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V: Università degli Studi della Campania Luigi Vanvitelli  
Dipartimento di Architettura e Design Industriale



## Examining the Resilience of Urban Spaces: Patterns of Human Movement in Urban Hotspots through the Lens of the COVID-19 Pandemic

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# 1. Background: How is the city doing after COVID-19



Before

During

Aftermath



## 2. Literature : Urban Resilience

1. Urban resilience, initially rooted in environmental sciences (Holling, 1973), has shifted from “**Bouncing back**” to “**Bouncing forward**” (Davoudi et al., 2012), emphasizing adaptive, sustainable urban systems.
2. The pandemic catalyzed resilience strategies focused on flexible infrastructures, digital connectivity, and social equity (Campanella, 2020; Aldrich & Meyer, 2015).
3. **Shifts in human mobility** were significant, with declines in public transport use and increased reliance on private vehicles, walking, and cycling (De Vos, 2020; Shakibaei et al., 2020).
4. LBS (Location-Based Service) data became crucial for tracking changes in mobility and urban vitality (Kitchin, 2020; Oliver et al., 2020), complementing traditional methods like surveys and censuses.

### 3. Methodology : Research Area

#### Lockdown Periods:

**Period 1:** 03/25/2020 at 11:59pm, *New Zealand moves to Alert Level 4*, and the entire nation goes into self-isolation.

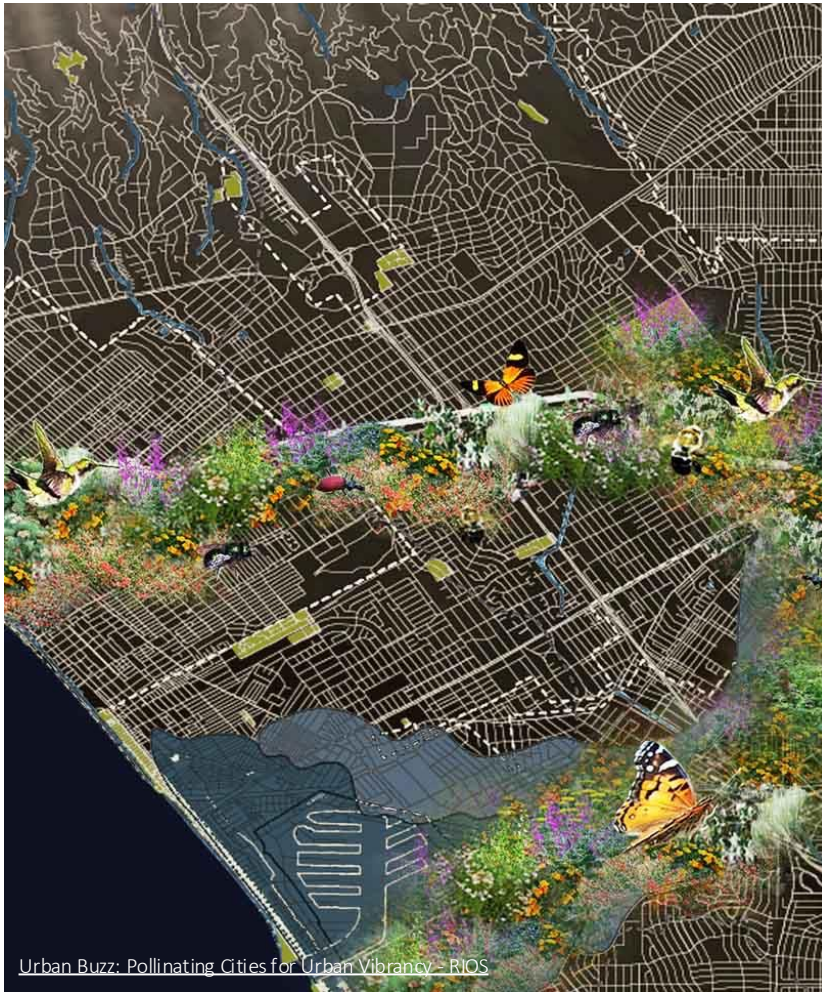
**Period 2:** 08/12/2020 at 12:00 noon, *Auckland region moves to Alert Level 3*. The rest of New Zealand moves to Alert Level 2.



### 3. Methodology : Define Urban Hot Spots

#### Locating “HOT SPOTS”

- Refers to **user-defined** urban spaces with crowded human mobility and intensive social and economic activities regardless of their designated urban programs.



*City is a place of diversity*

#### **Social hubs**

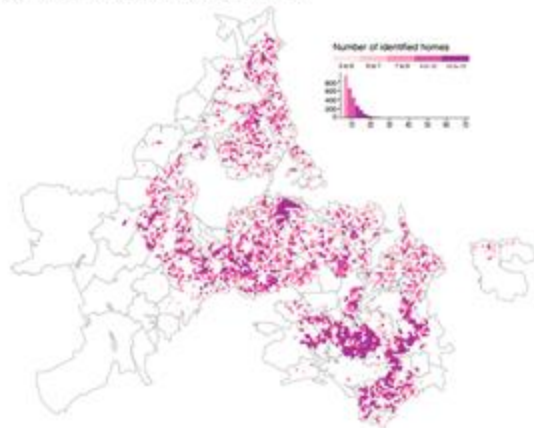
*a space that serves as an important site of social interactions.*

### 3. Methodology: Analyses

#### Construct Human-geographical Networks

- Customize the size of a place (i.e. a 300m grid cell)
- Identify home locations (*Chen and Poorthuis, 2021*)
- Construct home-to-destination networks

Spatial Distribution of Identified Home Locations



#### Analysis Local Density

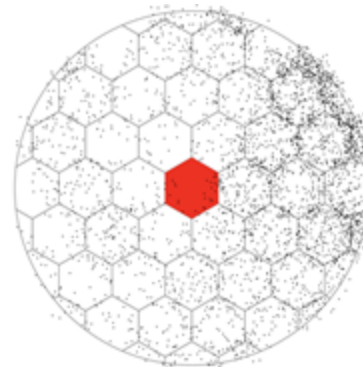
**Density:** visitor density in a local context of 1km radius derived from the geo-location to people's presence in a particular place.

##### Density

*Within 1km radius*

Local Density:

$$D_i = \frac{N_i}{\sum_{i=1}^n N_i - N_i}$$



#### Analysis Social Diversity

**Diversity:** variety of home locations of mobile phone users visit to each geographical location across the city (*Chen et al., 2021*).

##### Diversity

*With identified home locations*

Shannon Diversity Index:

$$H = - \sum_{i=1}^S p_i \ln p_i$$



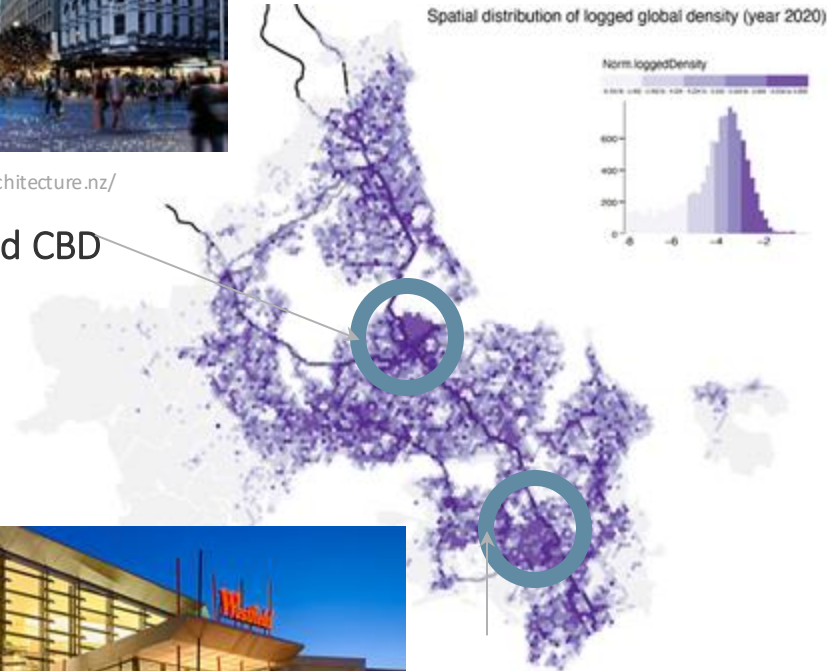
# 3. Methodology : Density vs. Diversity

## Density



<https://www.landscapearchitecture.nz/>

Auckland CBD



Manukau



<https://www.geoplastglobal.com/en/>

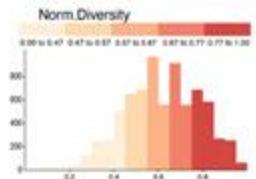
## Diversity

<https://www.alamy.com/>



Albany

Spatial distribution of normalized diversity (year 2020)



Southdown Inland Port

Manukau

East Tāmaki



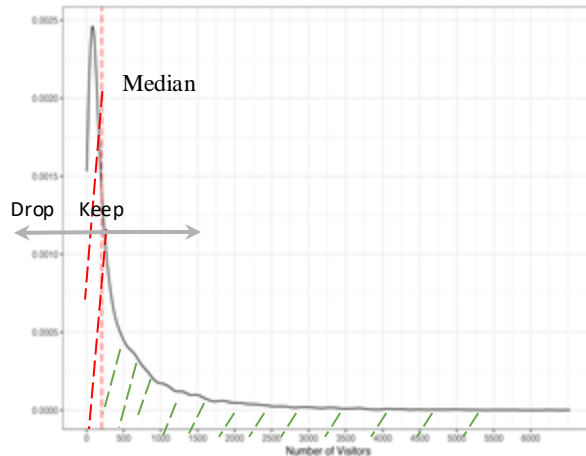
<https://www.alamy.com/>

<https://www.safeshop.co.nz/>

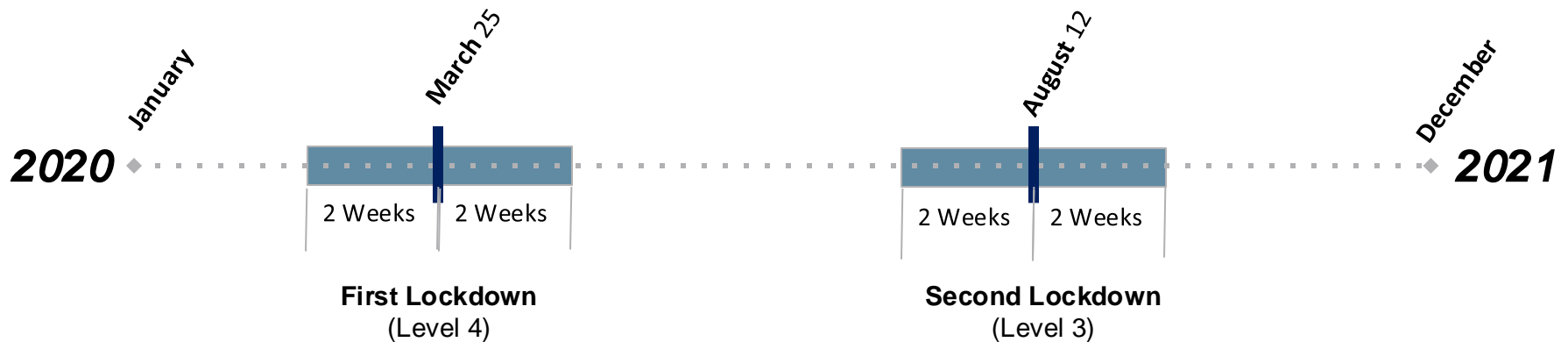
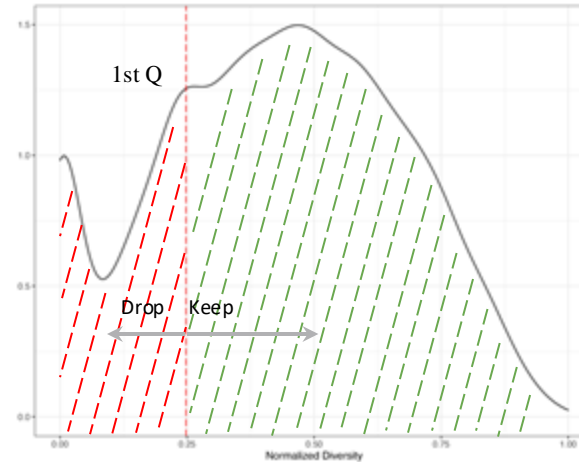


# 3. Methodology: Study Period

Filter above median density grid locations



Filter exclude lowest quantile dense grid locations



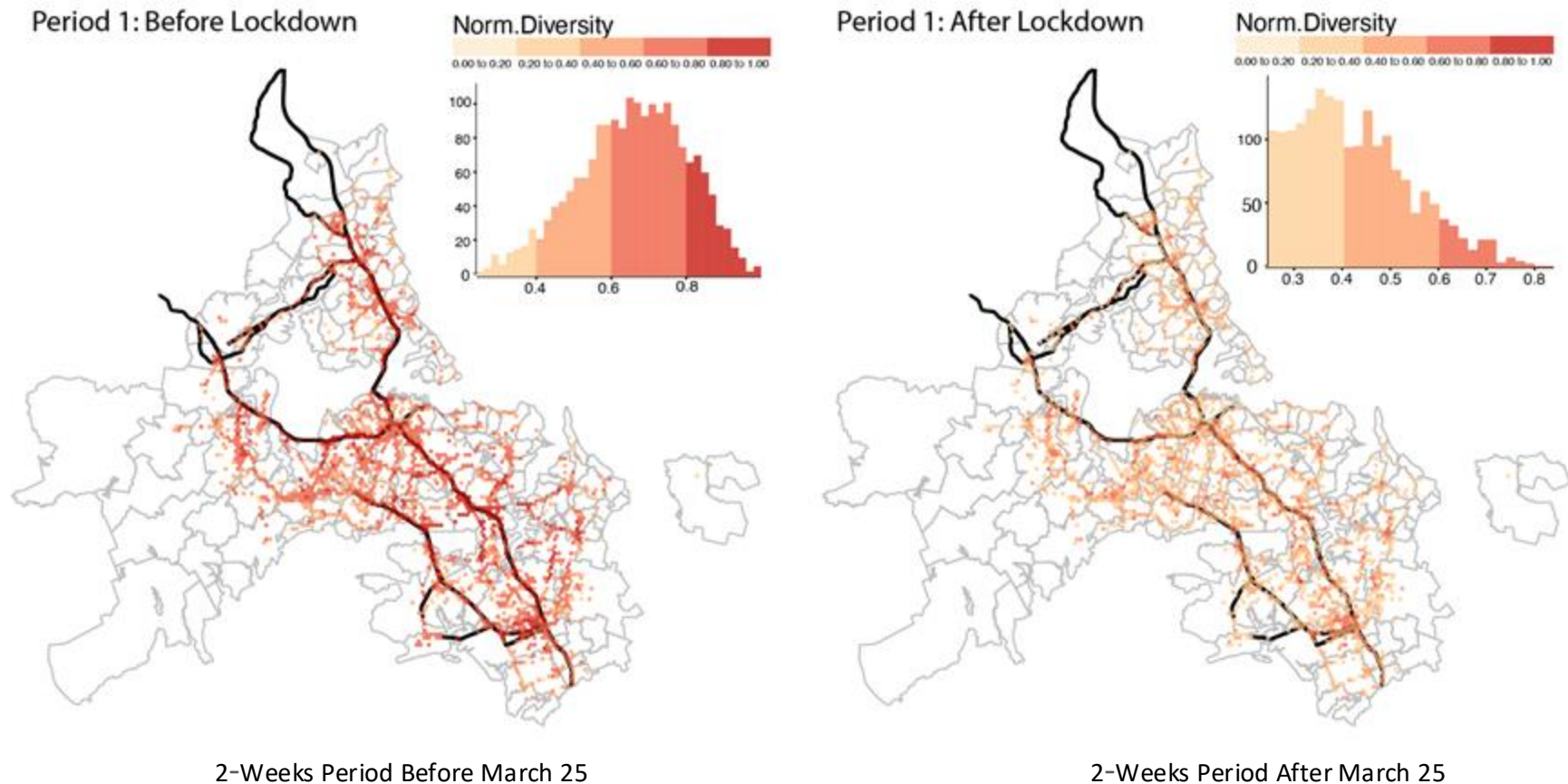


## 4. Results: Period 1 Diversity Distribution

### Period 1

- 03/25/2020 at 11:59pm, *New Zealand moves to Alert Level 4*
- Study period: 03/10/2020 - 04/08/2020

### Comparison of Normalized Diversity Before and After Lockdown



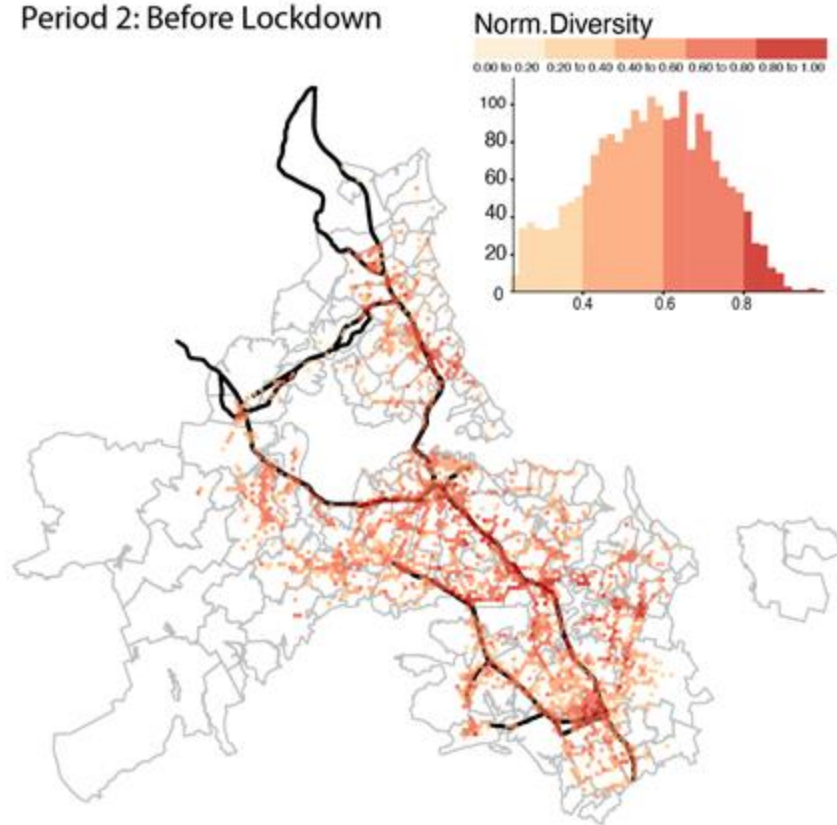
# 4. Results : Period 2 Diversity Distribution

## Period 2

- 08/12/2020 at 12:00 noon, *Auckland region moves to Alert Level 3*. The rest of New Zealand moves to Alert Level 2.
- Study period: 07/29/2020 - 08/26/2020

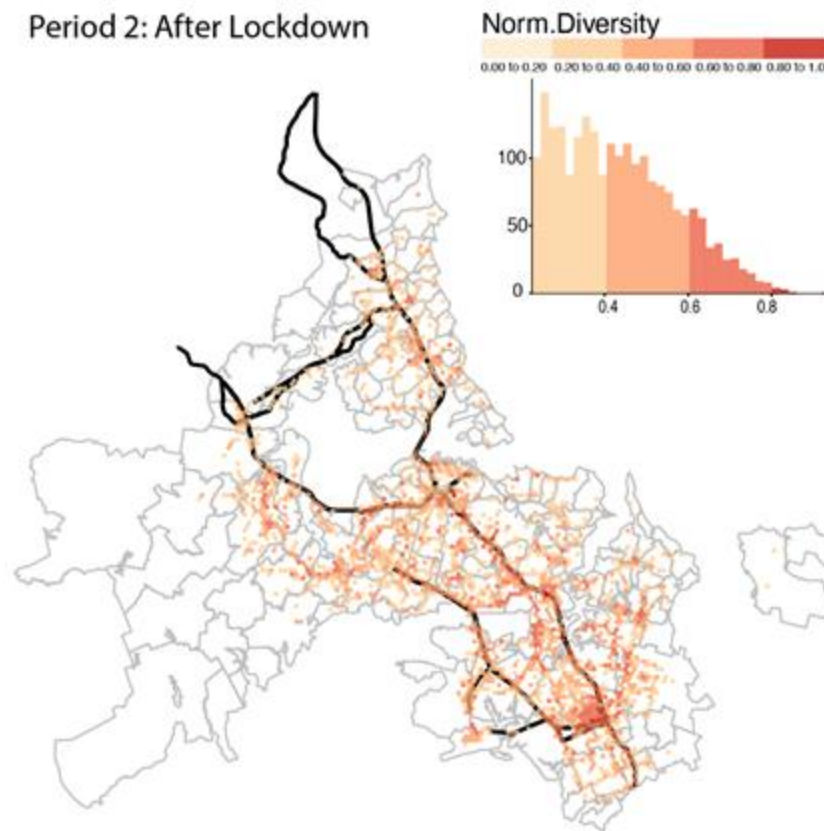
### Comparison of Normalized Diversity Before and After Lockdown

Period 2: Before Lockdown



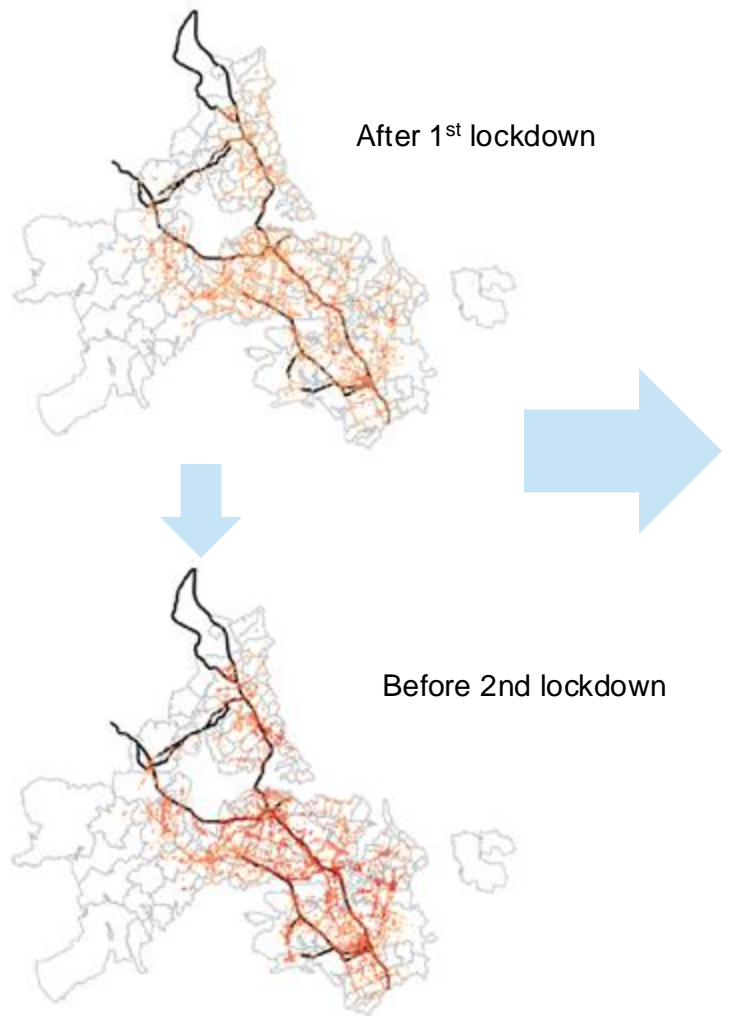
2-Weeks Period Before August 12

Period 2: After Lockdown



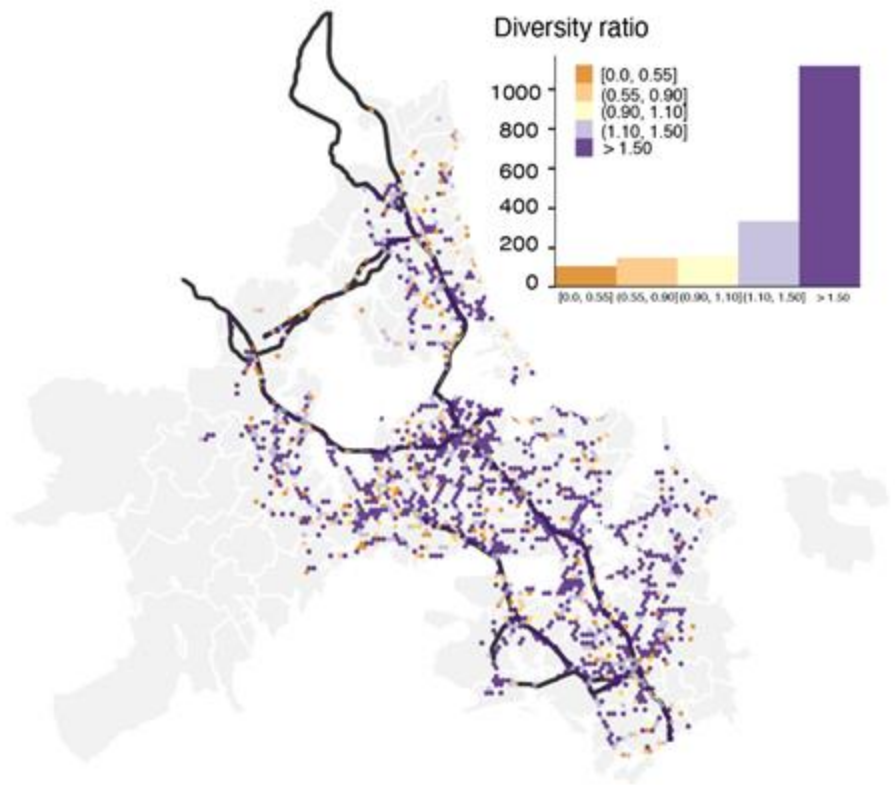
2-Weeks Period After August 12

# 4. Results: Recovery Ratio Visualisation



Ratio Analysis

Spatial Distribution of Diversity Ratio:  
Before second lockdown compared to after first lockdown



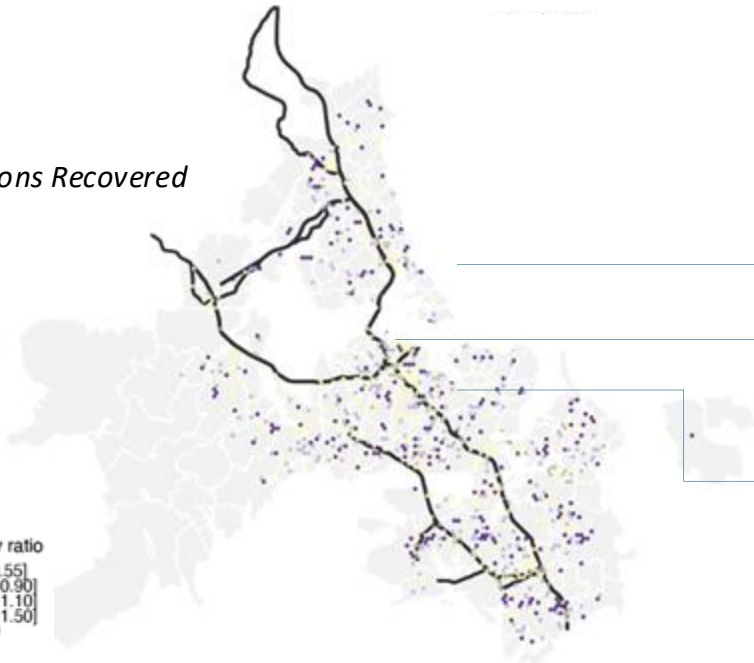
Diversity Before 2<sup>nd</sup> Lockdown / Before 1<sup>st</sup> Lockdown

# 4. Results: Identification of Resilient Urban Hot Spots

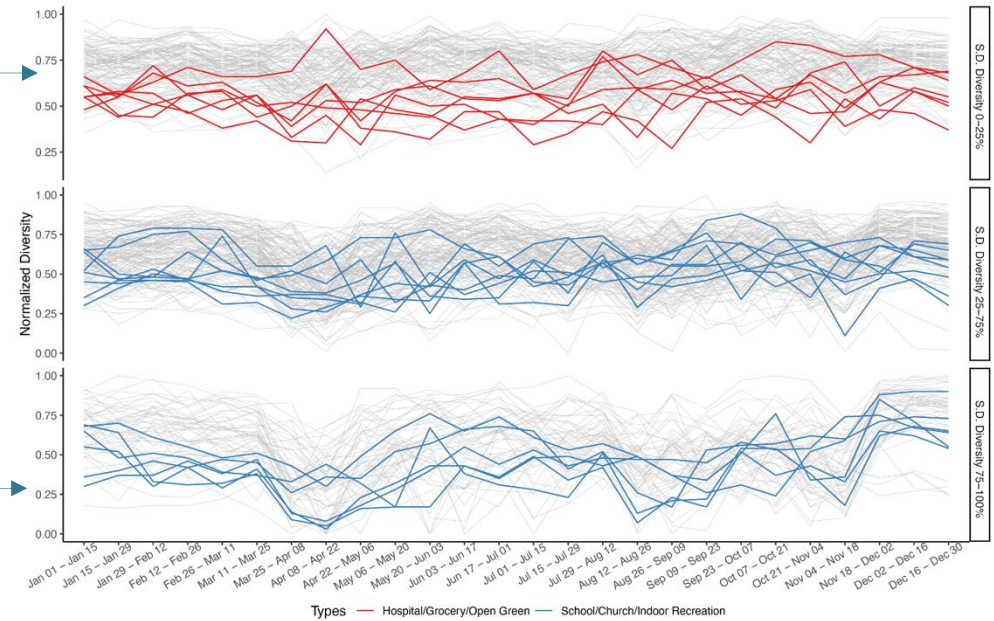
Locations Not



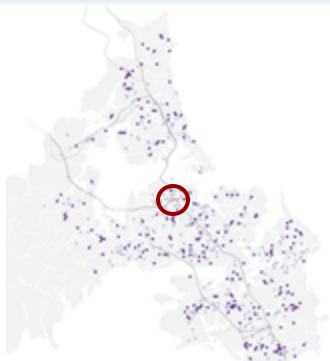
Locations Recovered



Measure against the normal life pattern allows us to provide insights into the recovery of urban places.



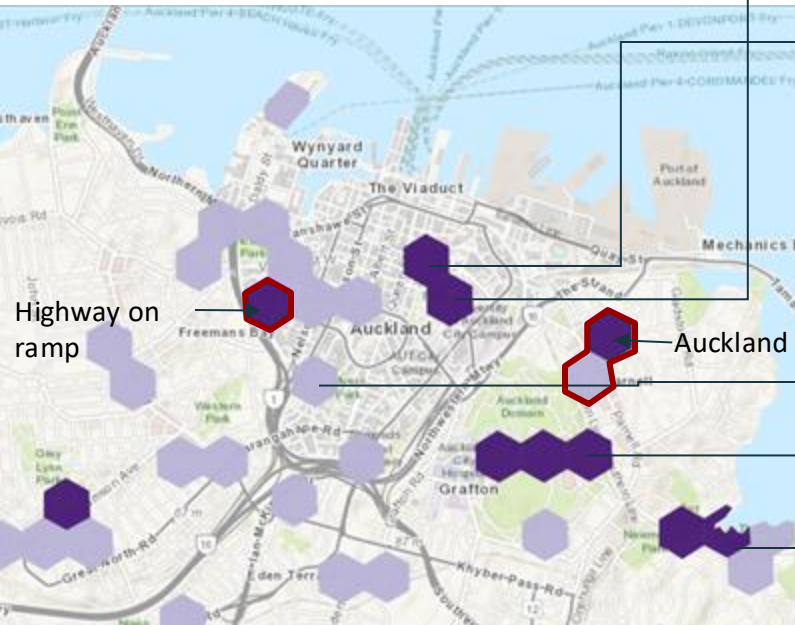
# 5. Resilient Urban Space Types



“Urban Hot Spots”



<https://heartofthecity.co.nz/attractions/parks/albert-park>



<https://www.totstoteens.co.nz/event/ellenmelville-centre-community-open-day/>



<https://www.aucklandmuseum.com/>



<https://www.mphsfoundation.org/>



<http://www.stuff.co.nz/auckland/>

Auckland CBD

# 5. Resilient Urban Space Types

## Essential Urban Programs (Schools/ Hospital/Highway Ramp )

## Green Open Space/ Leisure Places

Albany Senior High School

North Shore Hospital



<https://www.nzia.co.nz/awards/national/award-detail/3859#Albany%20Senior%20High%20School>

Auckland Hospital

Western Heights School

Kelston Primary School

Al Madinah School

Ormiston Senior/Junior  
College/Primary School

Manurewa Central Primary School

Albany Domain

Shepherds Park

Devonport Park

Memorial Park

One Tree Hill

Highland Park

Macleans Park



[https://p-cms-production.imgix.net/2019-06/GettyImages-472339930\\_super.jpg?auto=compress&crop=center&fit=crop&format=auto&h=832&w=1920](https://p-cms-production.imgix.net/2019-06/GettyImages-472339930_super.jpg?auto=compress&crop=center&fit=crop&format=auto&h=832&w=1920)

Kohuora Park

Botanic Garden



<https://www.aucklandbotanicgardens.co.nz/media/1395/autumn-julylake.jpg?crop=0,0.2200550964187328,0.16123329228211217&cropmode=percentage&quality=100&width=970&height=400&md=130816032580000000>

## 6. Conclusions

**Urban Parks:** These spaces displayed high recovery ratios, underscoring their importance for mental and physical health during lockdowns. Parks are identified as resilient infrastructures, essential for well-being, even during crises.



Great Lawn in Central Park

<https://cdn.auckland.ac.nz/aem/content/auckland/en/news/2020/06/17/crisis-of-public-spaces/jcr:content/leftpar/imagecomponent/image.img.1024.medium.jpg/1592349130896.jpg>



Madison Square Park during the coronavirus

### Contribution:

- Data Informed Insight into Urban Resilience
- Policy Implications
- Importance of Urban Parks



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Thank you!

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