In contrast, the transport authority notes that because the skirting option requires longer tunnels, it will need extra 'ugly' ventilation shafts to be constructed at the surface.[40] Clearly, the politics of visibility and invisibility is at work here, which is to say, things are placed underground and thus out of sight as part of an effort to resolve the problem. Ecofeminist philosopher Val Plumwood highlights the danger of the neglected, denied and 'unrecognised, shadow places that provide our material and ecological support'.[41] Although Plumwood's focus is on a different aspect of environmental justice, it is useful to think with this notion to make visible some of the ethical and justice issues relating to the underground. In urban expansion, a large part of what enables the further development of the underground train network—rather than improving bus services or taking the diversification of urban mobility seriously—is the seeming 'invisibility' of the subsurface. Yet discussions and questions often have to go much deeper in these 'shadow places'. Recent research has explored how we have imagined and dis-enchanted the subterranean in ways that might reduce it to a mere resource in urban development or a burial site for toxic waste.[42] What are some of the associated risks of underground activities? In the work of Maria Lourdes Melo Zurita, Paul Munro and Donna Houston, they suggest that the emergence of capitalisation and industrialisation 'are predicated on new technologies that redefine the underground as an epistemological space for economic, social and political calculation'.[43] Yet, the subterranean is not a smooth space and things are often more complex and interconnected than is immediately apparent.

Although not always readily visible, geologists and engineers have identified many problems of underground works including noise, soil erosion, loss of biodiversity, and pollution of groundwater and air.[38] In the case of CRL, *underground* seems to create an impression that there would be no significant damage to the Central Reserve. However, many of these issues need to be considered. The NSS, in particular, have highlighted that the mandatory geotechnical site investigation of the project would involve intensive borehole drilling operations within the reserve and extensive clearance of vegetation to prepare the sites.[44] During my interview with Tony O'Dempsey, a conservationist who played a key role in negotiating the CRL issue with the officials, he explained that these site tests produce their own set of problems and challenges:

> **I am most concerned about those boreholes. The ones that are needed for the engineering works on the surface for soil investigation. We are worried about the silt and other types of pollutants that will be released into the streams as a result of the soil test, which is likely to be the greatest direct threat to the stream ecosystems of the reserve. It will permanently destroy some of the most pristine stream habitats remaining in Singapore.**[45]

In 2016, the first phase of the environmental impact assessment (EIA) for the CRL with regard to soil investigation was released. Echoing some of the concerns raised by the NSS, it pointed out that the components of site investigation activities could lead to disturbance to vegetation and wildlife behaviour, disturbance of aquatic habitats, and more. In addition, it highlighted the possibility of unplanned events that could cause various ecological issues such as unplanned water pollution from site runoff, injury to wildlife including roadkill and habitat loss.[46] The EIA concluded that, from an ecological and biodiversity perspective, the impact on the reserve will only be kept to 'moderate' levels even if comprehensive mitigating measures are effectively carried out.[47] In contrast, the impact from the skirting alignment is negligible—at least with regard to the Central Reserve.

In the same year, following extended engagement with conservation groups, the transport authority announced that they would reduce the number of boreholes for site investigation of the CRL project from seventy-two to sixteen, to be placed within the existing public trails to minimise disturbance to vegetation.[48] It promised that more mitigation measures would be introduced to control the environmental impact. In early 2017, the soil investigation started. Tony told me that not everyone was happy with this reduced scope of soil testing:

> **The soil investigation so far is going well. But some of the nature communities do not think we have won as the train may still go underneath the reserve. I think we have been successful this time comparing to some of the other conservation battles we fought … There is a compromise we have to make …**[49]

In addition to hosting an extensive transportation network and shopping malls, Singapore's underground has been used as storage space for petroleum and ammunition. In these efforts, various others have been displaced. Importantly, since 1978, the government has had the power to acquire all private cemeteries 'as and when required for development'.[50] Since this time, thousands of graves have been exhumed to make way for transport infrastructure or public housing. If some parts of the underground were once imagined as the dwelling site for the dead as well as a liminal zone for the living to connect to the past through tomb-sweeping or other rituals, years of exhumation of the ancestors' tombs in Singapore to make way for development has relegated the underground to merely 'empty' usable spaces, accompanied by

a gradual erosion of associated memories and a broader burial culture.[51] A local activist who leads campaigns to save the cemeteries and associated secondary forests said to me in the most poignant way: 'Singaporeans shouldn't be forced to choose between their grandfathers' graves and their grandchildren's homes'.[52] In 2019, the pilot areas of an underground masterplan that maps out the island's subterranean spaces and their potential uses is set to be unveiled.[53] For Melo Zurita, Munro and Houston, it seems that as the underground spaces are 'harder to see, less accessible and directly experienced … they are perceived as less charismatic and as more pollutable'.[54] As subterranean spaces grow increasingly tantalising for urban development, it is all the more urgent to ask, 'what happens in places that are out of mind, out of sight?'[55]

Certainty: The Controllable Environmental Impacts

Since Singapore's independence, its accelerated modernisation with robust economic development through meticulous planning, controlling and engineering human and non-human elements has been the key cornerstone for the People's Action Party, Singapore's authoritarian one-party government. Its ability in planning to perfection has been held up as a model globally, packaged and exported to other countries.[56] Of course, the future mobility of the city-state is being planned with the same assurance. In the Masterplan, the state identifies an increased 'demand for transport' driven by a greater population:

> **Population growth in the last five years has brought new urgency to some of the plans we had already outlined. Our economy is also expected to continue to grow at an average annual rate of 3 to 4 percent over the next 10 to 15 years so we can expect that more people and goods will need to be transported. We are already planning for infrastructure to meet this future demand as this will take 10 years or more from conceptualisation to completion.**[57]

Perhaps unsurprisingly, the proposal for the new train line was released alongside the now infamous population White Paper which proclaims that by 2030 the population of Singapore must grow by two million people to maintain its economic outlook and development momentum. With one of the world's lowest fertility rates, this projected population growth requires further increase of strictly selected skilled immigrants.[58] Facing a rare protest from its people, the government insisted that the White Paper 'was not about any specific population size for beyond 2020, but rather that it was being used for the purpose of land use and infrastructure planning'.[59] As the need for mobility is dictated by a top-down policy grounded in a firm belief that the future needs to be systematically planned and contained, the potential sacrifice of, and damage to, the Central Reserve is based on a manufactured and quantifiable demand for future mobility, envisioned by a single ruling party hinged on sustained economic growth, technological advancement and a supervised population mix.

In many ways, the appeal of framing things with certainty lies in a seemingly simplified account of issues which, in turn, creates the illusion that things are always controllable. In his work on statecraft, James C. Scott discussed extensively this dynamic of control and manipulation through scientific rationality and schematic knowledge enabled by focusing on 'certain limited aspects of an otherwise far more complex and unwieldy reality'.[60] In response to public enquiries about potential impacts of the direct alignment on the reserve, the LTA shifted focus to their certainty of mitigating and containing risks. In doing so, the tension of cutting across a highly ecologically sensitive area and the related complex environmental, social and cultural issues are reduced to a controllable set of measures of engineering and science. Yet complete reliance on mitigation measures is not only problematic but also never realistic.

In calling for zero impact on the CRL, local biologist David Tan highlighted a 2013 incident in which a stream at a forest just outside the Central Reserve was polluted by contractors despite mitigation measures being in place: 'Similar lapses could irreversibly damage the rich biodiversity of the reserve'. Similarly, Natalia Huang, an ecologist, cast her doubts noting, 'how much of the impact is mitigated cannot be guaranteed and may not be measured either'.[61] As the State considers the alignment options and associated potential damage to the reserve, it expresses much certainty and emphasis in its ability to mitigate and to decide what is the best for all, but little respect for speculative conservation issues. In recent years, some researchers in urban ecology and more-than-human studies have challenged this dominance of the certainty of knowing (the known) and controlling, asserting the importance of 'understanding the limitations of that knowing, its uncertainties and indeterminacies'.[62] As Steve Hinchliffe and Sarah Whatmore put it, a living city consists of experimental activities with elements of not knowing, the unknown and the unknowable.[63]

Importantly, much of the emphasis on trains as having a positive environmental outcome is because sustainable mobility is often narrowed down to an issue of quantifiable and measurable benefits while all other environmental impacts are framed as necessary costs, or as risks that can be controlled through scientific measures. As a result, the dynamics of sustainability are dangerously reduced and run the risk of being recruited into the development regime. Indeed, our considerations of urban mobility, including its associated risks, cannot stop at the edge of what we know or think we may know, and are therefore able to control or mitigate. Rather this situation demands that we search more widely and respect what we may not know, and may never know.

While the inhabitants of the city-state, human and non-human are awaiting the decision on the final CRL alignment pending the phase two release of the EIA, it has become clear that the issue of urban mobility is much more complicated than advocating for a narrowed version of sustainable transport or a battle between green groups and the state, as many media outlets tend to frame it. Rather it is a process entangled with the desire for velocity, the enabling politics of invisibility, and the alluring perception of being in control. Intriguingly, in contrast to the underground rail project that threatens to further fragment the Central Reserve, another, more visible, repair work is taking place at the edge of the same reserve.

A Celebrated Bridge

There were no signs indicating the direction of the bridge. Often noises from the highway were my guide. So as not to trespass on the restricted area or disturb the animals that may be looking for their way to the bridge, I decided to move towards the edge of the reserve where it met the road. The path I took was perhaps not often trodden. Bushes were overgrown, impenetrable. Tree branches were thick, tightly woven and entangled, leaving almost no gap for me to walk. There were times when I had to get low and really close to the ground. As I tried to remember the skills of moving on all fours, my body started to assume the steps of a pangolin or a civet, moving carefully but also somewhat aimlessly, hoping that a green field may appear soon to reconnect me to the other side of the forest. After quite some walking and crawling, I arrived at the border of the forest adjacent to a six-lane highway, where the thick green was separated from grey concrete only by a narrow ditch. There, I had an unobstructed front view of the bridge I was looking for with its large signage decorated with animal figures, 'Eco-link@BKE'. The bridge was still in its first few years of use and the vegetation growing on it was thinly formed. I had seen satellite and aerial images while sitting in front of my computer. I had passed underneath the bridge numerous times as a passenger in a moving

vehicle. Yet, unlike these distant encounters, seeing it in this manner hit me in a visceral way. Without being shielded by the steel-structure of a car, my body was intensely aware of how the whole environment trembled as it endured the velocity of non-stop traffic including heavy trucks moving along the expressway. The noises and vibrations were almost unbearable, making me anxious and uncomfortable.

The green area I walked through on my way to the bridge is part of the Central Reserve, the same forest that is at the centre of the CRL controversy. Even without the proposed train line, the reserve is already a thoroughly contested landscape. In 1986, the eleven kilometre six-lane Bukit Timah Expressway (BKE) was constructed, separating the Central Reserve and its adjacent Bukit Timah Nature Reserve. Since then, the highway that supposedly saves motorists thirty minutes in travel time has cast a long shadow on the ecological conditions of the once continuous forest, from the reduction of flora and fauna to the rise in roadkill. After disrupting the animal mobility of the two reserves for decades, in 2013 a 62-meter long ecological bridge, Eco-Link@BKE (eco-link), was completed. The bridge is not for human use. Rather it aims to restore ecological connection by allowing animals to move freely between the two forests, thus expanding their habitat and linking up genetic populations in an attempt to increase their species' survival chances.[64] One prominent feature of this ecological path is its wide hourglass-shape measuring fifty meters at the narrowest point. This width was determined by the local conservation experts as the minimum width for some animals—including Sunda pangolins, civets, native small mammals such as squirrels or shrub birds—to 'feel comfortable' when crossing the bridge.[65]

In recent decades in particular, the concept of wildlife corridors has been gaining traction around the world, despite the fact that data on their effectiveness in restoring ecological connectivity remains limited.[66] Some researchers suggest that non-biologists can easily connect with the concept.[67] Others argue that animal movements are not always welcome, for example, invasive species might become unintended users of the corridors to travel and expand their ranges.[68] Though researchers hold diverse and sometimes conflicting views in regard to these green passages, there is some consensus that the design of corridors needs to be specific, tailored to the animal users and the site.[69] It is not a script or universal model that can simply be replicated and mobilised as a quick solution.

Although discussions often focus on the structure of the corridors or scientific evidence of their usage by target animals, in her analysis Alexandra Koelle turns to the soft tissues of this connectivity technology. As she joined road ecologists in collecting data on roadkilled western painted turtles in the US, she was acutely aware of the speed and volume of cars and even the danger of researchers themselves becoming roadkill. Koelle highlights the 'care' that biologists and road ecologists have practised and their attention 'to the movements, habits, and preferences of animals' in evaluating wildlife crossing structures.[70]

In Singapore, substantial efforts have equally been put into the design and construction of the eco-link, from the structure of the bridge to the composition of the plants as well as the source of the soil. Years before the start of construction, the National Parks Board of Singapore embarked on surveys of the area including installing camera traps to monitor animals.[71] In doing so, they helped the researchers understand and 'guess' what animals may want from the bridge. Since the eco-link was put into use in 2013, night cameras have captured the images of diverse users including pangolins, slender squirrels, civets and various species of birds and snakes. As the trees grow taller, the users of the bridge are expected to vary even further with this change in conditions. The eco-link, comprised of a dynamic composition of materials, will continue to evolve through the intertwined rhythms of vegetation and animals. Indeed, the

assemblage of this structural linkage and its users inspires a more lively approach to rethinking mobility through 'a politics of conviviality' proposed by Hinchliffe and Whatmore, which 'is serious about the heterogeneous company and messy business of living together'.[72] From this perspective, the bridge performs an alternative and experimental way in which urban nature may be imagined, resisting a singular way of moving.

A Functional and Ethical Bypass

As I continued my exploration in Singapore, I found that not everyone was thrilled by the concept of a wildlife bridge. During my visit to Animal Concerns Research and Education Society (ACRES) wildlife rescue centre, after learning the average number of phone calls they received for animal assistance including roadkill, the conversation turned to their view on the eco-link bridge. Sumita Thiagarajan, the education executive of the group, trained in environmental biology, explained to me that there had continued to be frequent roadkill since the construction of the BKE highway as animals continued to move between the two very important yet separated central forests. And now, although some animals may have found the eco-link, the roadkill continues outside the immediate vicinity of the bridge as the barricades along the forest are just bushes, which do not stop animals running through and onto the road.[73] After all as she noted: 'Animals wouldn't know, "hey I shouldn't cross here", there is an eco-link coming up in forty meters.'"

The frustration and scepticism of groups like ACRES is understandable. I was unable to find a record of a fence installed along the edge of the reserve, and certainly did not encounter one on my walks. Indeed, Stephen Caffyn, the director of the land architecture firm that assisted in devising the eco-link, pointed out that some of their favourite ideas for the design of the eco-link 'stayed on the drawing board' including funnel fencing.[74] Akin to maps for humans, fences are often thought to be a necessary part of green passages to 'prevent the animals from entering the roadway, and [to] funnel them to the crossing structures'.[75]

Intriguingly, though the bridge may not be obvious to some animals, it is highly visible to humans. Caffyn further explained that they always intended to include humans as an unexpected set of end-users:

> **The signage and façade of the bridge is something that we thought would be a simple and effective way to spread the word about the function of the bridge to motorists passing below and give it an identity that is instantly recognisable even when traveling at speed.**[76]

In reality, this particular 'end-use' of the bridge has travelled much further than the designer likely had in mind. The eco-link, alongside other green initiatives—such as the 'Park Connector', a green matrix of paths connecting parks and nature areas—has been heavily promoted as part of Singapore's environmental planning and its commitment to preserving biodiversity in an urban landscape, integral to pursuing the cachet of the world's leading sustainable city.[77] Yet, despite the strong rhetoric directed at the public surrounding these park connectors, some ecologists have questioned their ecological value for wildlife movement, as most of these green paths are only a few meters wide, consisting of pedestrian or cycling trails with sparse trees and shrubs.[78] Some recent analyses suggest that planners, scientists and civil society actors need to be realistic about the potential and limitations of green infrastructure in terms of biodiversity and habitat restoration.[79]

Koelle encountered a related situation in her study in the US, where even though wildlife underpasses for some animals can be used more effectively and cheaply, it is the highly visible overpass bridges that continue to draw attention and attract funding, despite the uncertainties surrounding their usage.[80] The more I reflect on the overtly visible ecological overpass and the proposed underground CRL rail link, the clearer it becomes that it is this strategy of (in) visibility that has successfully distracted us from the irony of this situation. That is, the reserve that the proposed train line threatens to cut through (even if underground) is exactly the same fragmented habitat which the eco-link attempts to reconnect. As I recall the non-stop traffic passing under the eco-link, I begin to realise that the heavily publicised bridge is not only an ecological path that encourages animal movement but also, from the perspective of the state, an avenue for continued forward momentum in the development of transformative infrastructure with minimal friction. In this way, the eco-link and similar projects are used as a functional technology and 'ethical bypass'.[81] This is to say that whatever it might do for wildlife, the bridge also functions to enable the continuity and expansion of auto-mobility both in its actual 'working' and in its giving the appearance of having 'fixed' the environmental issue associated with a highway running through the Central Reserve.

A primary role of projects such as the eco-link is to counter the 'conflict between animal mobility and auto-mobility' that results in roadkill, 'a problem for drivers, [and] a challenge to the highway engineer's goal of creating fast and friction-free mobility'.[82] Although the issue of roadkill has not attracted as much attention in Singapore as in some other countries, the death of the globally endangered pangolin while trying to cross the highway was highlighted as a key motivation for building the bridge.[83] Other common casualties are macaques, wild boars, leopards, and various reptiles and amphibian.[84] The recent vehicular death of a rare sambar deer, of which fewer than 20 remain in Singapore, has given rise to a call to reduce the speed limit on one particular road. It has also sparked questions about increasing animal movements in the Mandai area and their connection to recent development projects (discussed below).[85] As Barter notes, since congestion has often been equated with economic paralysis in Singapore, the authority is reluctant to lower speed limits.[86] Thus, the bridge that may reduce the number of roadkill becomes a functional structure to minimise potential disruption, thereby ensuring free-flowing traffic without needing to reduce the speed.

Furthermore, the eco-link and similar environmental measures sometimes take on an ambivalent role in conservation, where they are subject to being instrumentalised to legitimise further disruption in other areas. In Sarah Franklin's work, she proposes the concept of ethical bypass that allow us to design around culturally and ethically difficult questions and issues.[87] In my discussion with a Singaporean conservationist, he alerted me to a recent large-scale eco-tourism project:

> **The development of the Mandai Safari Theme Park has started. It is said to be an eco-tourist mega-attraction that will combine the existing zoo, a bird park to be relocated from its current Jurong site and a rainforest park. The existing secondary forest needs to be cleared up to make space for these new eco sites. The solution for dispersed animals is to follow the example of eco-link@BKE, and to build an eco-link@Mandai.[88]**

The Mandai area, the site of a new eco-tourism hub in the making, is rich in wildlife as it sits on a secondary forest right next to the Central Reserve.[89] Although a width of fifty meters is said to be the minimum requirement for an ecological overpass to attract local wildlife, the eco-link@Mandai, to be ready by the end of 2019, was initially planned to be

only thirty meters wide. After environmental groups raised concerns along with the potential edge effect highlighted by the environmental impact assessment, it was later revised to forty-four meters.[90] While the effectiveness of the eco-link@BKE is yet to be evaluated, the technological fix that it embodies is already being celebrated and adopted as a solution for this new development project. As environmental concerns attract increasing attention in Singapore and globally, the eco-link becomes a way of managing public opinion by seemingly incorporating environmental concerns into a project that will disrupt the existing ecological condition, suggesting that developers are actively implementing measures to safeguard wildlife in the vicinity. In Franklin's words, this type of technique is deployed as a very practical way of 'containing' public anxiety by 'building in' ethical concerns to a development programme.[91] Positioned as a sensitive gesture towards the environment, the wildlife overpass morphs into a kind of ethical technology, one that enables us to 'bypass' difficult questions about our modes of life and to sustain continuous development and uninterrupted mobilities at other's expense.

While the eco-link and similar projects are the latest practices in conservation which may help to restore ecological connection to a certain extent, we should not forget that these green infrastructures are ultimately the consequence of some of the broken movements caused by desires for our own mobility and drive for velocity. In other words, they are living reminders of the detrimental effect that some human-centric ways of movement have imposed on the non-human world. Tony Clevenger, a wildlife biologist who has long been involved in various types of ecological passages in Banff, Canada describes the process of some animal users becoming comfortable with these paths as a lengthy one, assuming they manage to find them at all. Yet, once such a path is established it can become intergenerational knowledge among the targeted users.[92] Indeed, urban infrastructures such as the eco-link or railway are more than a technology of spatial connectivity, rather they offer or close temporal possibilities that sustain relations. Returning to the debate of the alignment of the CRL, the additional few minutes of travel time arising from the skirting option is imagined as unbearable disturbance to human users, despite the fact that this route could go around the Central Reserve and thereby prevent further environmental impact on an already fragmented forest. Here, the transportation project is narrowly positioned as a technology that compresses space and aids development. At the same time, as discussed, the construction of the railway is in part motivated by the hope that it will calm political unrest due to the uneven distribution of speed among various sectors of society; one that favours private motorised traffic. Holding these two cases together, the seemingly conflicting acts of connecting and disconnecting enacted in the same reserve demonstrate the ambivalence in urban mobility, prompting us to rethink infrastructure as layered shadowy places and raising the serious need to craft new possibilities for urban movement.

According to historian Gary Kroll, the lack of widespread protests over 'the increasing loss of wildlife as a result of the modern car, the improved road and the lust for speed' is because roadkill is not perceived as 'a deliberate or malicious act'.[93] Indeed, reimagining urban movement has important ethical implications. It not only calls for attention to the fact that animal movements (stillness) have been profoundly shaped by human actions in which life and death are at stake, but it also invites us to consider how our own movement (stillness) might be shaped by desires beyond sheer velocity, including that of learning to be moved and/or slowed down by animal residents. In this light, reimagining urban movement refuses a velocity-charged and human-centred approach to urban movement. Rather it requires taking seriously and carefully a more democratic way of moving. This may involve troubling some of the taken-for-granted ways of approaching urban mobilities, such as challenging the premise that mass

transit which privileges human comfort automatically equals sustainable movement, or the prevailing 'certainty of knowing' in mitigating the environmental risks of transport projects. This involves respecting and acting with unknowability, or in Colin McFarlane's words, 'putting knowledge "at risk" and attending to the unexpected behaviour of urban wildlife in ways that coproduce new assemblages of knowledge, people and wildlife'.[94] In this context, rethinking urban movement seeks not only to develop an approach, but evoke a conceptual change in meditating the way we move that may sustain a multiplicity of relations. In thinking of mobility, whose movements we intend to include, who we move with, how and to what extent we slow down, and what connections are enabled or disabled, are all questions of what type of future we are imagining.

Conclusion

In Singapore's pursuit of its imagined liveable and sustainable city, the case of CRL shows that mobility is often thought of as a key tool to maintain continuous economic development; and sustainable mobility is narrowly imagined as the practice of providing rapid mass transit with great comfort and lower carbon emissions, while any resultant environmental issues can be controlled or ignored through a kind of disavowal that assigns particular entities to the shadows. On the other hand, the emergence of the eco-link enabled by the city's growing awareness of the intersections between human and animal movements reflects a more experimental, negotiated and situated practice of care and a genuine, if only partial, desire to explore what others may need, pointing to an ethics of a more inclusive way of moving. Yet, as we have seen, this type of green path is also subject to misuse as convenient technological and ethical bypasses.

Situated at the nexus of a nature reserve, an underground railway and an eco-bridge, this article reveals the complexity of urban transportation, in which the dynamics of sustainability are enlisted in both development and conservation oriented projects, the politics of visibility are engaged in foregrounding or casting into shadow some human or more-than-human movements, and the thirst for velocity in nation building takes centre stage. Moving through these divergent yet entangled issues troubles the proposition of 'liveable cities', envisioned as a singular human-centred, efficient and comfortable yet reductive mode of life sustained by continuous acceleration and controlled through suppressing certain mobilities. Automobility and transport infrastructure are complex and contested processes that cannot be approached from the sole aspect of mechanistic engineering and scientific measures. Rather with some critical attention to mobility, these transportation projects, and cities at large, might be re-imagined as an apparatus of care and multispecies flourishing.

As Singapore and many other cities around the world outline the need to further expand transportation infrastructure, and as a certain version of human-centric sustainable mobility underpinned by a set of problematic shadowy issues is increasingly evoked, it is important to question the purpose of this constant 'improvement' and continuous expansion. If the desire to move is carried out without any serious engagement with unknown parts of the city and their inhabitants, and if velocity continues to be the dominant force in directing urban narratives, a complex, multi-layered way of living and interacting is at risk of being sacrificed for a perpetual flow between locations at record speeds. At the heart of this article is a call for attention to the various mobilities, *and their interplays*, that are required to sustain diverse entities, human and other. In order for each of them to craft liveable lives, we need to attend to the rhetoric and narratives of urban mobility that enable and render obvious or background and make invisible some movements, their priorities and needs, over others. Reimagining

urban movement in a more democratic way may offer a pathway to instigating deeper, wider and more serious discussions of how we might reconfigure contemporary practices and ethics towards entangled multispecies movements in an increasingly urbanised environment. This may suggest a re-examination of the current transport model which is predominantly directed by the projected economic and population growth, and involves more experimentation with urban planning and development. In doing so, urban mobility may emerge as a more 'difficult' and less straight-forward practice, yet at the same time one more supportive of permeable, ethical and imaginative ways of moving.[95]

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73. Interviews with Sumita Thiagarajan, the member of the ACRES, conducted by the author on 15 Sept 2017.

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These programs have seen Singapore being commended by some as the model of future green urban living, for example, featured in BBC's Planet Earth II.

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85. For an overview of this issue, see Audrey Tan, 'Animals affected by Mandai park works: Wildlife groups', The Straits Times, 24 Mar 2018.

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87. I am inspired by Sarah Franklin's proposition of ethical bypass, through her work in the context of biomedical health technologies. Franklin discusses a biomedical company that reprograms a normal body cell to perform 'as if it were an embryonic cell'. In doing so, it avoids political or religious objections to the use of human embryos for research, or the production of replacement body parts from aborted foetal tissue. Franklin, p. 346.

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89. Audrey Tan, 'Mandai makeover: Eco-bridge, biodiversity classes for contractors among measures to protect wildlife in area', The Straits Times, 26 July 2017.

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91. Franklin, p. 342.

92. Starre Vartan, 'How wildlife bridges over highways make animals—and people—safer', National Geographic, 16 Apr 2019.

93. Kroll, p. 10.

94. Colin McFarlane, 'Assemblage and critical urbanism', City, vol. 15 no. 2, 2011, p. 221. Here, McFarlane is thinking with Steve Hinchliffe, Matthew Keames, Monica Degen and Sarah Whatmore who draw inspiration from Isabelle Stenger's proposition of cosmopolitics 'in an effort to 'ecologise the political'. See their article 'Urban Wild Things: A Cosmopolitical Experiment', Environment and Planning D: Society and Space 2005, vol. 23, 2005, pp. 643-658.

95. The author has obtained ethics approval for this research project from the HREC of the University of New South Wales.