Geographical variation in sensitivity to wildflower harvesting inferred from range-wide demographic data for 26 Proteaceae species

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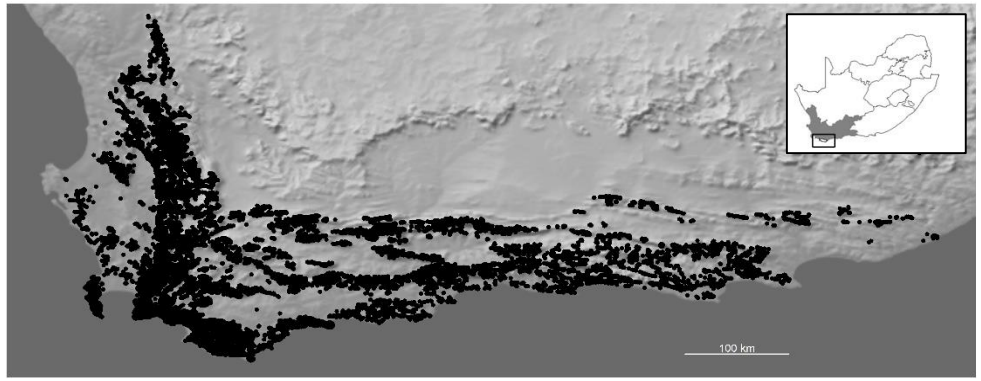
Proteaceae wildflower harvesting

The Cape Floristic Region biodiversity hotspot



- Proteaceae shrubs form the overstorey of vegetation (fire-driven ecosystem)
- Proteaceae wildflower harvesting is an economically-important activity
- The demand for wildflowers is increasing (local- and export market)
- **Sustainable harvesting: 50% harvesting (or flower removal)…**

(Turpie, Heydenrych & Lamberth 2003; Van Wilgen *et al.* 2016)


Images: Flower Valley Conservation Trust

Serotinous Proteaceae & their life cycle

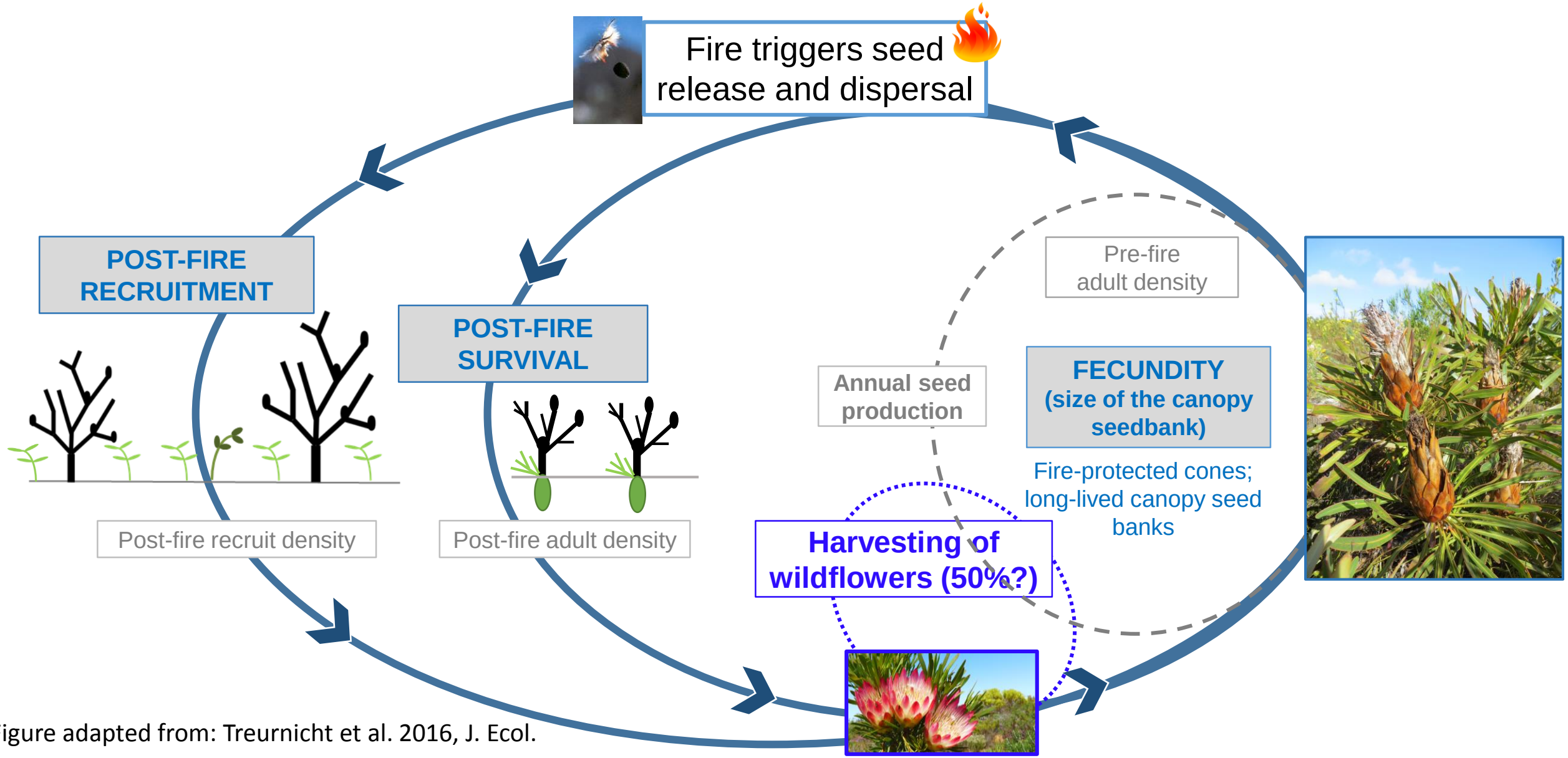
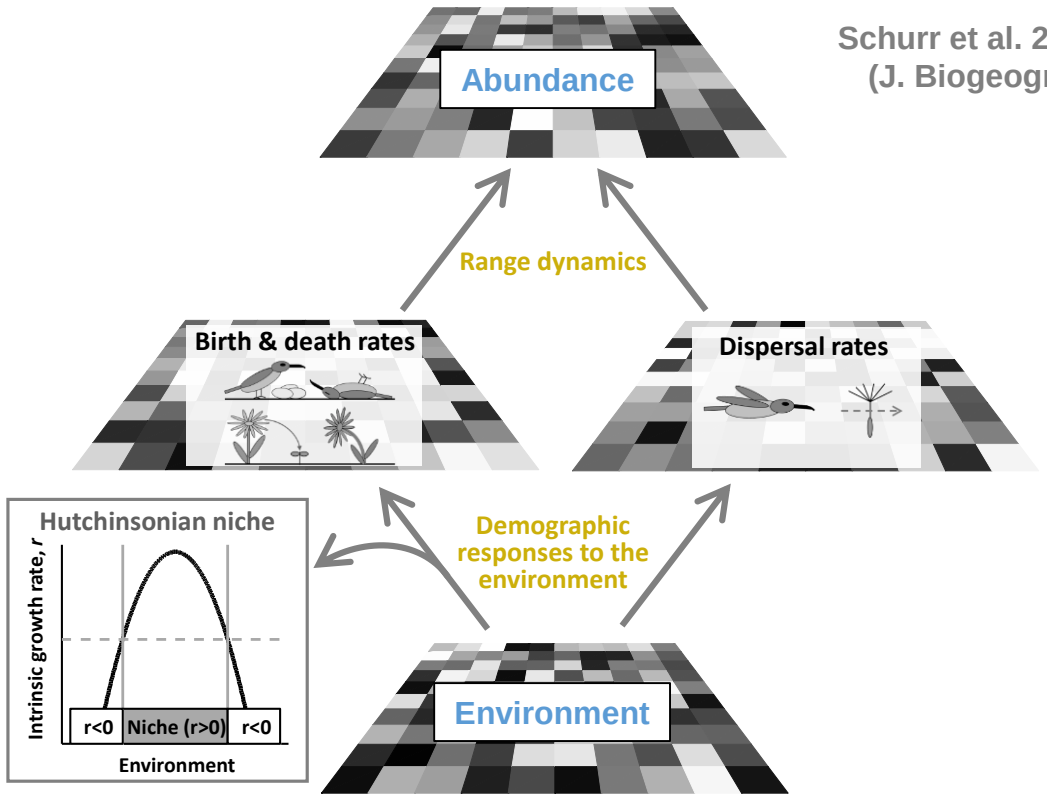


Figure adapted from: Treurnicht et al. 2016, J. Ecol.

The demographic perspective

WHY DEMOGRAPHY?

- Rates of reproduction and survival jointly determine the local dynamics of populations
- **Spatiotemporal variation in demographic rates (demographic responses to the environment)**
- Species niches and range dynamics arise from this variation



Schurr et al. 2012 (J. Biogeogr.)

Schurr et al. 2012 (J. Biogeogr.); Ehrlén & Morris 2015 (Ecol. Lett.); Pulliam 2000 (Ecol. Lett.); Holt 2009 (PNAS)

The demographic perspective

100 YEARS Journal of Ecology

Journal of Ecology 2016, **104**, 331–342 doi: 10.1111/1365-2745.12508

DEMOGRAPHY BEYOND THE POPULATION

Environmental drivers of demographic variation across the global geographical range of 26 plant species

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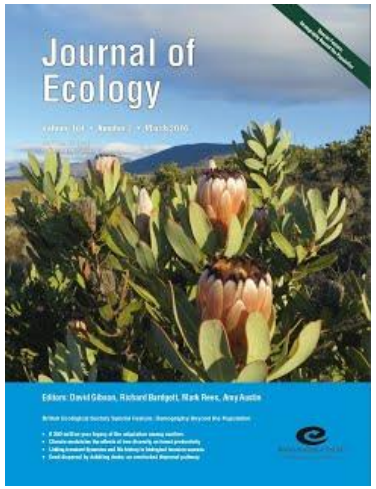
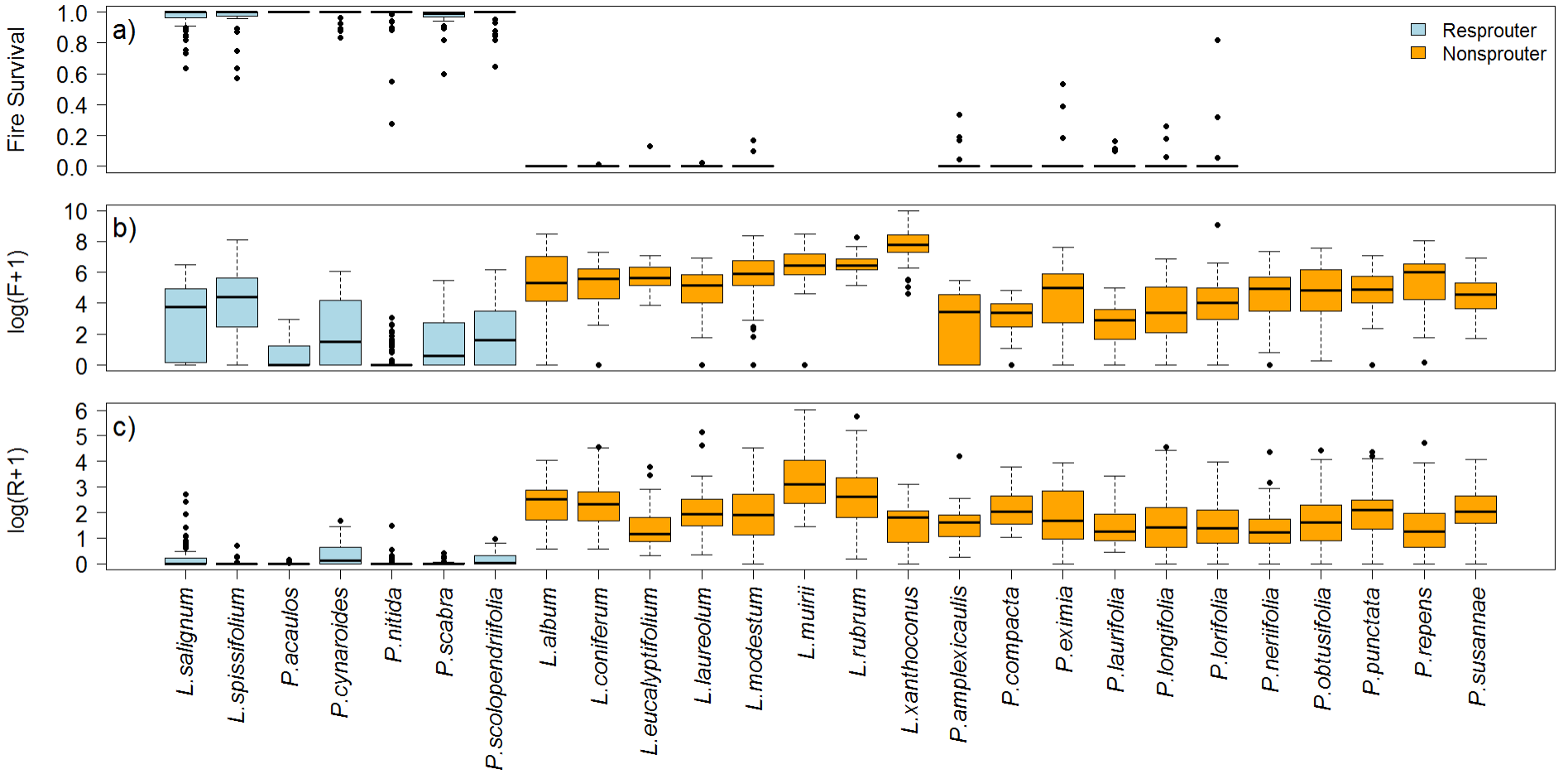
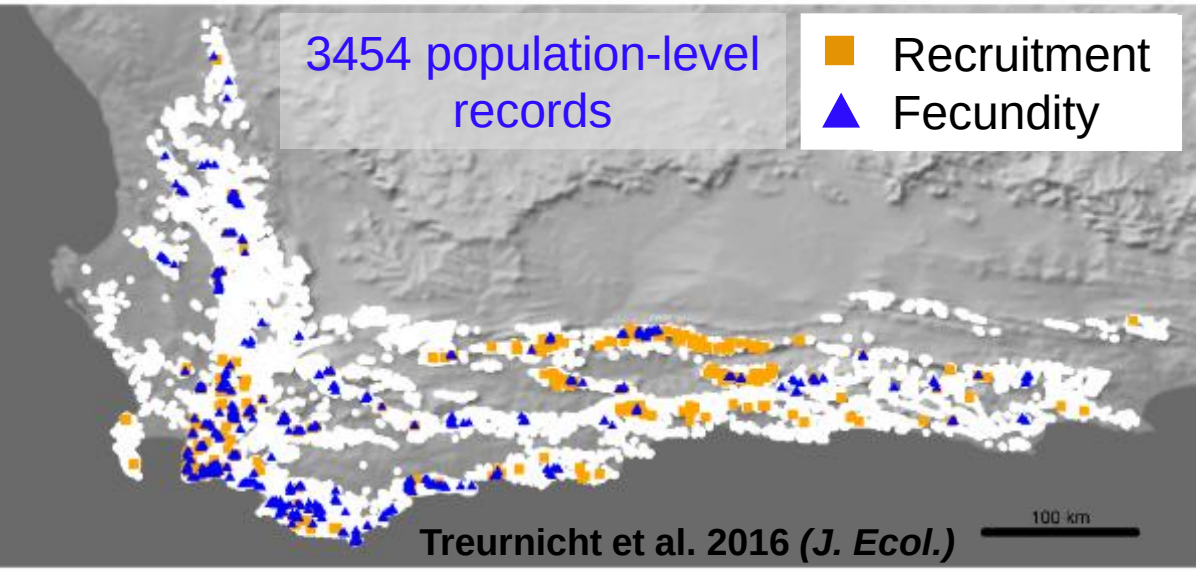




Resprouters | Nonsprouters

Integration of data types and population dynamic model

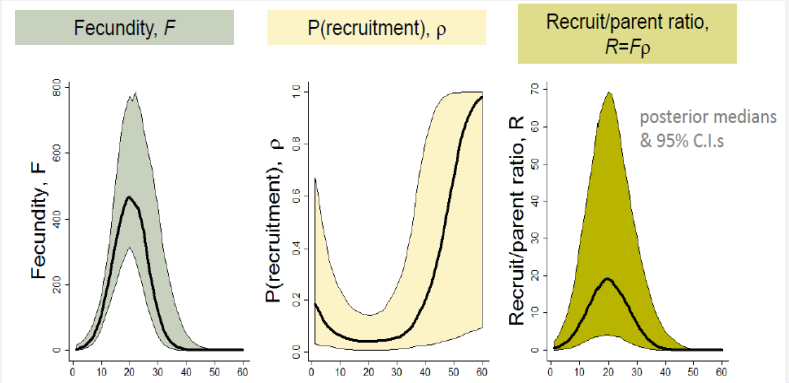


Treurnicht et al. 2016 *(J. Ecol.)*

Jörn Pagel

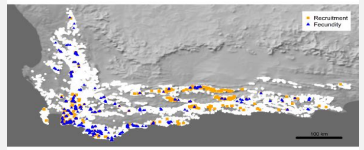
Pagel et al. (2019) *BioRxiv*

Predictions of individual demographic rates and population growth rates



Combine environmental-, demographic data and population dynamic model

Range-wide demographic data



Environmental data

Climate (aridity, T_{min}, T_{max})
Fire return interval
Soil nutrient status

Population dynamic model

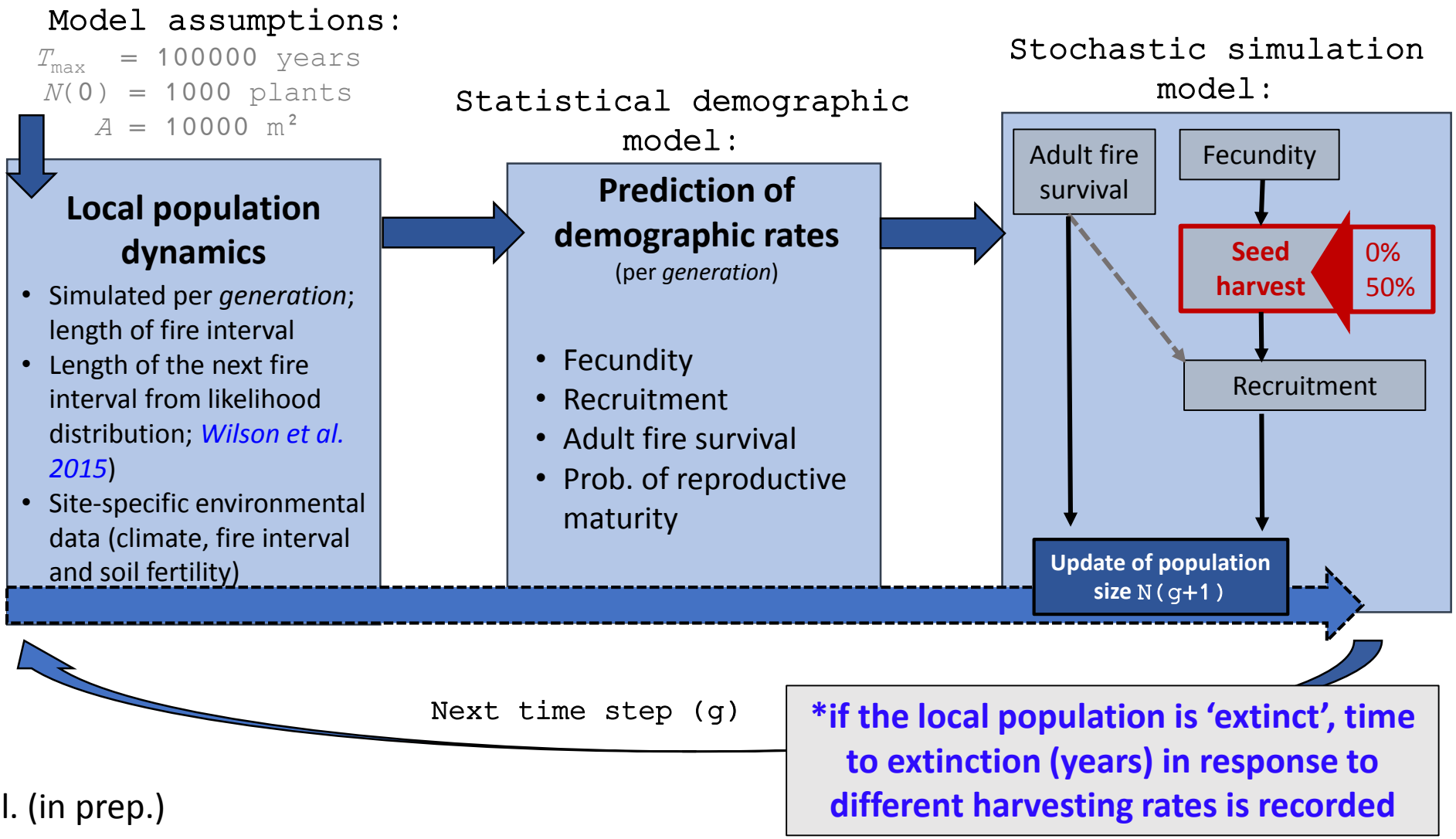
Extinction risk to wildflower harvesting

MODEL SIMULATION APPROACH: SIMULATE THE EFFECTS OF 0% & 50% WILDFLOWER HARVESTING

Treurnicht et al. (in prep.)

Overview of model simulation approach

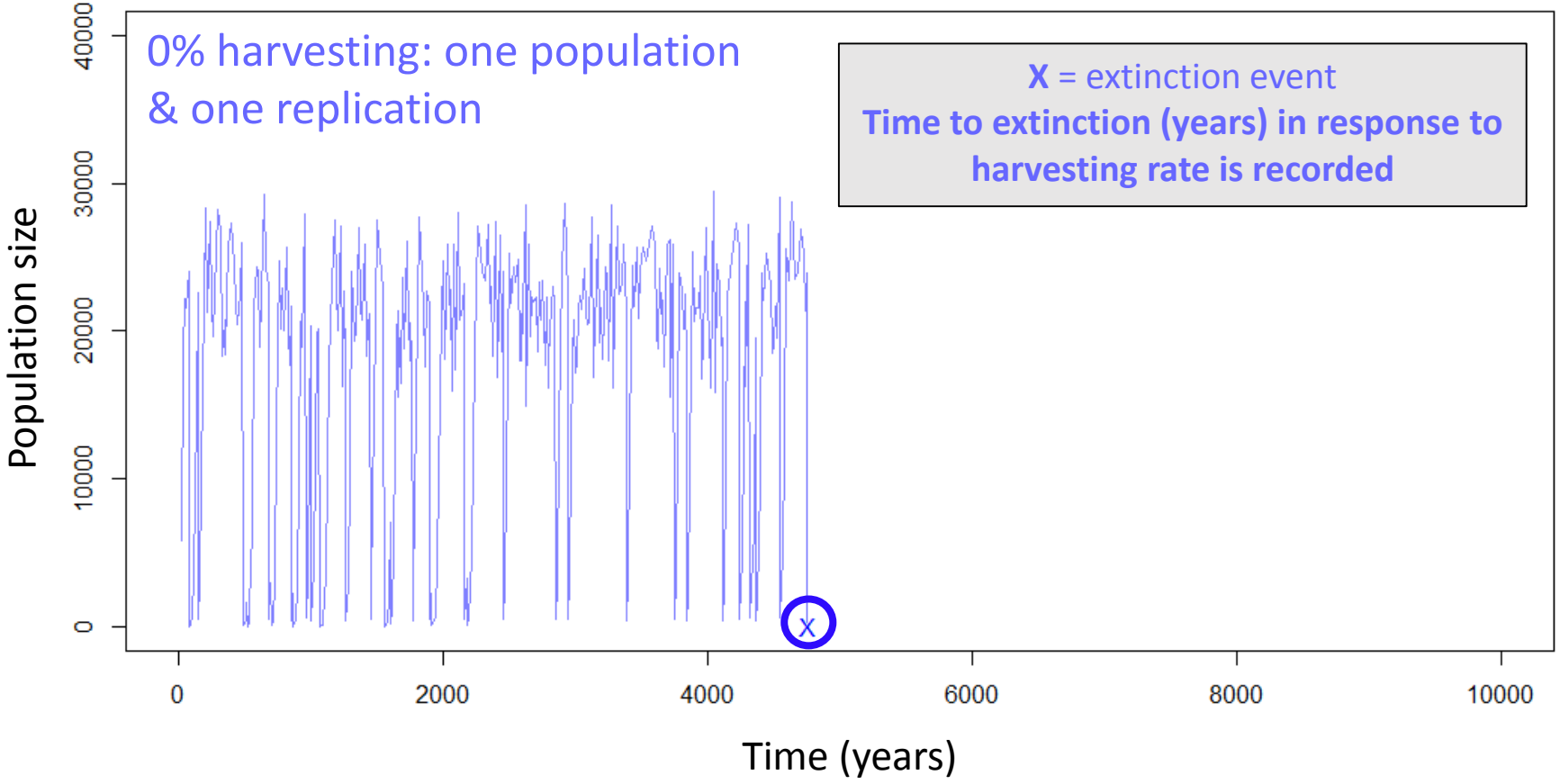
The model describes responses of local populations to seed harvesting (seed removal from canopy seed bank)



Treurnicht et al. (in prep.)

Model simulation (0% harvesting)

Protea repens



Treurnicht et al.
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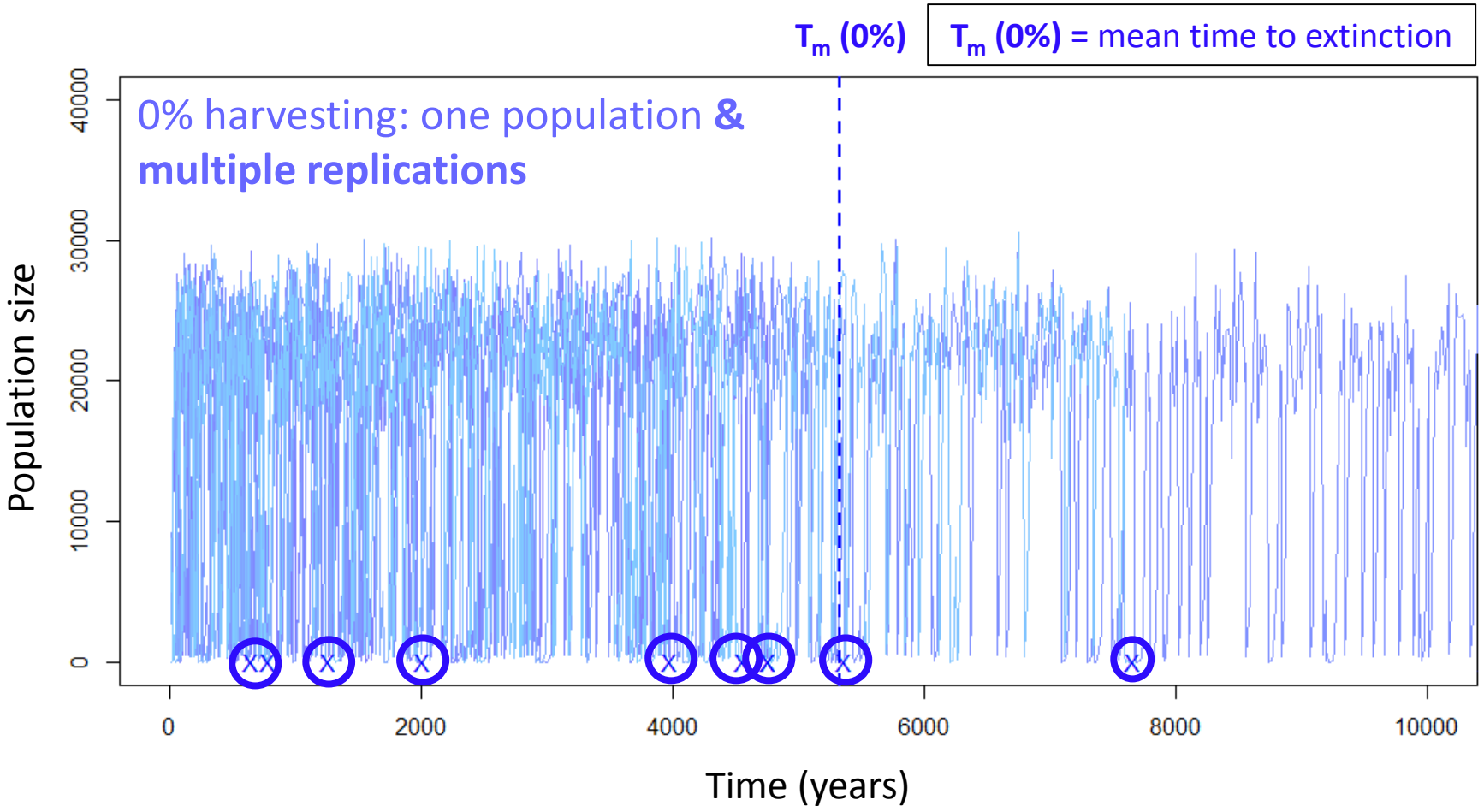
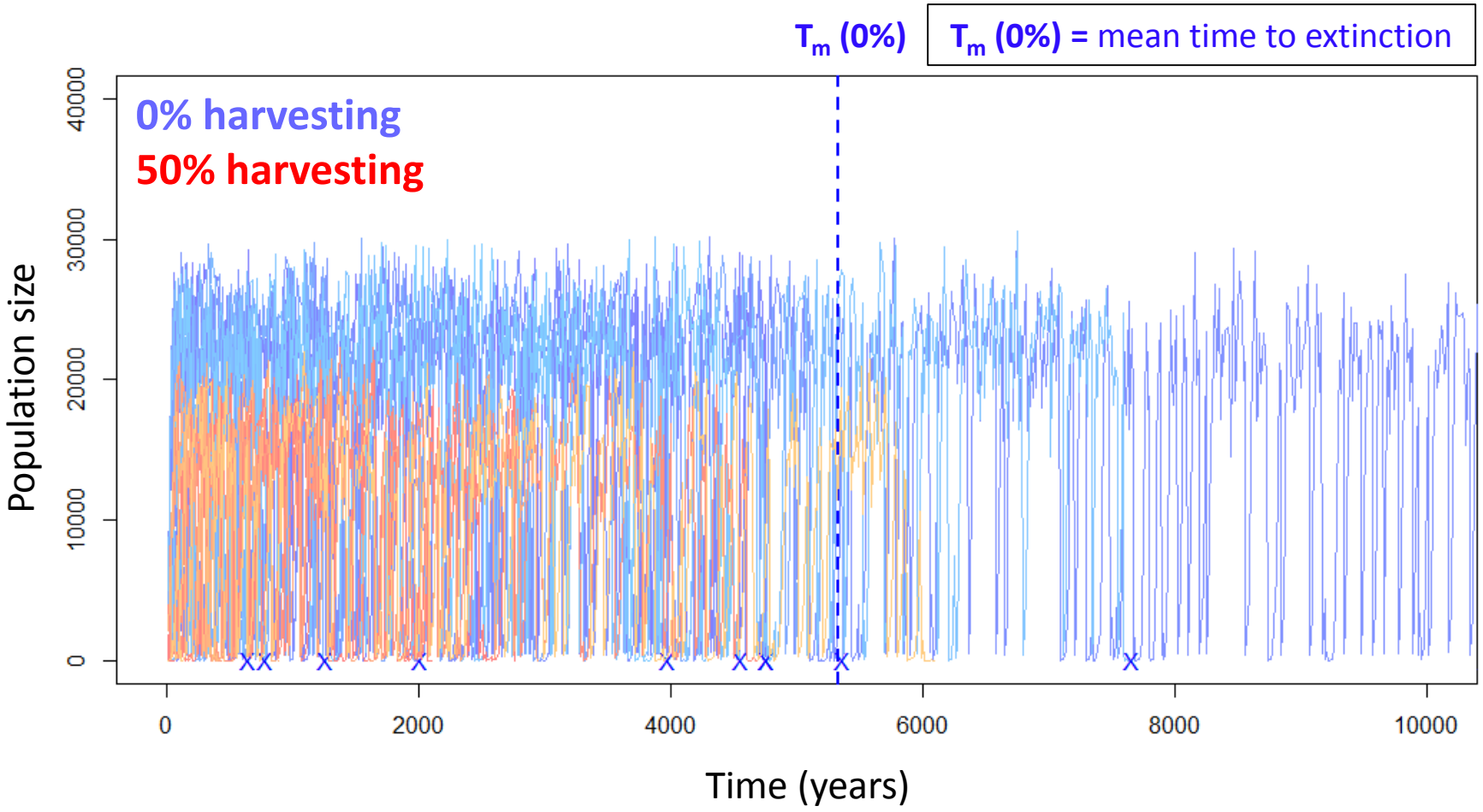


Treurnicht et al.
(in prep.)

Model simulation (0% & 50% harvesting)

Protea repens



Treurnicht et al.
(in prep.)

Model simulation (0% & 50% harvesting)

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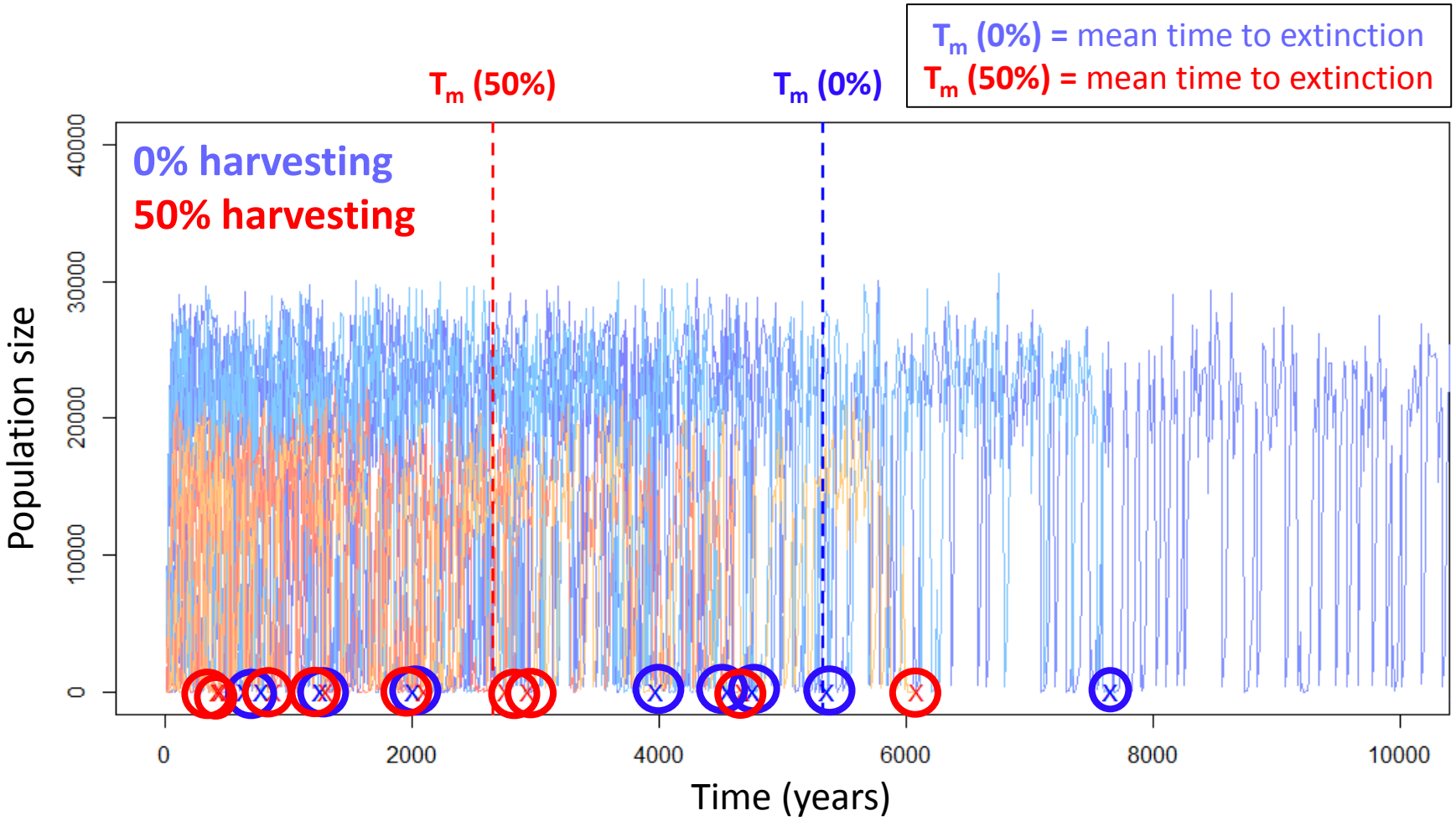

Treurnicht et al.
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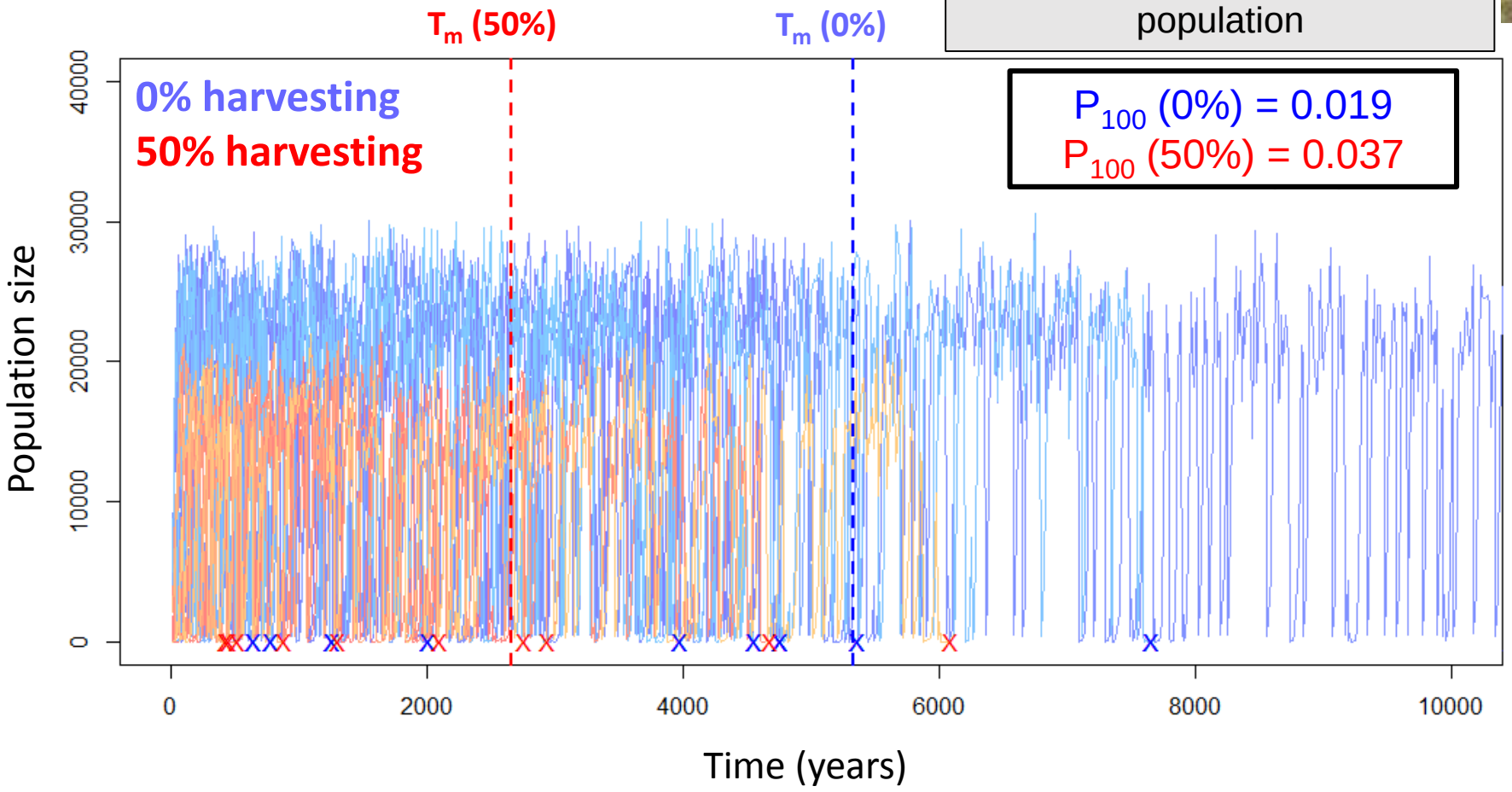
Model simulation (0% & 50% harvesting)

Protea repens

P_{100}: Extinction probability for a 100 year time horizon per population

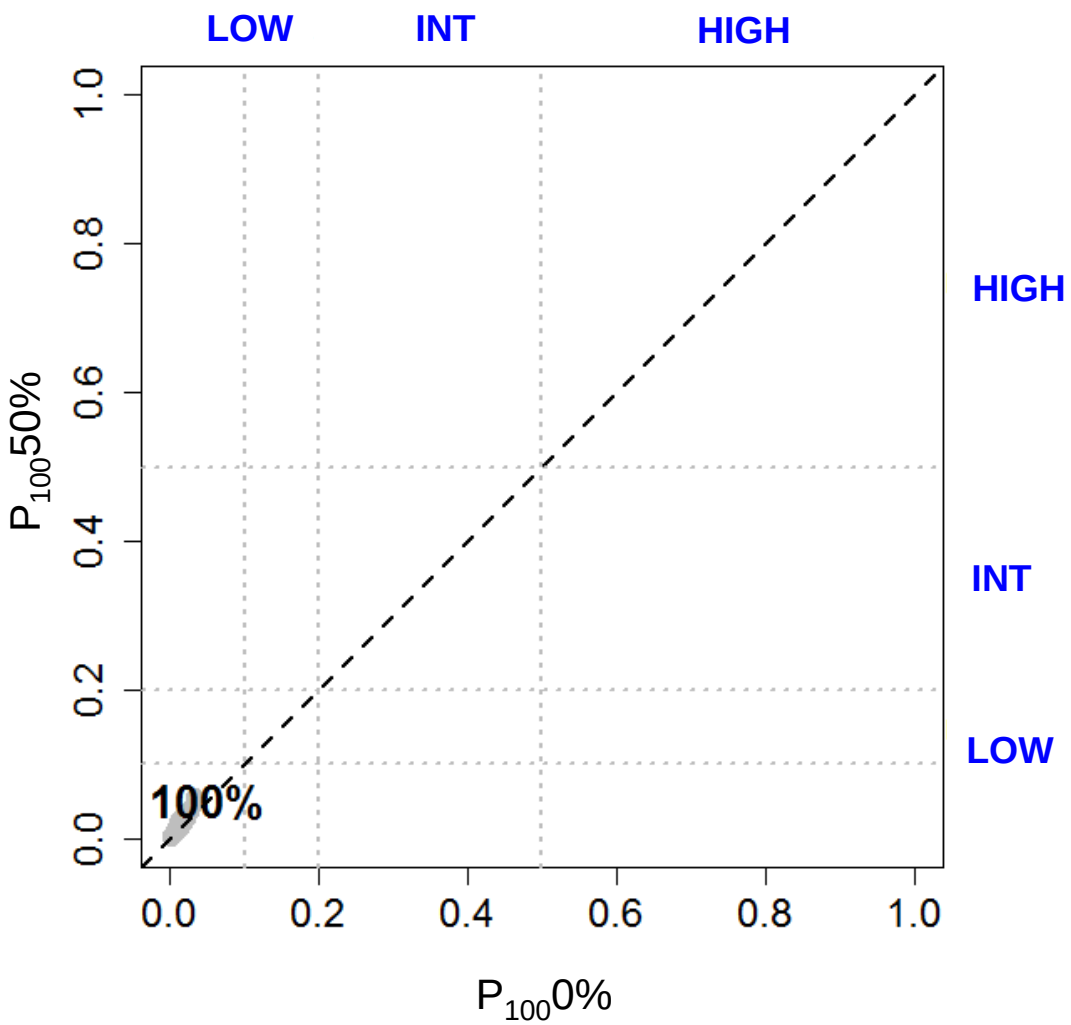


Treurnicht et al. (in prep.)

Quantifying sensitivity to harvesting

Extinction probability thresholds:

LOW: $P_{100} > 0.1$
INT: $P_{100} > 0.2$
HIGH: $P_{100} > 0.5$



P. neriifolia

Treurnicht et al.
(in prep.)

Quantifying sensitivity to harvesting

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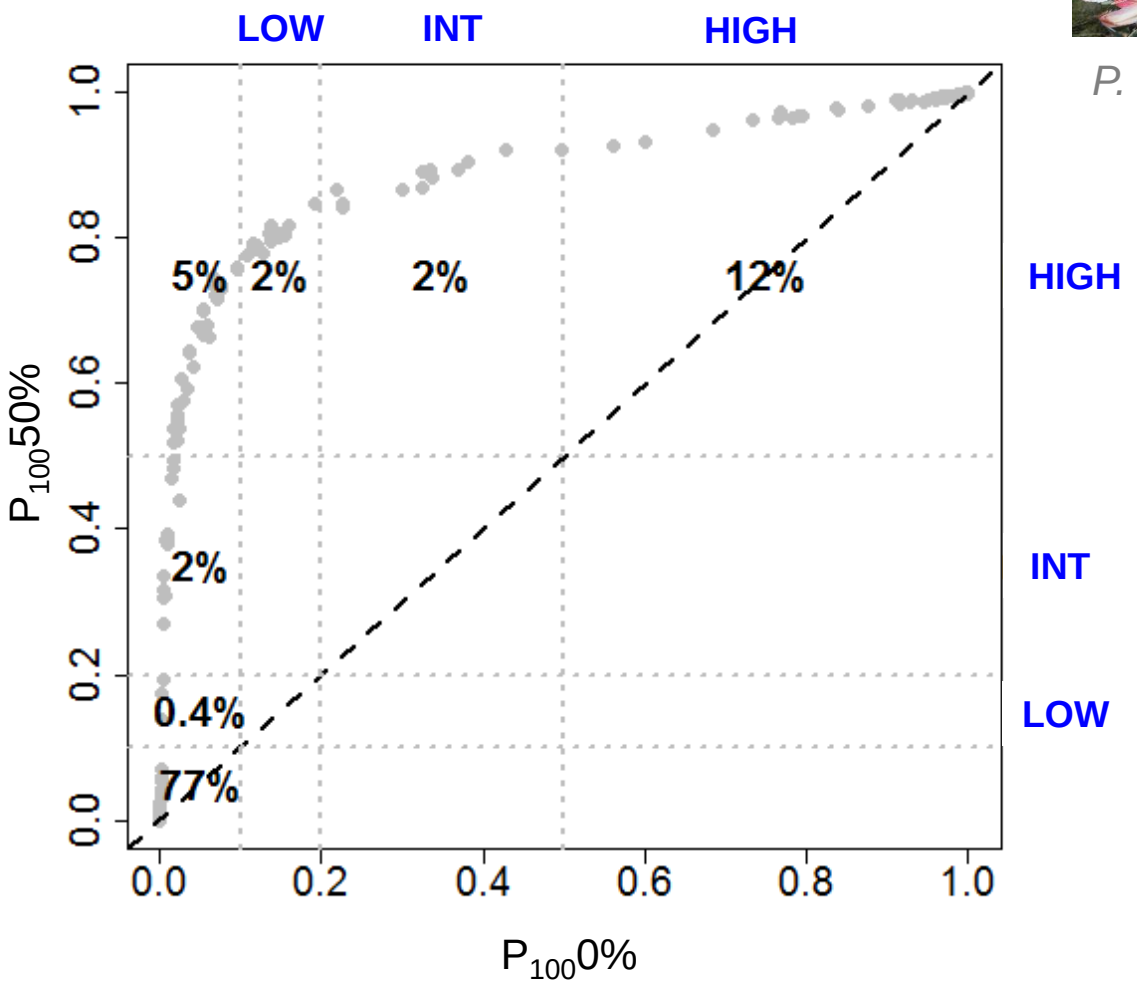
P. punctata



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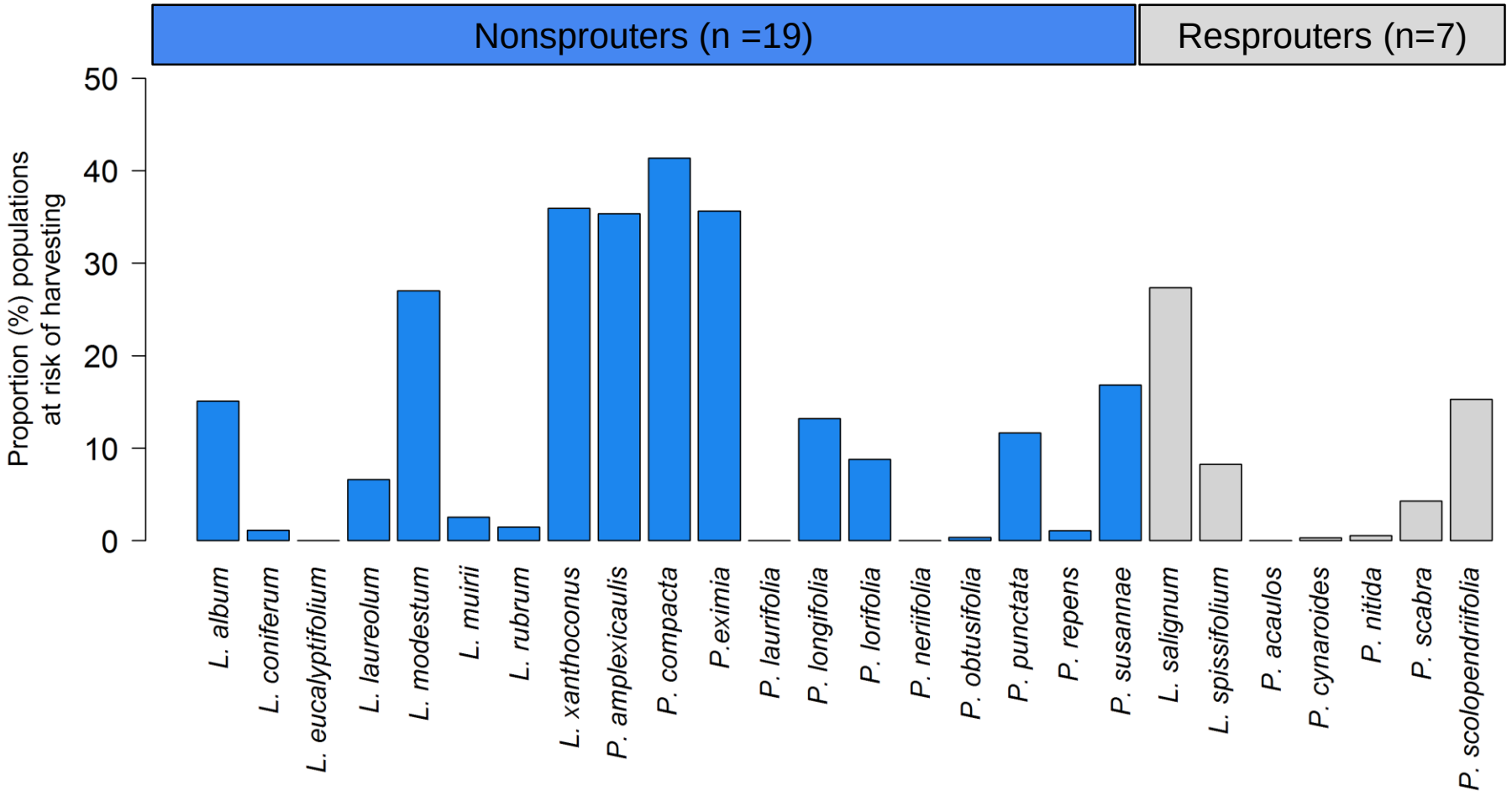
Interspecific sensitivity to harvesting

Mean proportion of populations (%) per species that increase in sensitivity due to harvesting



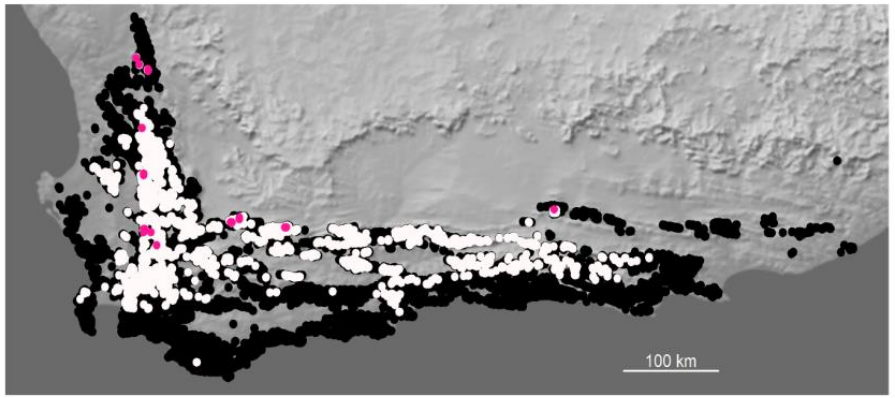
Treurnicht et al.
(in prep.)

Geographical variation in sensitivity to harvesting

Grid cells (1’ x 1’) within the range of a species where populations are sensitive to wildflower harvesting

CFR
Species range
$P_{abs} > 0.1$

a) *L. rubrum*



Treurnicht et al.
(in prep.)

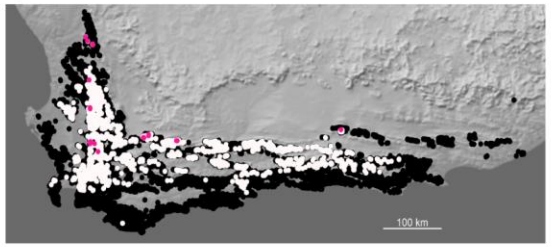
Conclusion & Take-home message

- **Geographical variation in sensitivity to 50% harvesting**
  - Inter- and intraspecific variation
  - sensitivity to harvesting tends to cluster at range edges
  - climate change may amplify effects of harvesting (?)

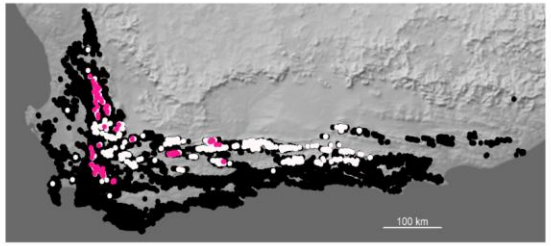
- **Take home message:** caution against the application of a general management guideline ("50% harvesting rule") applied across species/populations and regions

- **Can this type of information be used to develop locally adapted and/or species-specific harvesting regimes?**

a) *L. rubrum*



c) *P. punctata*



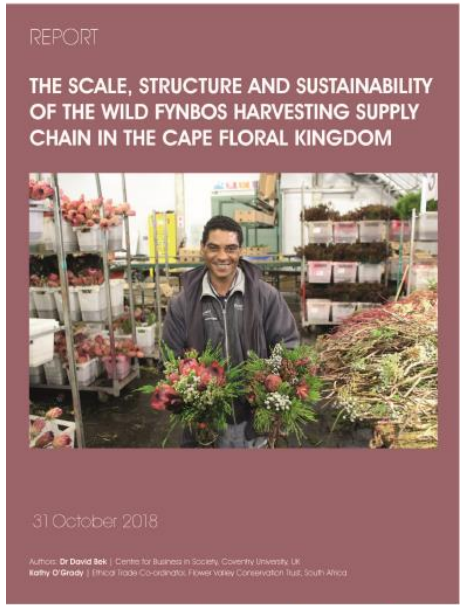



Photo: Martina Treurnicht

Acknowledgements

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Photo: Martina Treurnicht