Changing tree populations

Neutral and non-neutral change

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International Symposium
Climate Change and Forest Biodiversity Conservation
CTFS-SIGEO & CForBio
Institute of Botany, Beijing
July 2011

Ecological theory

- Do populations of tree species fluctuate stochastically (neutrally)?
- Are populations tightly regulated and more stable than neutral?
- Are population fluctuations more than random (environmental variation)?

Outline

A BCI milestone

Survivorship of trees tagged in 1982 ($\geq$ 1 cm dbh)

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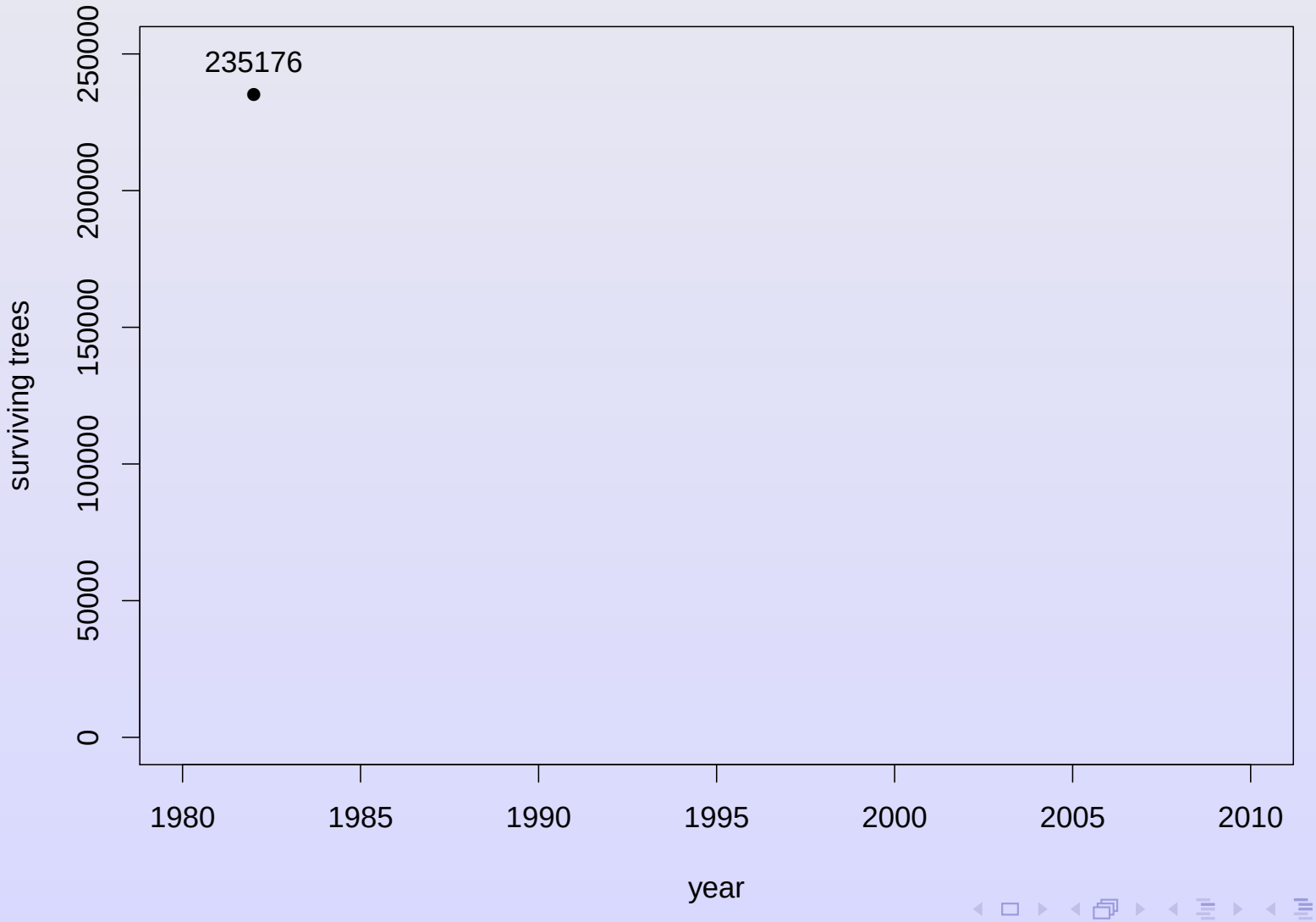

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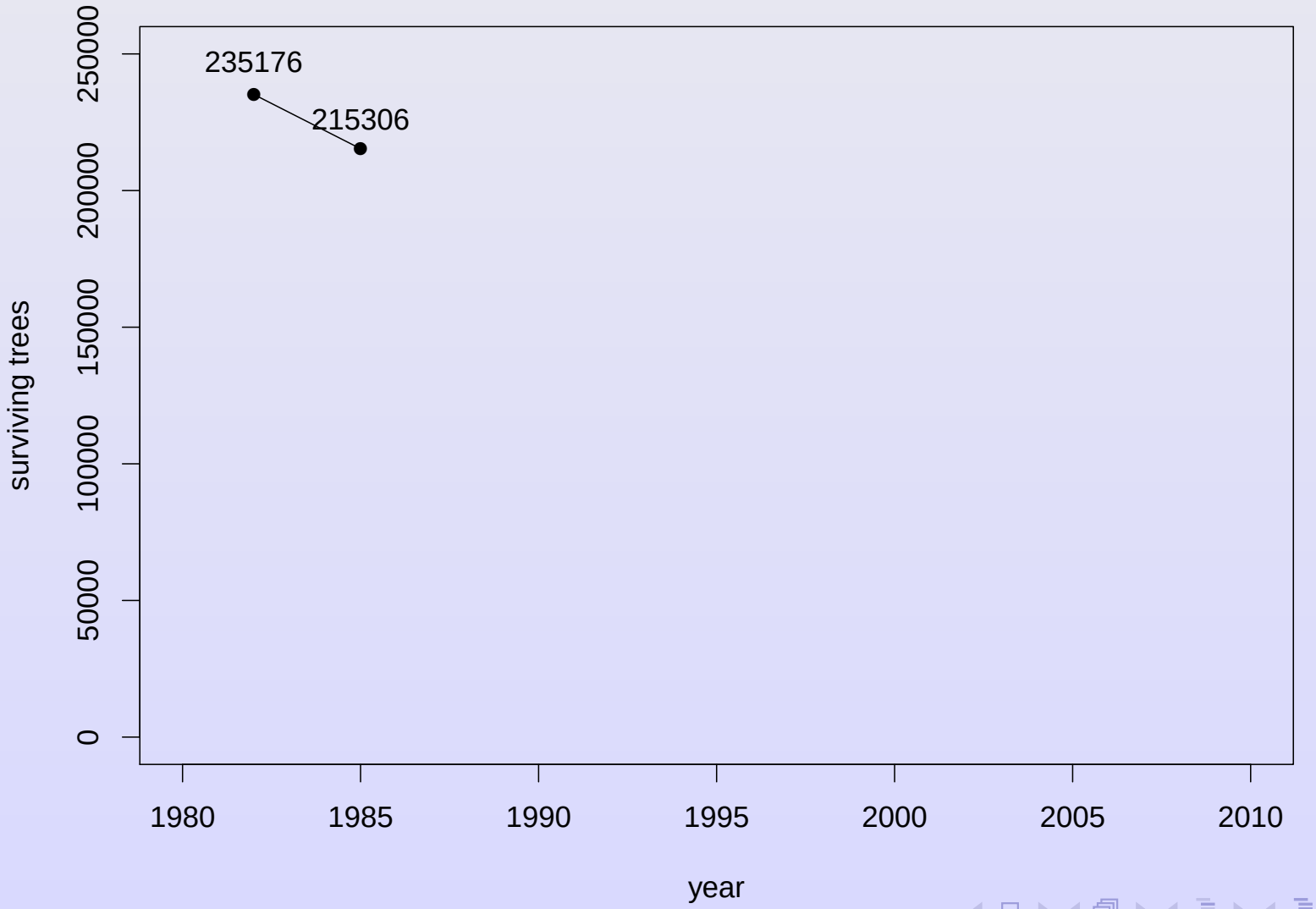

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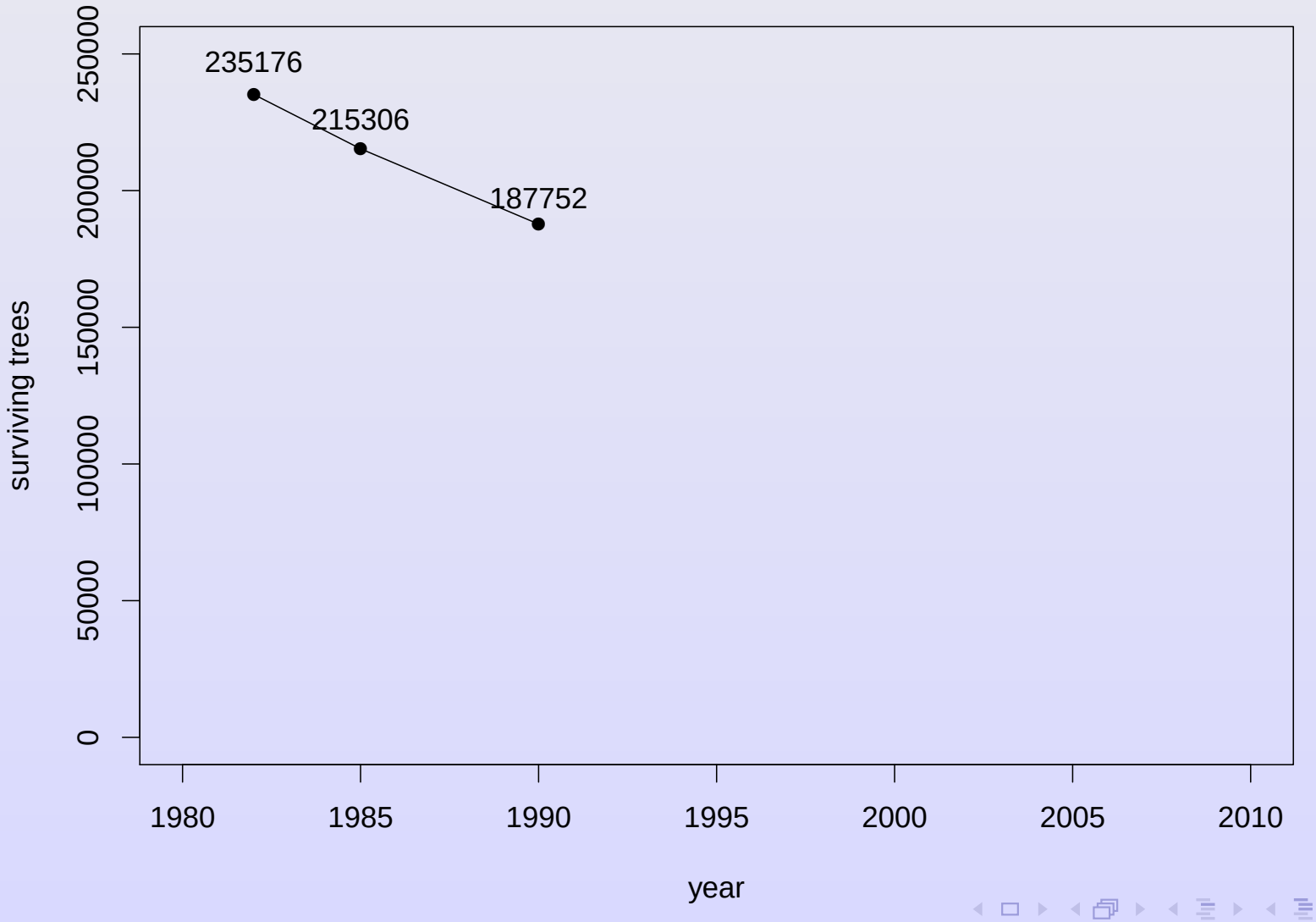

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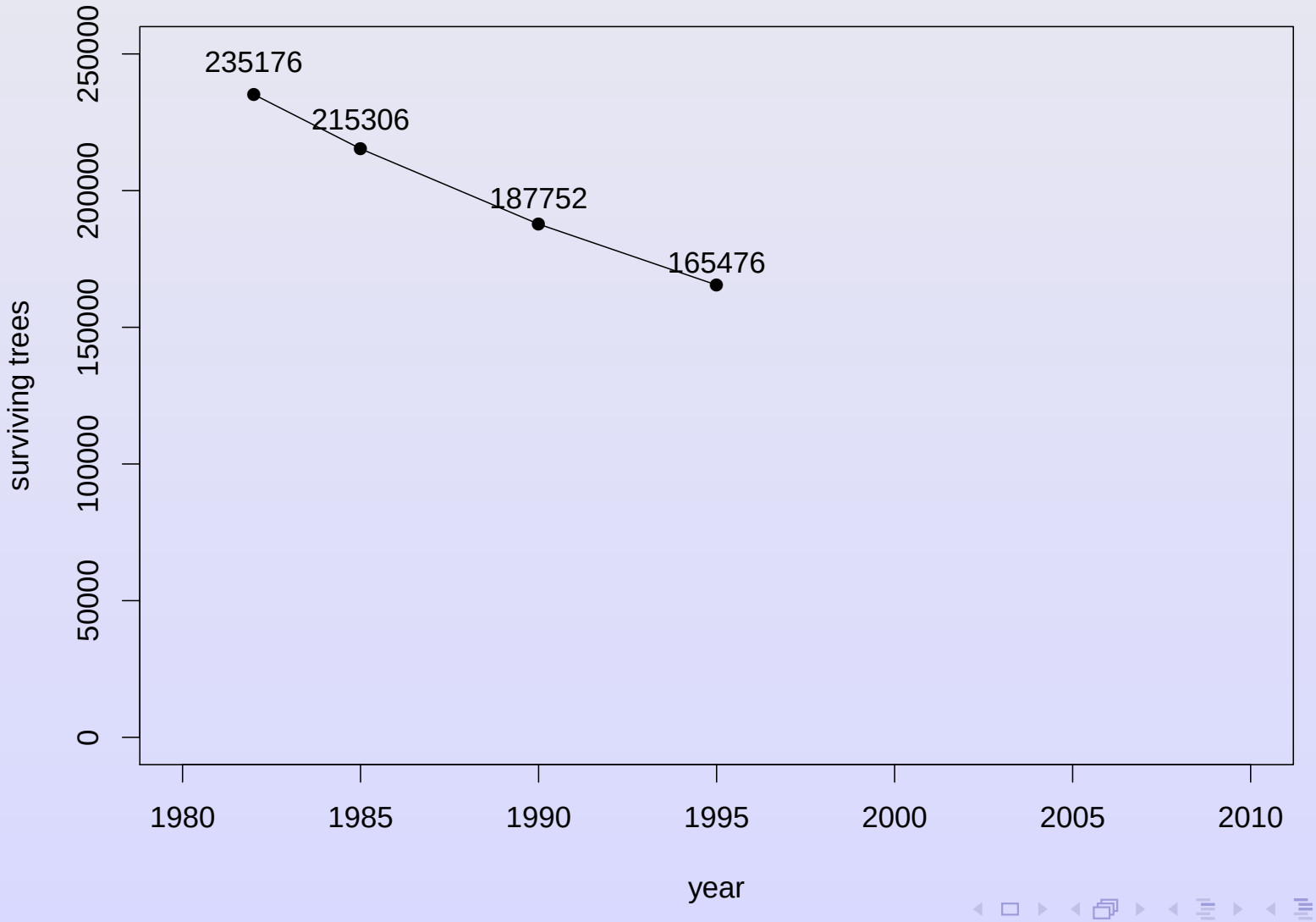

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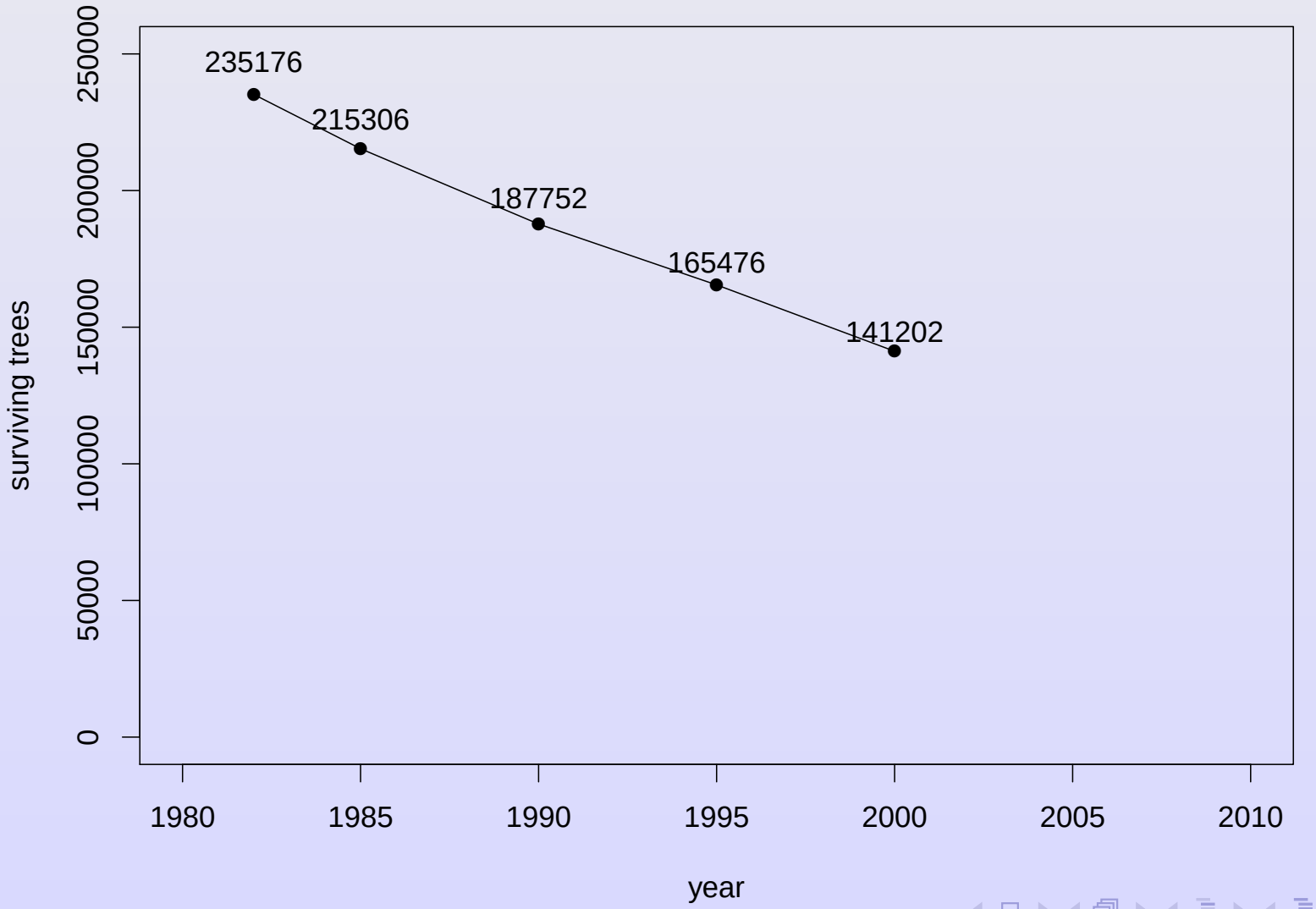

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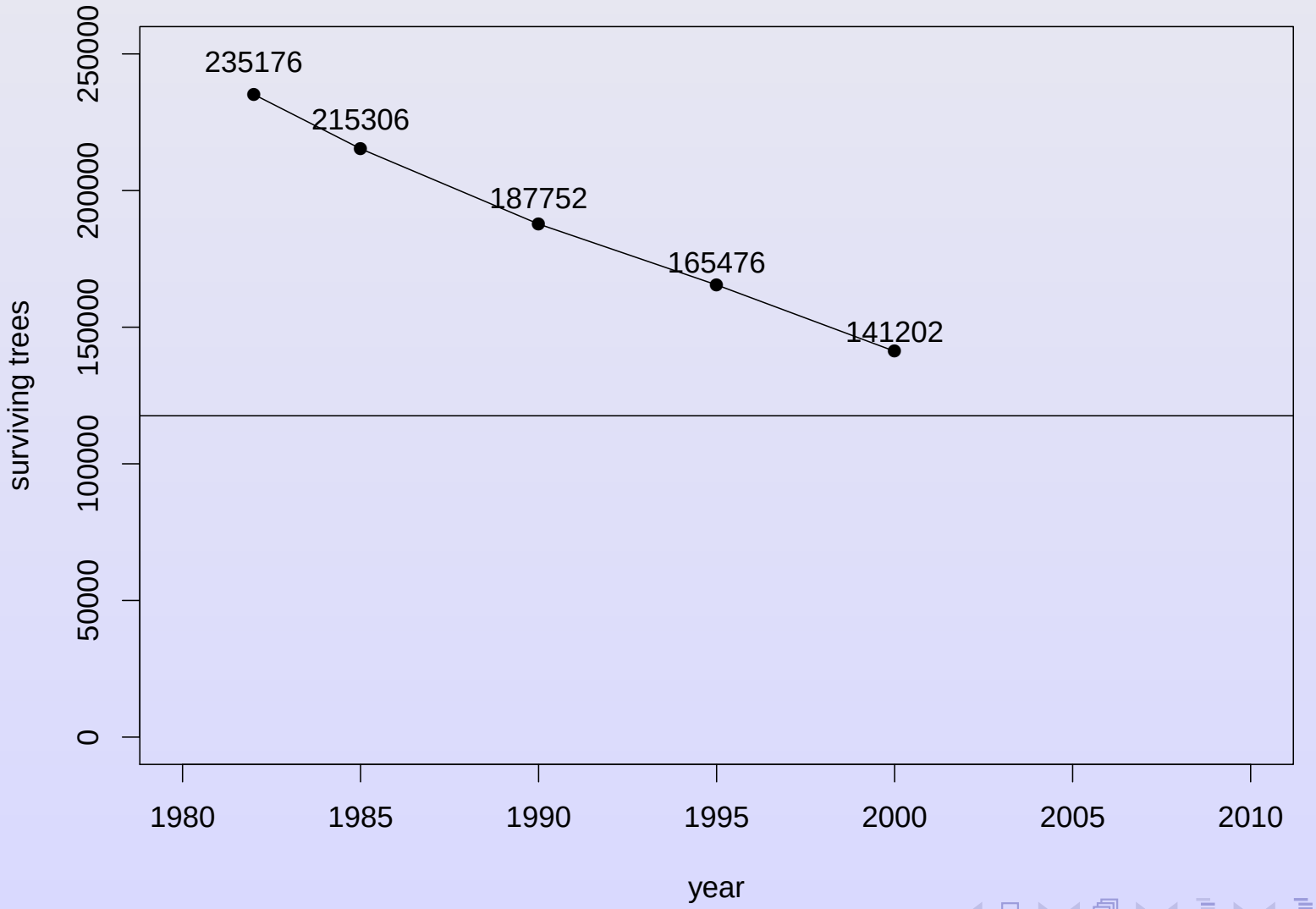

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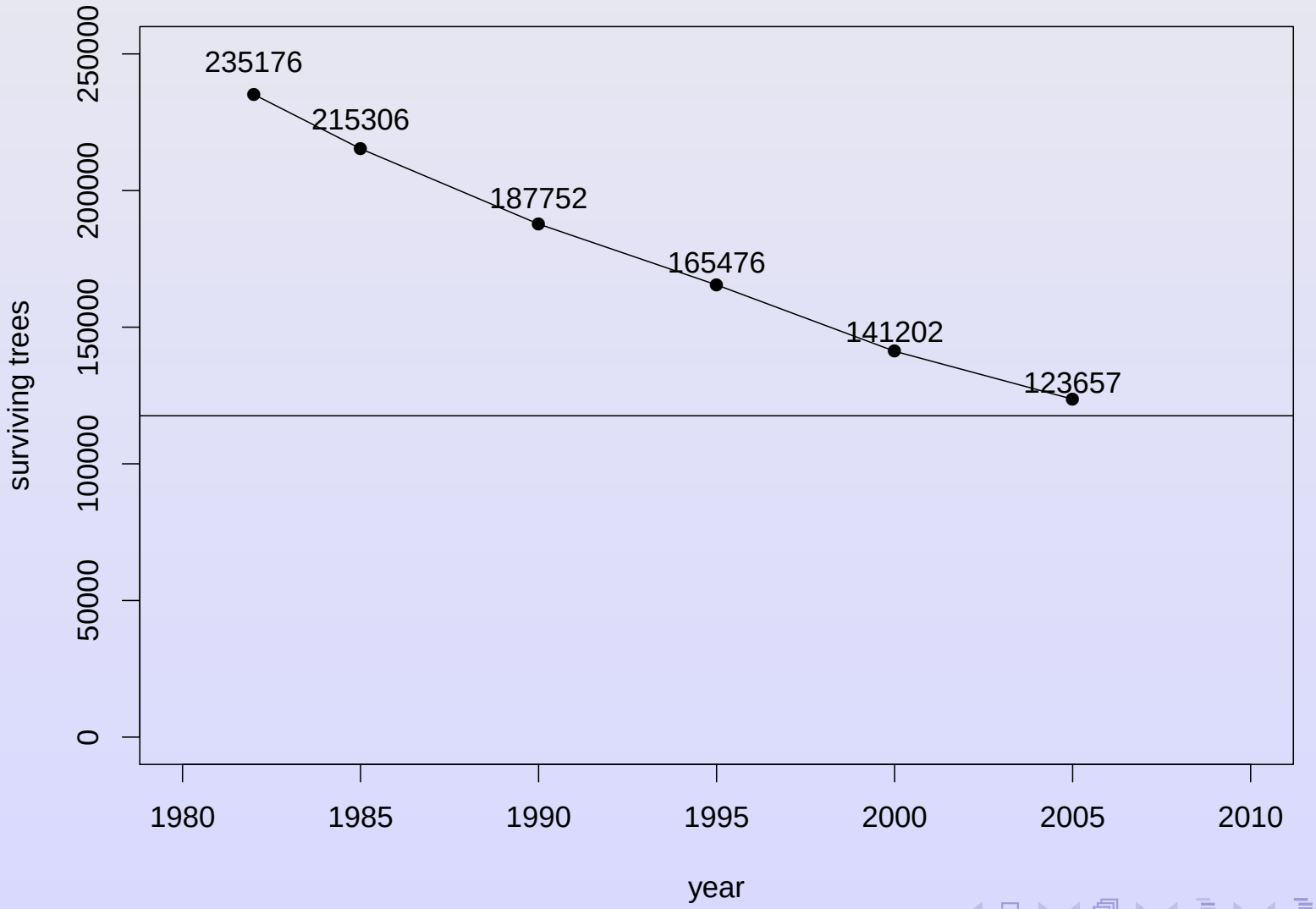

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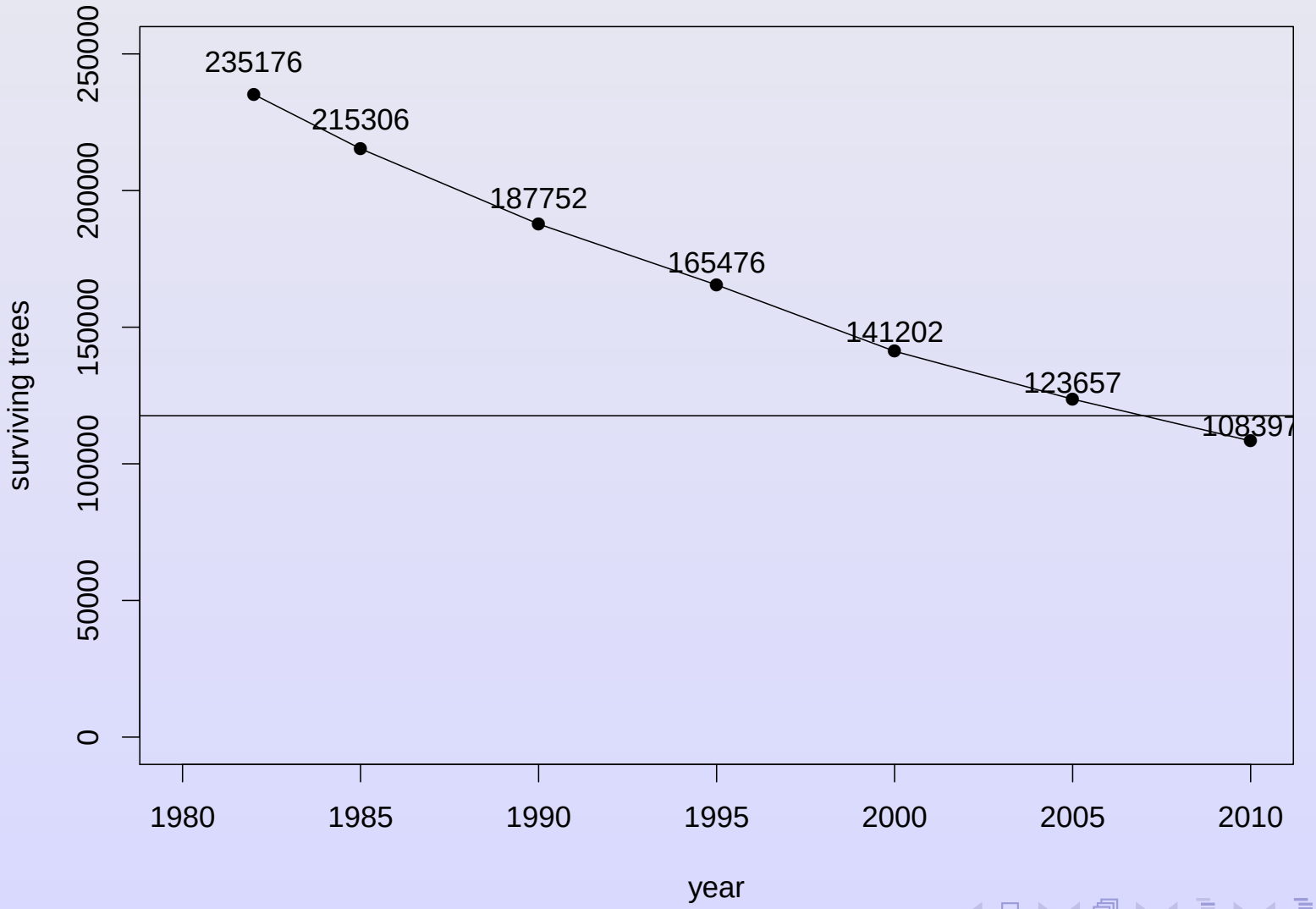

Fluctuation abundance of the entire forest

Number of living trees since 1982 ($\geq$ 1 cm dbh)

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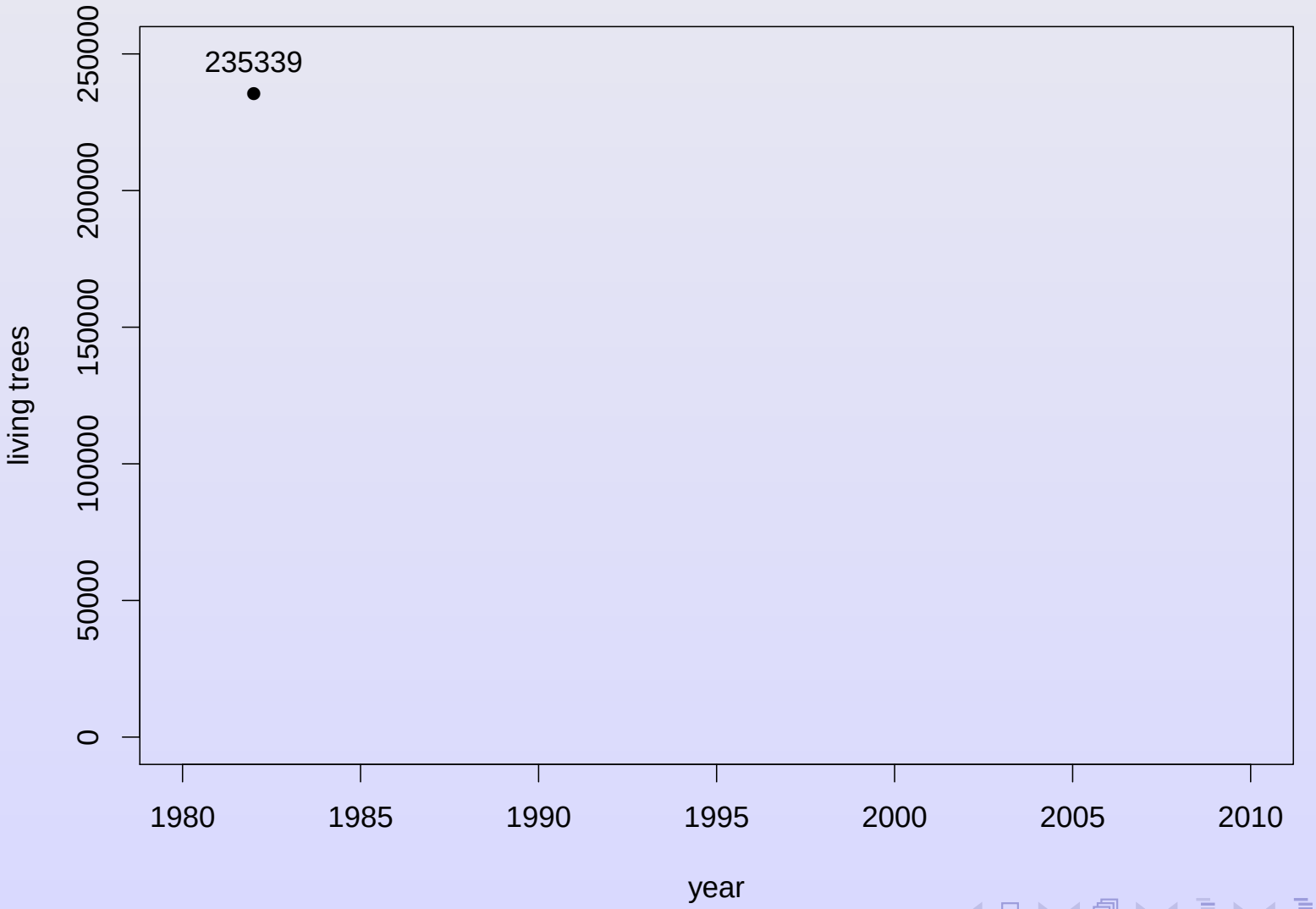

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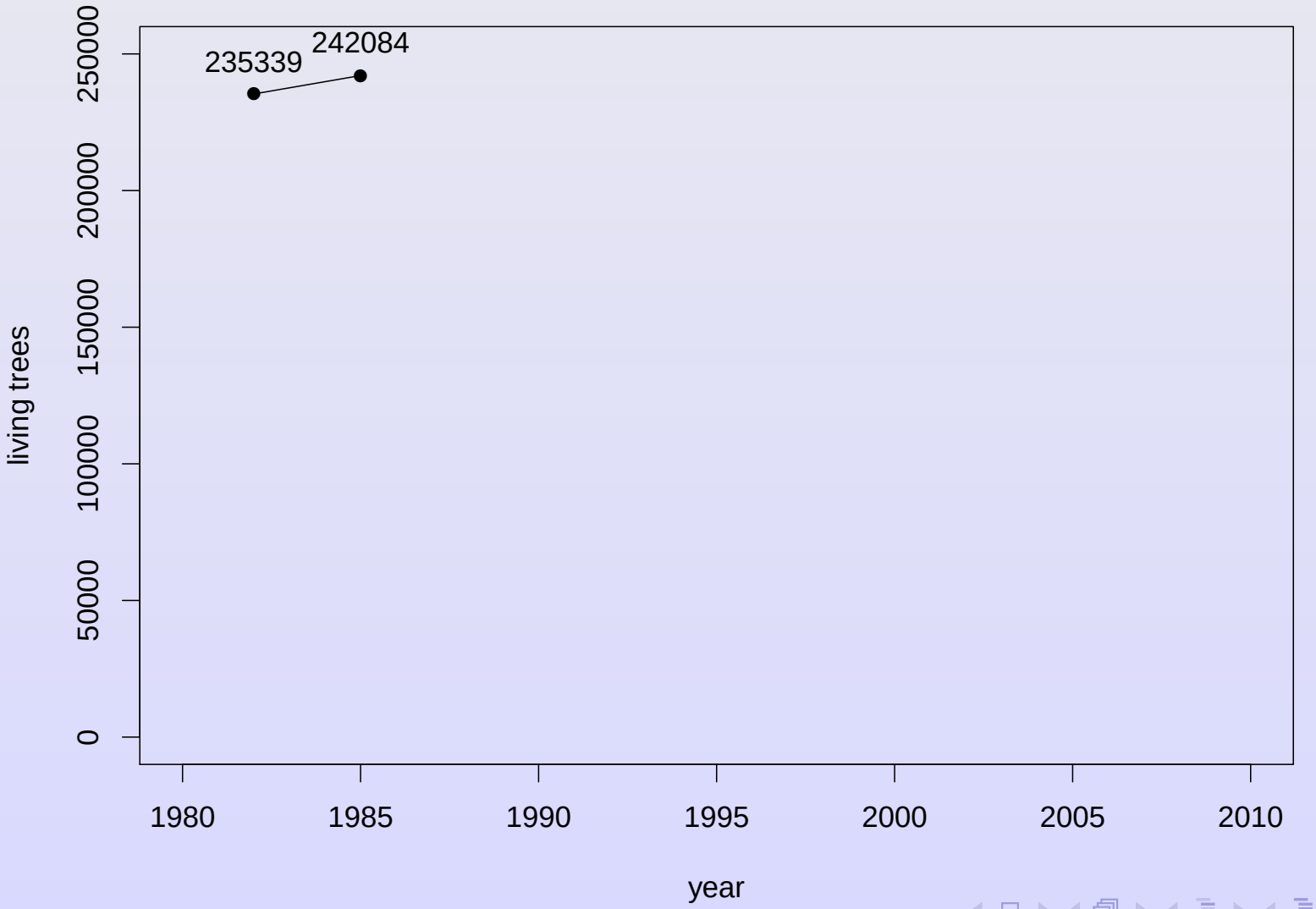

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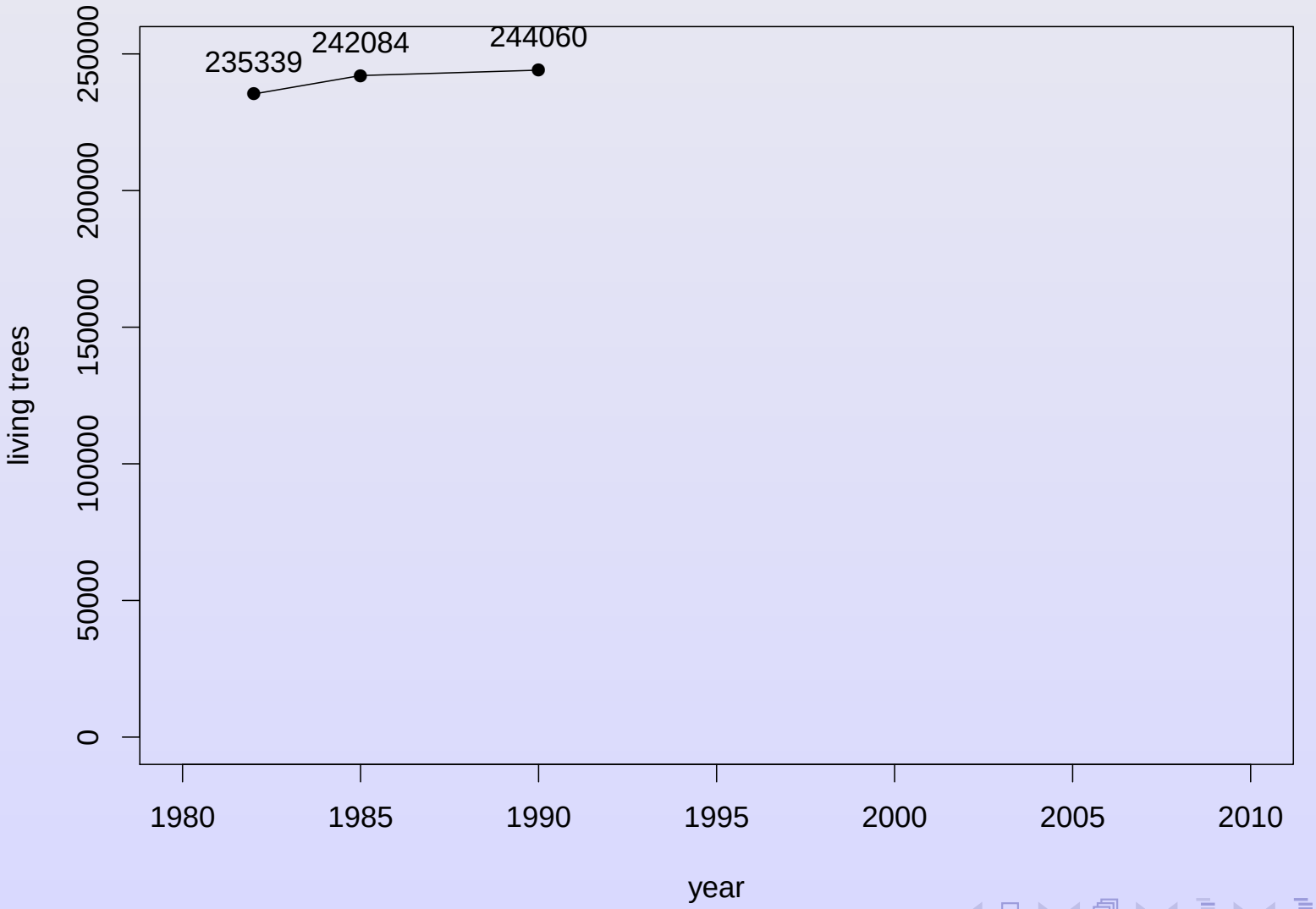

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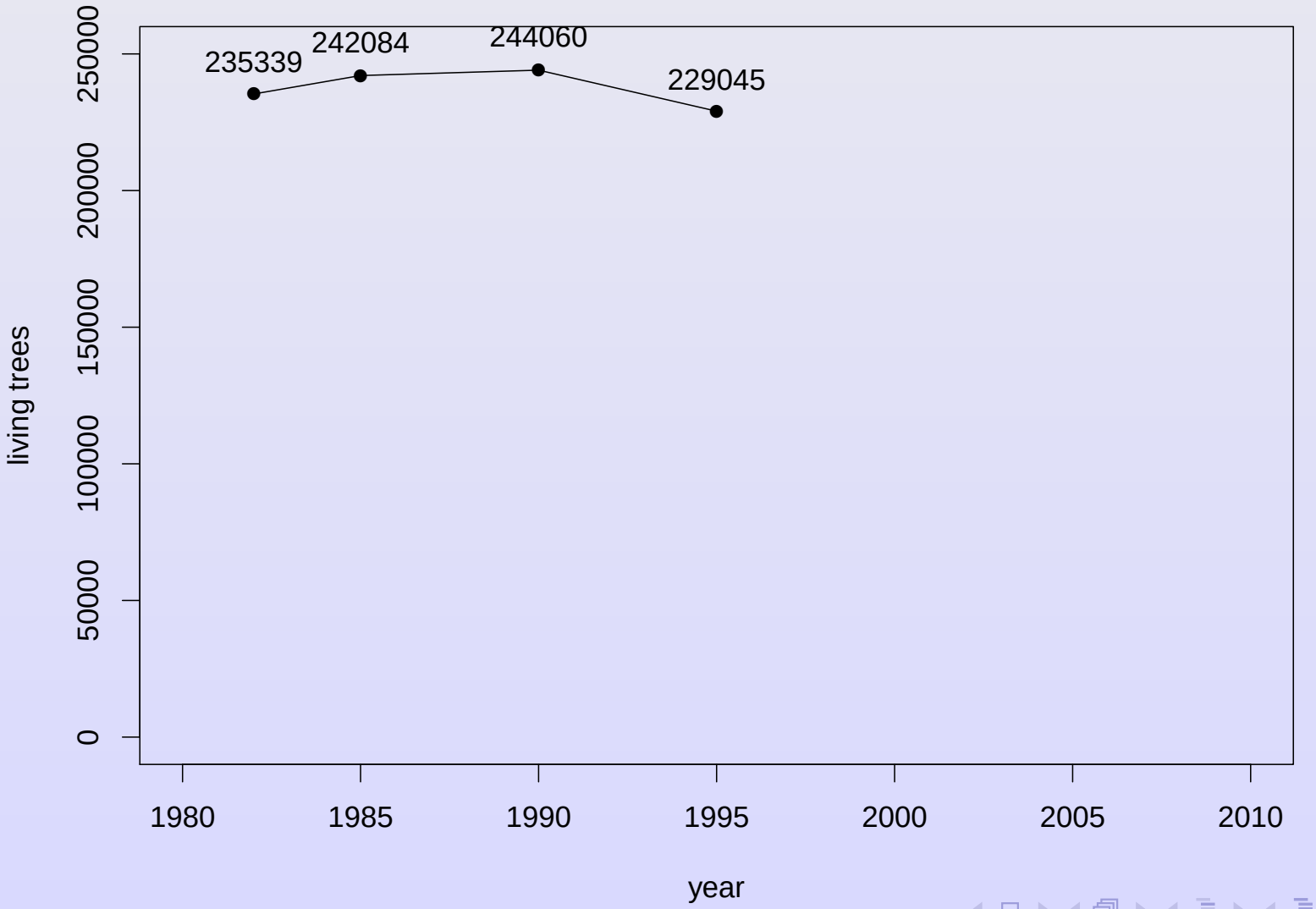

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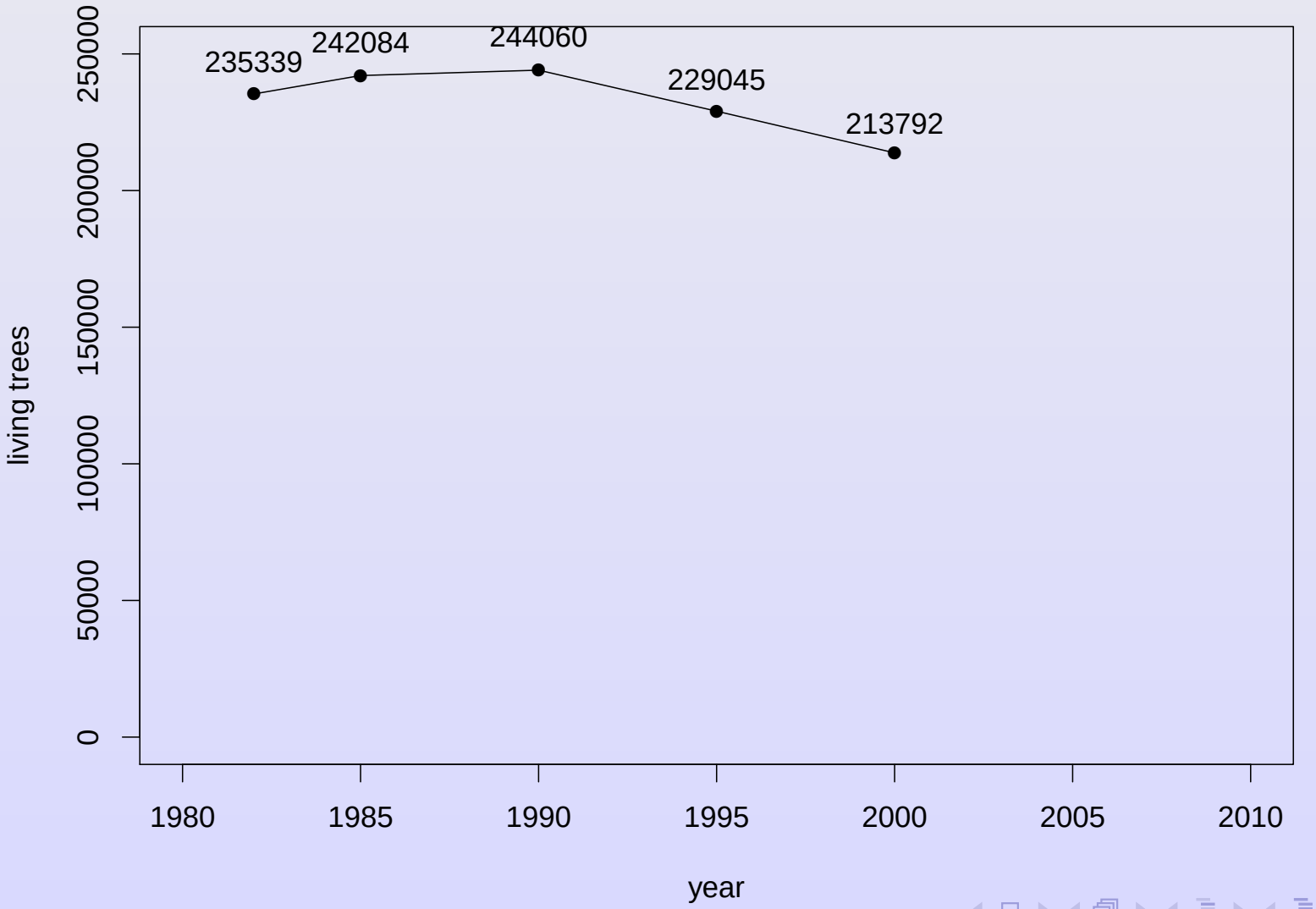

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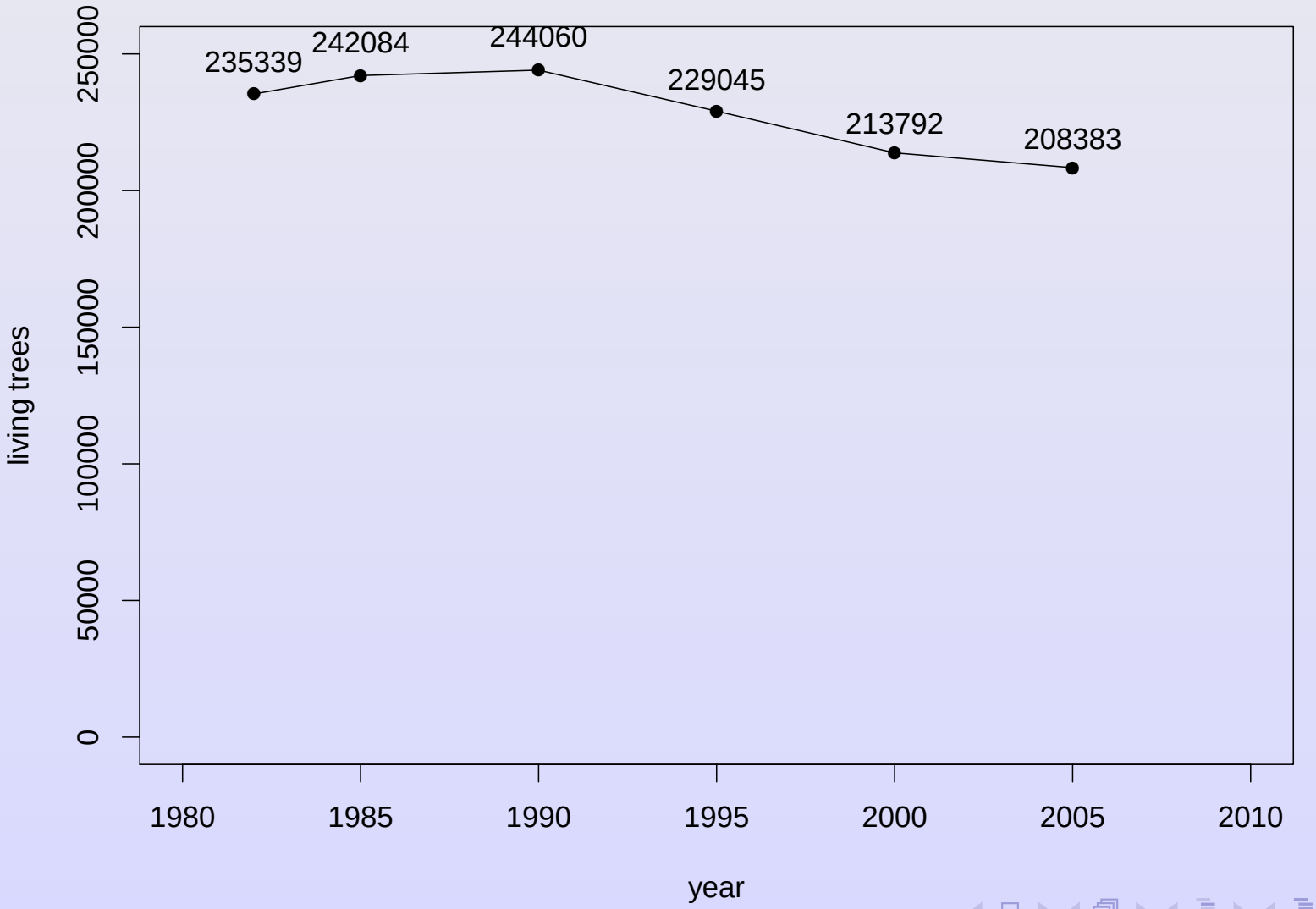

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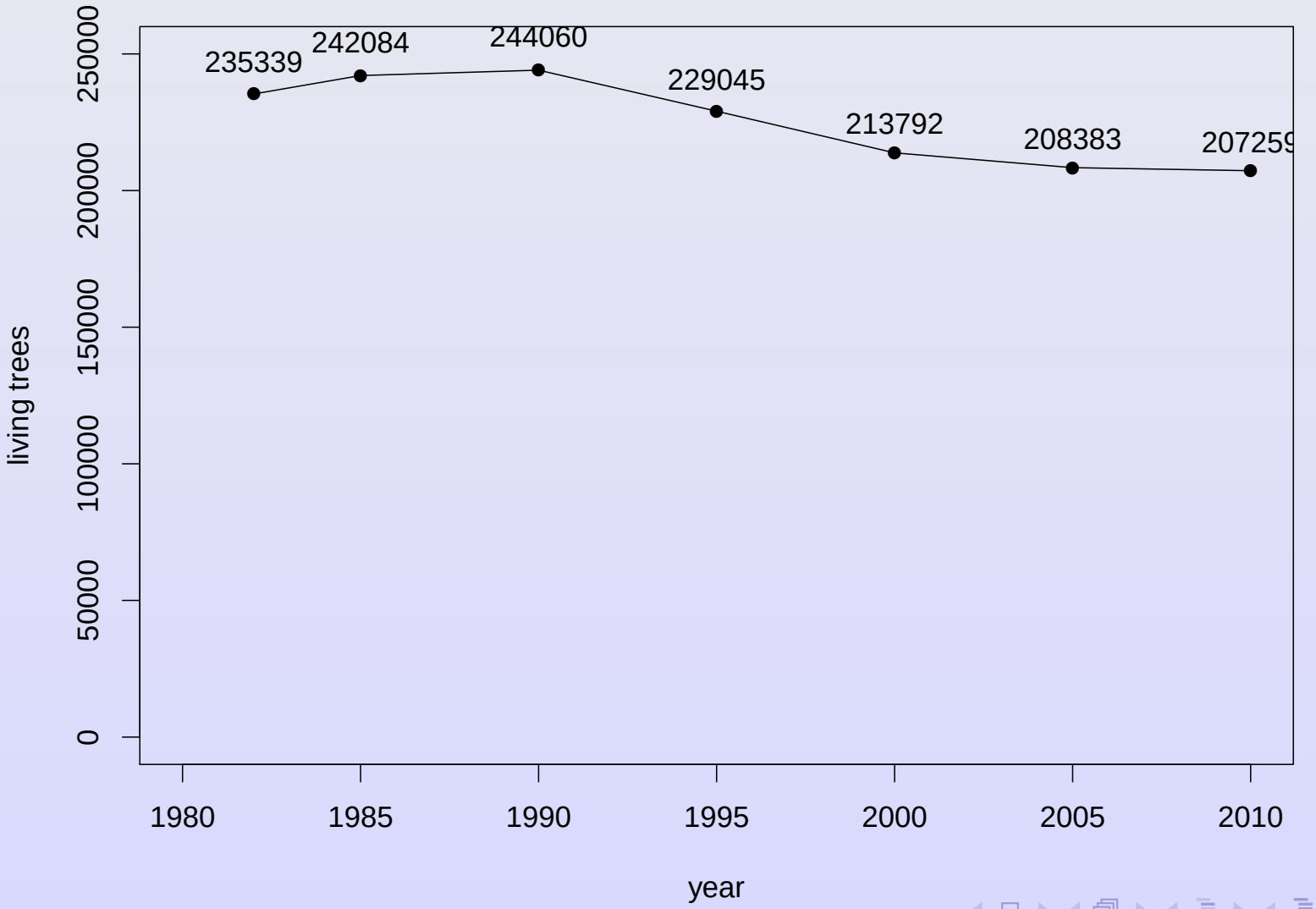
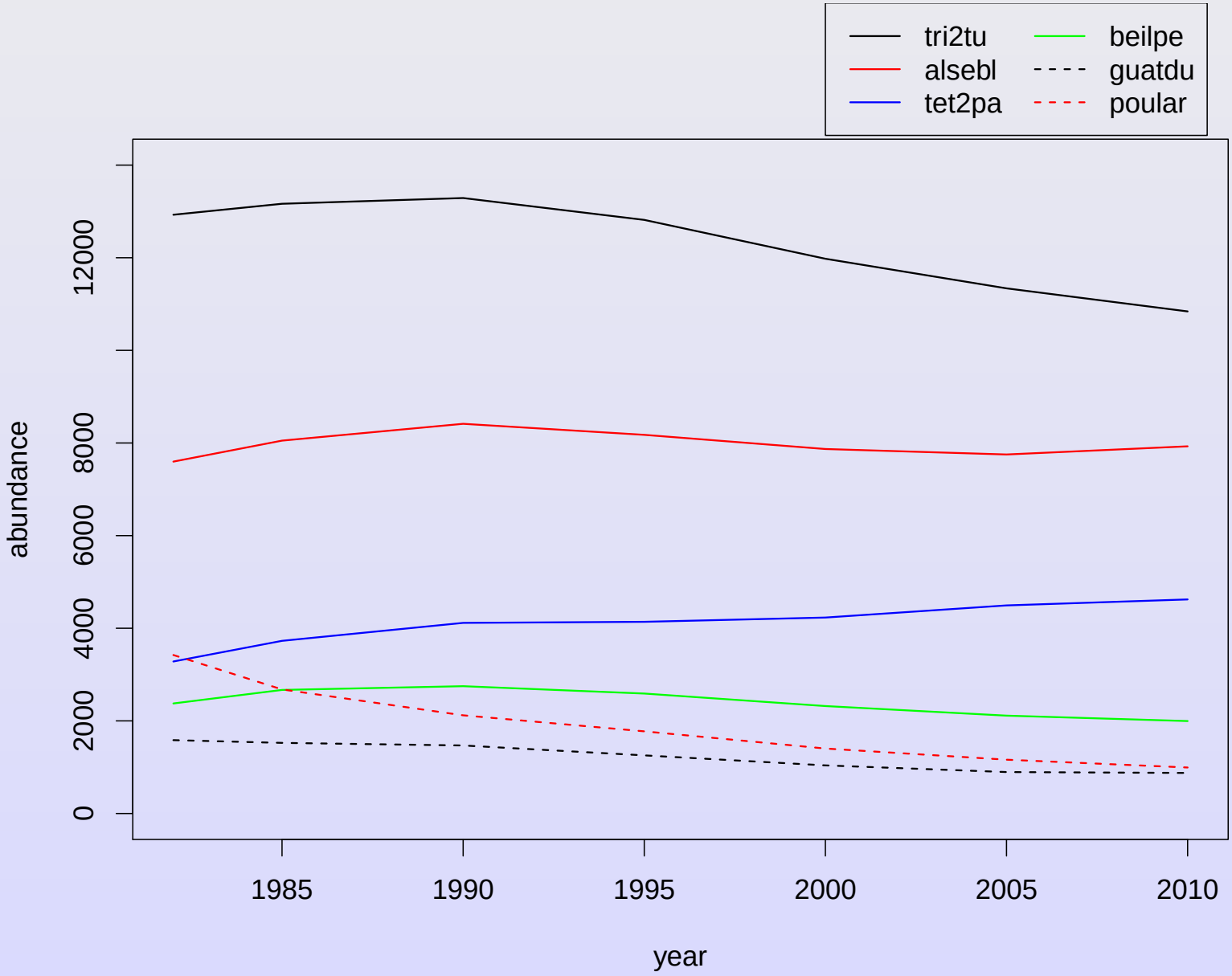


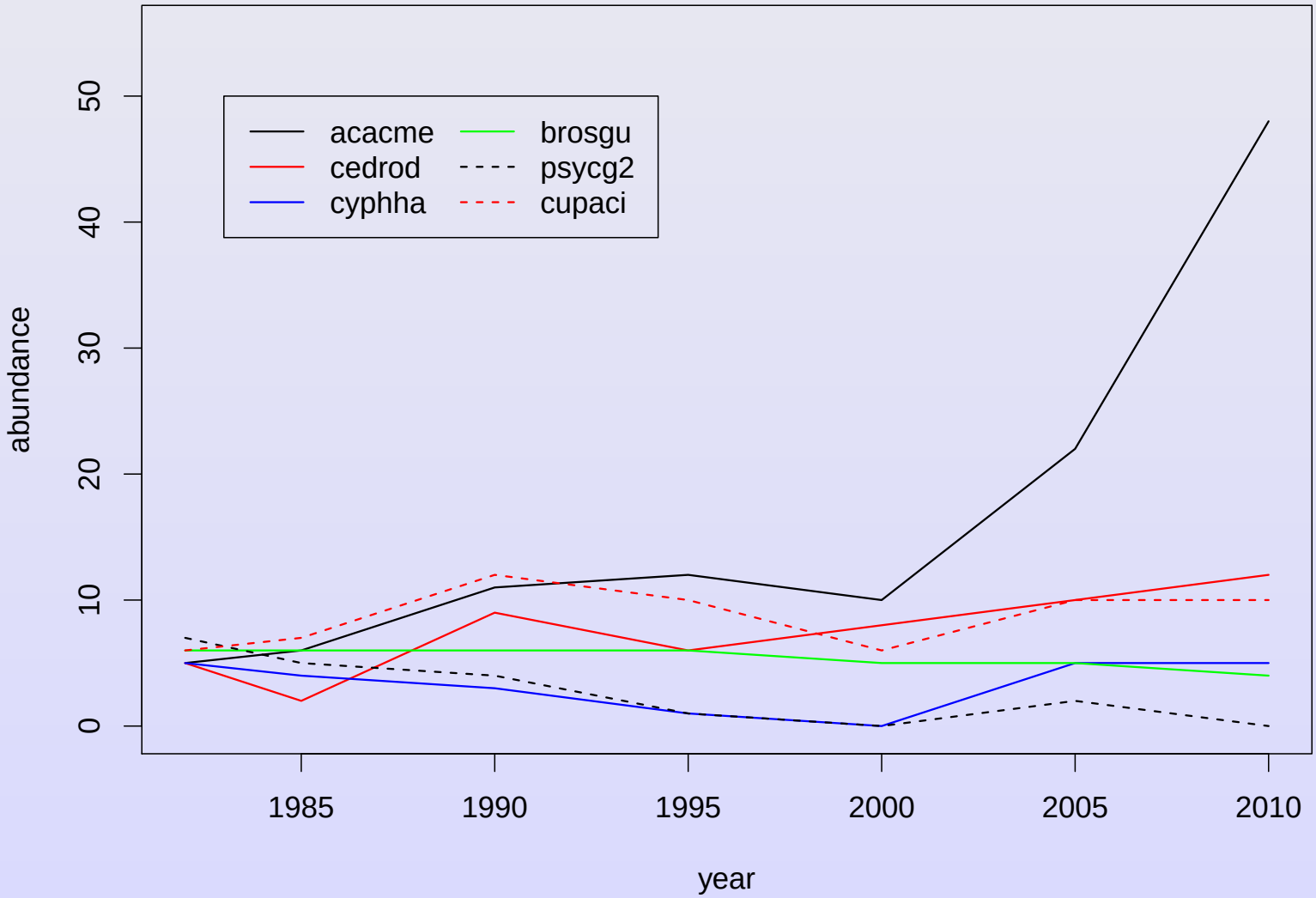
Decomposing change across the forest into the individual species

Understanding a diversity of mechanisms

Population changes in common species 30 years



Population changes in rare species 30 years



spcode	N1	N2	time	little r	date1	date2
acacme	22	49	5.0	0.1611	01Jun2005	22May2010
acaldi	853	1146	5.0	0.0595	17Jun2005	02Jun2010
acalma	52	53	5.0	0.0038	25Mar2005	26Mar2010
ade1tr	145	146	5.0	0.0014	13Jun2005	29May2010
aegipa	46	40	5.0	-0.0281	02May2005	21Apr2010
alchco	229	317	5.0	0.0656	18Jun2005	03Jun2010
alchla	2	1	5.0	-0.1382	17Jan2005	22Jan2010

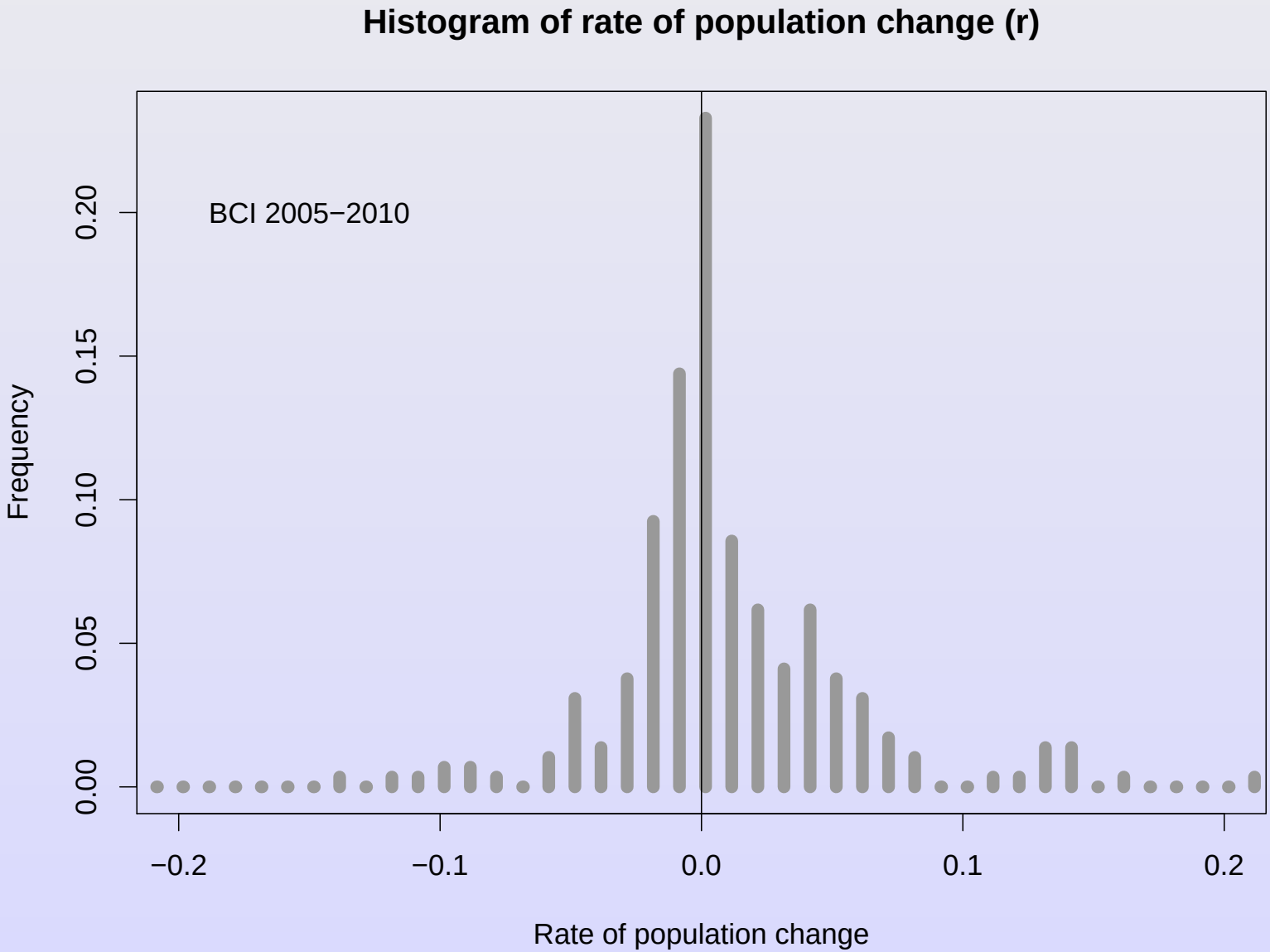
...

...

etc. for 326 species

* $r = \frac{1}{time}(\ln N_2 - \ln N_1)$

Modeling rates of population change

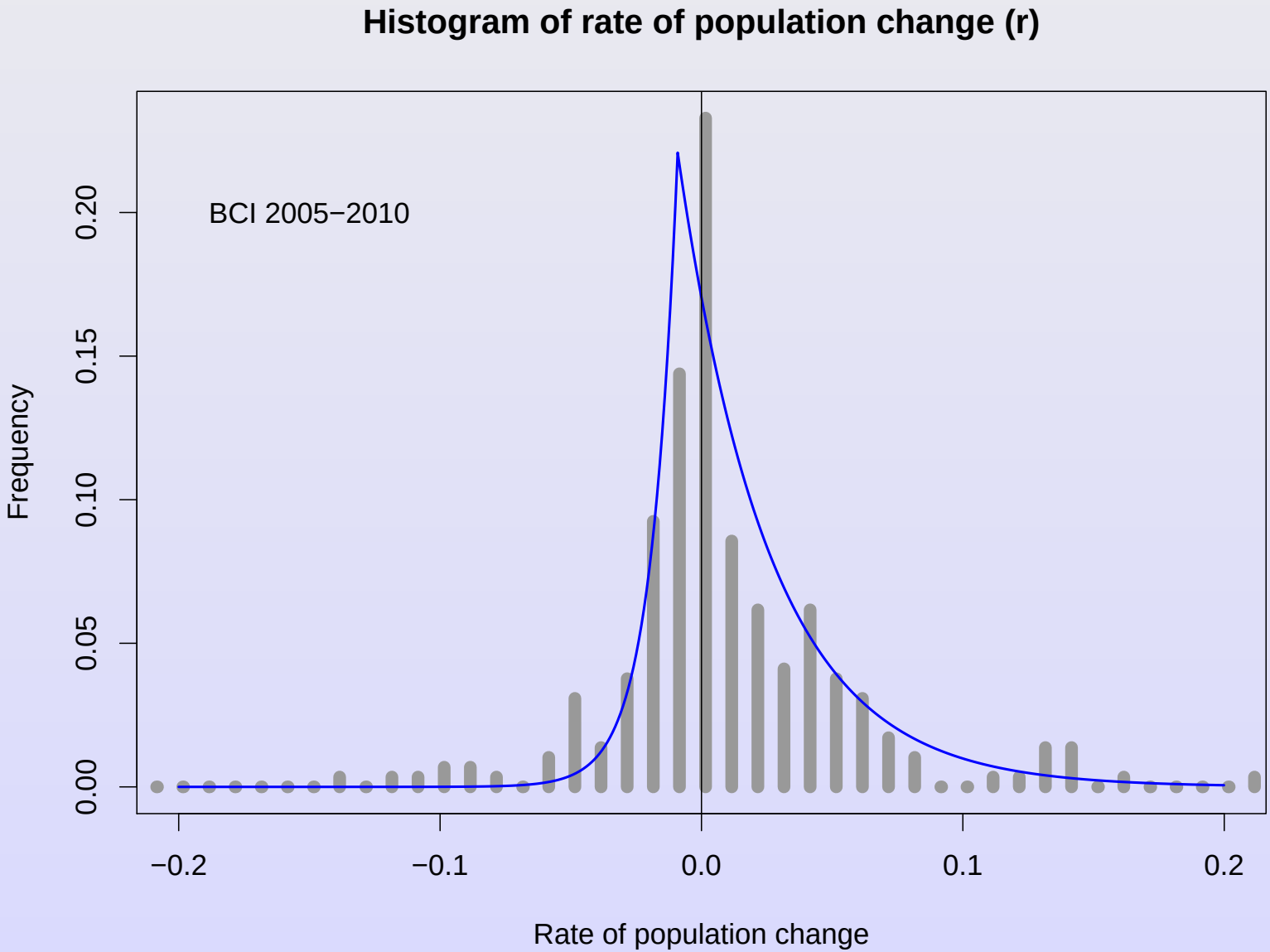


Separating stochastic variance from environmental[1] variance in population sizes

- Stochastic demography (random fluctuations) must be discounted
- Fluctuations that remain are due to environmental change
- Species respond differently to change

[1] any environmental feature that might vary (climate, predators, competitors...)

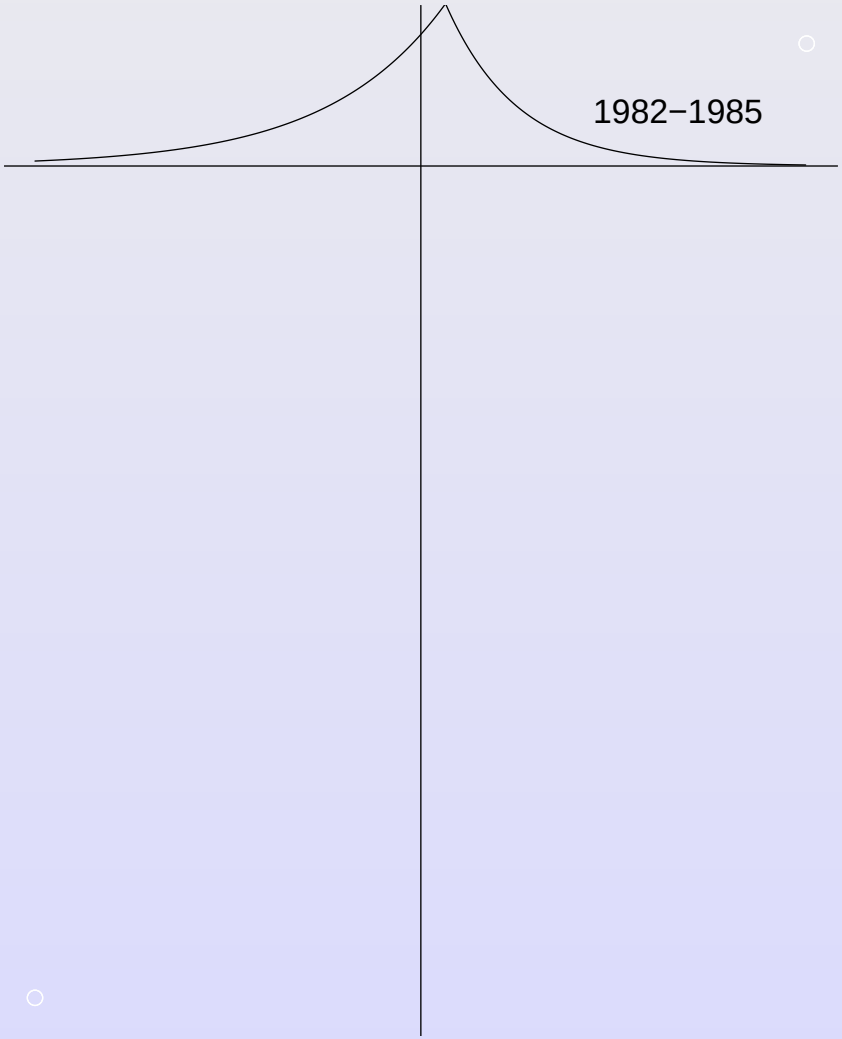
Modeling rates of population change



Fluctuations in abundance across the community

Through 30 years

Fluctuations in abundance across the community



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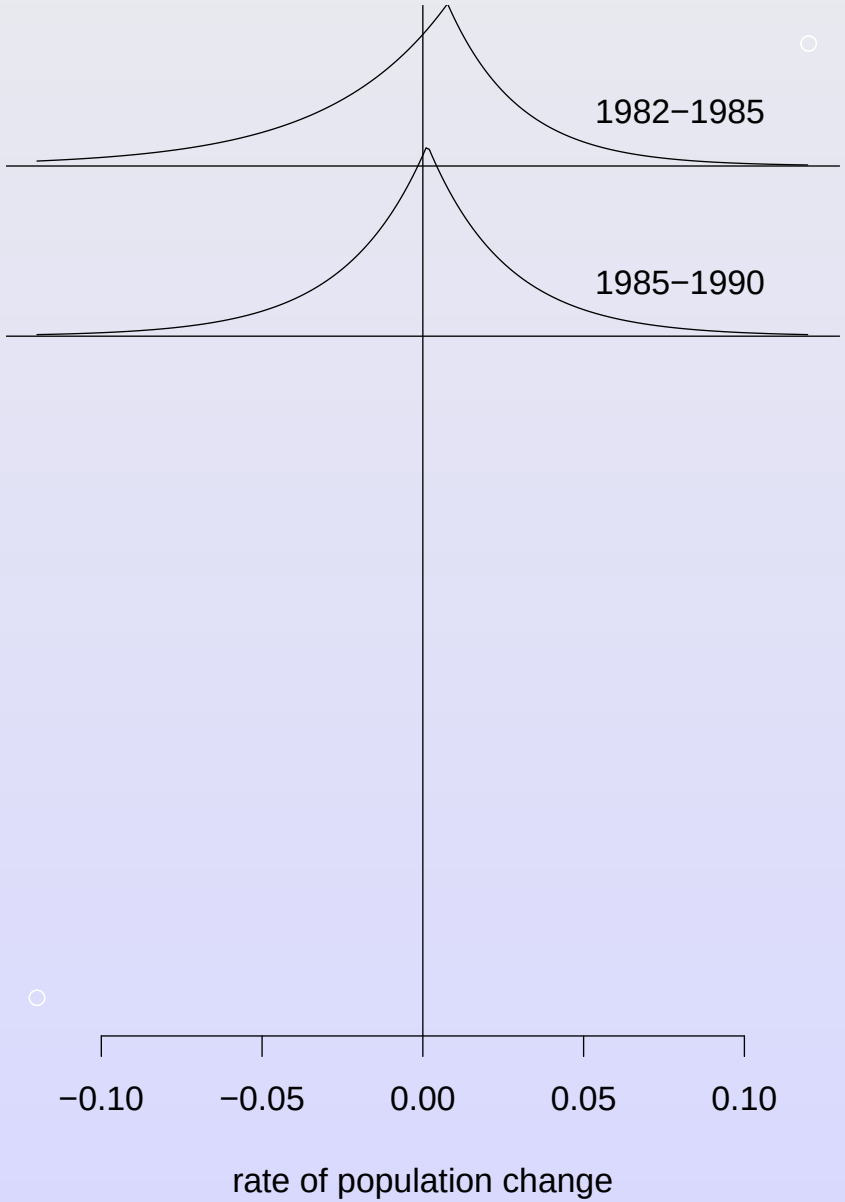

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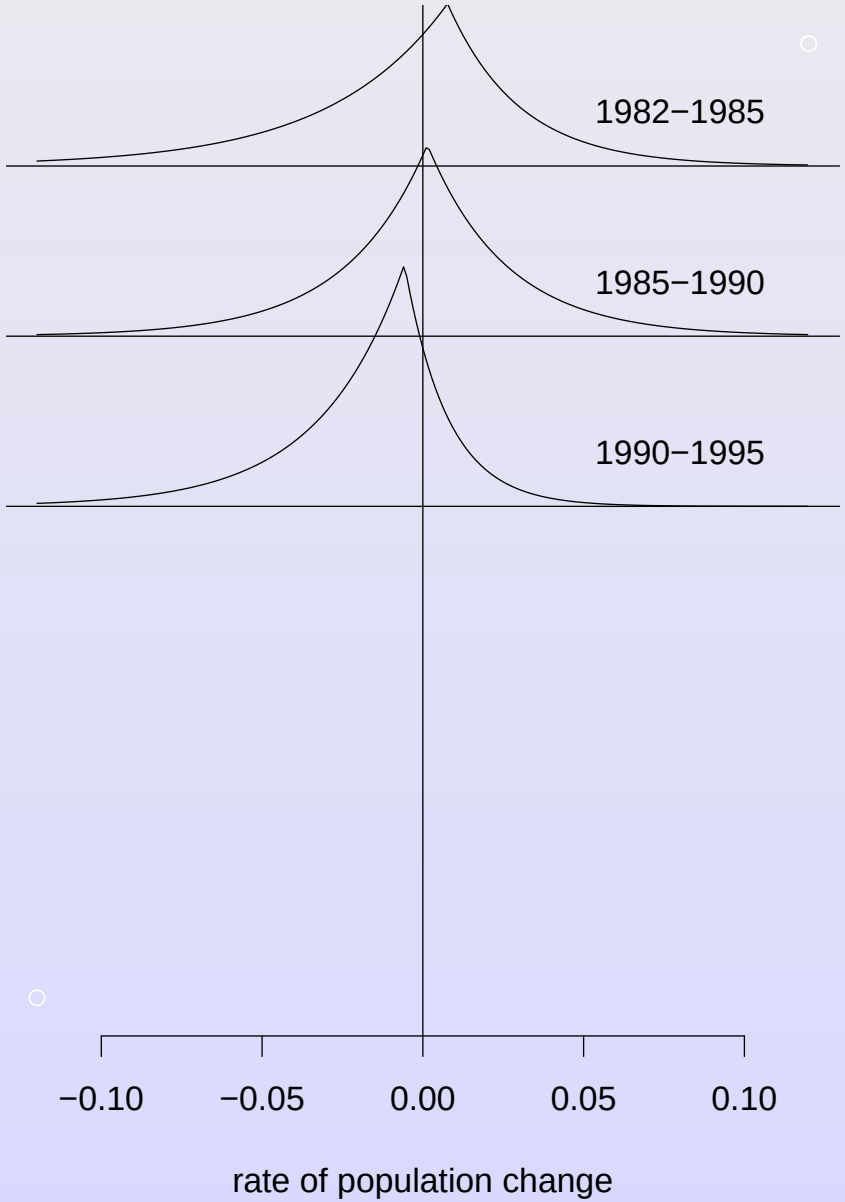

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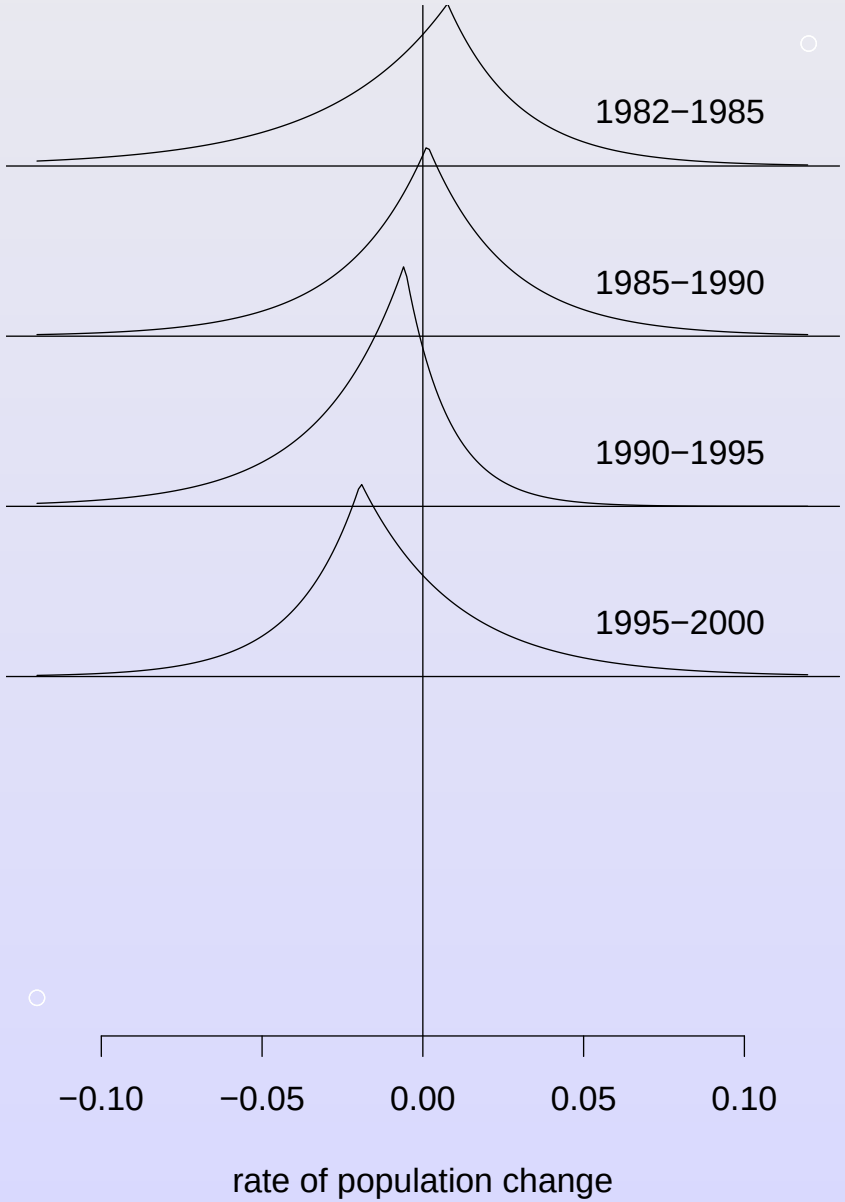

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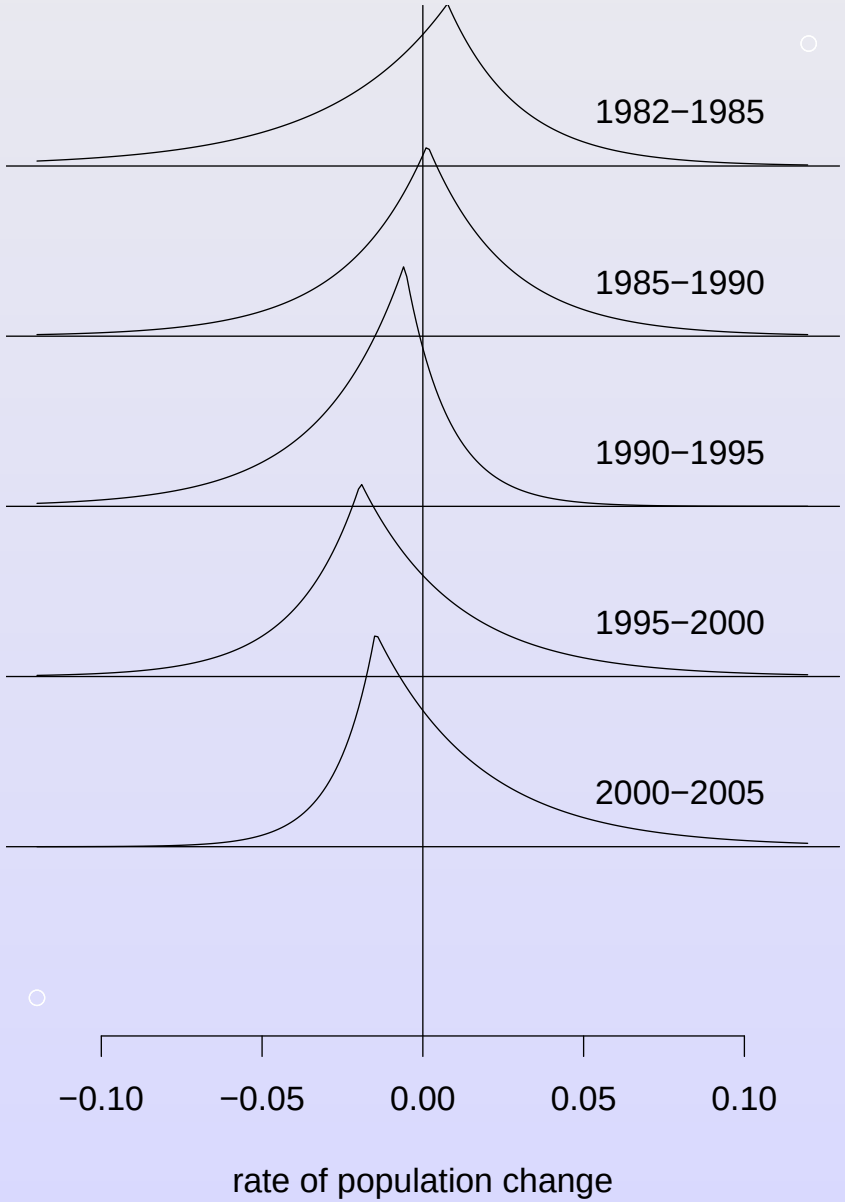

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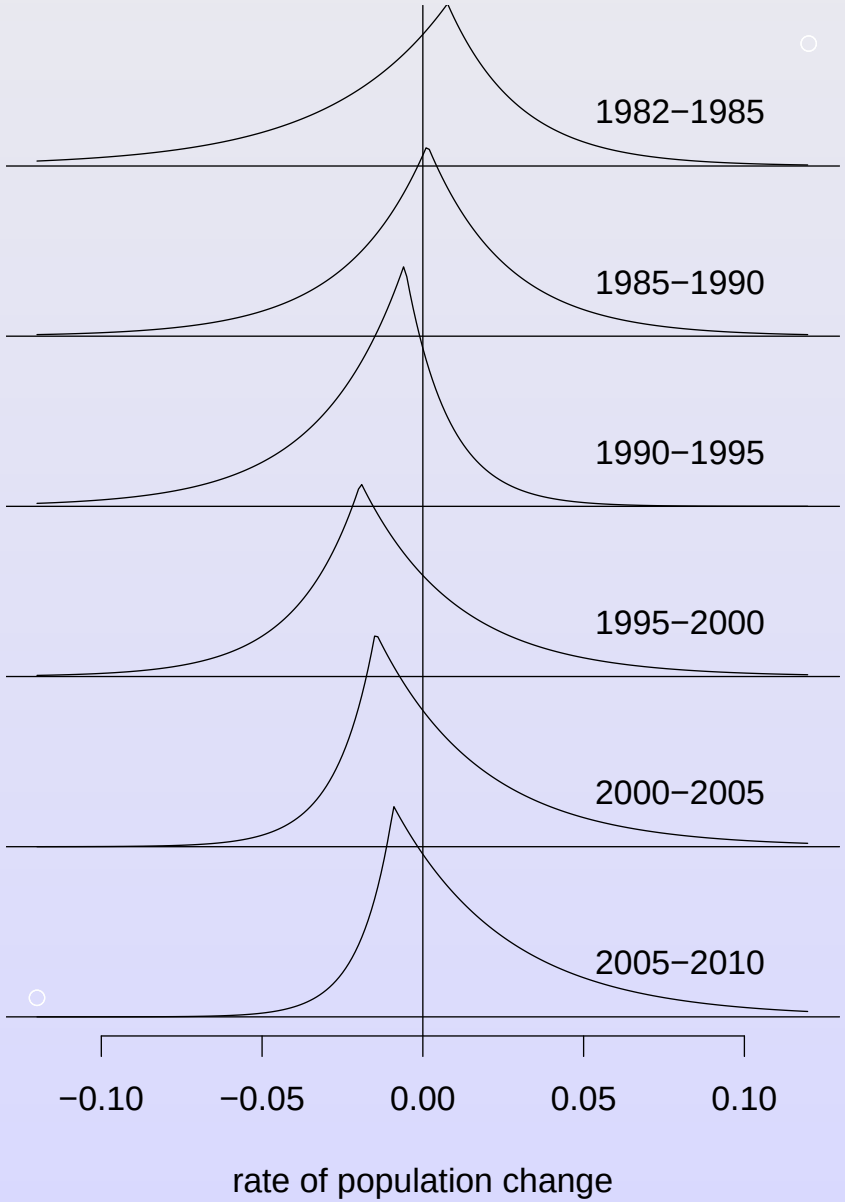

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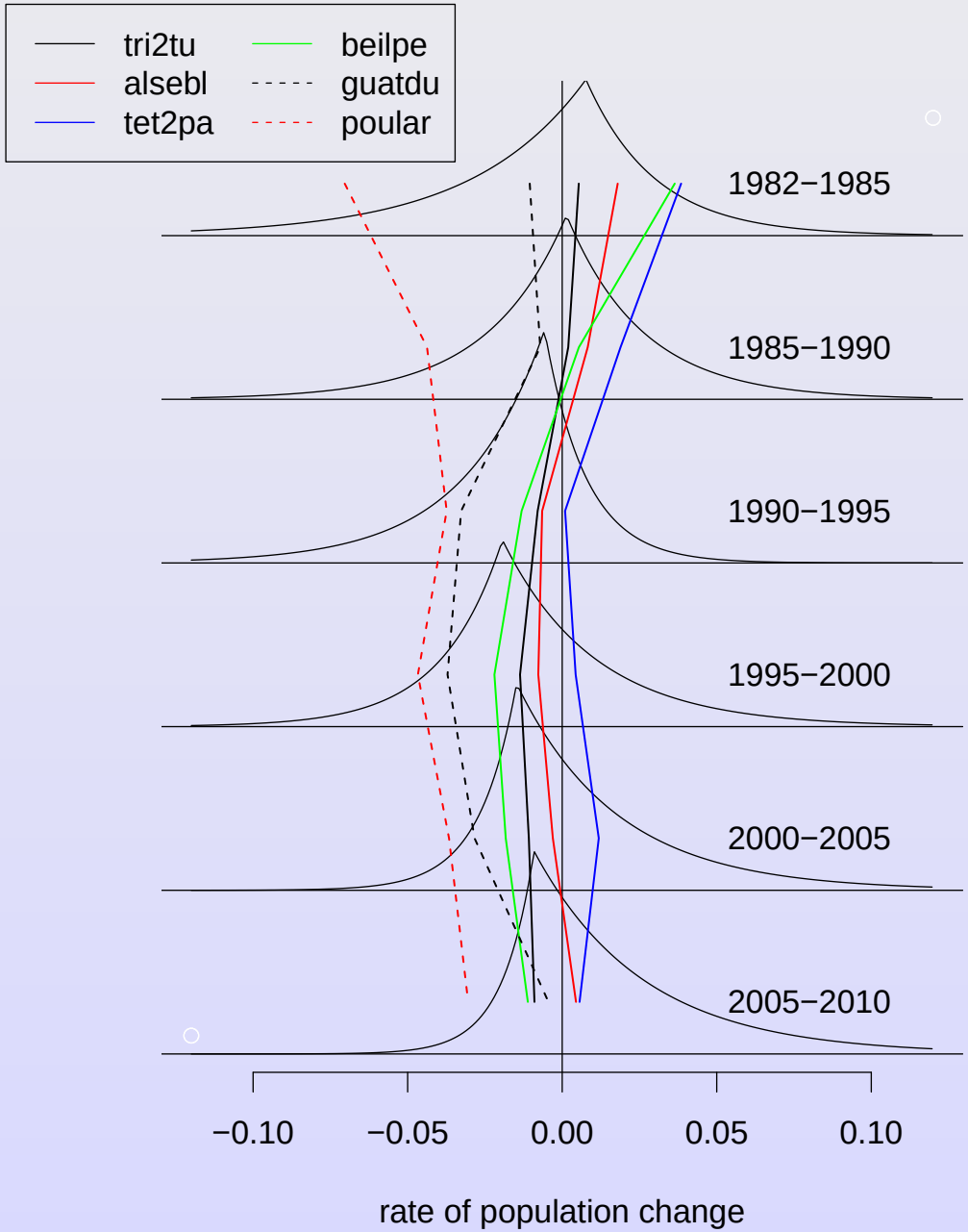

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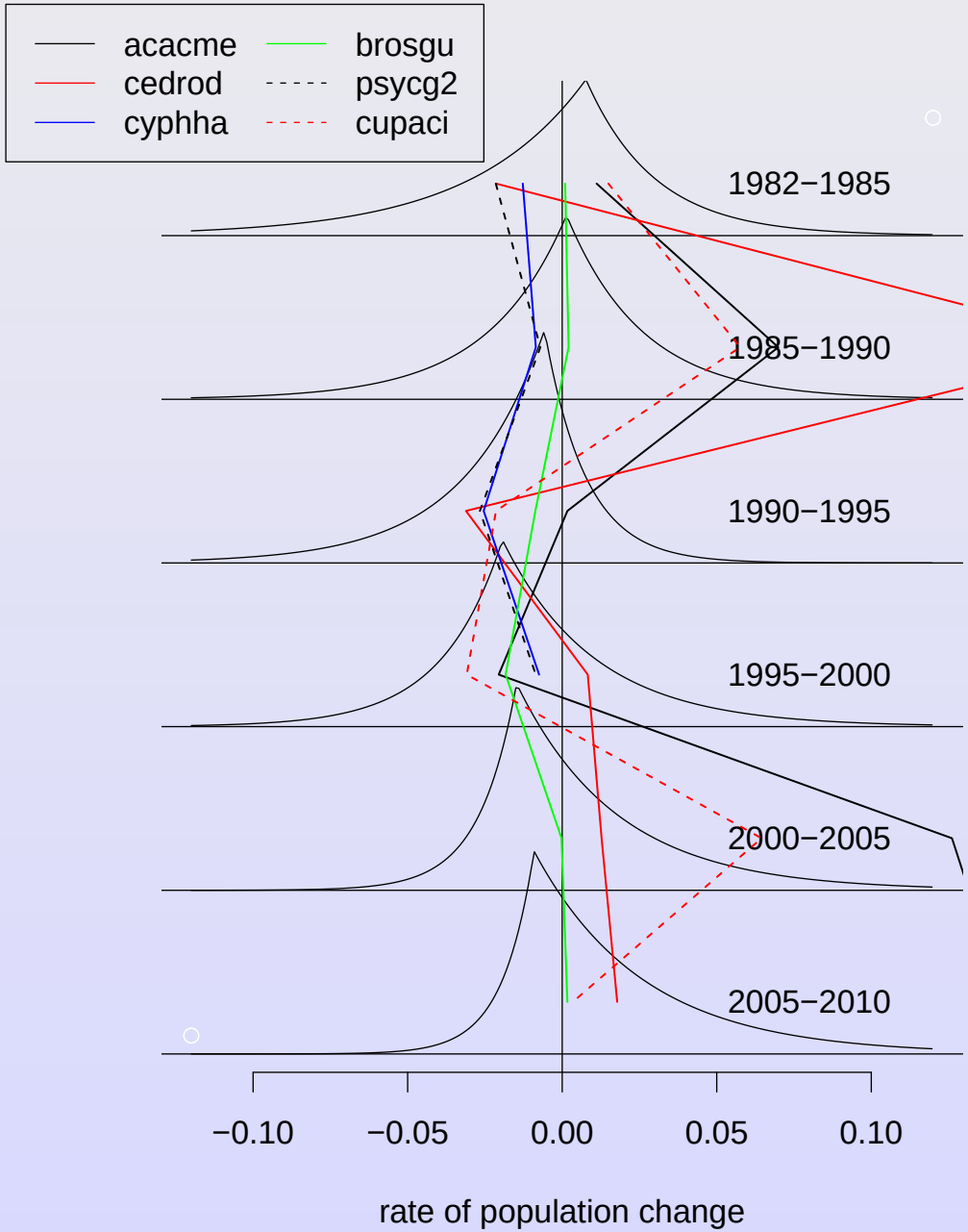
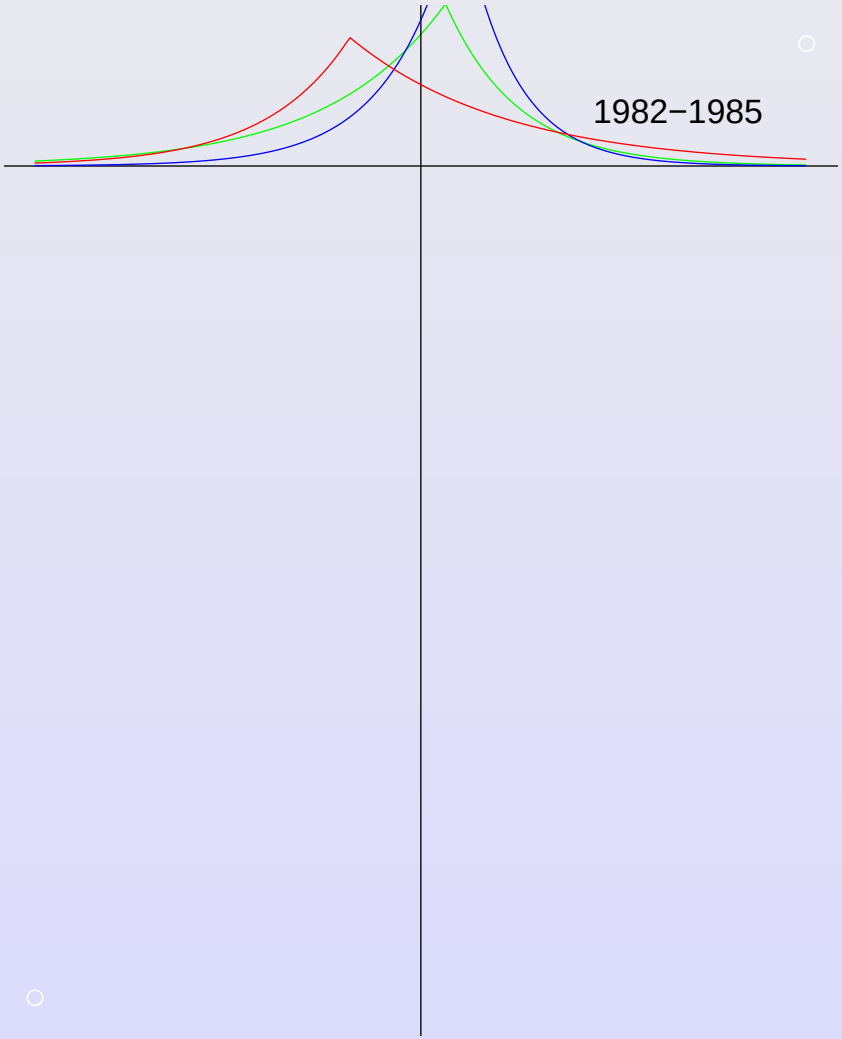


Fluctuations in rare (red) and common (blue) species

Through 30 years

Fluctuations in rare (red) and common (blue) species



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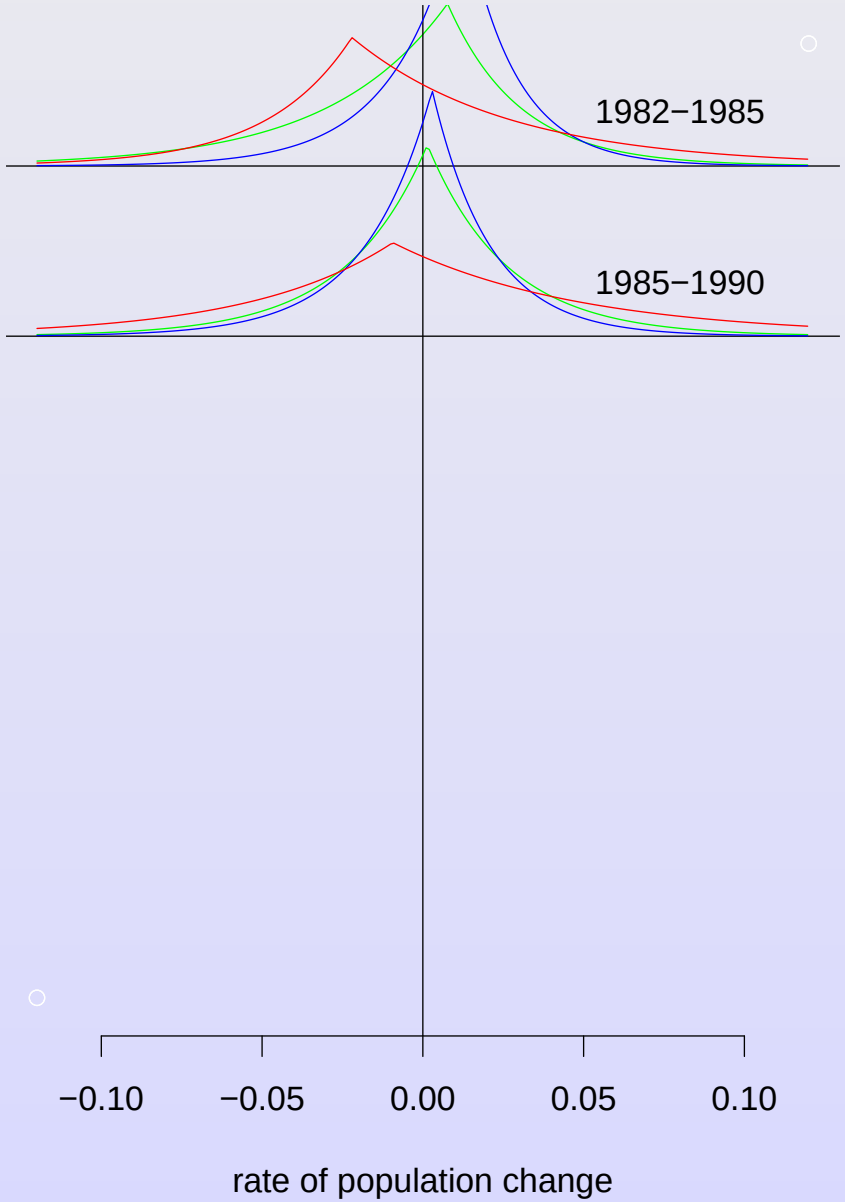

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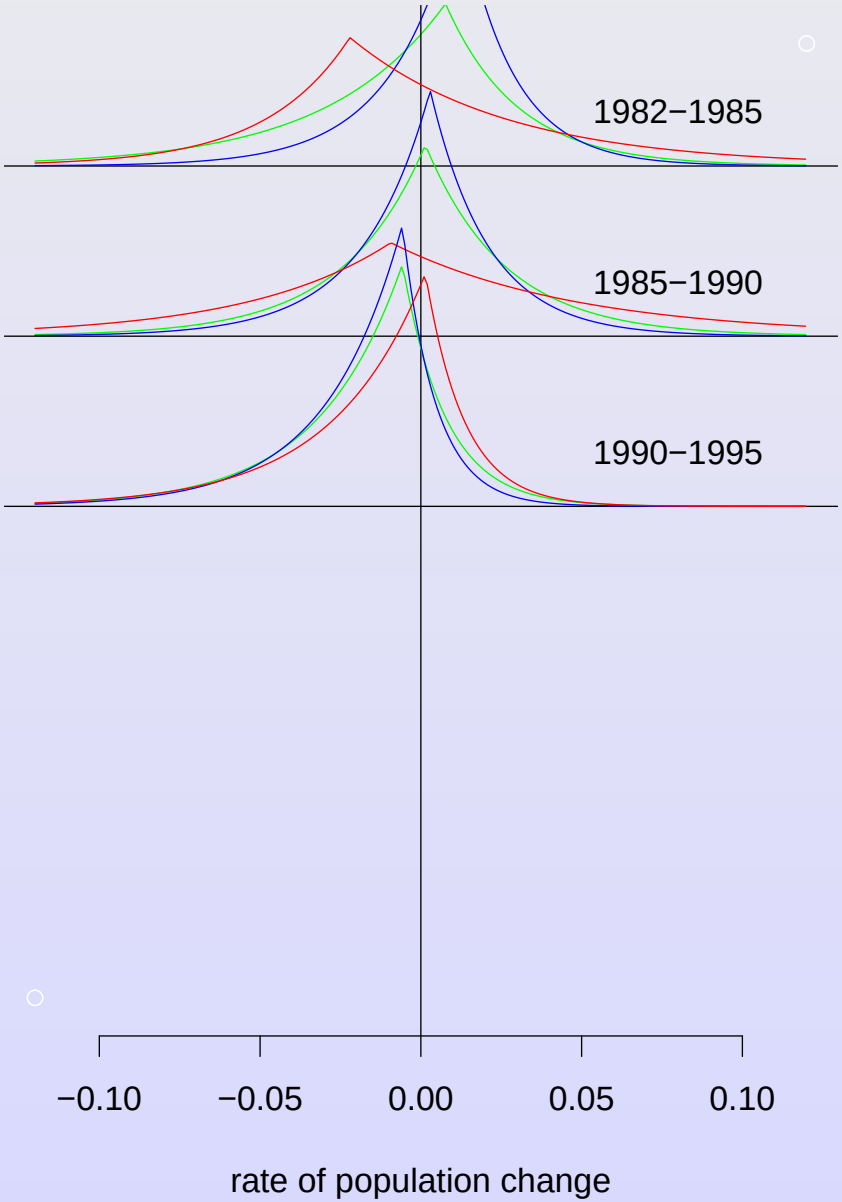

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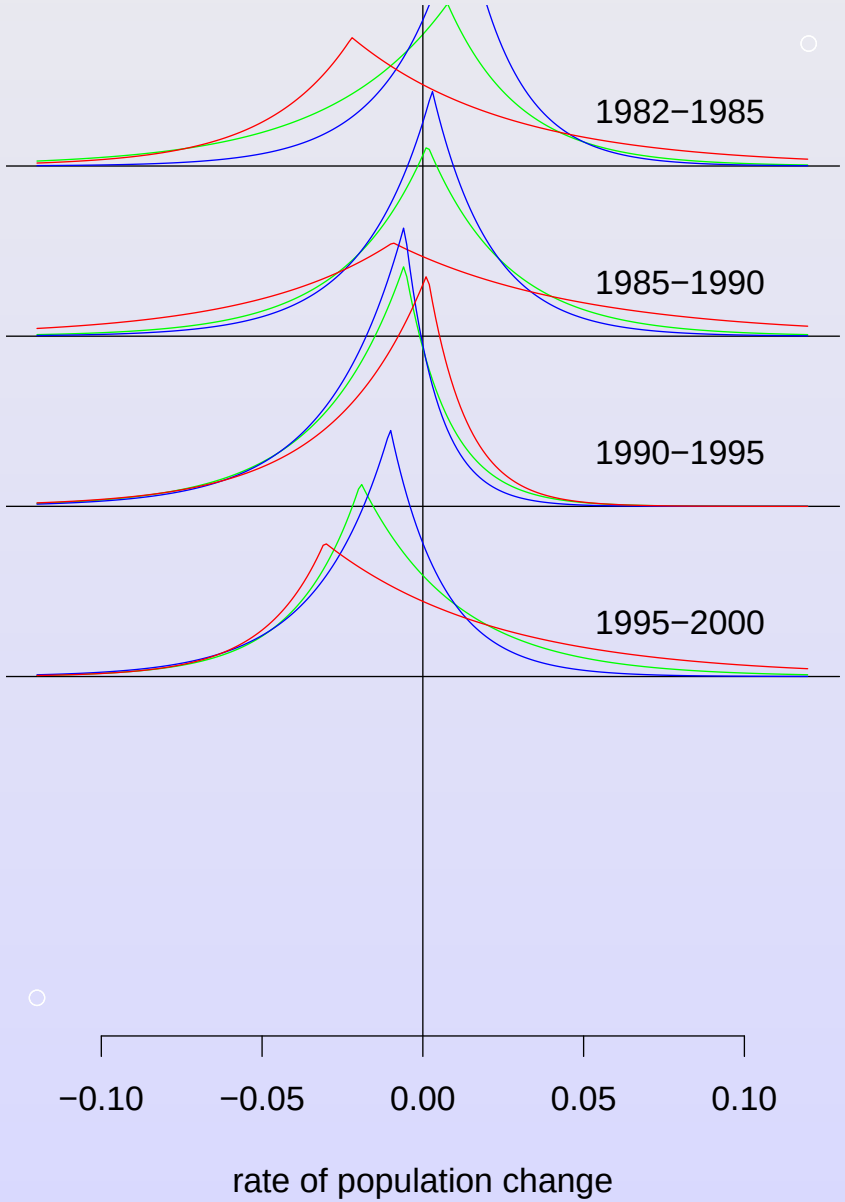

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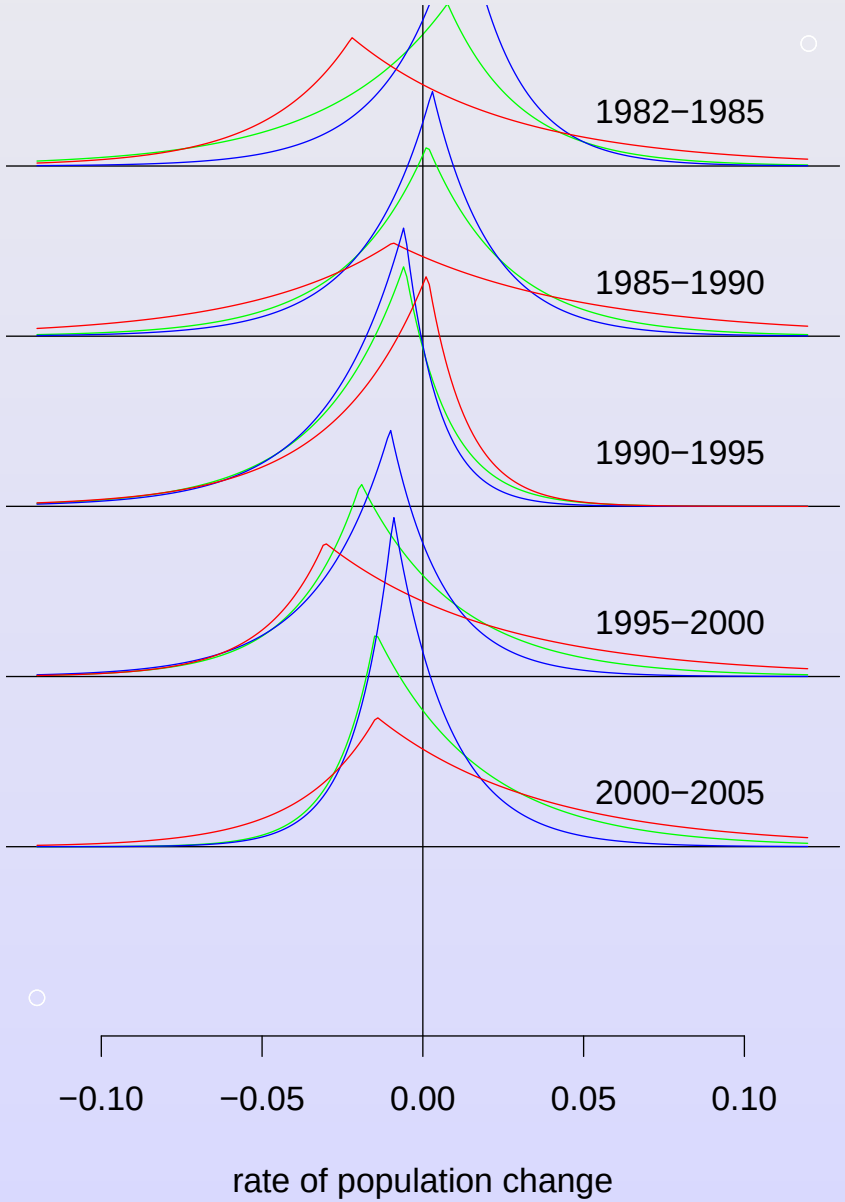

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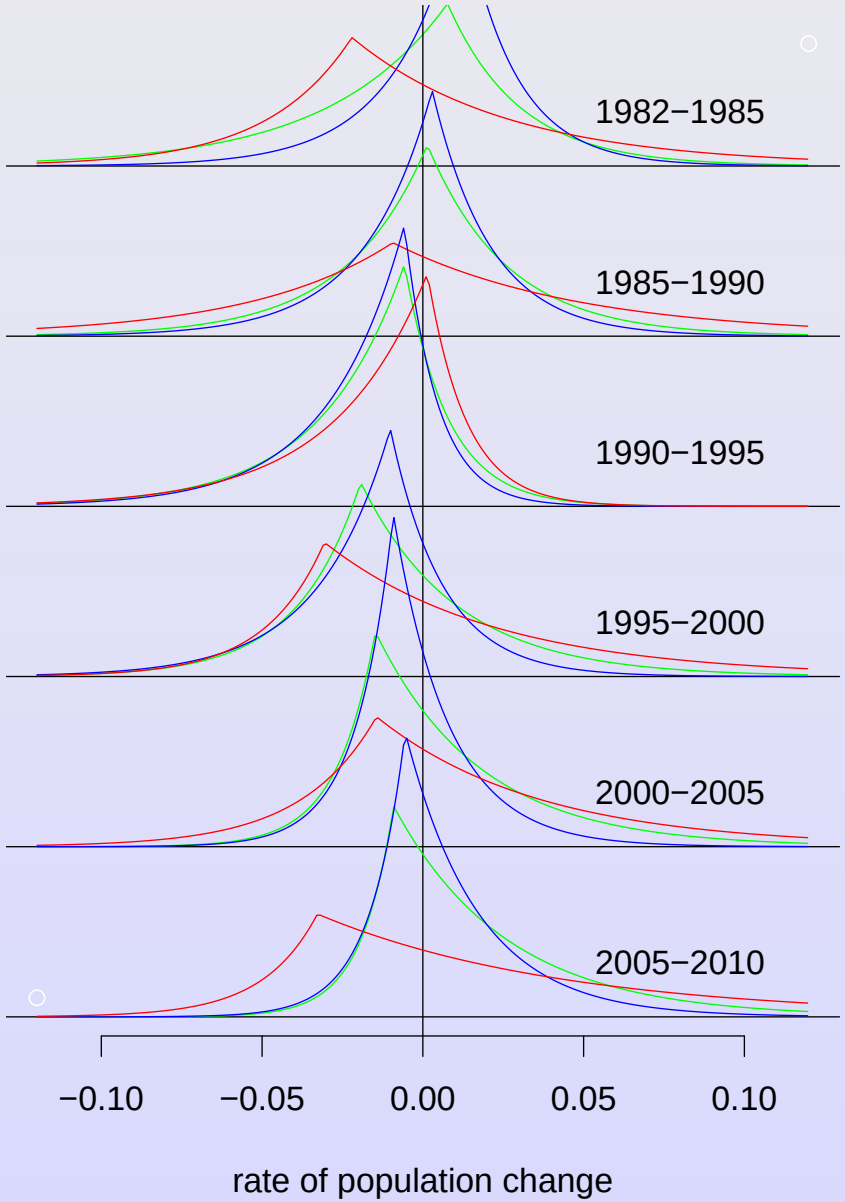
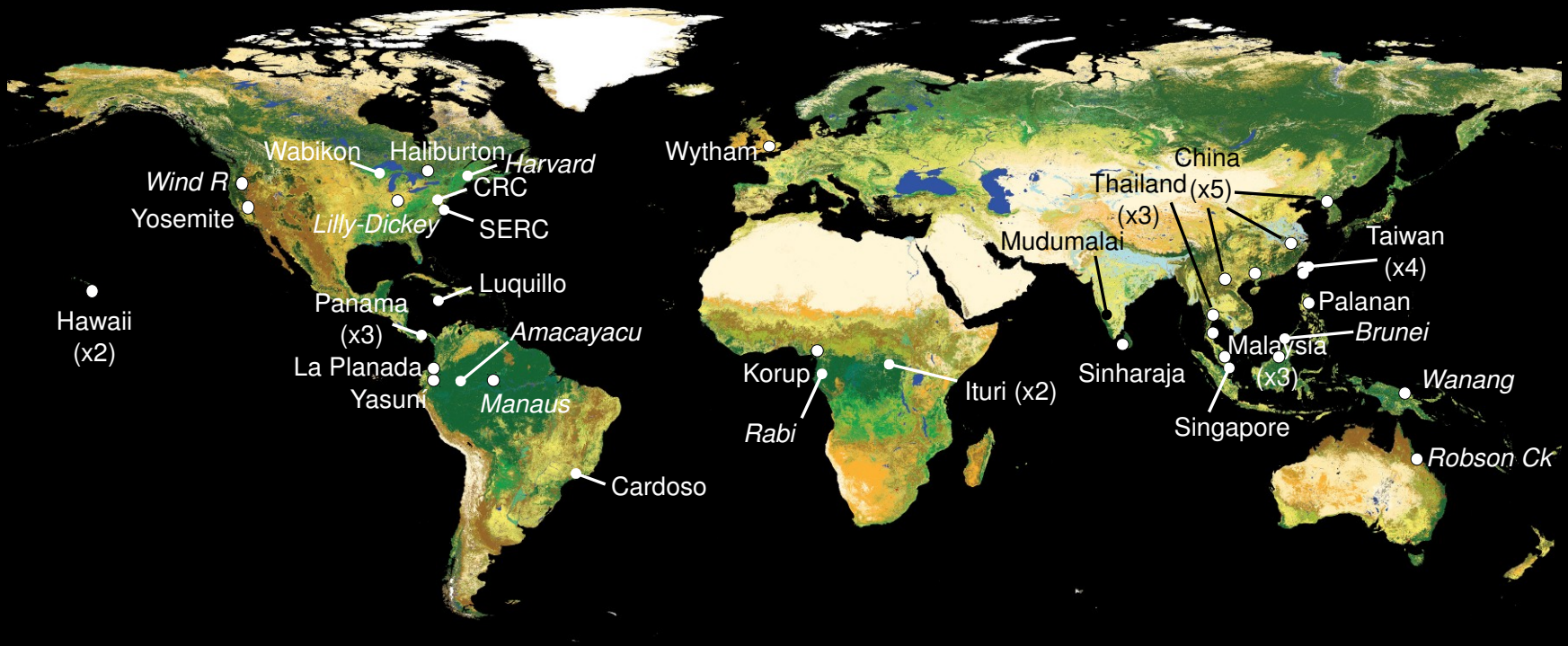


How do other forests compare to BCI?

The CTFS-SIGEO-CForBio plot network and the NSF-NSFC Changbai working group

- Assemble data in common format
- Encourage broad comparisons

SIGEO-CTFS-CForBio: Forest censuses following common methods

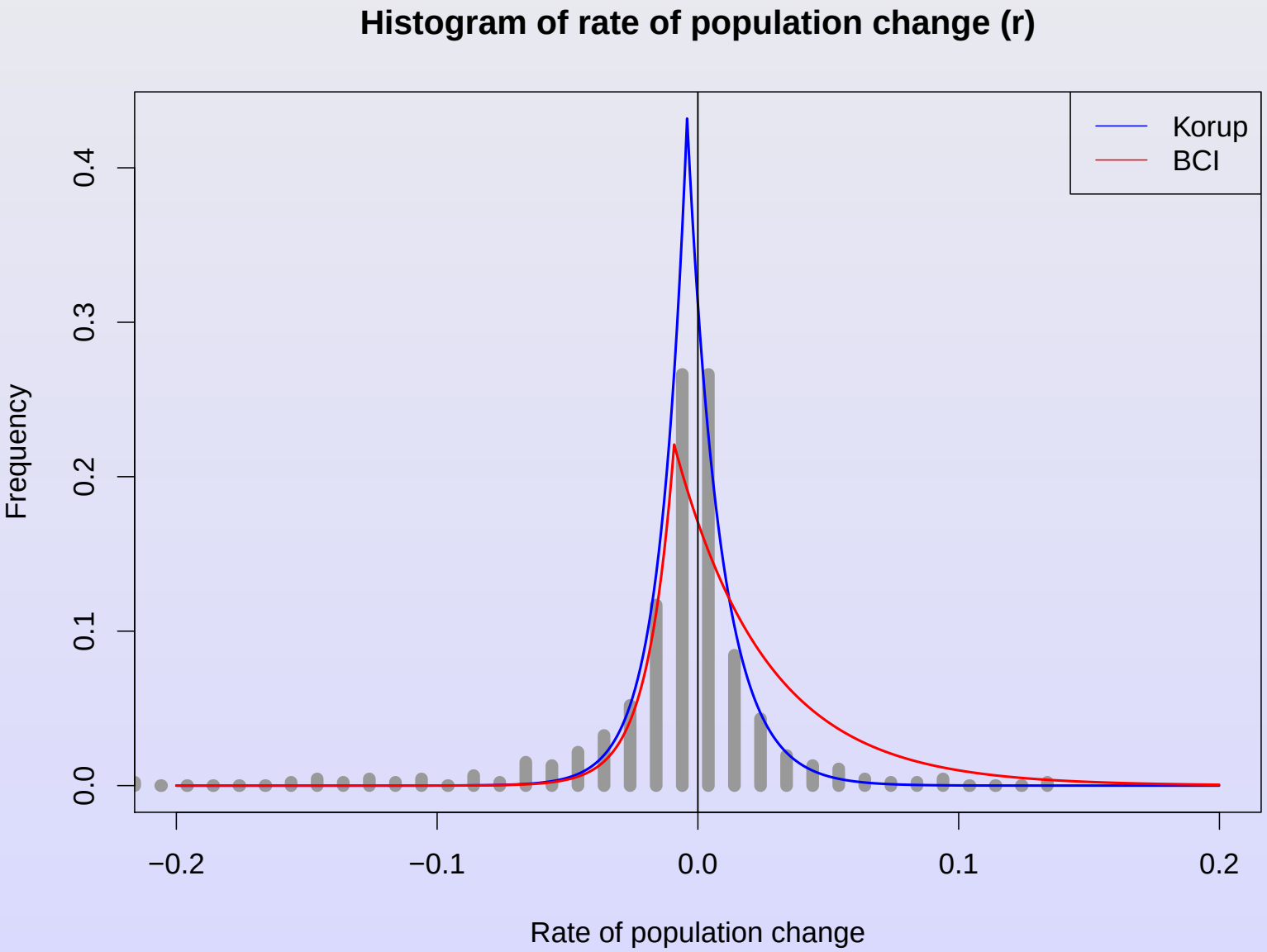


33 completed plots have data in a common database format on one of 4 servers

-- 3,802,654 trees (ie 3.80×10^6)

-- 9,073,531 measurements (ie 9.07×10^6) in 89 plot censuses

Korup, Cameroon (compared to BCI)



contributors
G. Chuyong
D. Kenfack
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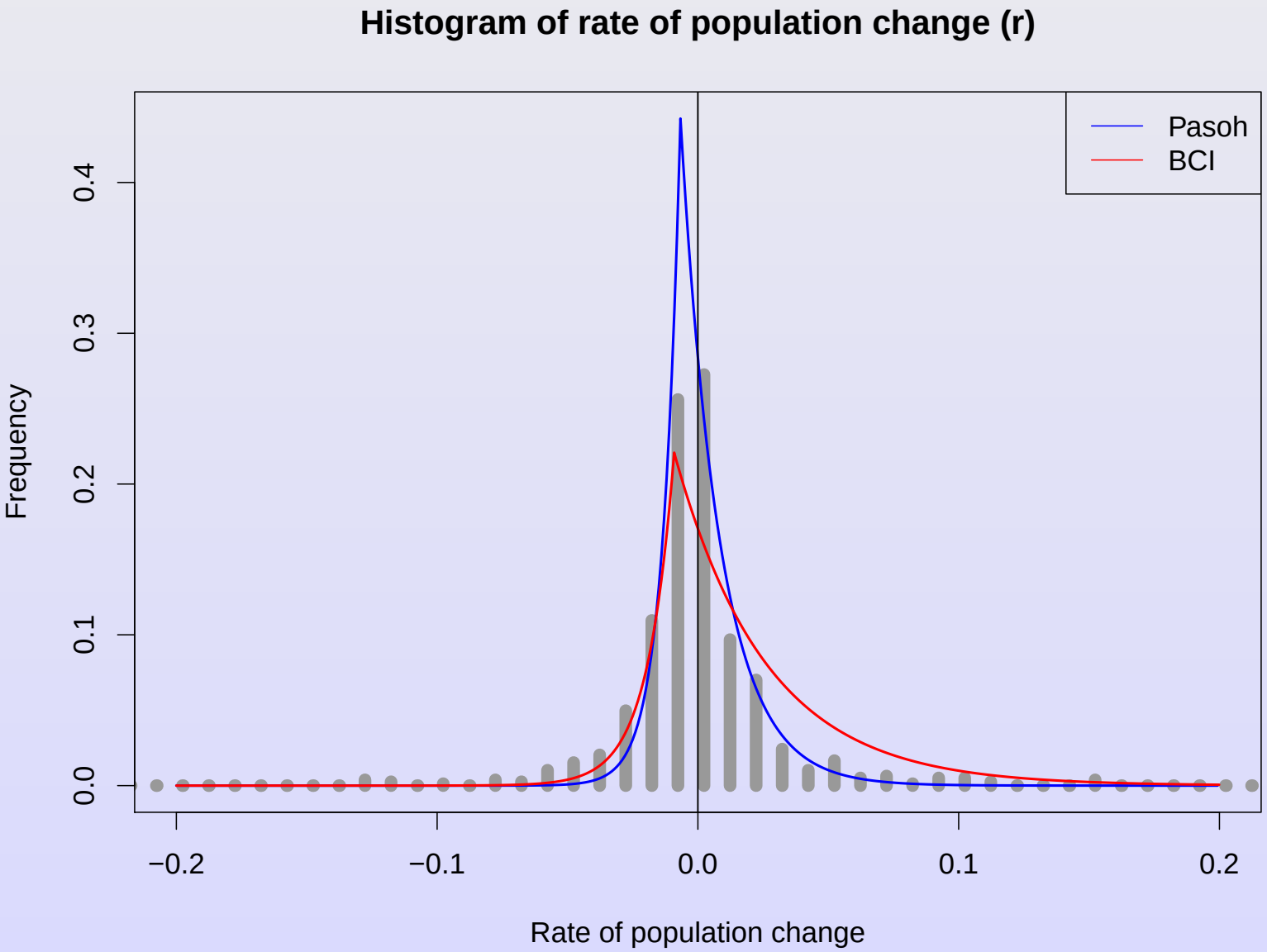
Pasoh, Malaysia (compared to BCI)



contributors
A. Razman
S. Davies
J. Lutz
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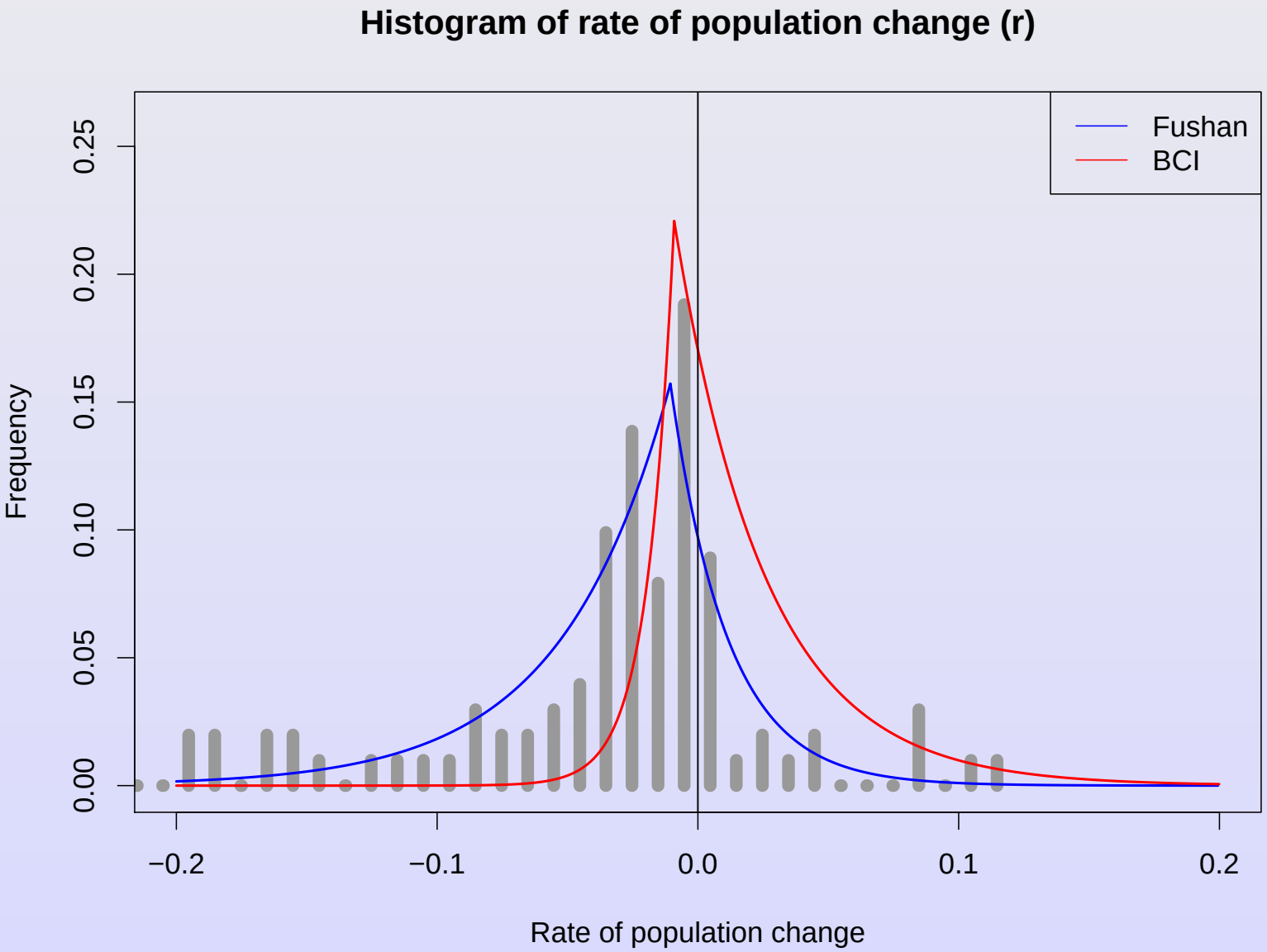
Fushan, Taiwan (compared to BCI)



contributors
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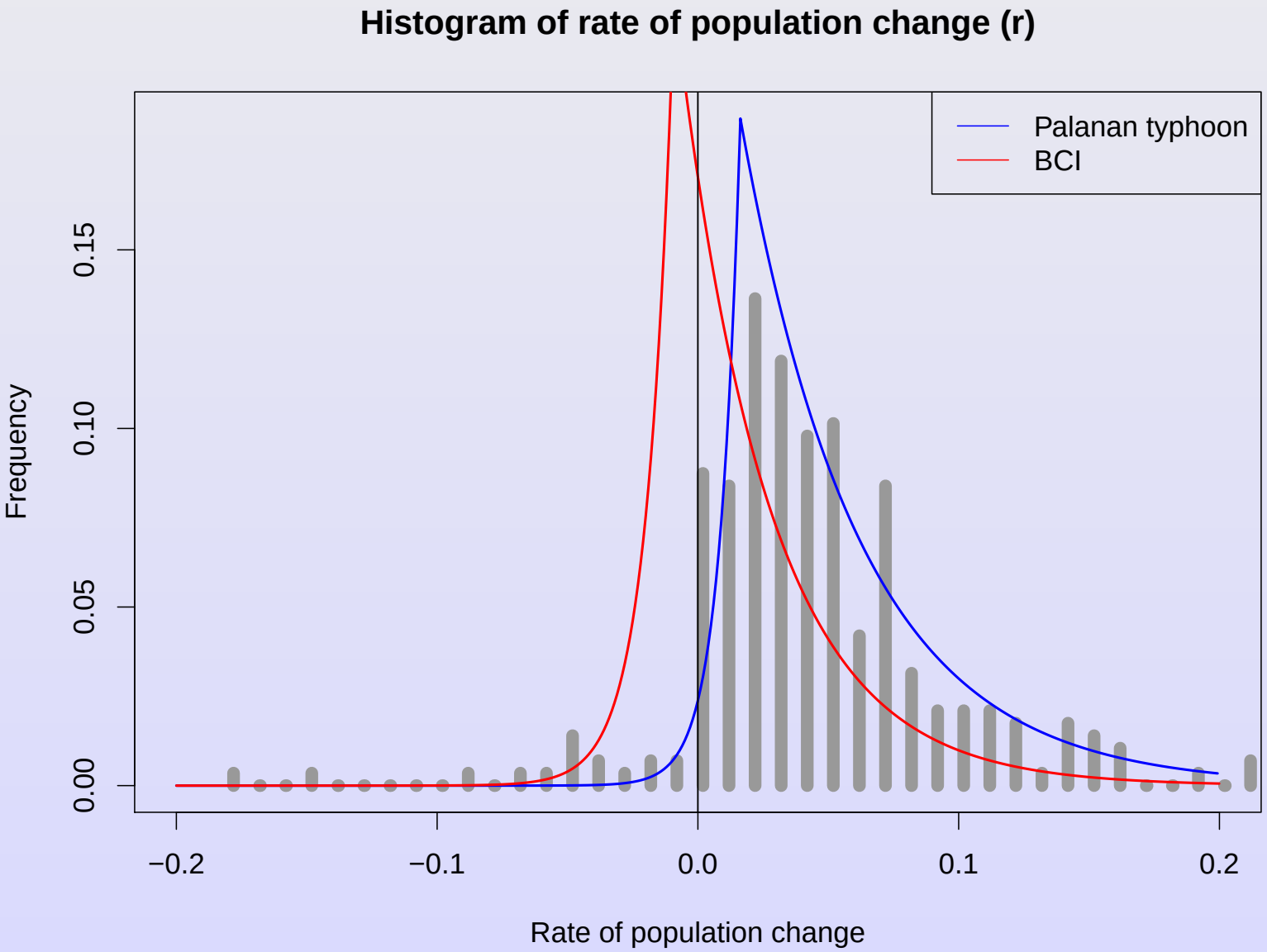
Palanan, Philippines (compared to BCI)



contributors
S. Yap
et al.

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Conclusions

Fluctuations in abundance of tree species

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- Exceed demographic stochasticity in all forests studied

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  drought
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- Underlying variation and long-term shifts not yet explained

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Conclusions

Fluctuations in abundance of tree species

Fluctuations in species abundances greatly exceed fluctuations in the entire forest

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- Exceed demographic stochasticity in all forests studied
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BCI Plot 30 years