The importance of midstorey connectivity on the dynamic habitat suitability model (HSM) for Leadbeater's Possum

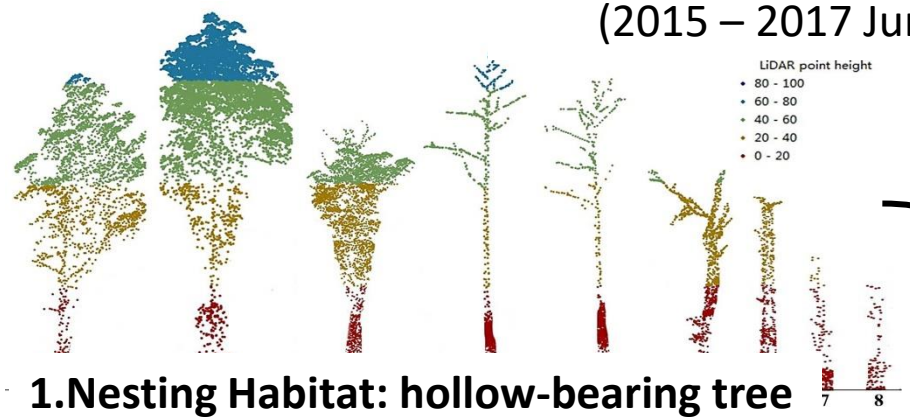
Dr Ruizhu Jiang
ruizhu.jiang@vicforests.com.au

VicForests

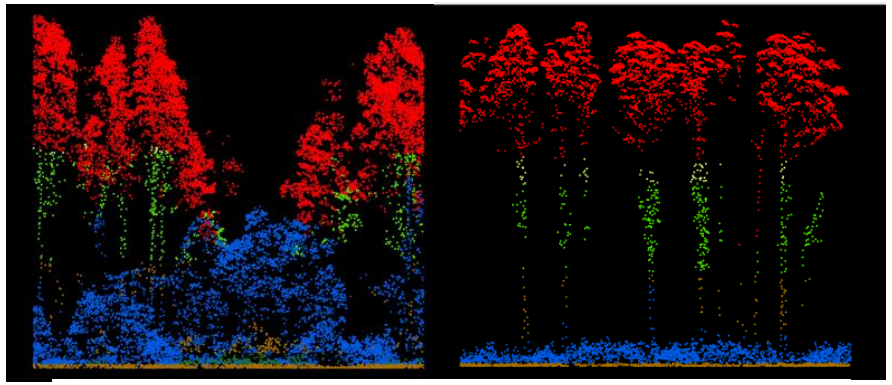
THE UNIVERSITY OF MELBOURNE

Leadbeater's Possum (LBP)
(2015 – 2017 Jun.)

2016 Airborne LiDAR (ALS) data

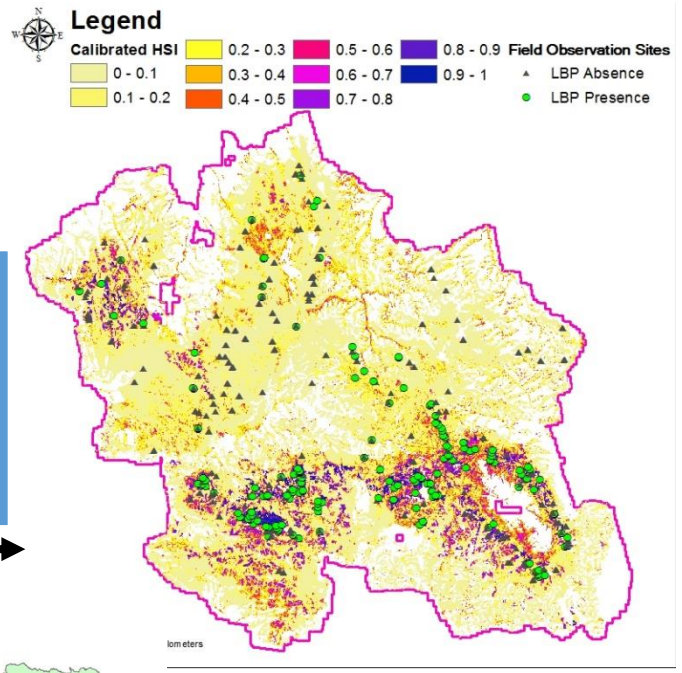


1.Nesting Habitat: hollow-bearing tree



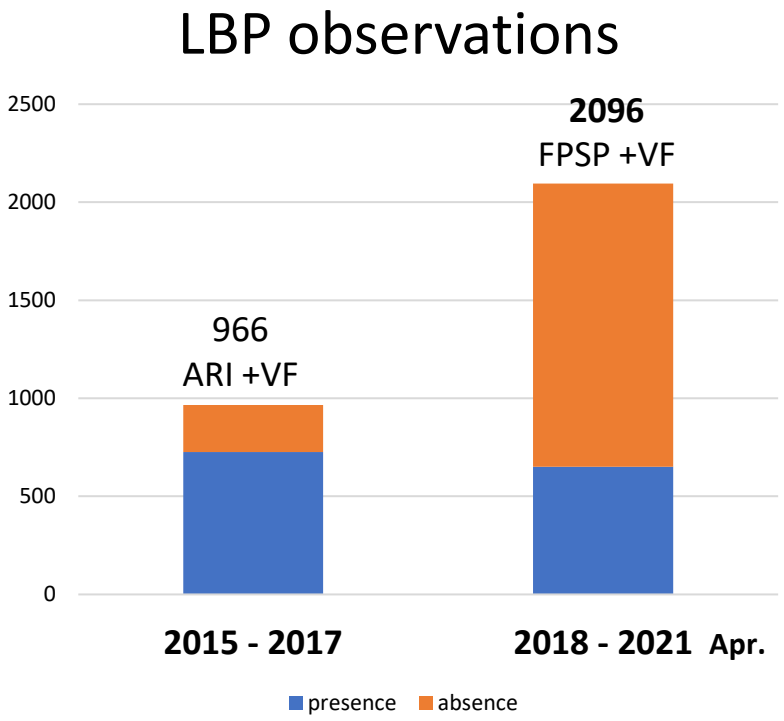
2.Foraging habitat: under-/mid-storey

Machine-learning methods
(eg. random forest)
To identify required habitat attributes (classification rules)

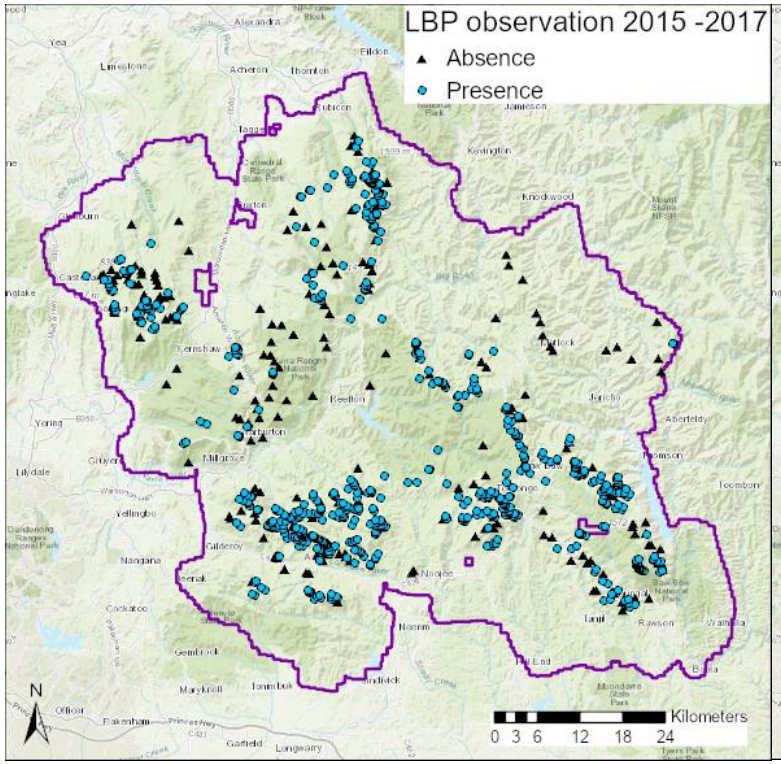


3. Distribution of habitat suitability

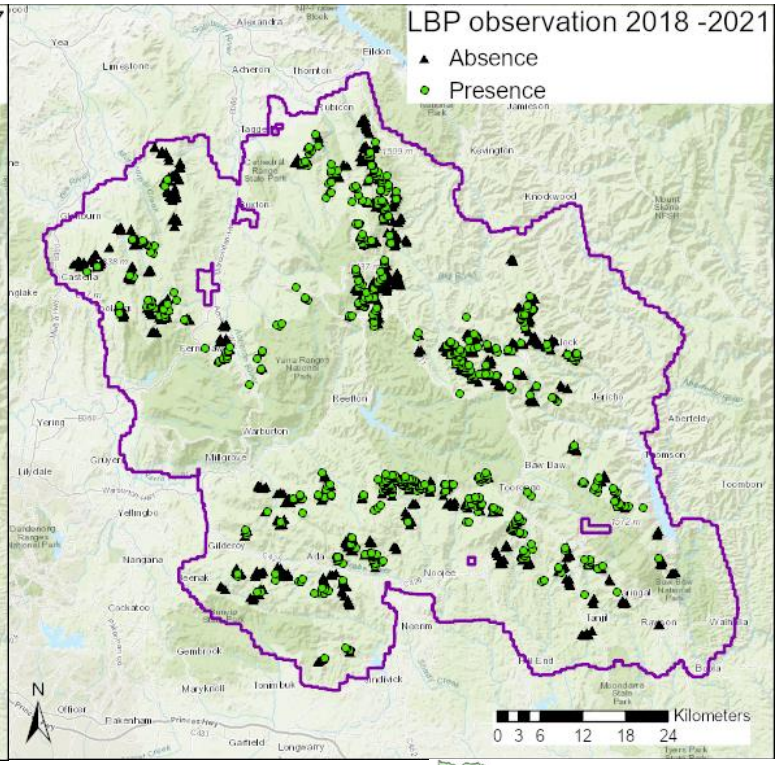
Improved detection and changed habitat suitability

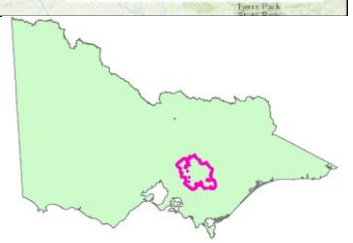


2015 - 2017



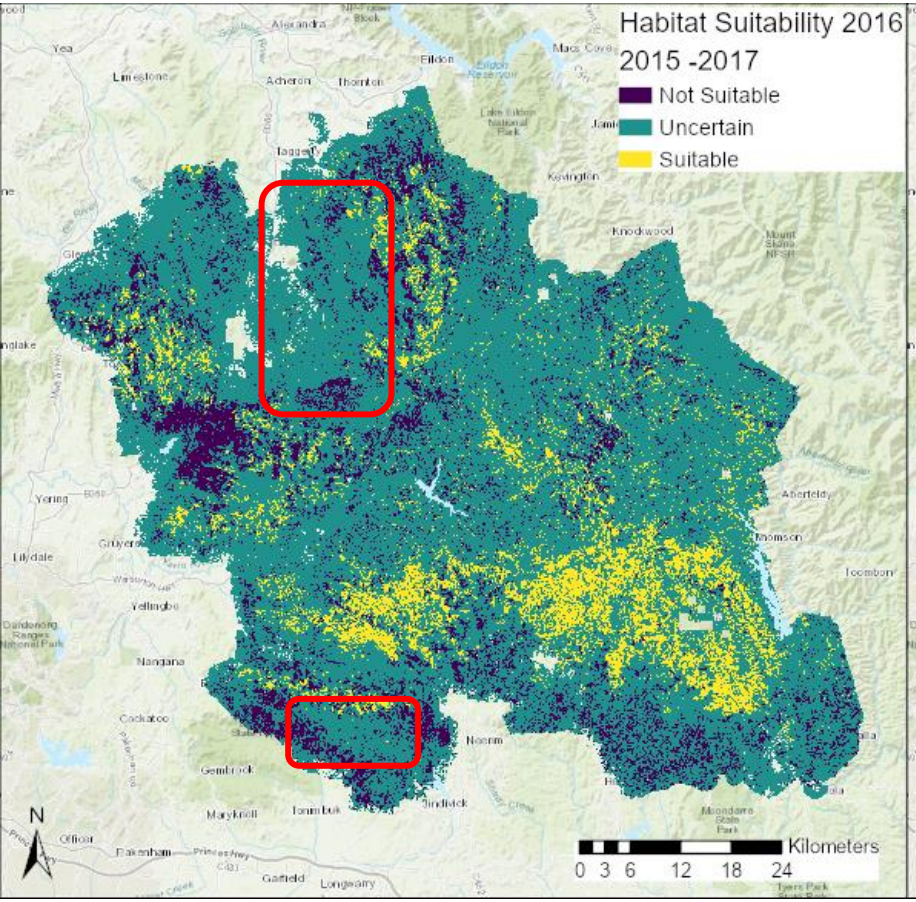
2018 - 2021

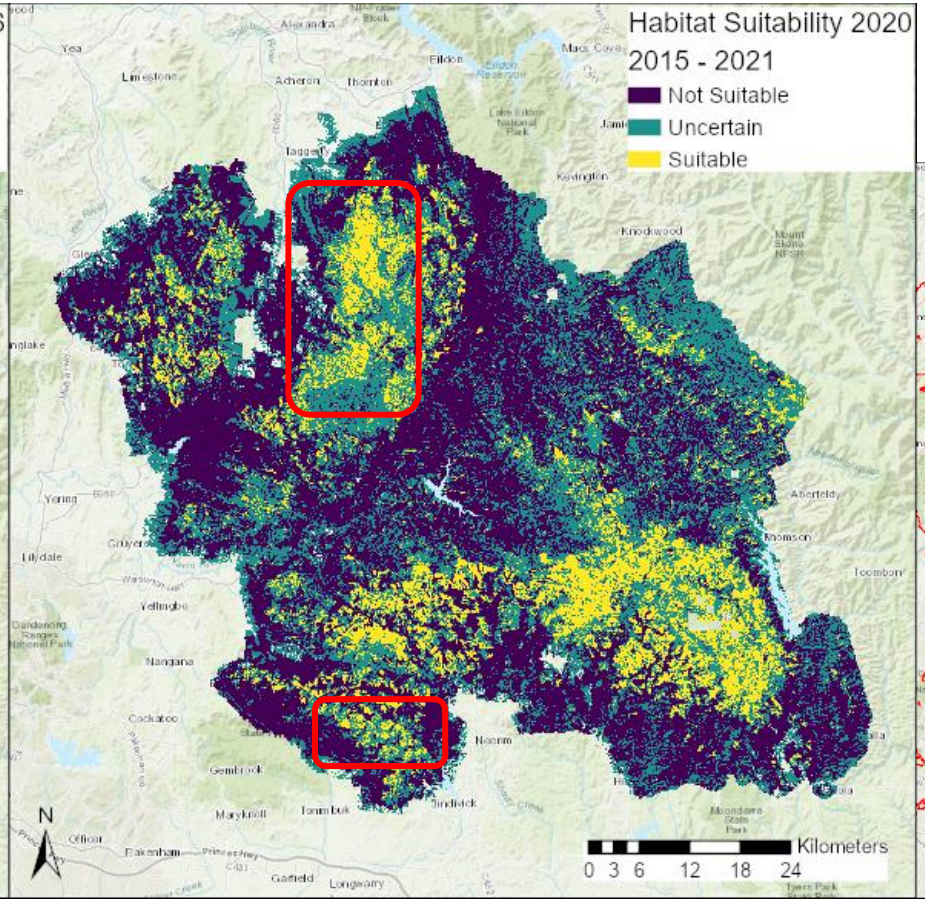


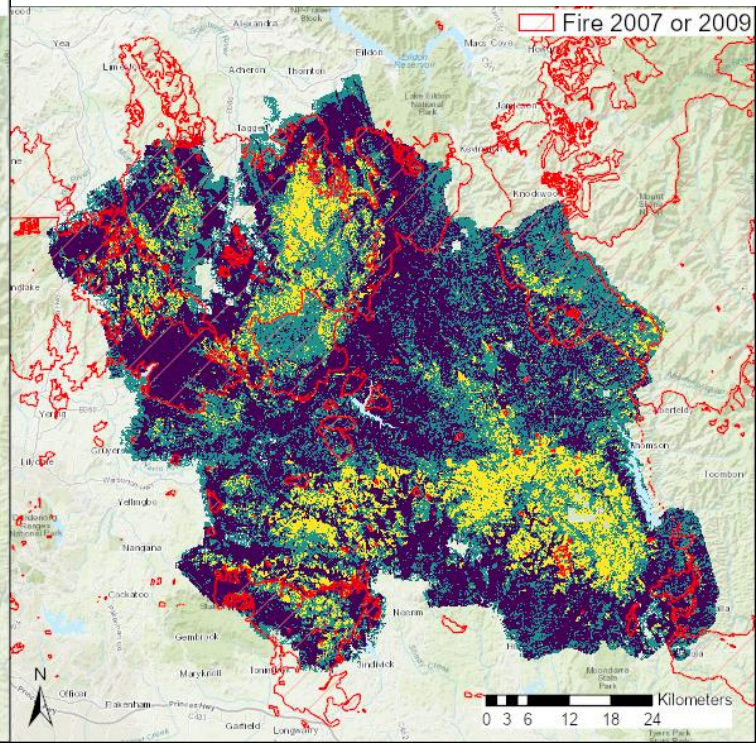


ARI: the Arthur Rylah Institute
FPSP: Forest Protection Survey Program
VF: VicForests

Improved detection and changed habitat suitability



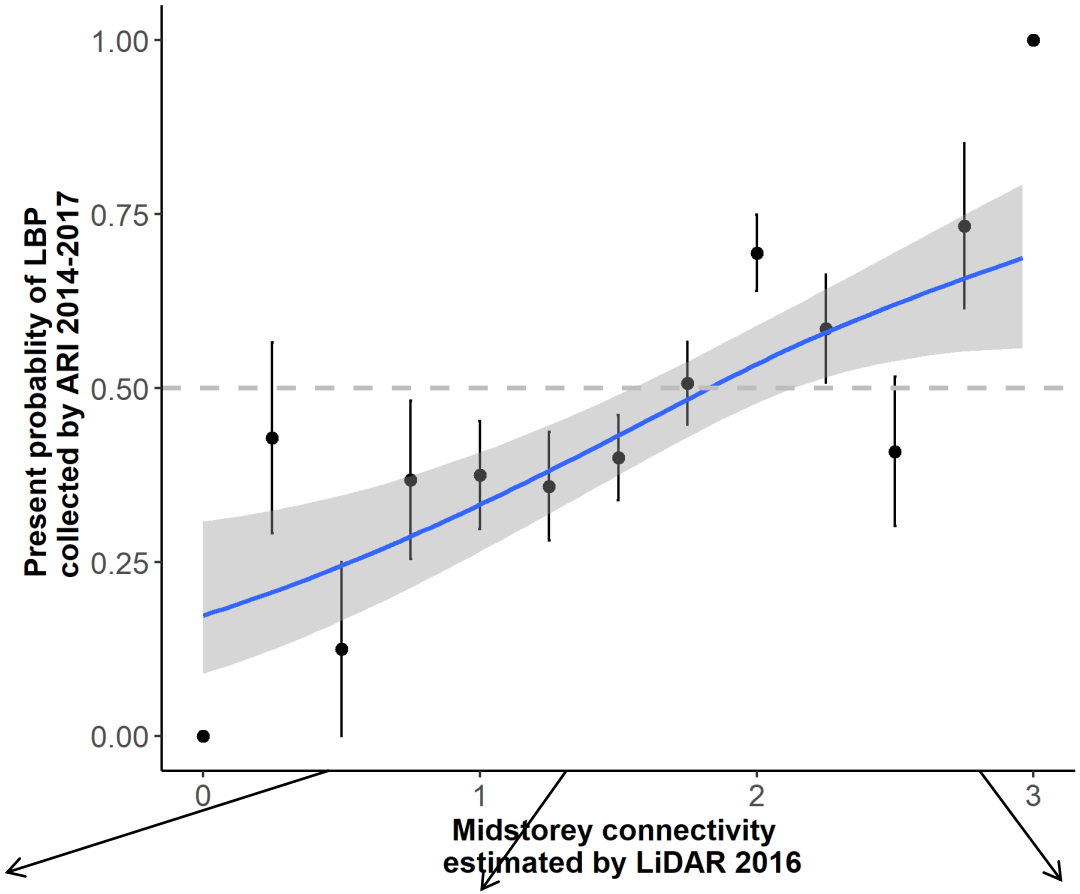


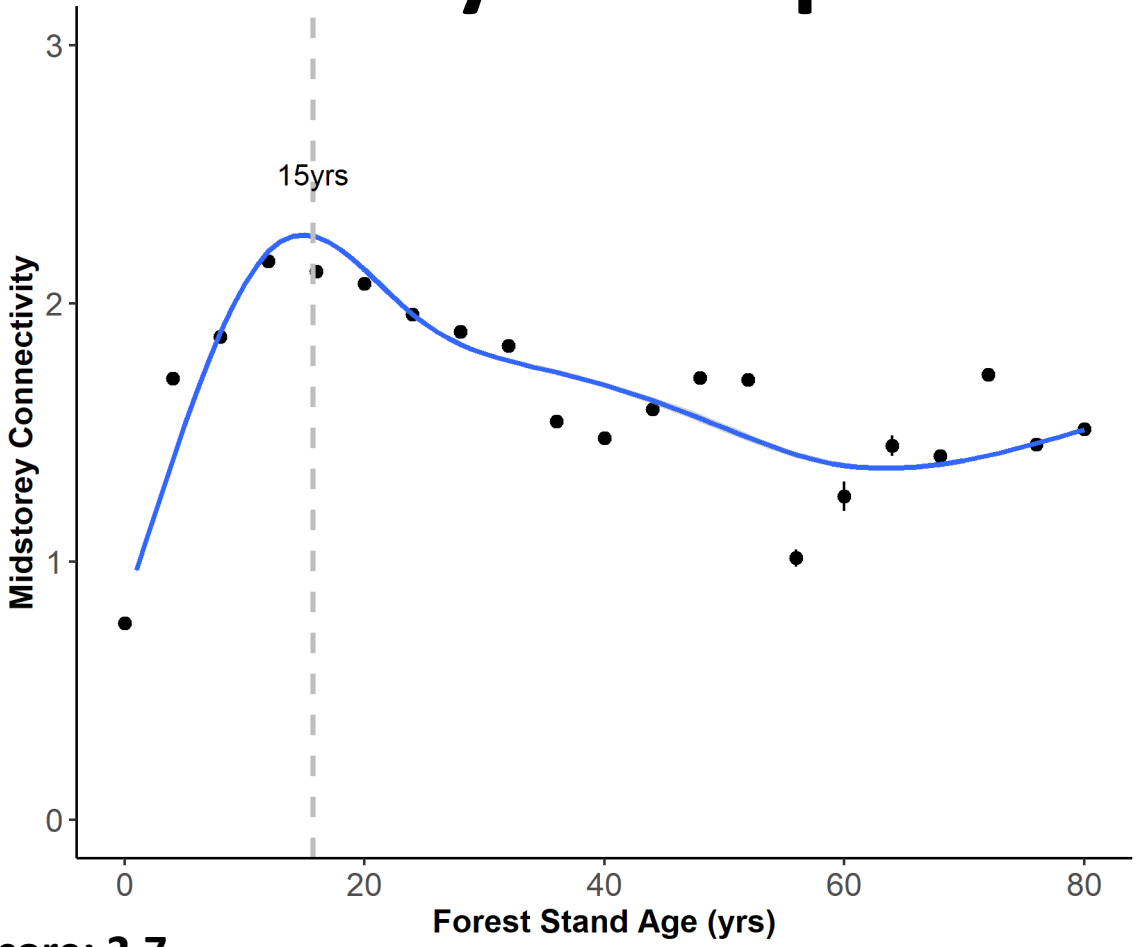


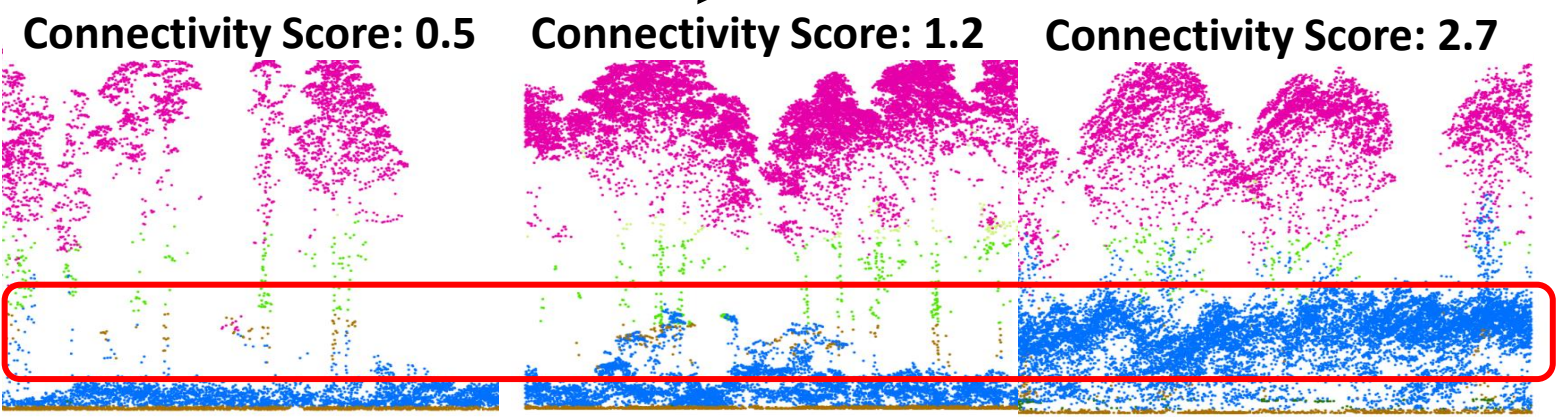
2015 – **2017** ALS
(966 observations)

2015 – **2021** ALS
(3062 observations)

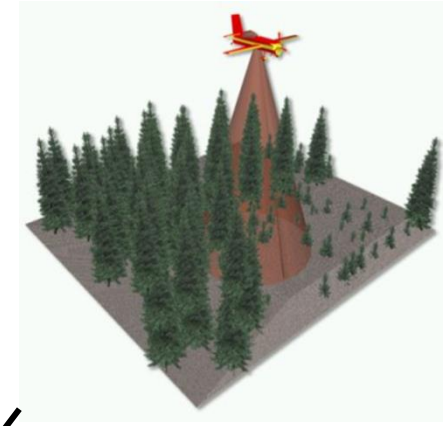
Midstorey connectivity for LBP and its dynamic pattern



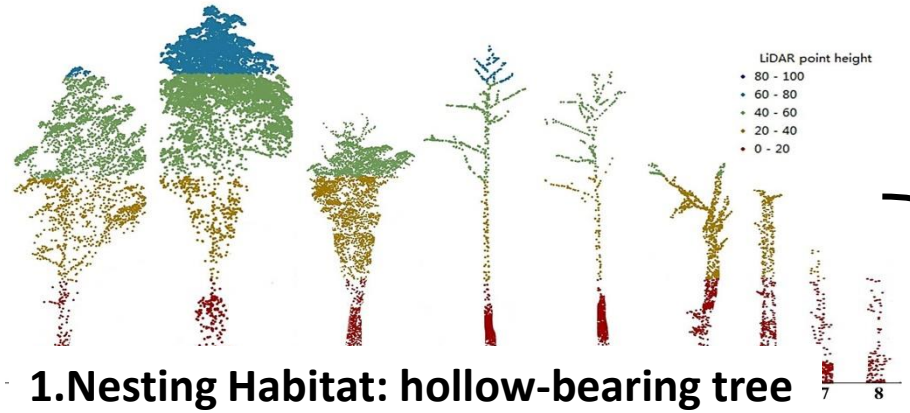




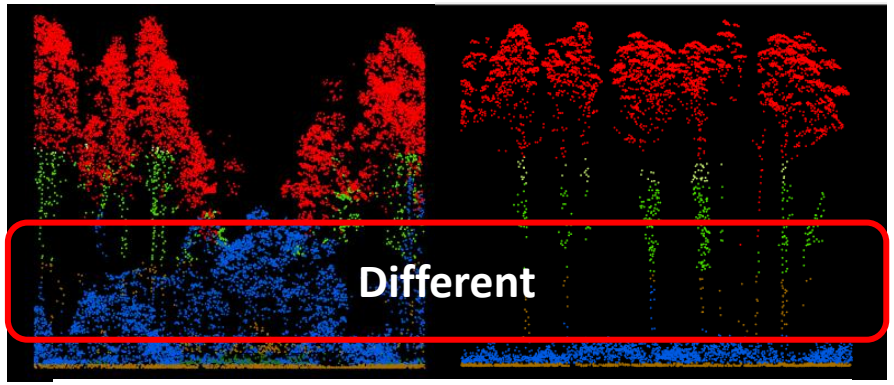
2020 Leadbeater's Possum (LBP)



2016 ALS data

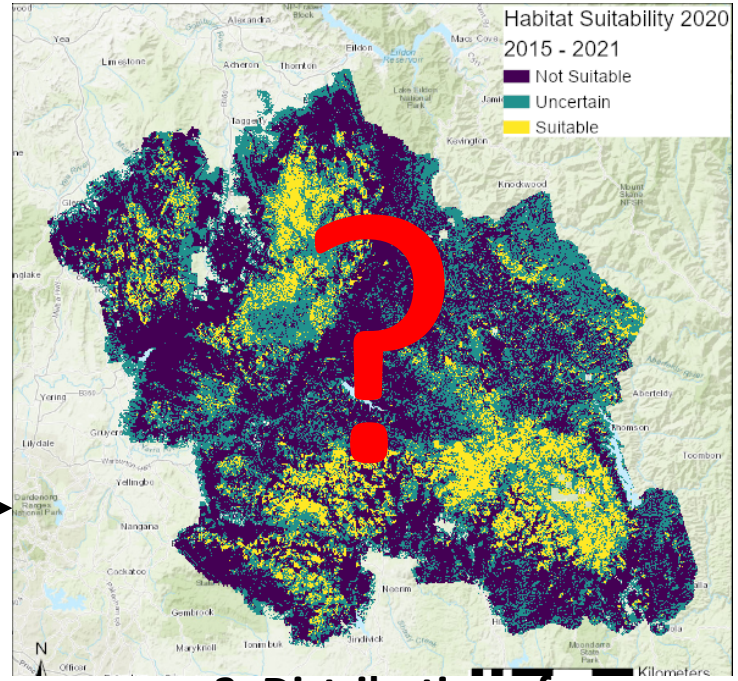


1.Nesting Habitat: hollow-bearing tree



2.Foraging habitat: under-/mid-storey

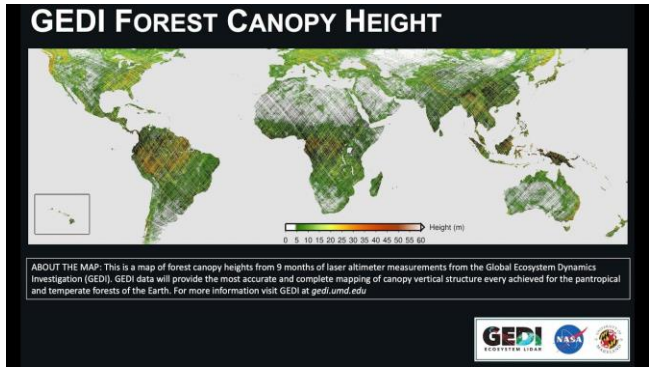
Machine-learning methods
(eg. random forest)
To identify required habitat attributes (classification rules)

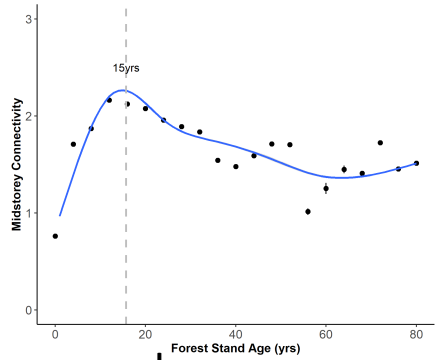


3. Distribution of habitat suitability

How to predict habitat suitability in 2020?

- Method 1: Same period forest structural data
  - Satellite LiDAR: Global Ecosystem Dynamics Investigation (GEDI), 2019-2020
  - Keep ALS-based nesting habitat attributes (eg. hollow-bearing tree), not sensitive to stand age in short period
- Method 2: Predict the dynamic of forest structures which highly affected by stand age (such as strata density and midstorey connectivity)
  - 4-year dynamic models of each structural variable (dy ~ stand age)
  - Generate dynamic HSM in both 2016 and 2020, may also predict HSM in 2024 and 2028…
- Two results can cross validate each other



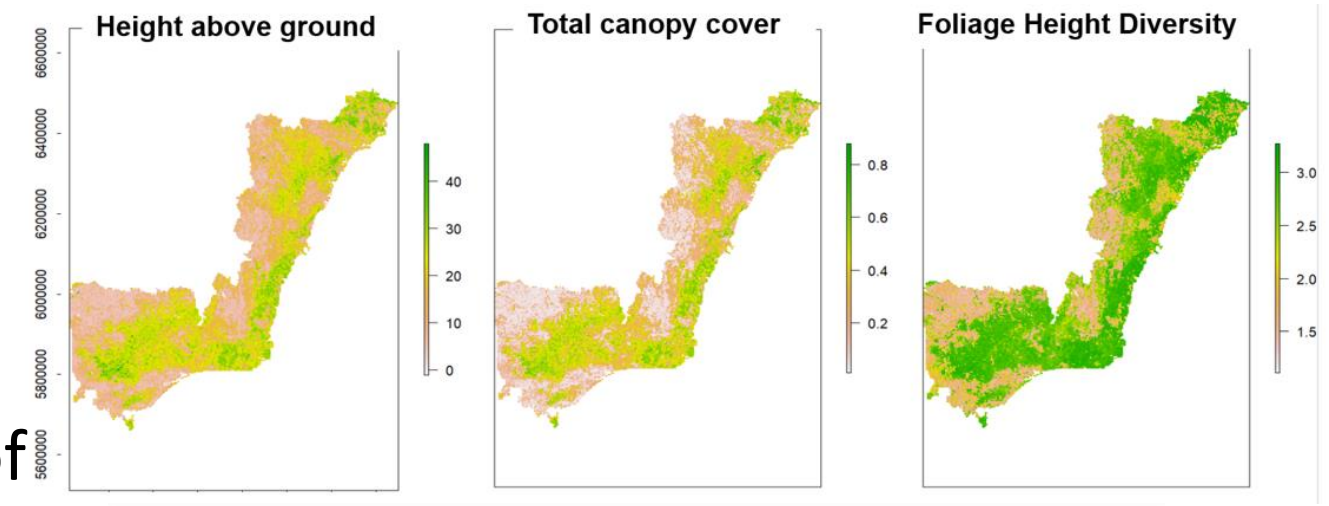


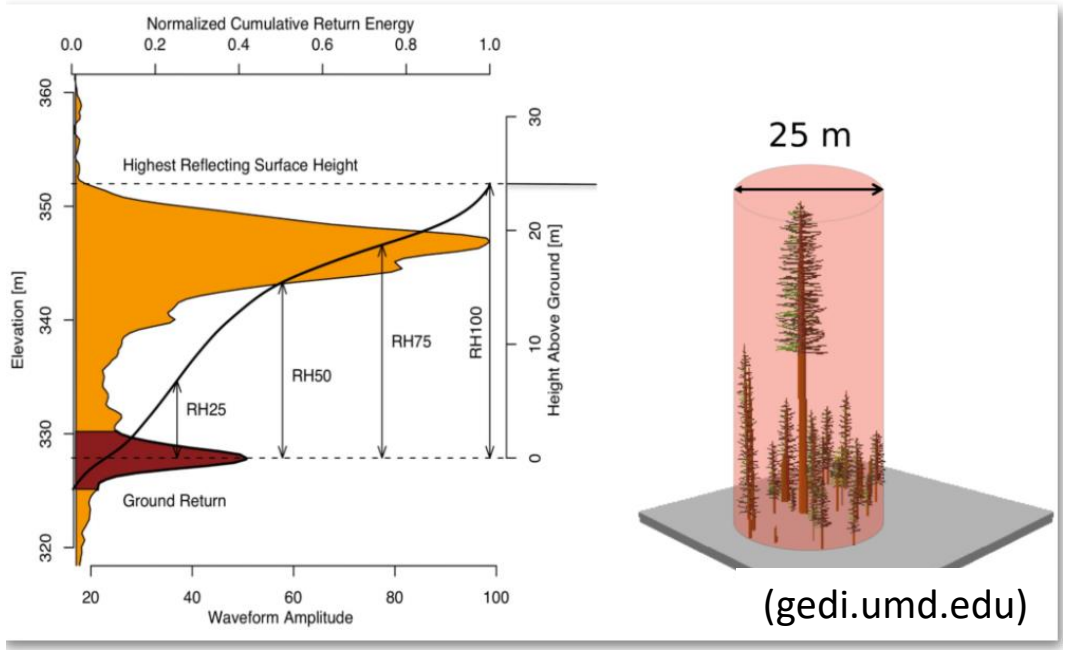
$dy = y_{t2} - y_{t1}$

$t2 - t1 = 4$

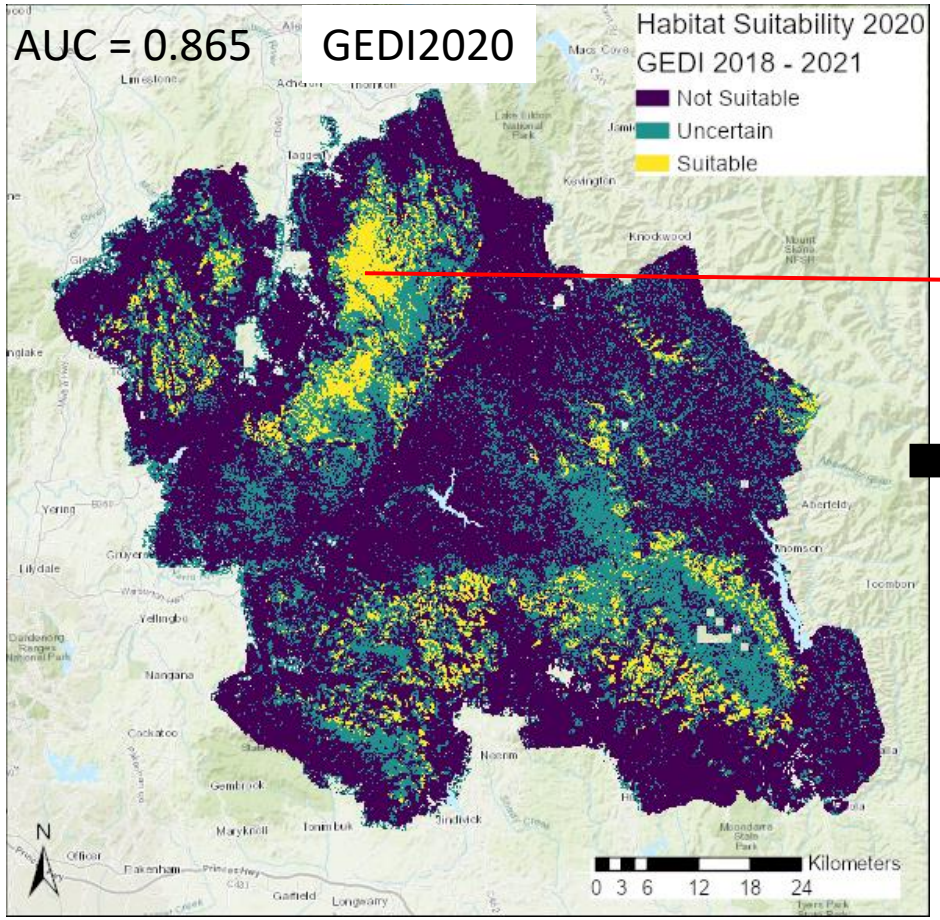
Method 1: Global Ecosystem Dynamics Investigation

- two-year mission 2019 - 2020
- GEDI produce 25m high resolution laser ranging observations of the 3-dimensional (3D) view of Earth's forests.
- GEDI provide precise measurements of forest canopy height, **canopy vertical structure**, and surface elevation.
- GEDI characterize the spatial and temporal distribution of forest structure and its relationship to habitat quality and biodiversity

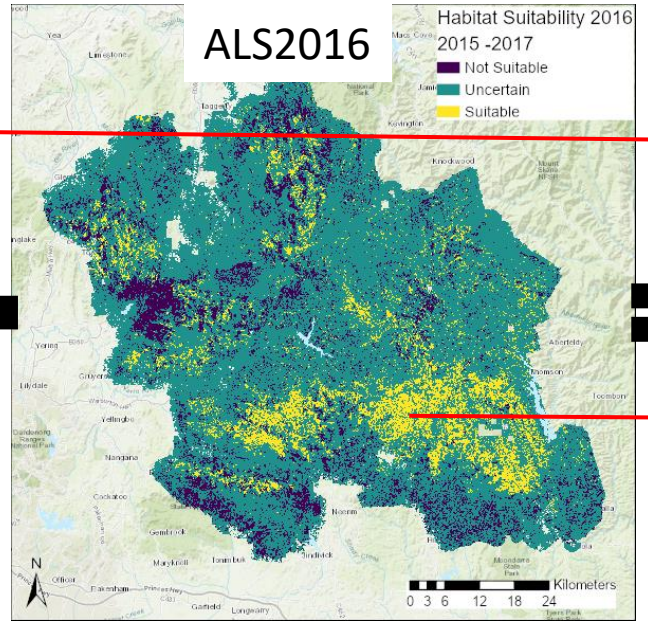




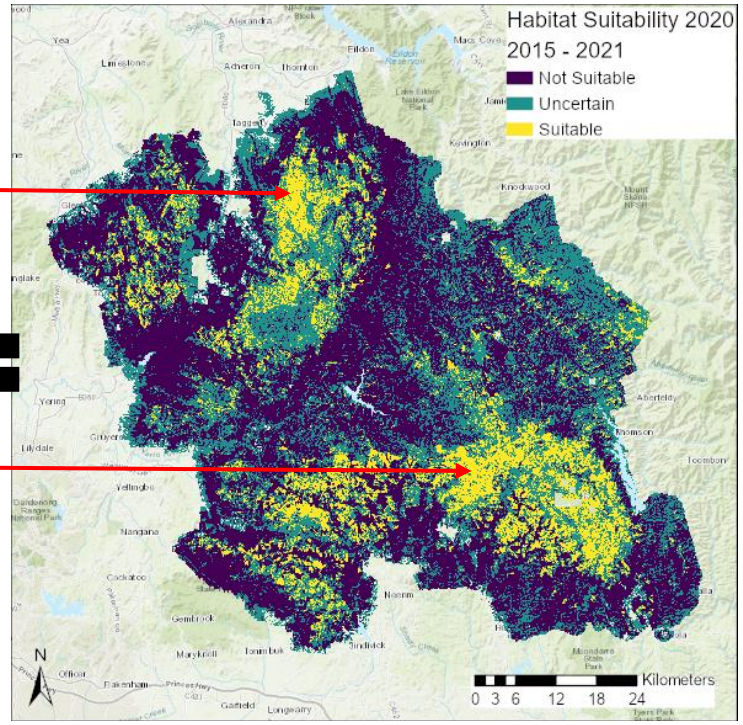
GEDI-based HSM



2018—2021 GEDI
(2096 records)



2015 – **2017** ALS
(966 observations)

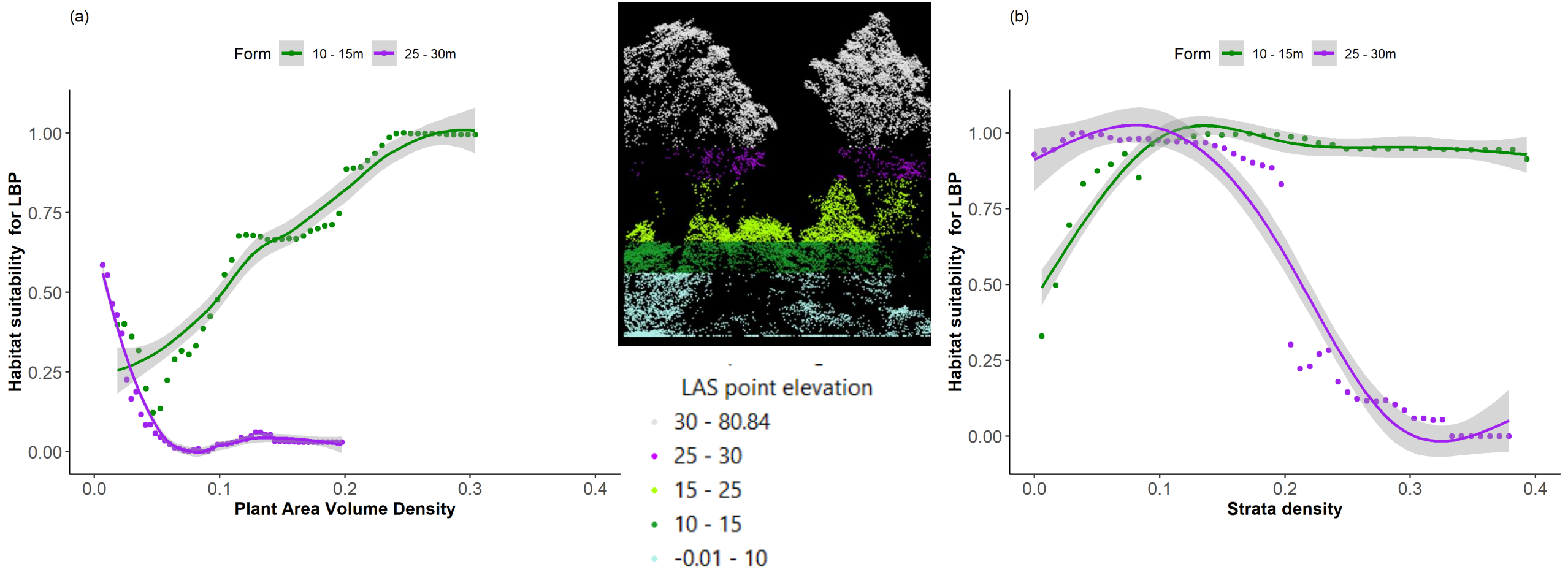


2015 – 2021 ALS
(3062 observations)

Required habitat attributes for LBP: GEDI HSM vs ALS HSM

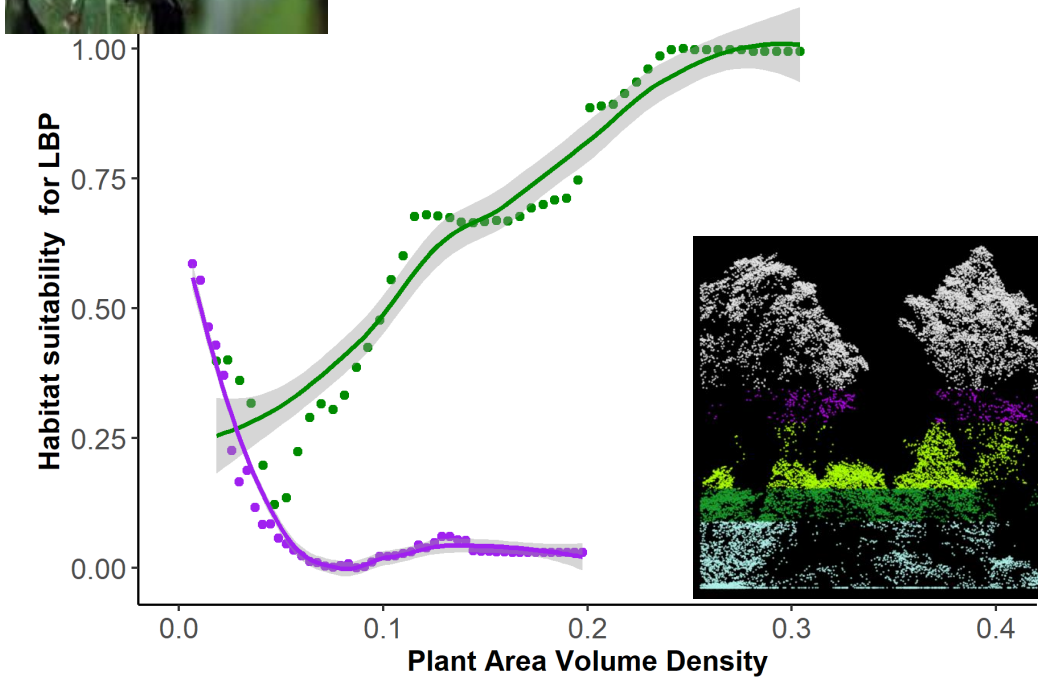
GEDI2020

ALS2016



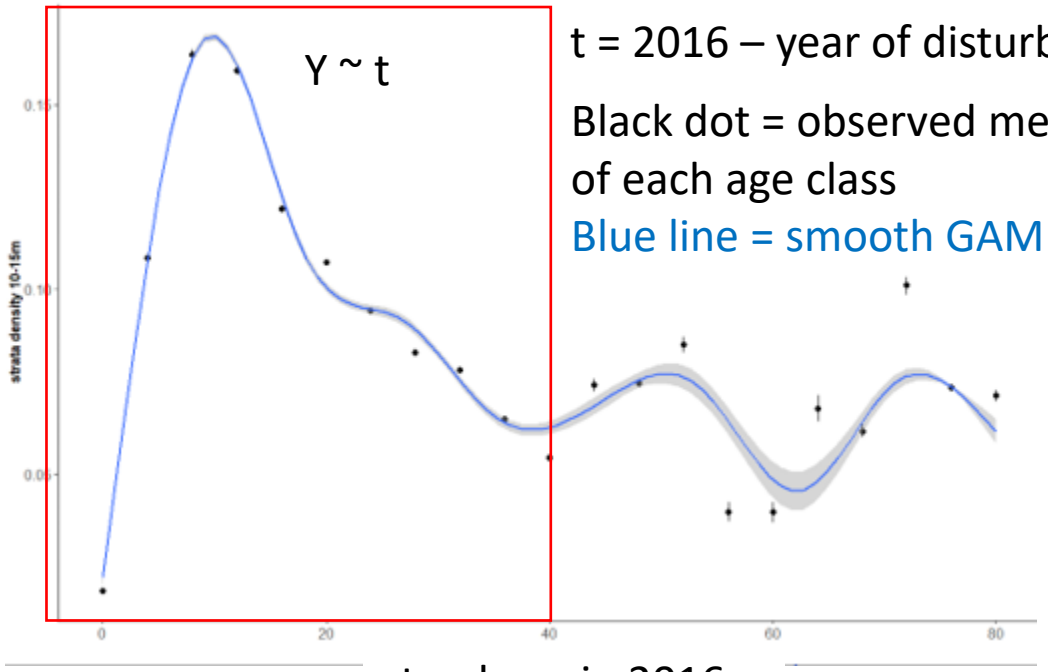
Required habitat attributes (GEDI HSM): LBP vs Greater Glider

LBP



Greater Glider

Method 2: 4-yrs dynamic model of structural variable



t = 2016 – year of disturbance

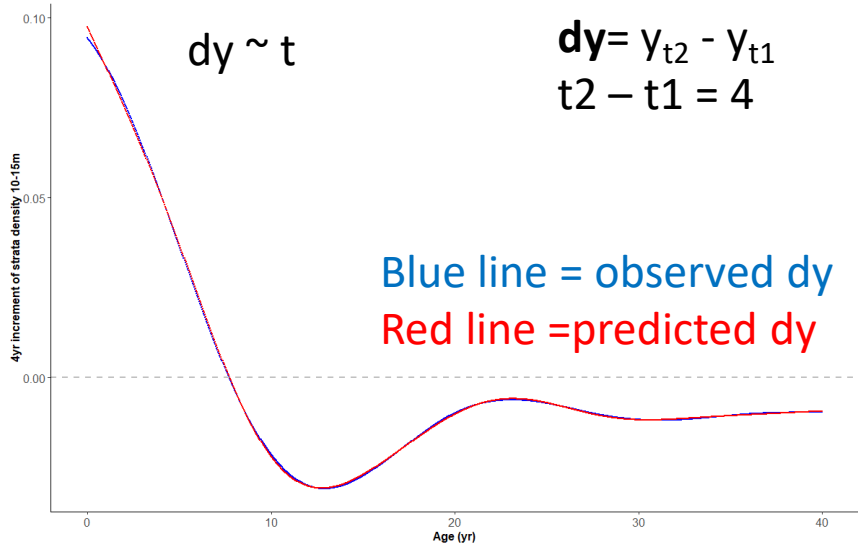
Black dot = observed mean Y of each age class

Blue line = smooth GAM line

stand age in 2016

Y: any structural variable

dy: 4-yrs difference of structural variable

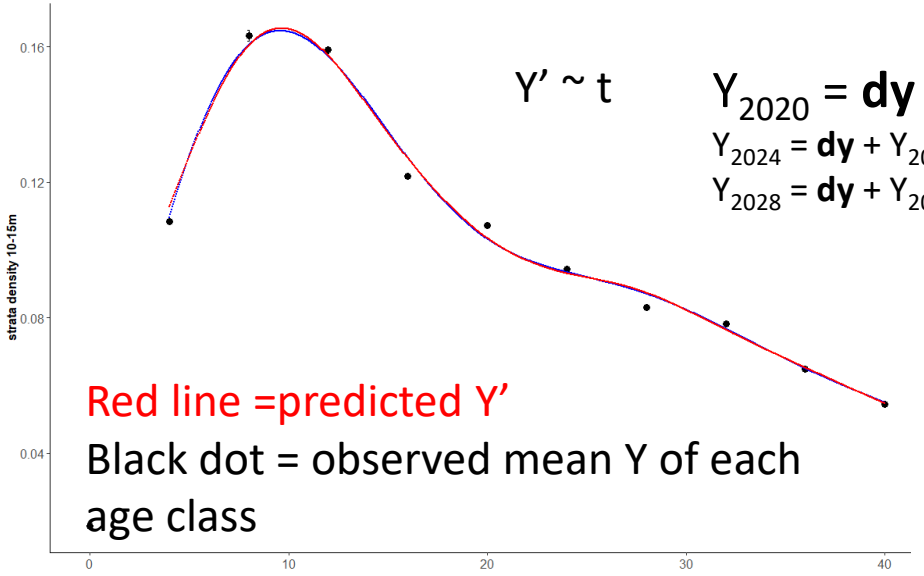


$\mathbf{dy} = y_{t2} - y_{t1}$

t2 – t1 = 4

Blue line = observed dy

Red line =predicted dy



$Y_{2020} = \mathbf{dy} + Y_{2016}$

$Y_{2024} = \mathbf{dy} + Y_{2020}$

$Y_{2028} = \mathbf{dy} + Y_{2024}$

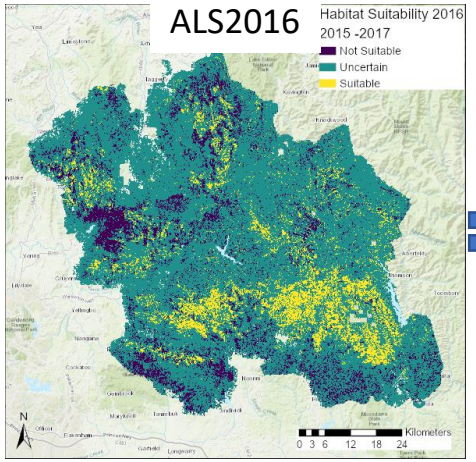
Red line =predicted Y'

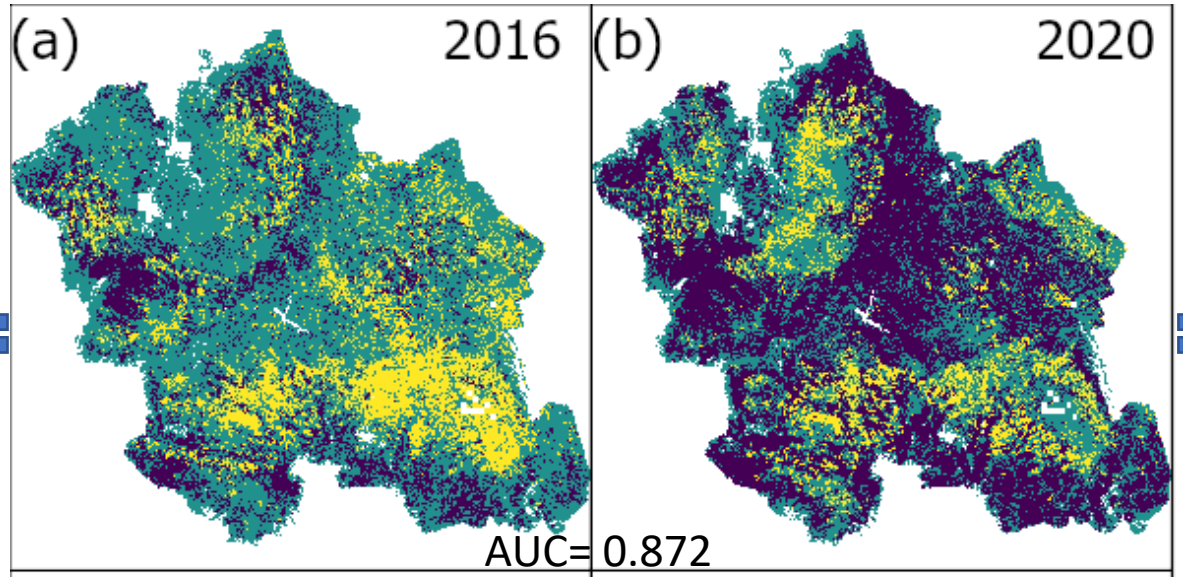
Black dot = observed mean Y of each age class

stand age in 2020

Dynamic ALS-based HSM

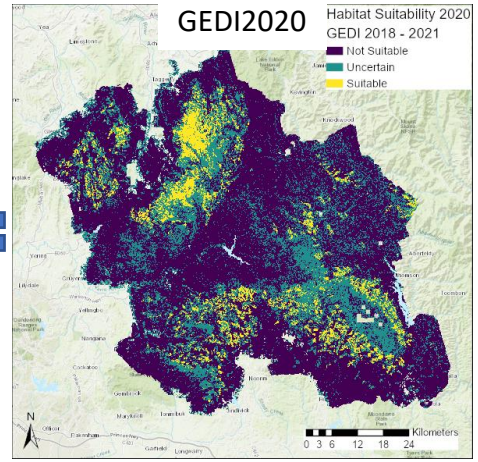
2015 – **2017** ALS
(966 observations)





2015 – 2021 dynamic model
(3062 observations)

2018—2021 GEDI
(2096 records)



Habitat suitability
- Not Suitable
- Uncertain
- Suitable

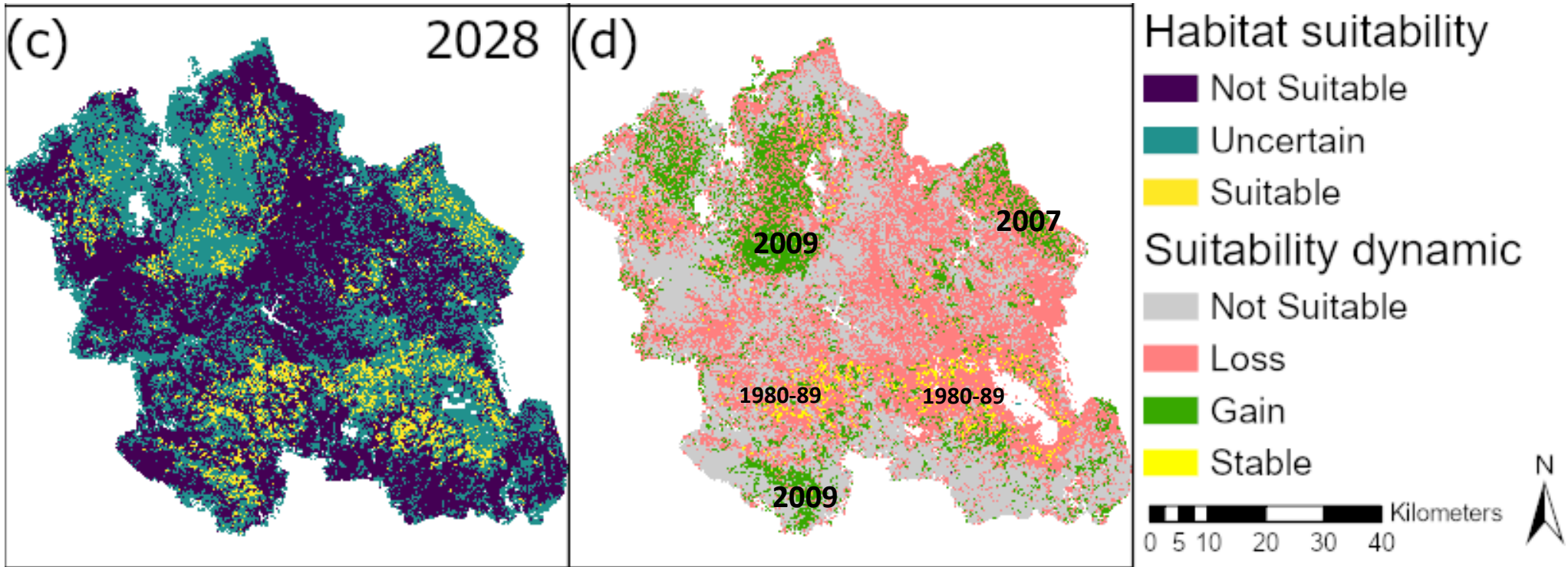
Suitability dynamic
- Not Suitable
- Loss
- Gain
- Stable

0 5 10 20 30 40 Kilometers

N

Habitat Suitability dynamic in future

1. Total suitable area ↓ in 2028, if there is **no disturbance** after 2020
2. The suitable habitat of LBP shifts in response **to the dynamic midstorey connectivity** and other strata density related habitat features. Even just 4 year difference, suitable habitat will change to not suitable habitat
   * Stable: 2% * Gain: 2007 or 2009 crown fire * Loss: 1980-90 regrowth or older
3. Besides hollow-bearing trees, we should also take actions to build **landscape connectivity networks** for Leadbeater's possum



Acknowledgements

- the School of Ecosystem and Forest Sciences, the University of Melbourne
  - A/Prof Craig Nitschke, Prof Patrick Baker and Dr Raphaël Trouvé, etc.
- Arthur Rylah Institute for Environmental Research (ARI)
  - Dr Lindy Lumsden, Dr Jenny Nelson, Louise Durkin, Dr Jemma Cripps, Dr. Michael Scroggie, etc.
- Forest Protection Survey Program
- Colleagues from VicForests
  - Bruce McTavish, Ishara Kotiah, Bill Paul, Jessica Slapp, Michael Ryan, Scott Arnold, Angela Nunes, Ruohong Yuan, Julian Black, Cai Li, etc.

Thank you!

Dr Ruizhu Jiang
ruizhu.jiang@vicforests.com.au