

Impacts of Forest Fragmentation on Floristics and Carbon Storage

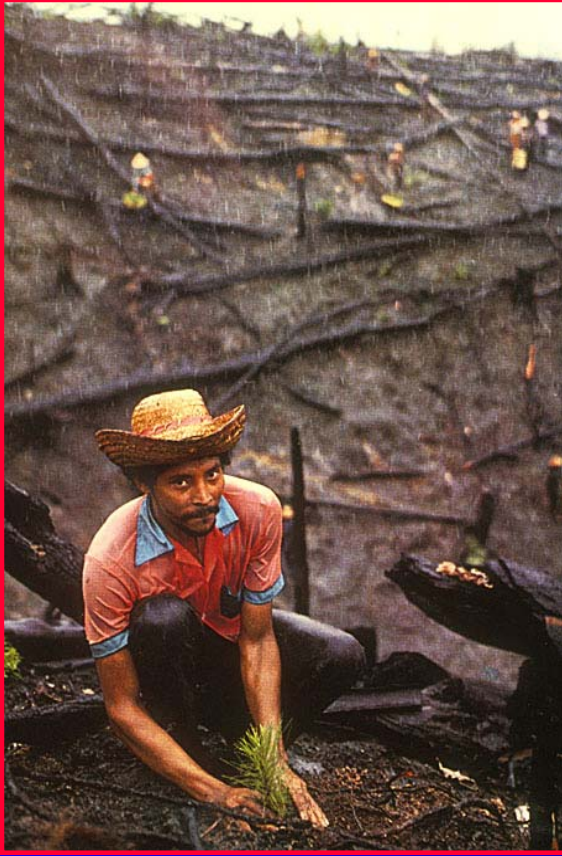
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Manaus, Brazil

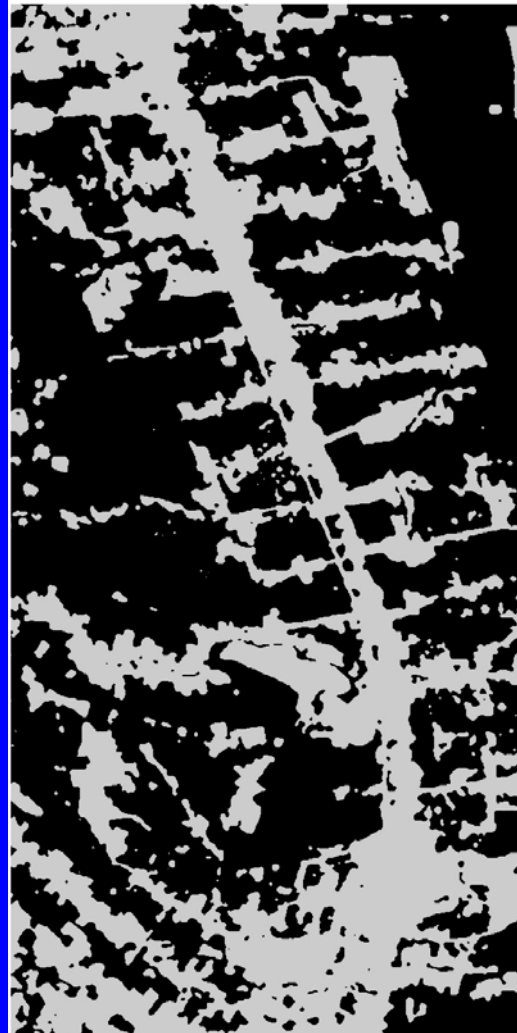


Rapid Forest Destruction in Amazonia

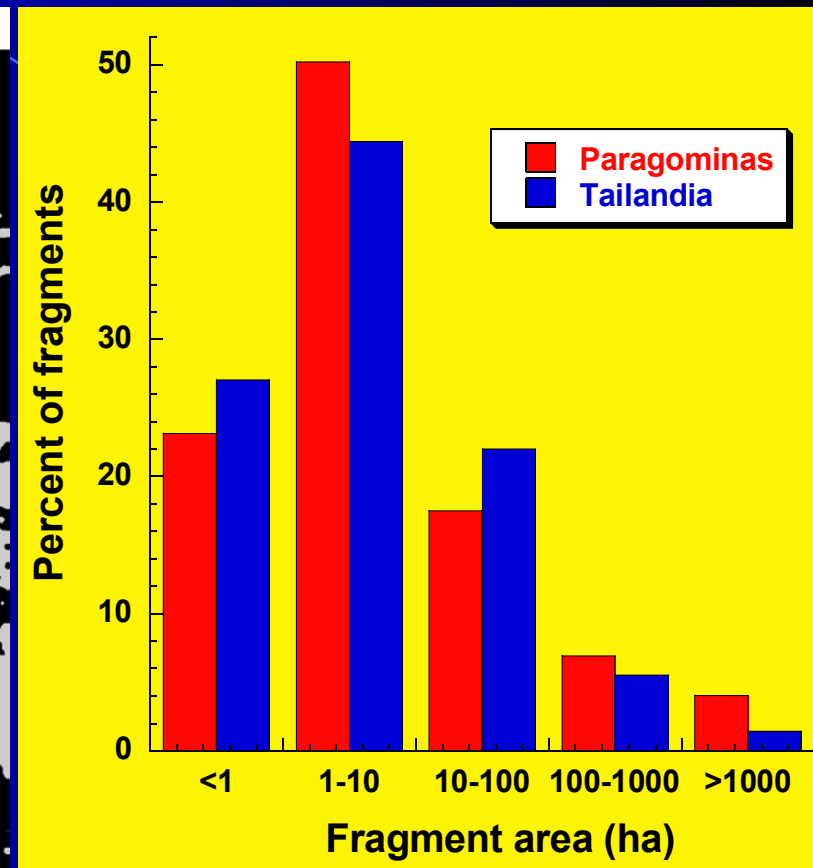
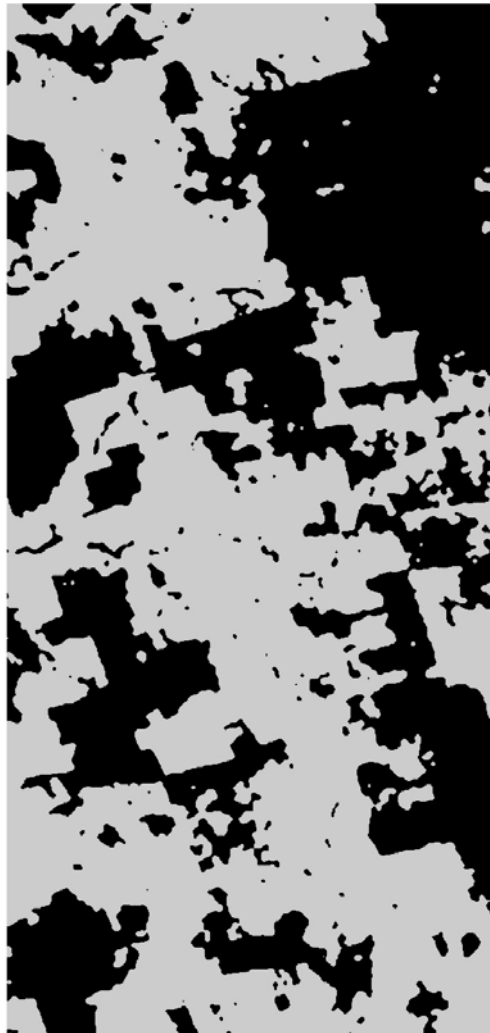


Fragmented Landscapes

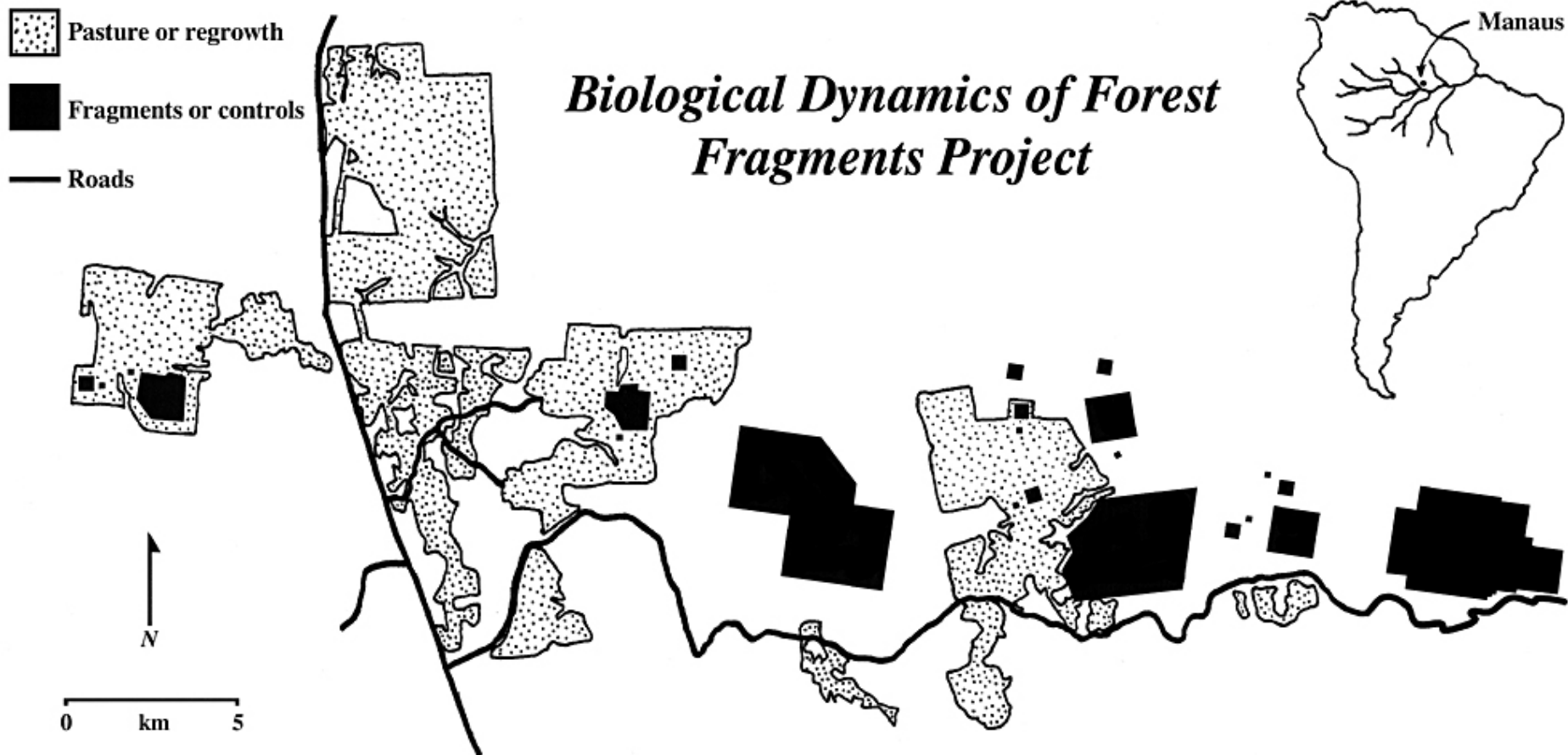
Tailândia



Paragominas



20,000 km of new forest edge created each year



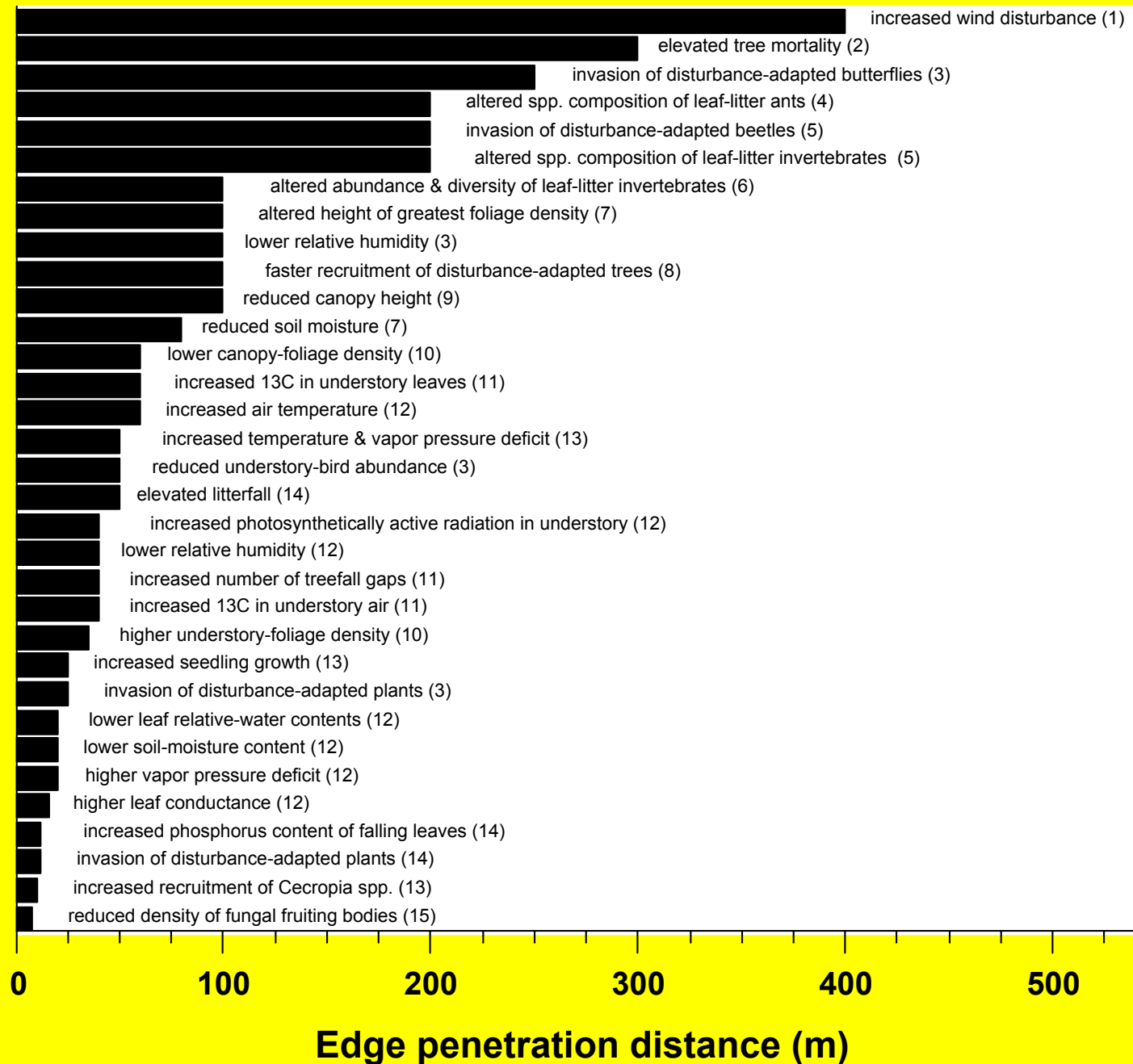
- Initiated in 1979, operated cooperatively by INPA and STRI
- Pre-fragmentation censuses of many taxa
- No hunting, logging, or significant forest fires

Permanent Plots



- 40 1-ha plots
 - 24 in fragments or near edges
 - 16 in intact-forest interiors
- 32,000 trees (≥ 10 cm dbh) monitored since early 1980s
- Mortality, recruitment, and growth determined during recensuses every 4-6 years
- 95.3% of trees identified
 - 267 genera
 - 1162 species

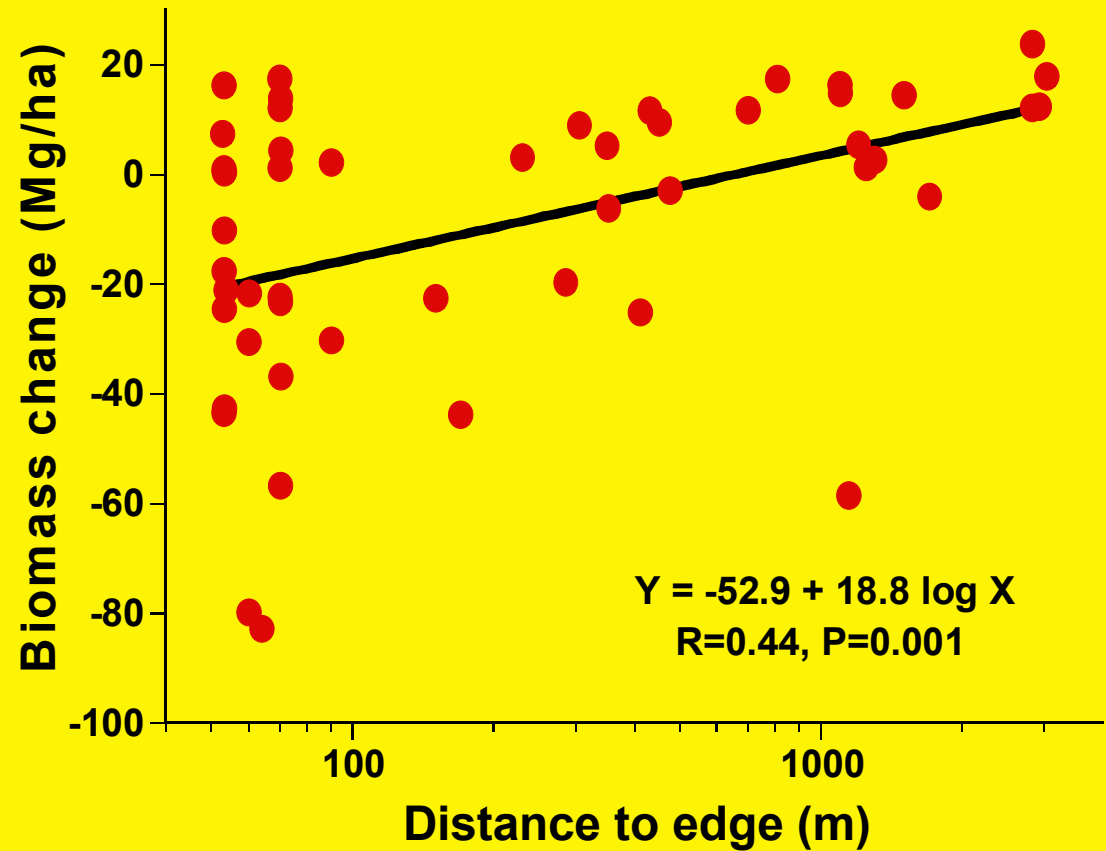
Edge parameter



A photograph of a tall, slender tree trunk in a dense tropical forest. The tree trunk is light-colored, possibly bleached or decaying, with significant peeling and cracking of the bark. It stands prominently in the foreground, reaching towards the top of the frame. The background is filled with lush green foliage, including various types of ferns and other tropical plants, creating a dense canopy. The sky is visible through the upper part of the forest, appearing bright and overcast.

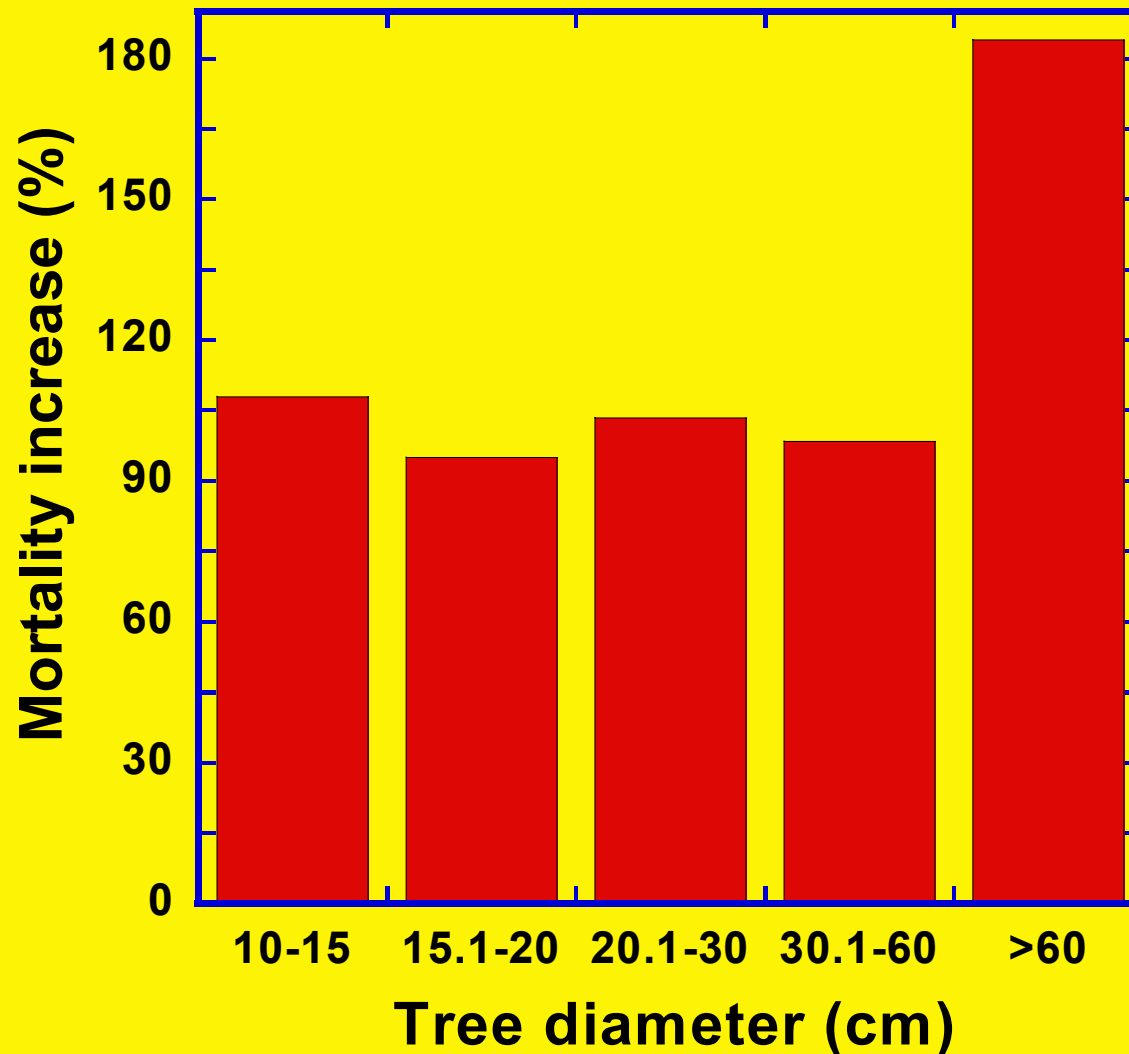


Biomass Collapse



Laurance *et al.* (1997) *Science* 278:1117-1118

Big Trees are Especially Vulnerable

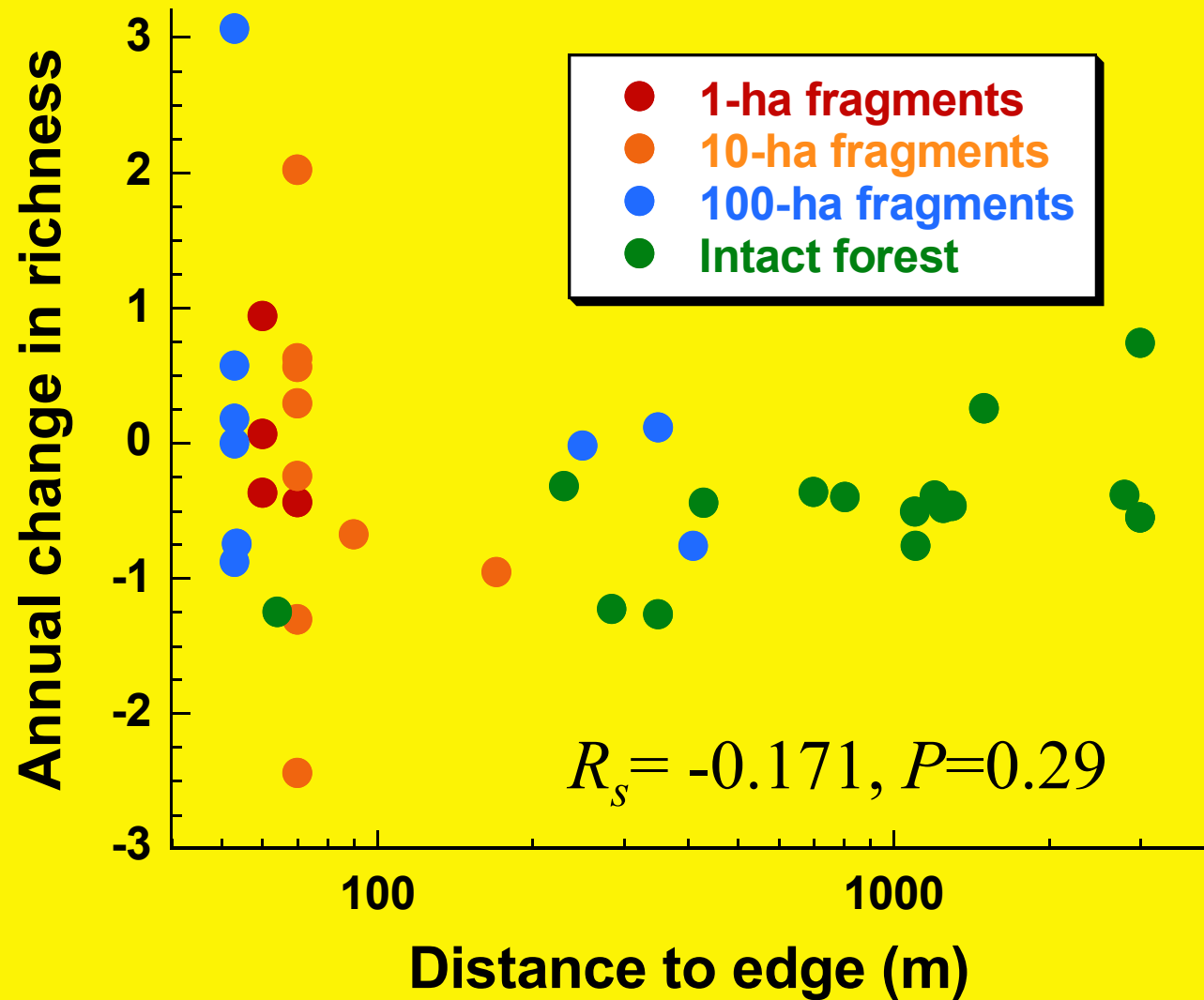


Laurance *et al.* (2000)
Nature 404:836

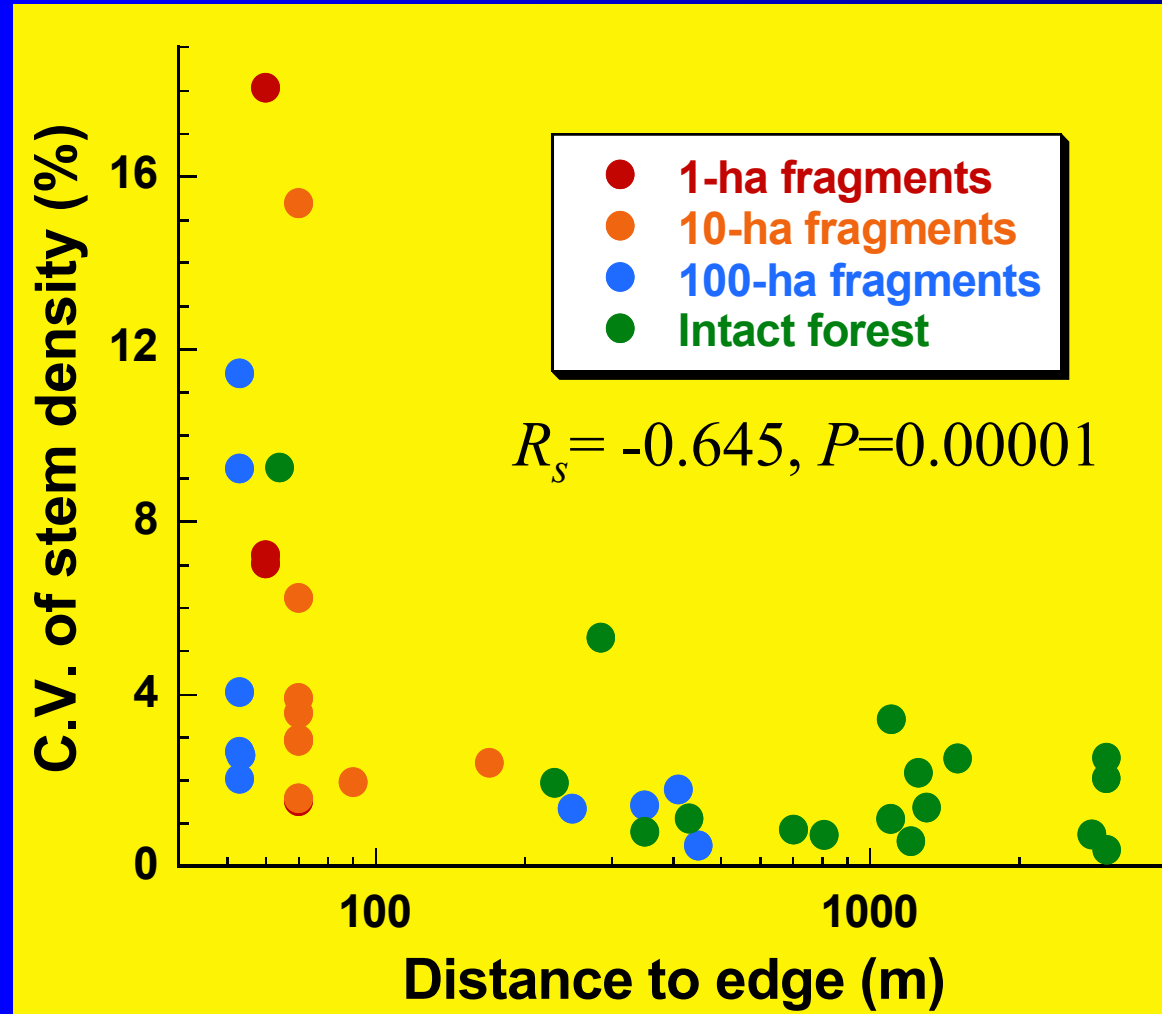
Change in Species Richness



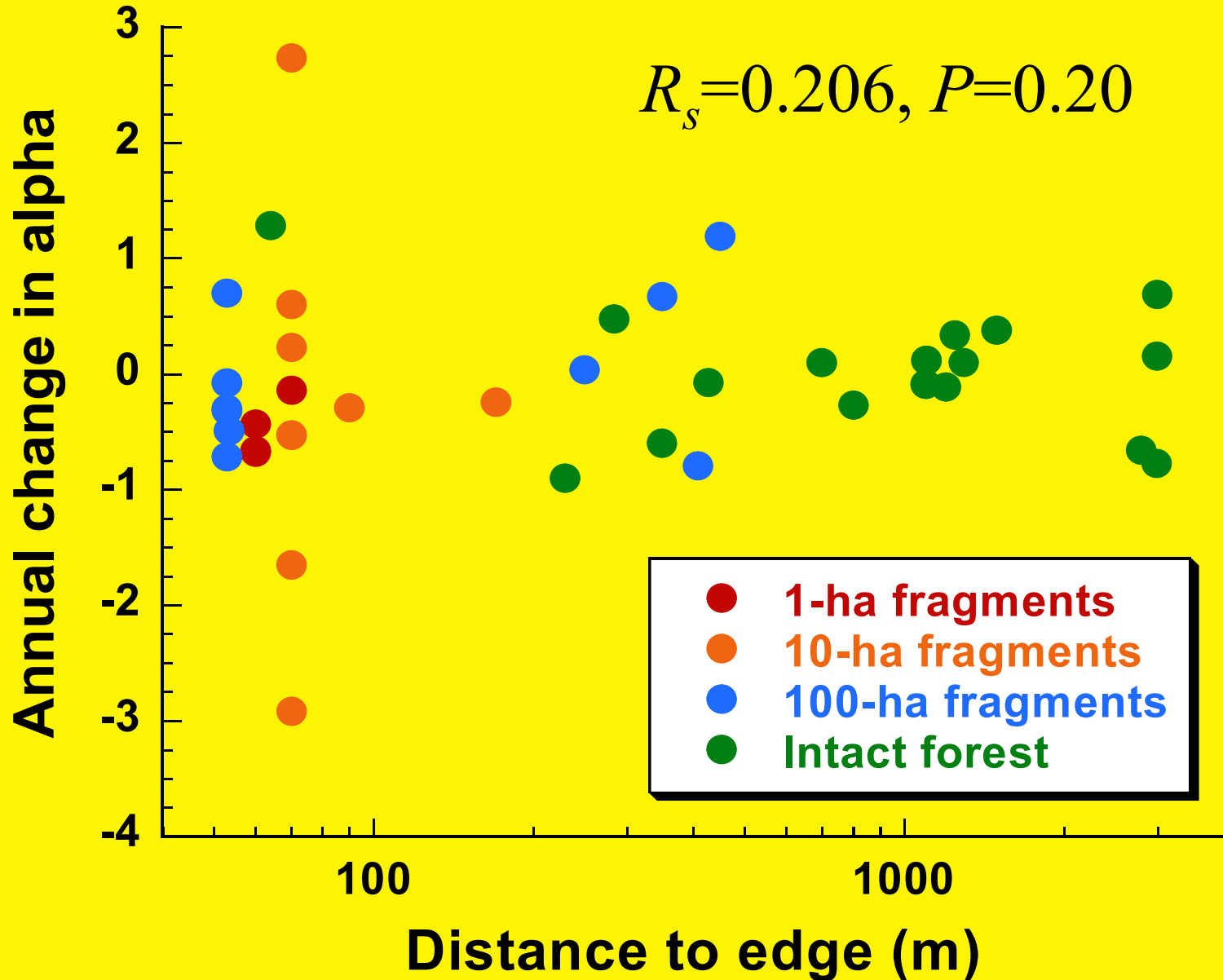
Based on analysis
of 1162 species or
morphospecies



Fluctuating Stem Numbers



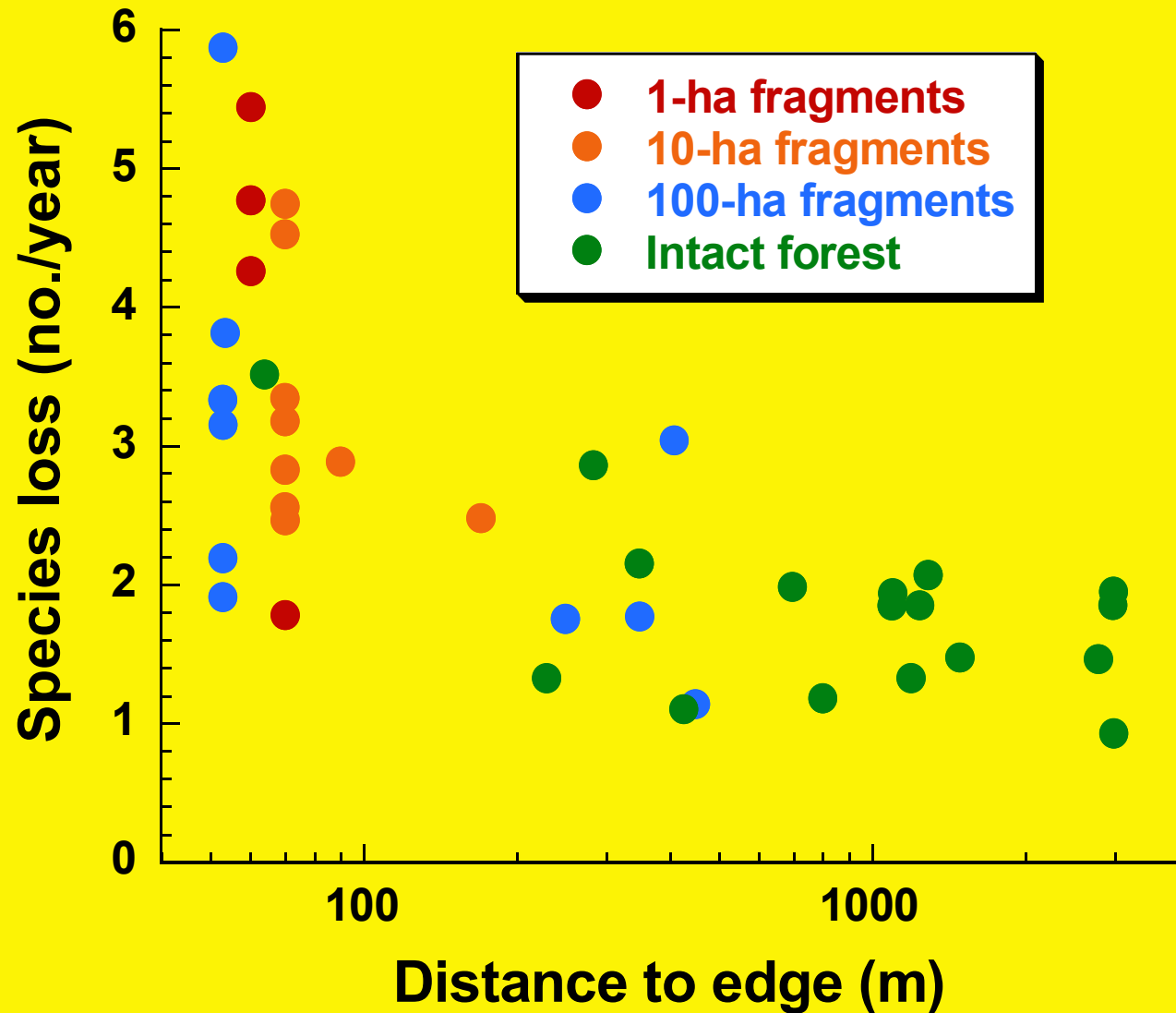
Change in Fisher's Alpha



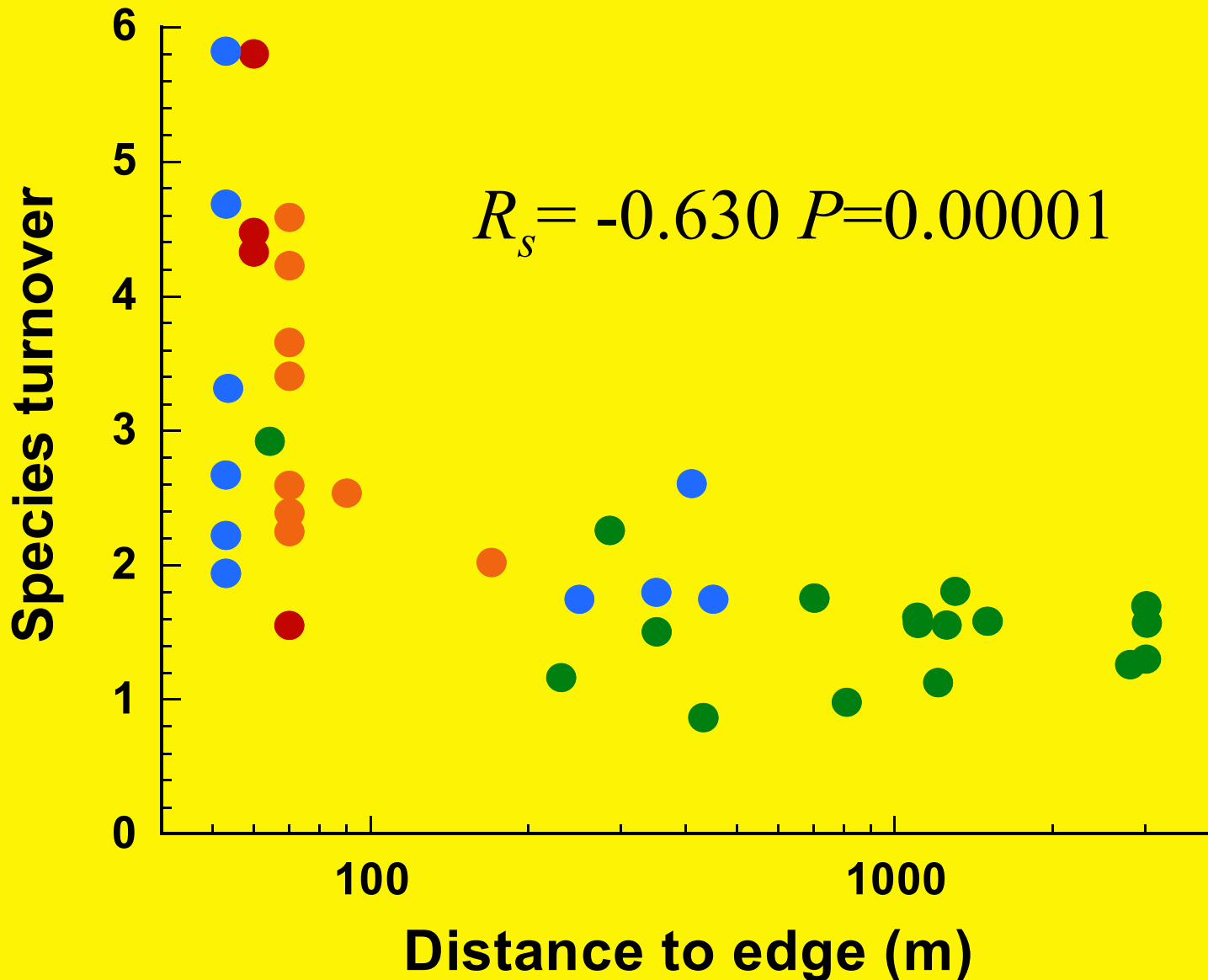
Rate of Species Loss



$$R_s = -0.612$$
$$P = 0.00003$$



Species Turnover



Tree-Size Distributions

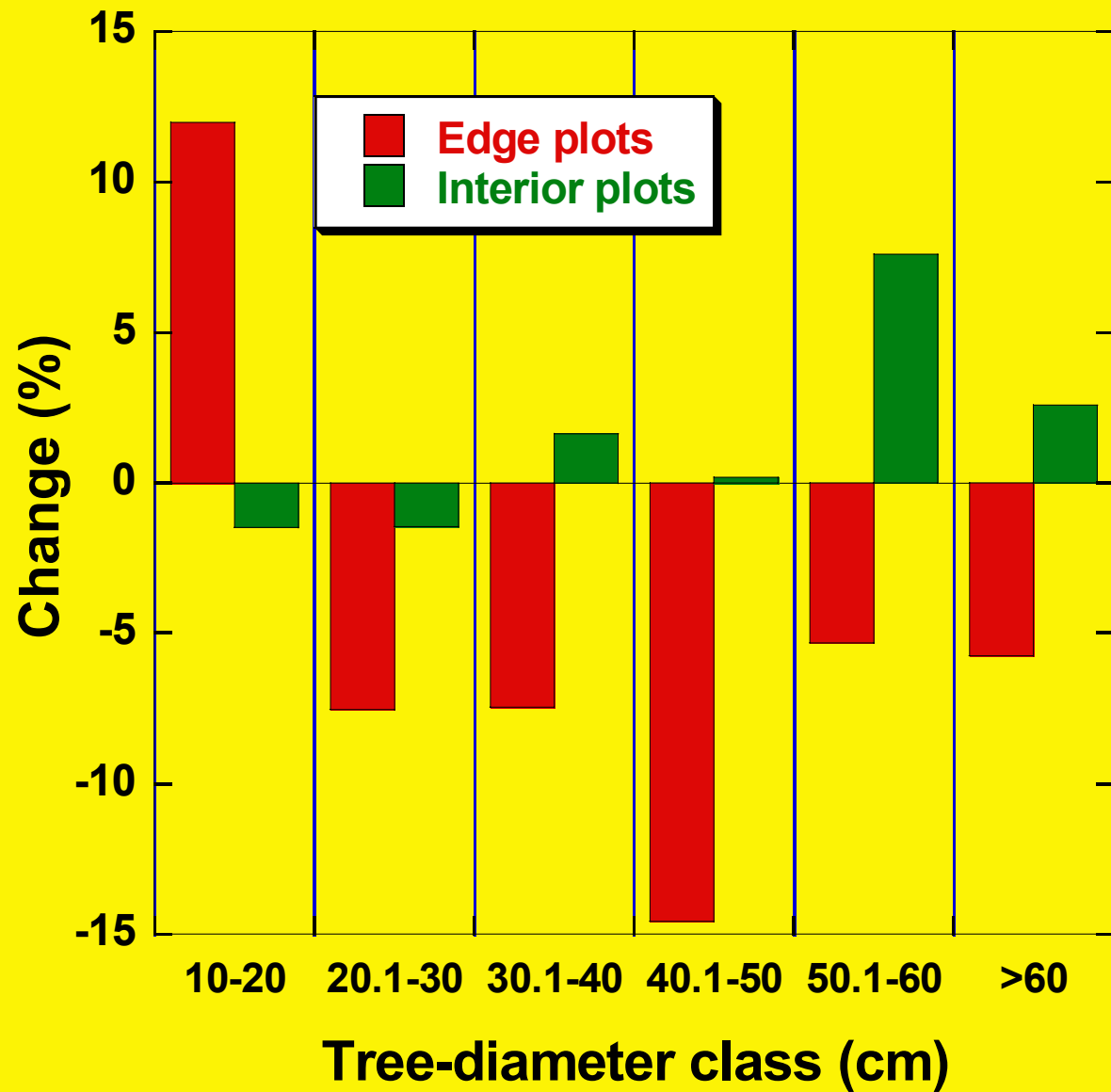


● Edge plots

— $\chi^2=56.4$, $df=5$,
 $P<0.00001$

● Interior plots

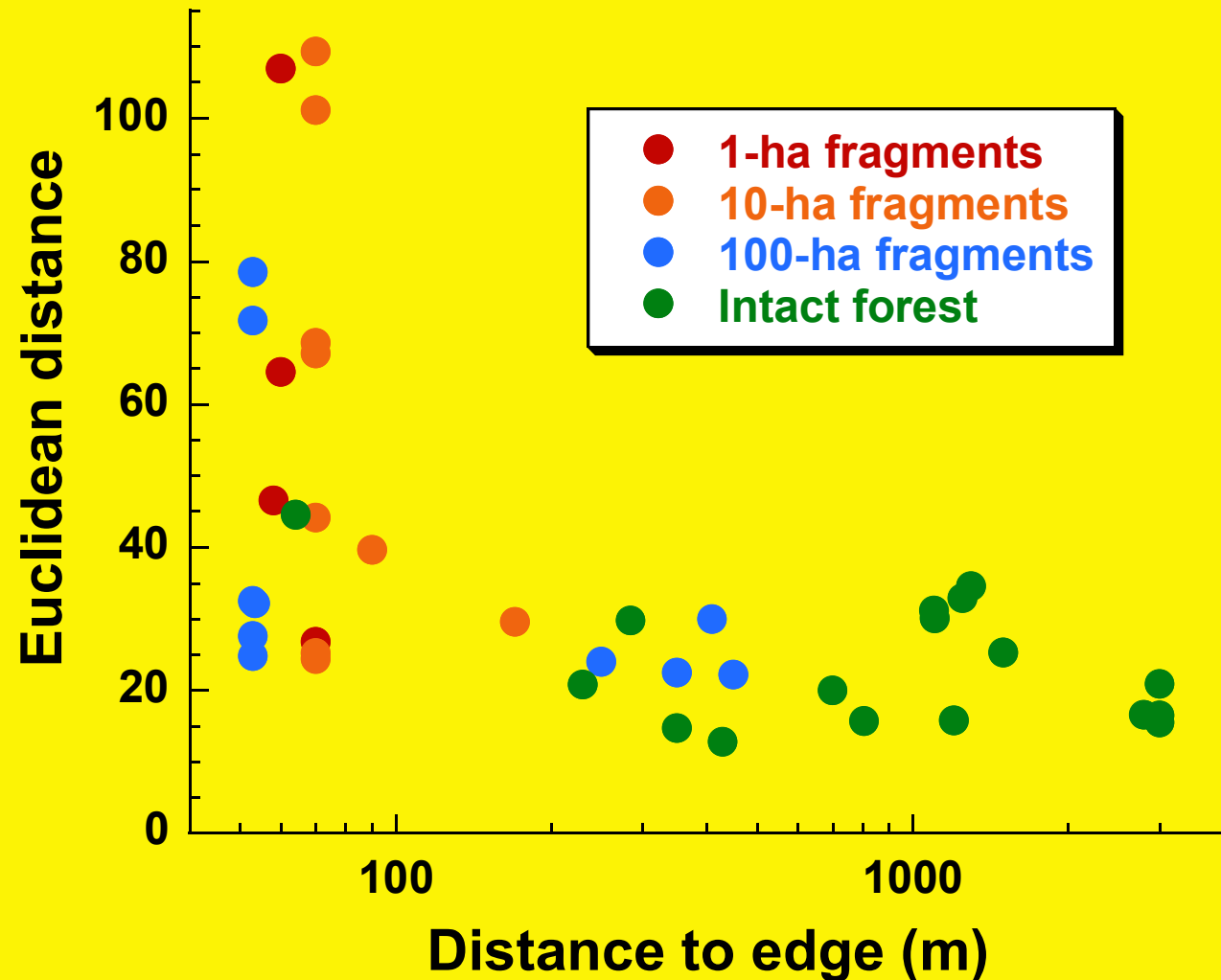
— $\chi^2=1.58$, $df=5$,
 $P=0.90$



Changing Floristic Composition



$$R_s = -0.593$$
$$P = 0.00005$$

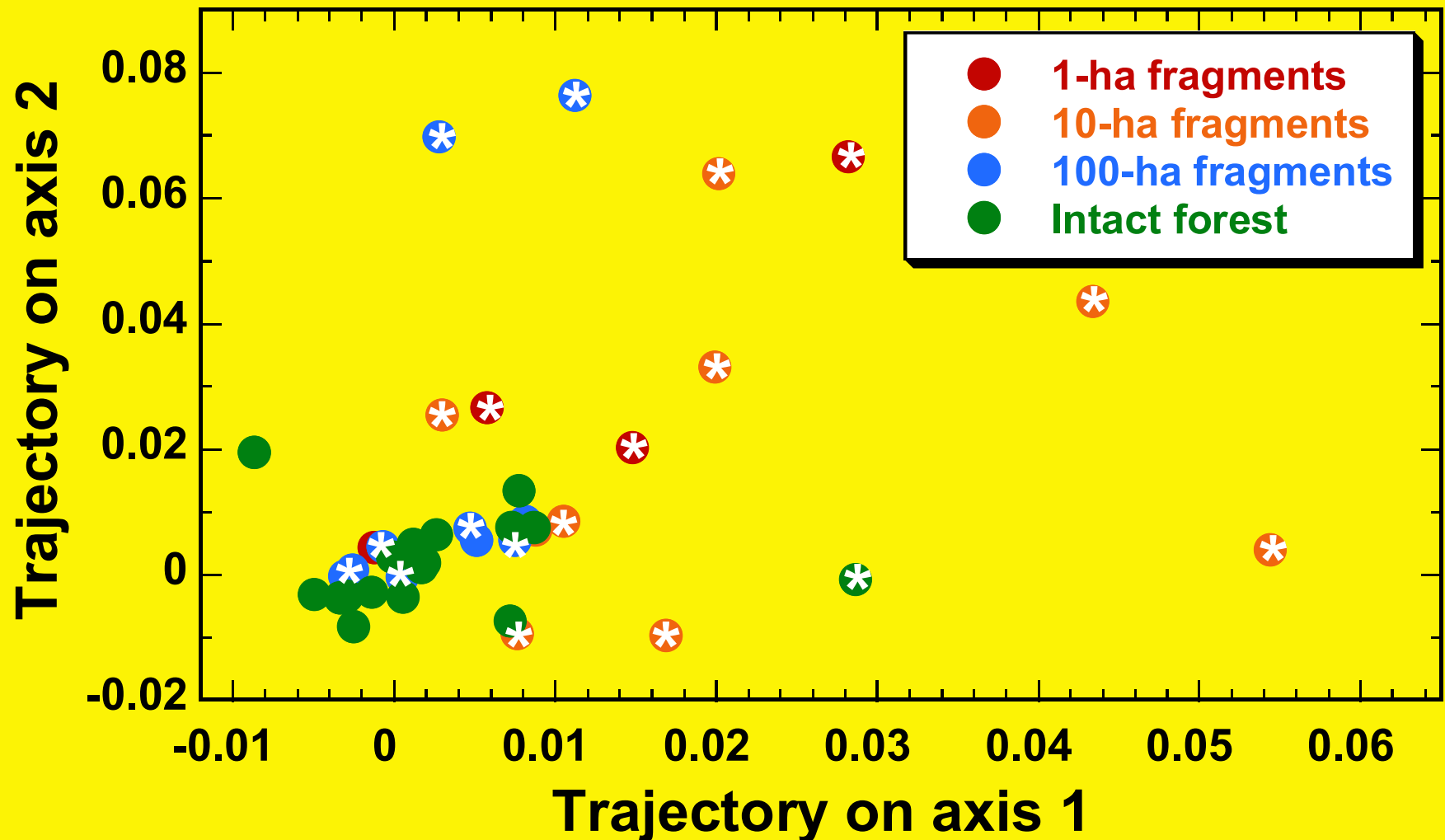


Changes in Abundances of Tree Genera in Fragments

- Bootstrapping analysis ($P \leq 0.01$) of Importance Values
- 141 genera sufficiently common (in ≥ 5 plots) for analysis
 - 15 increased significantly (10.6%)
 - 26 declined significantly (18.4%)
- Average magnitude of change across all genera far larger than in intact forest (38.3% vs. 10.7%)

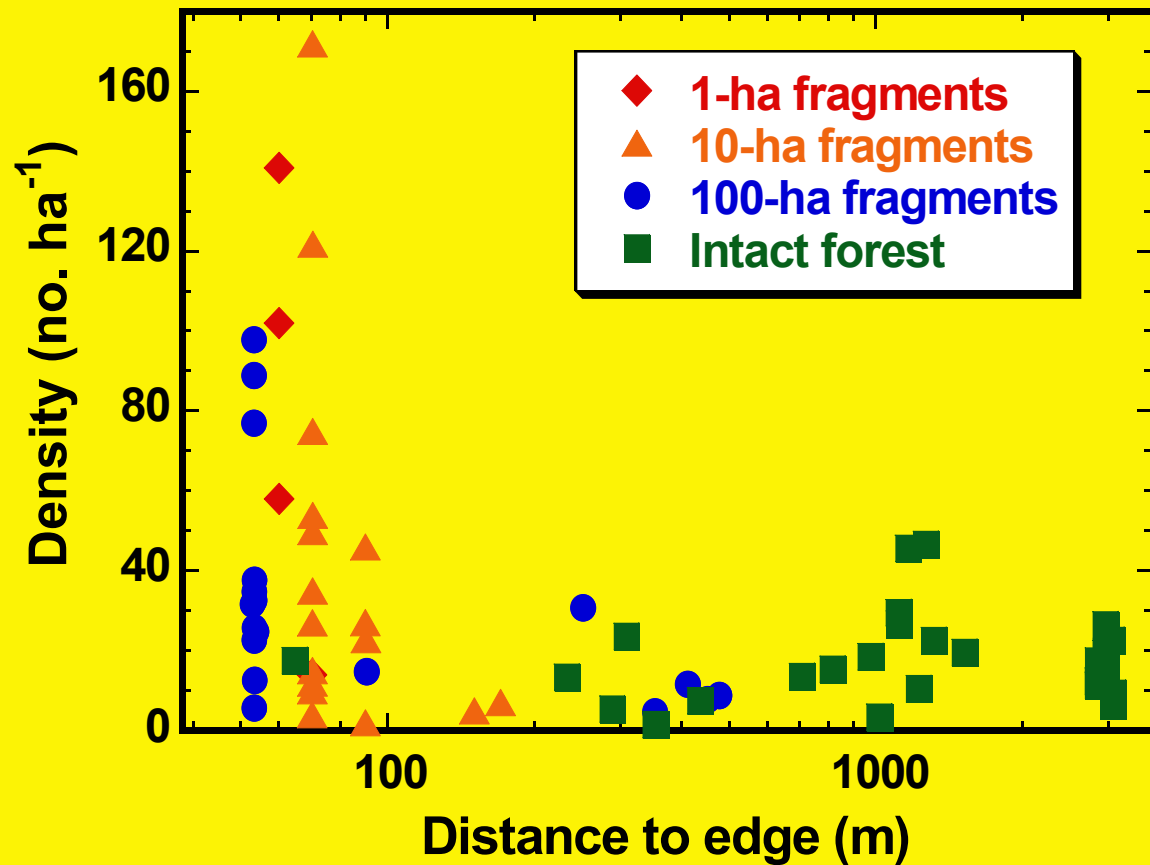


Floristic Changes are Highly Non-random



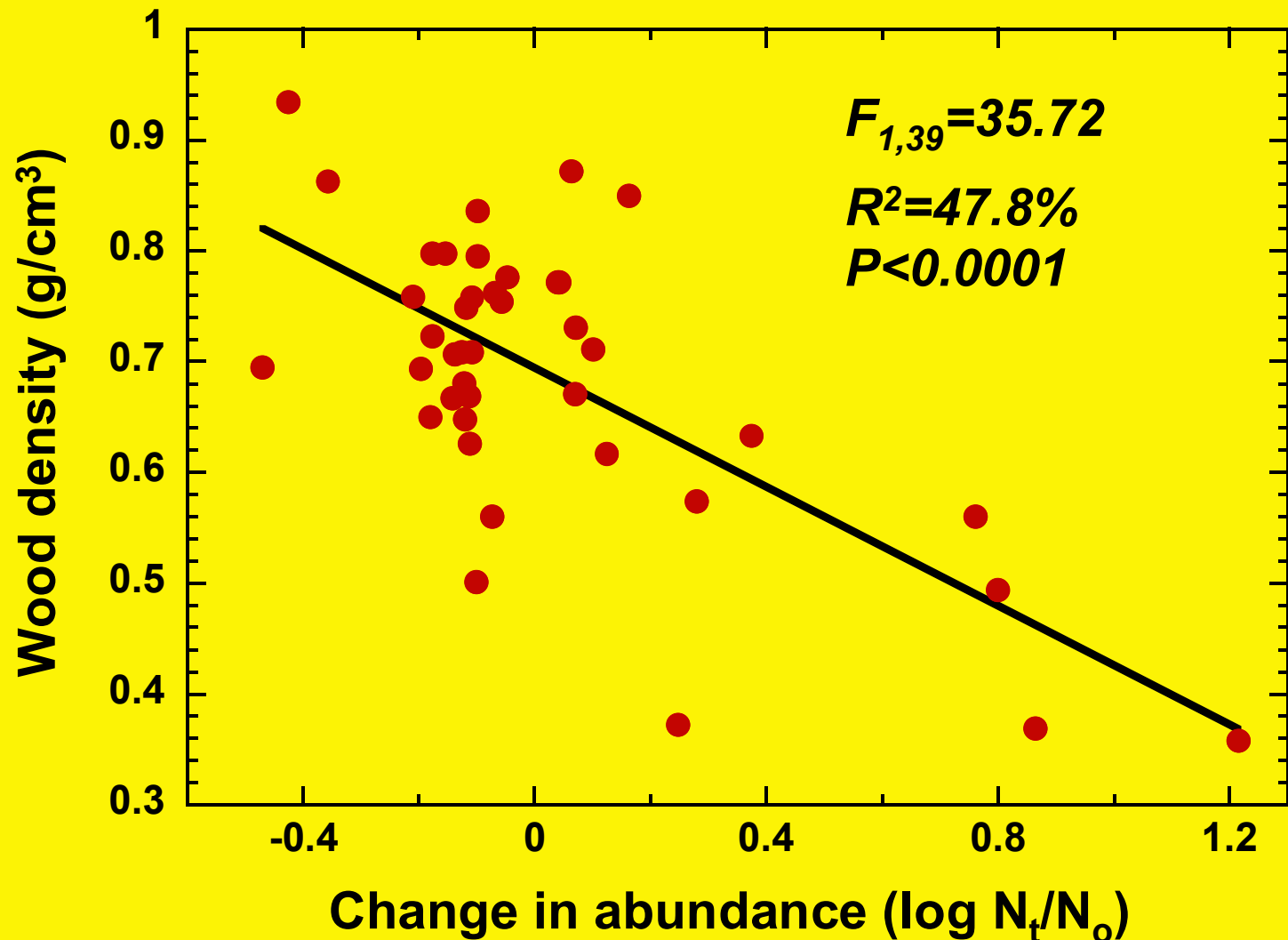
Proliferating Pioneers Near Edges

Density of 52 Mainly Successional Species

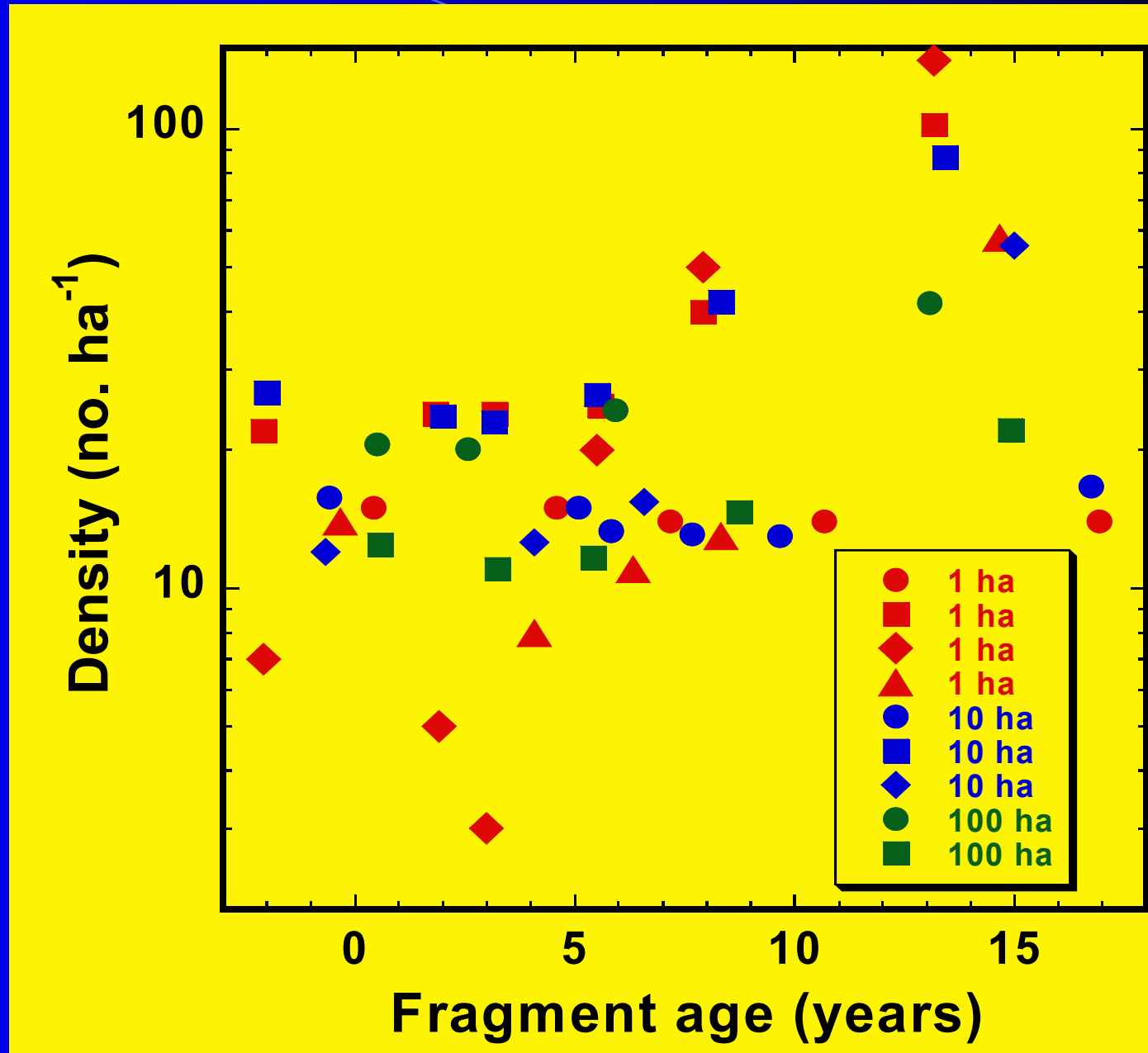


Laurance *et al.* (In press) *Ecology*

Change in Abundance vs. Wood Density



Successional Trees are Still Increasing



Summary

● Edge Effects

- At least in the first two decades after isolation, edge effects are the dominant driver of ecological change
- Although local tree diversity has not yet declined, chronically elevated tree mortality causes a “violent revolution” in community composition and dynamics
- Observed changes in tree communities are highly nonrandom

● Altered Carbon Dynamics

- Proliferating trees in fragments are often early successional species that have much lower wood densities than the old-growth species they are replacing
- Short longevities of pioneer trees and high edge-related tree mortality means that carbon cycling accelerates markedly in fragments
- The changes in community composition are increasing over time





Thank You