Negli agro-ecosistemi, bisogna davvero scegliere fra produttività e biodiversità?

Do we have to choose between productivity and biodiversity in agroecosystems?

UNIVERSITÀ DEGLI STUDI DI MILANO

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Grassland agroecosystems can be biodiversity hotspots

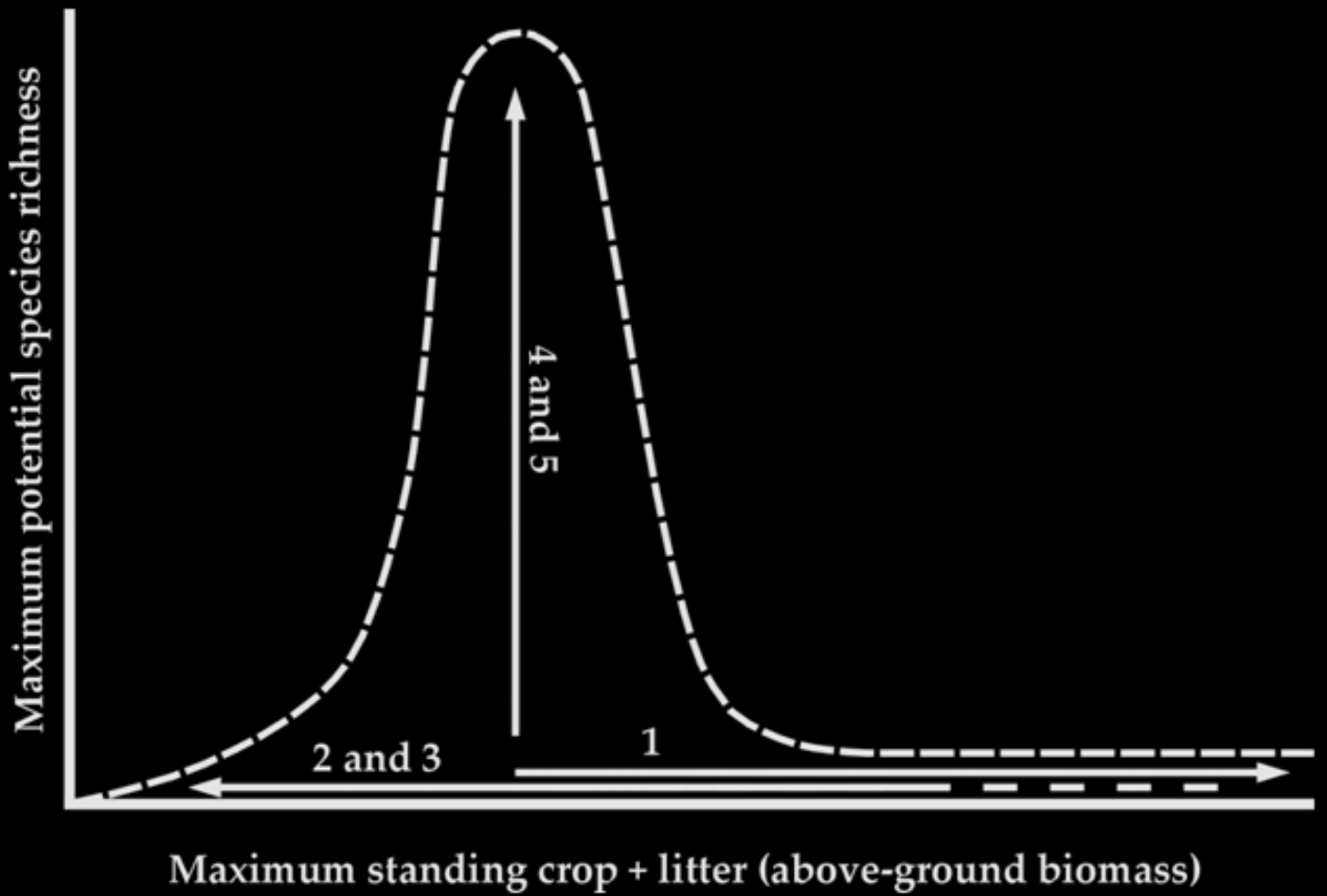
The global record for plant species richness in herbaceous communities is 89 species m^2

"high-richness short grasslands are all subject to repeated disturbance – mowing, grazing or fire"

Wilson *et al.* 2012. *Journal of Vegetation Science* 23: 796-802

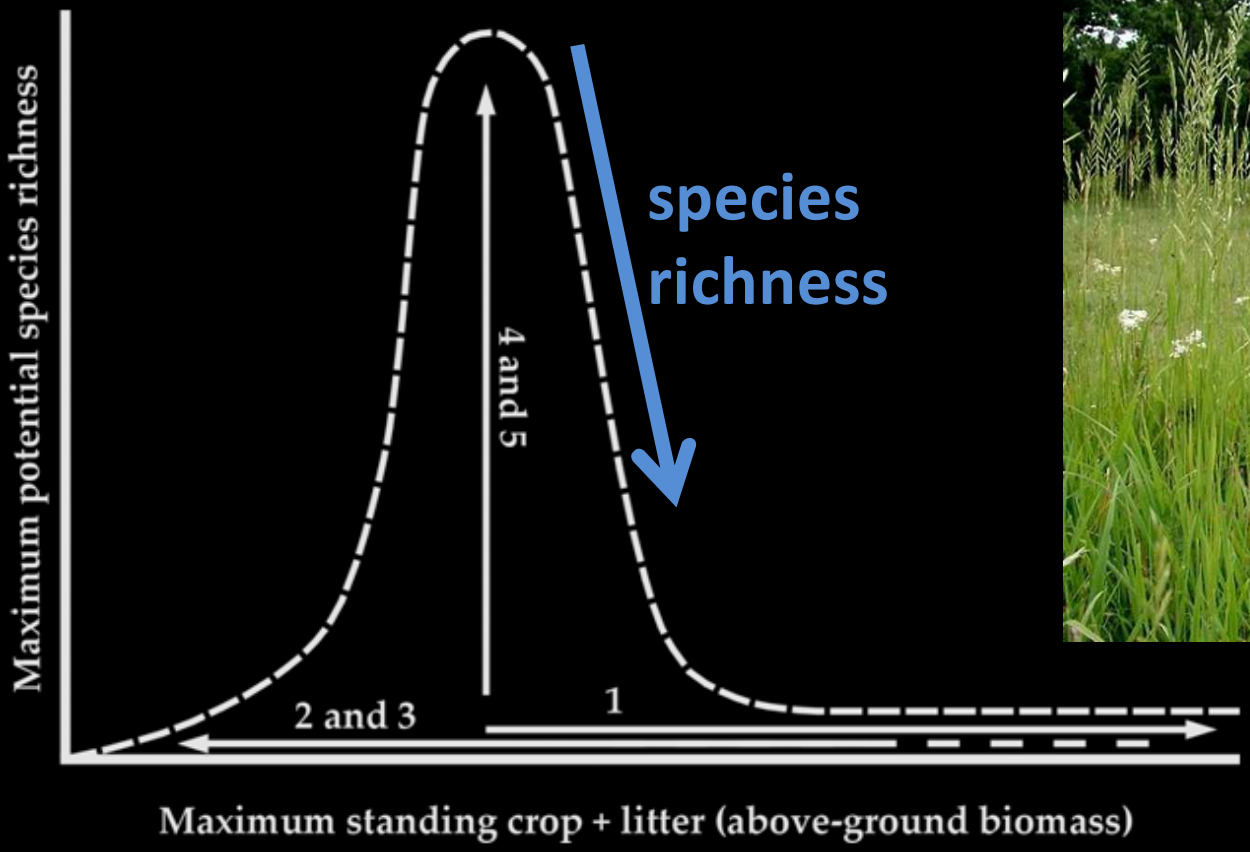
The Humped-back model (HBM) of species richness/biomass production

Low richness and low productivity | High richness | High productivity



Grime 1973. *Journal of Environmental Management* 1: 151-167.
Al-Mufti *et al*. 1977. *Journal of Ecology* 65: 759-791.

Predicting shifts in species and vegetation in response to environmental perturbation



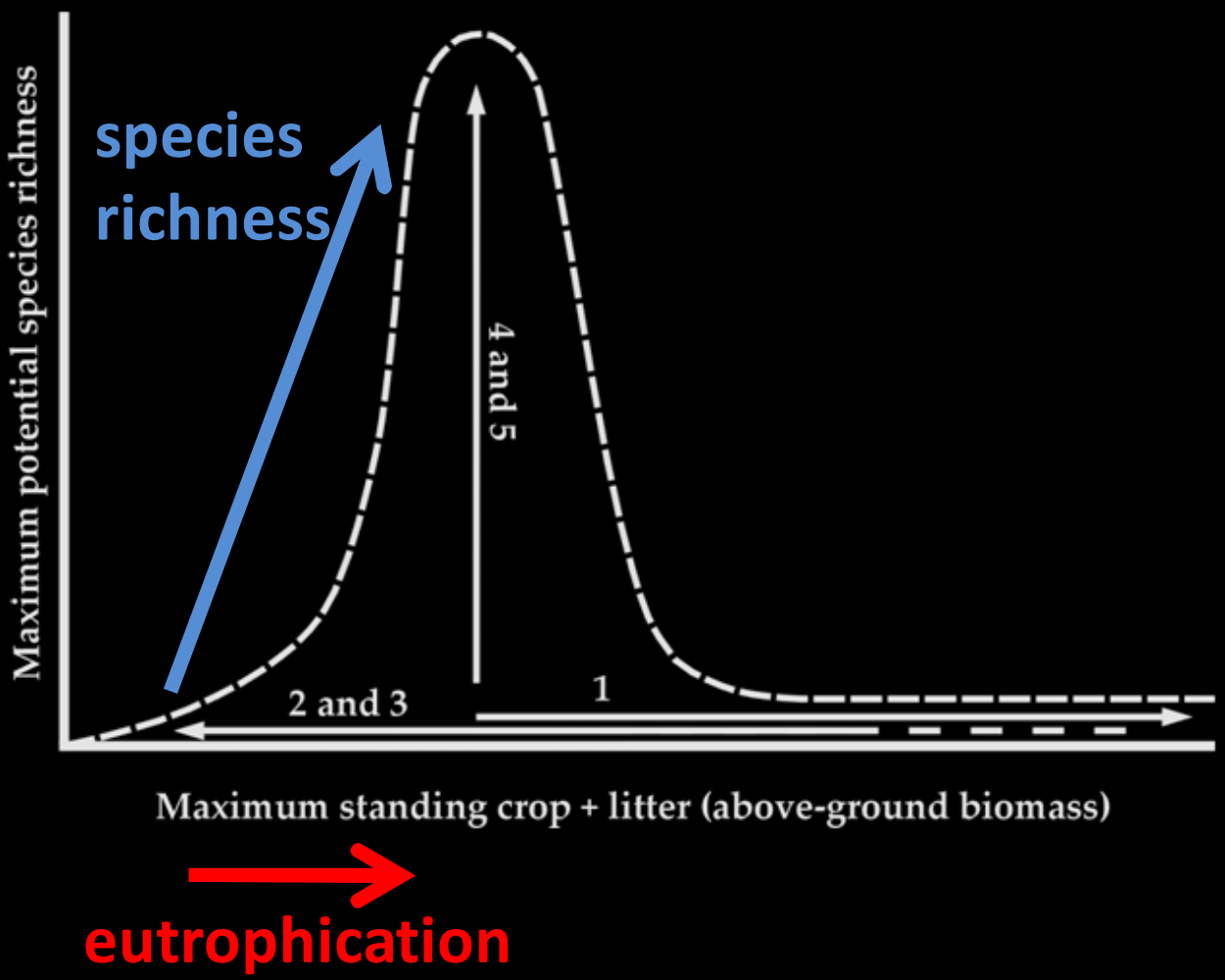
species richness

eutrophication

Nitrogen deposition favours dominance by *Brachypodium rupestre*, which suppresses other species and decreases species richness

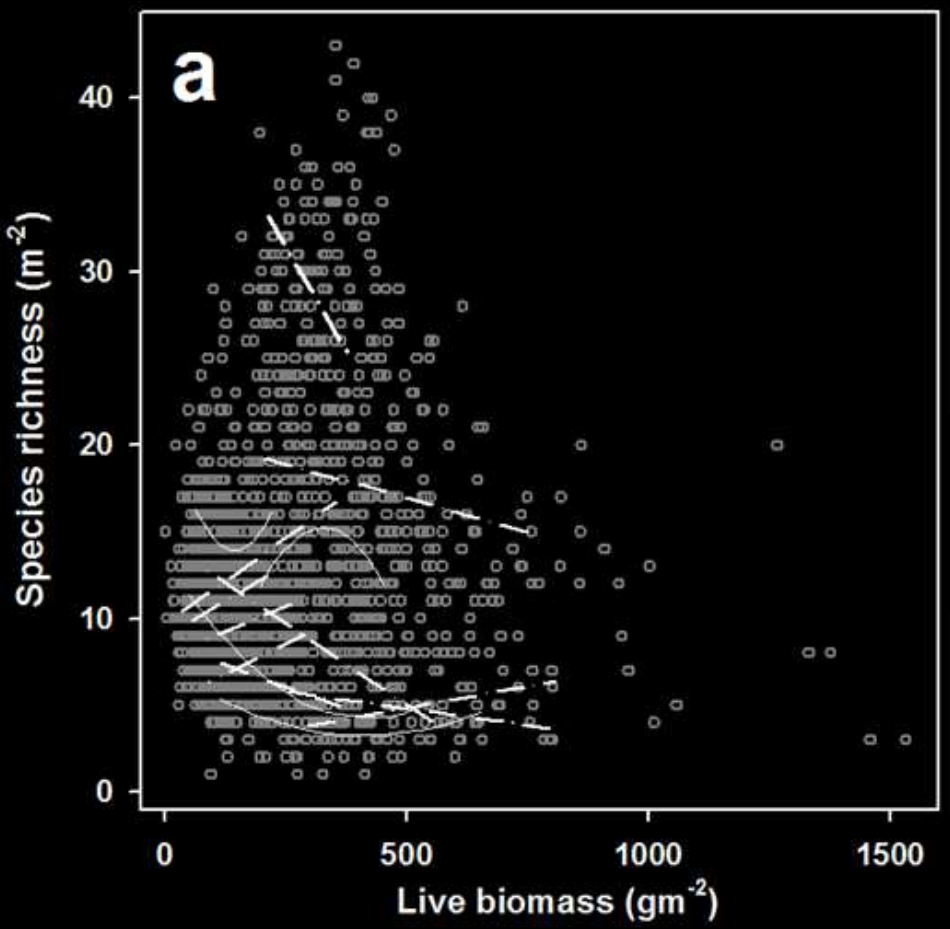
Bobbink *et al.* 1998. *Journal of Ecology* **86:** 717-738

Predicting shifts in species and vegetation in response to environmental perturbation

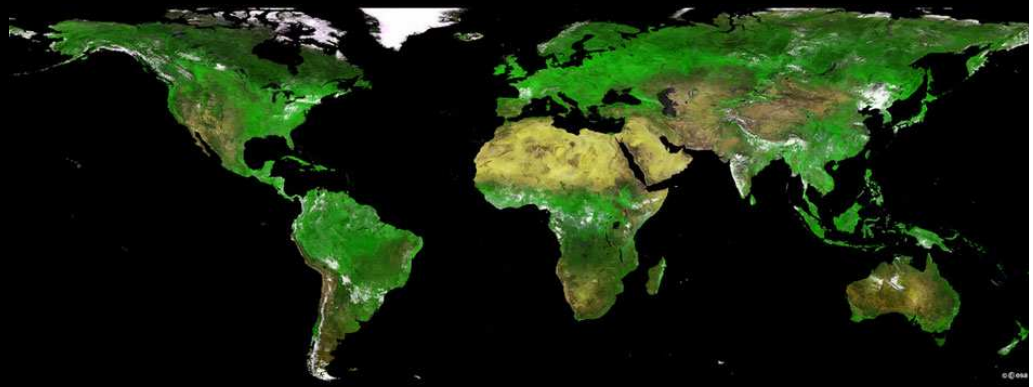


Bobbink *et al.* 1998. *Journal of Ecology* **86:** 717-738

The humped-back curve in global herbaceous vegetation



Field site:



Adler *et al.* 2011. *Science* 333(6050): 1750-1753

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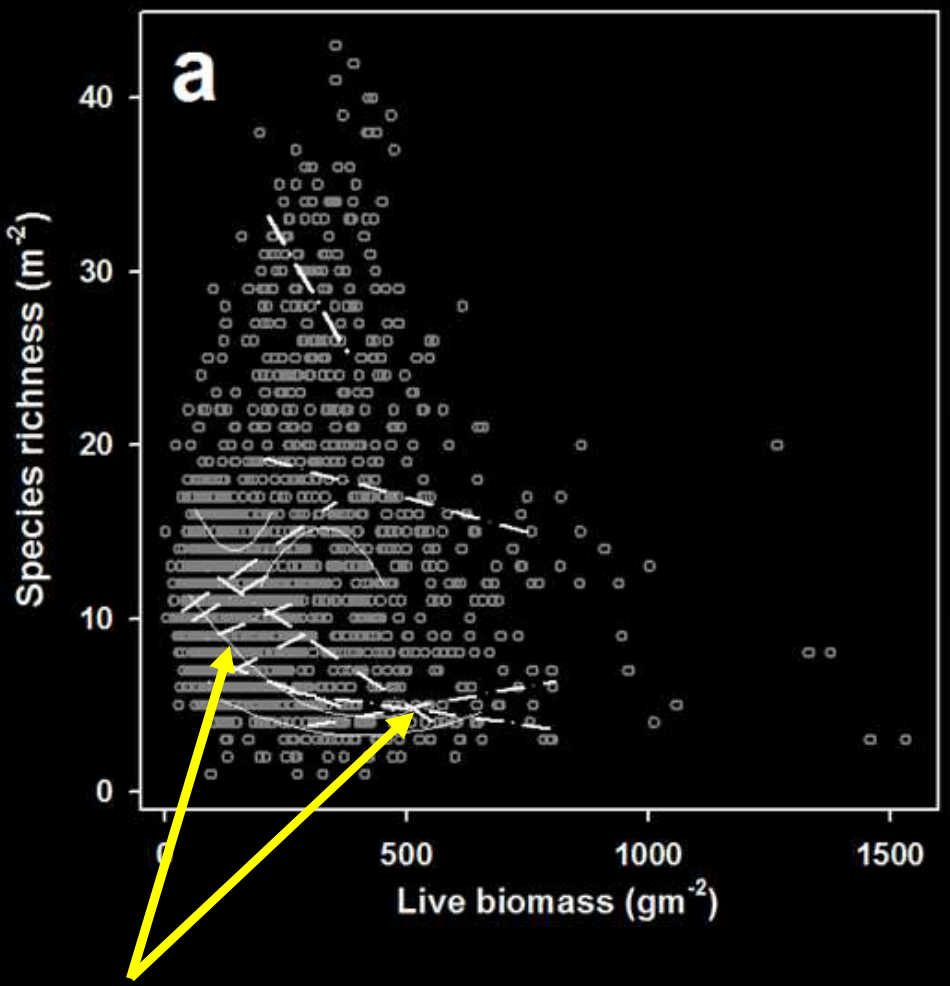
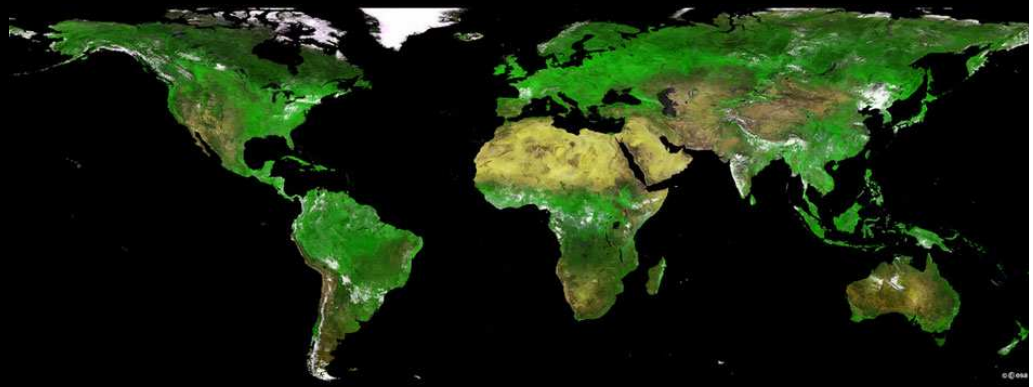


Field site:

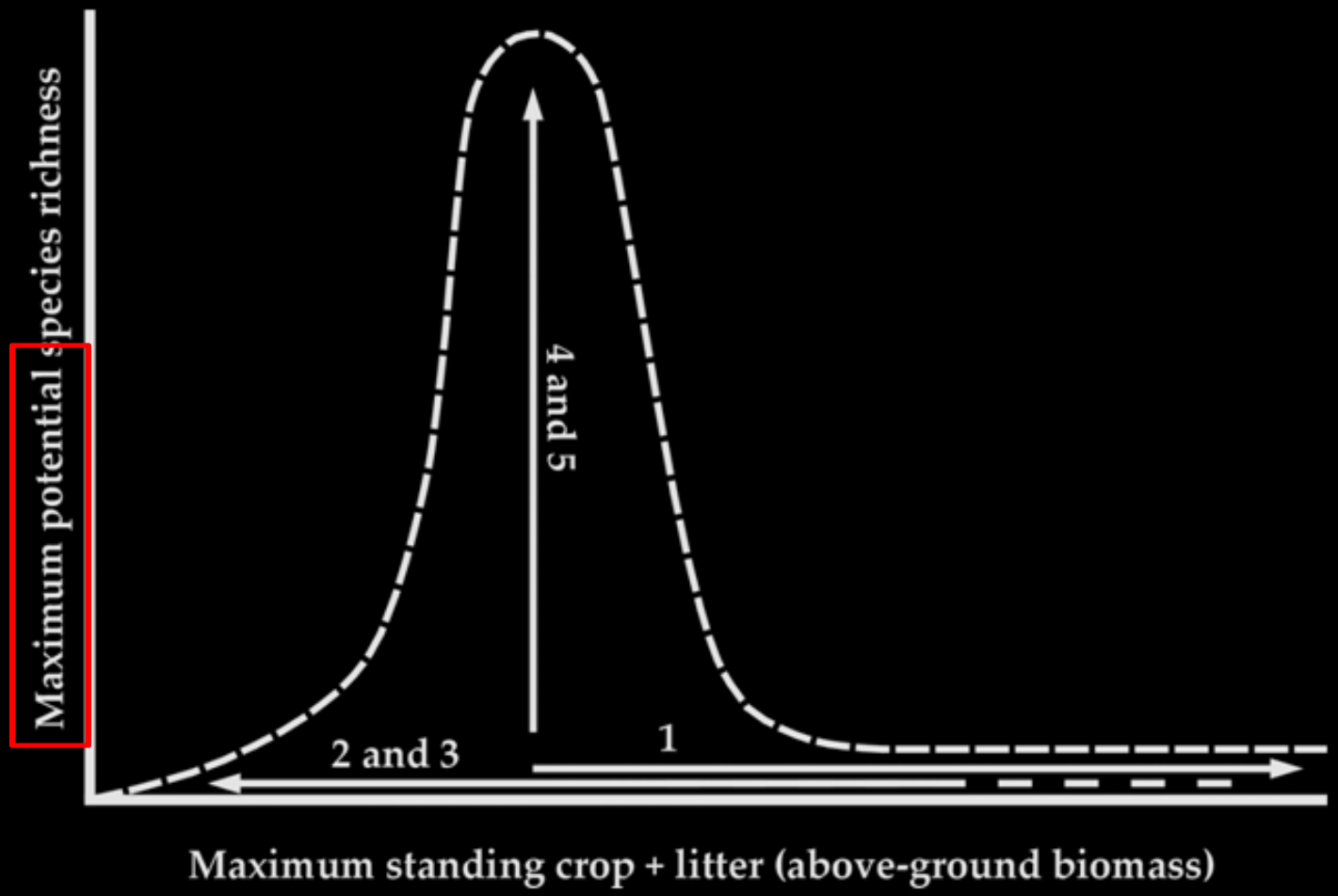


Various regressions were applied to different subsets of the data (different sites) but not to the entire dataset

Adler *et al.*'s conclusion: various relationships exist (!?!)

Adler *et al.* 2011. *Science* 333(6050): 1750-1753

The humped-back curve is a maximum potential species richness relationship



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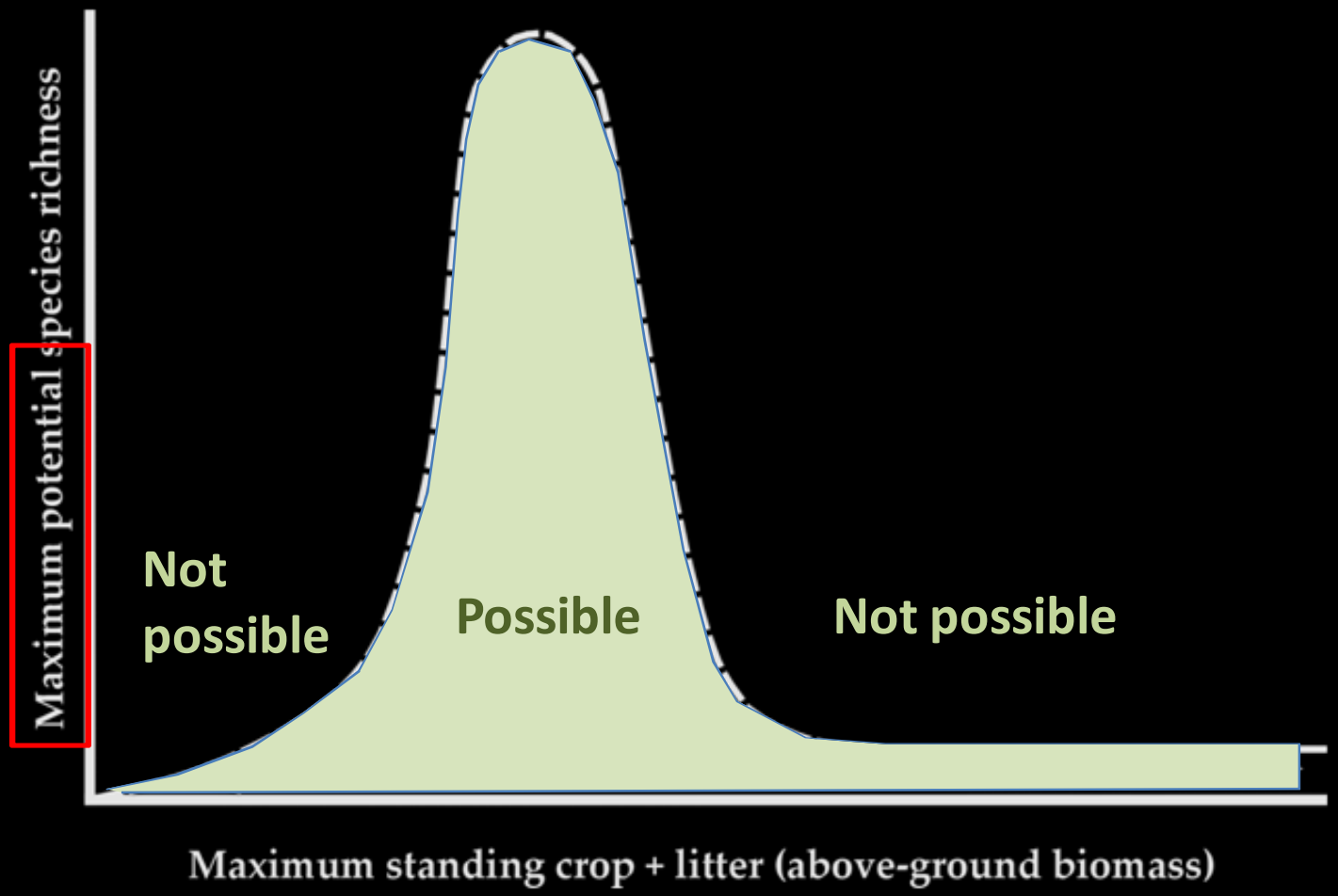

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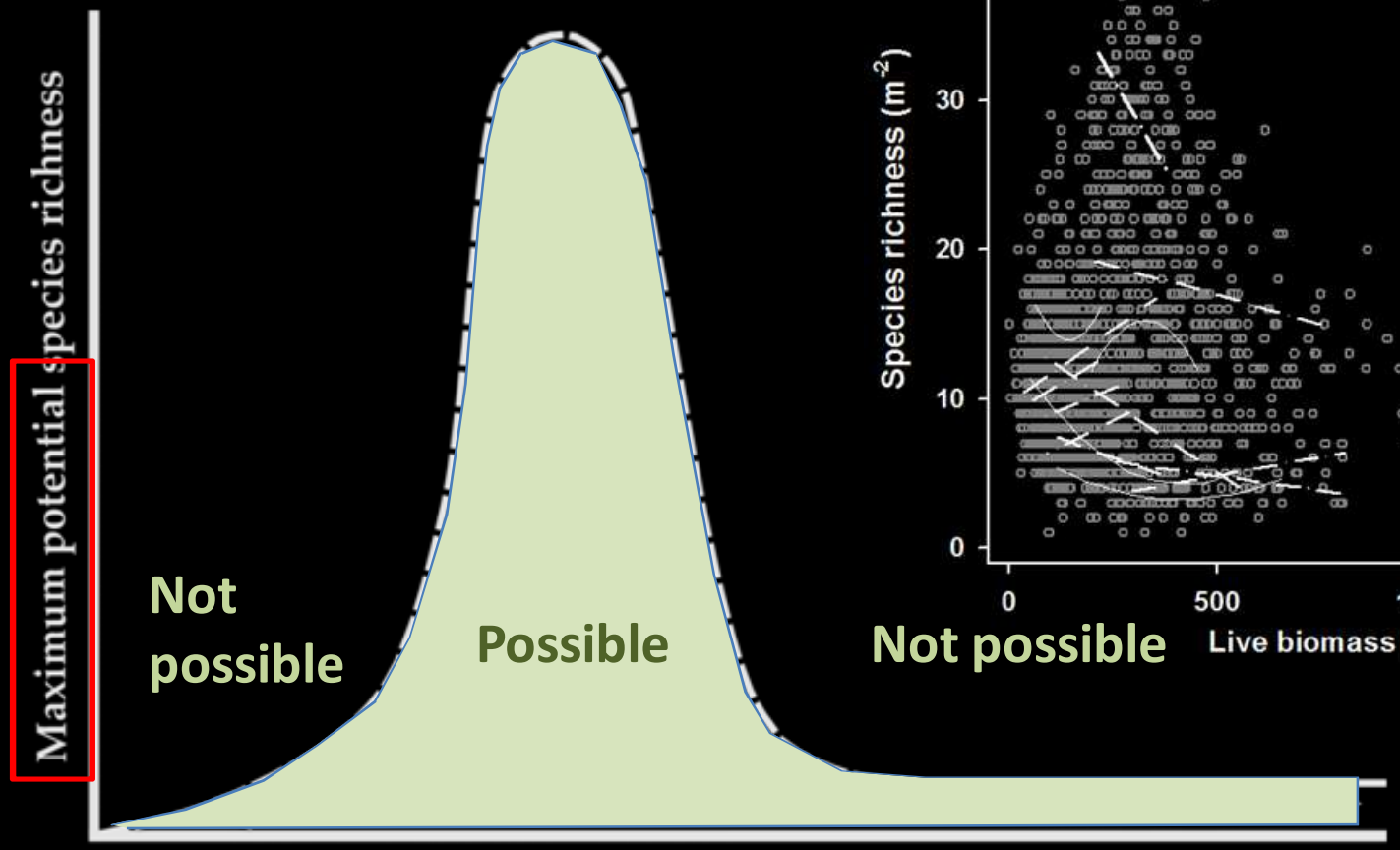
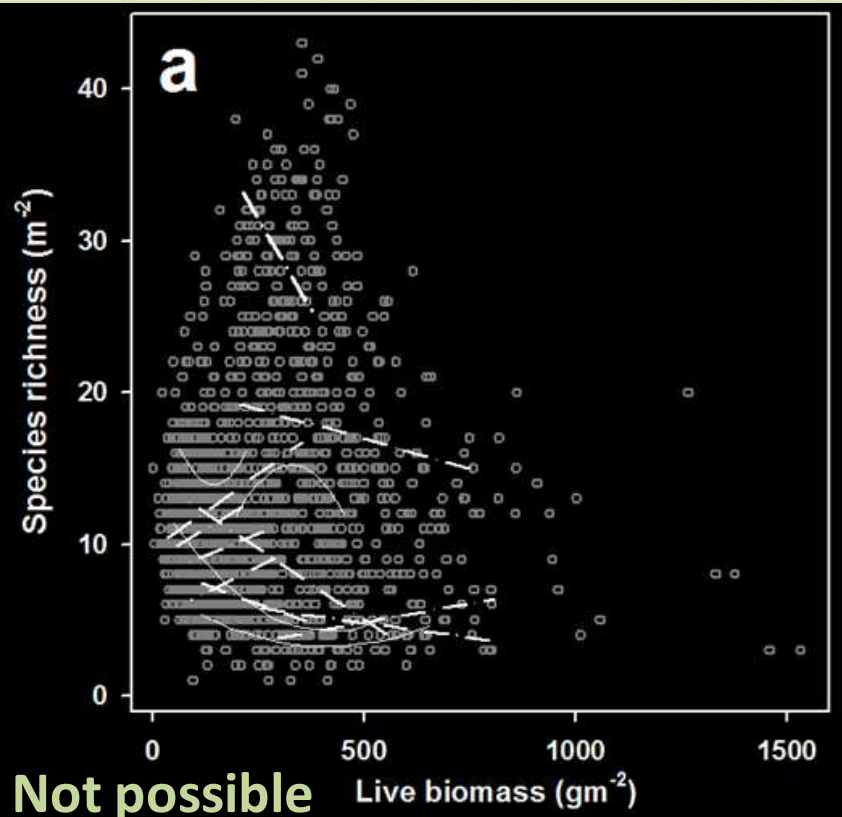
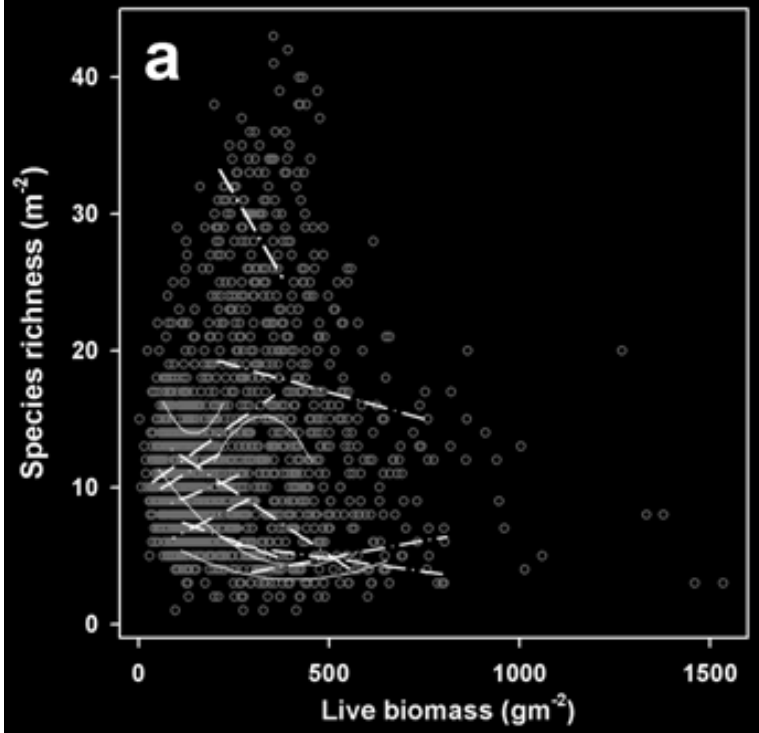




Is there a hump-shaped upper boundary to the Adler *et al.* (2011) dataset?

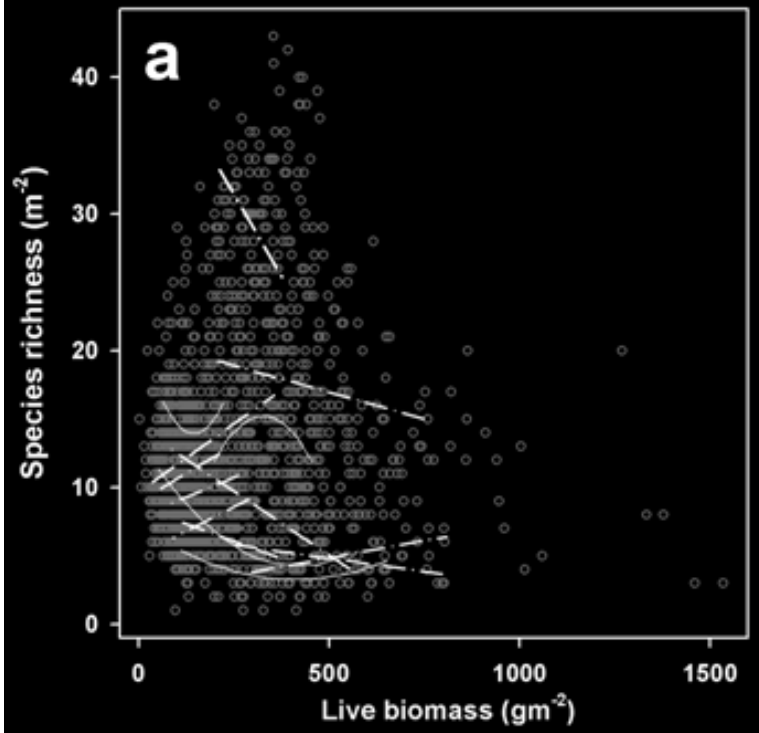
The controversy – why did Adler et al. exclude some agroecosystems but not others?



"we did find evidence of a hump shape, with a significant quadratic effect of productivity on richness. However, when we removed five sites of anthropogenic origin the quadratic term was no longer significant"

Adler *et al.* 2011. *Science* 333(6050): 1750-1753

The controversy – why did Adler et al. exclude some agroecosystems but not others?

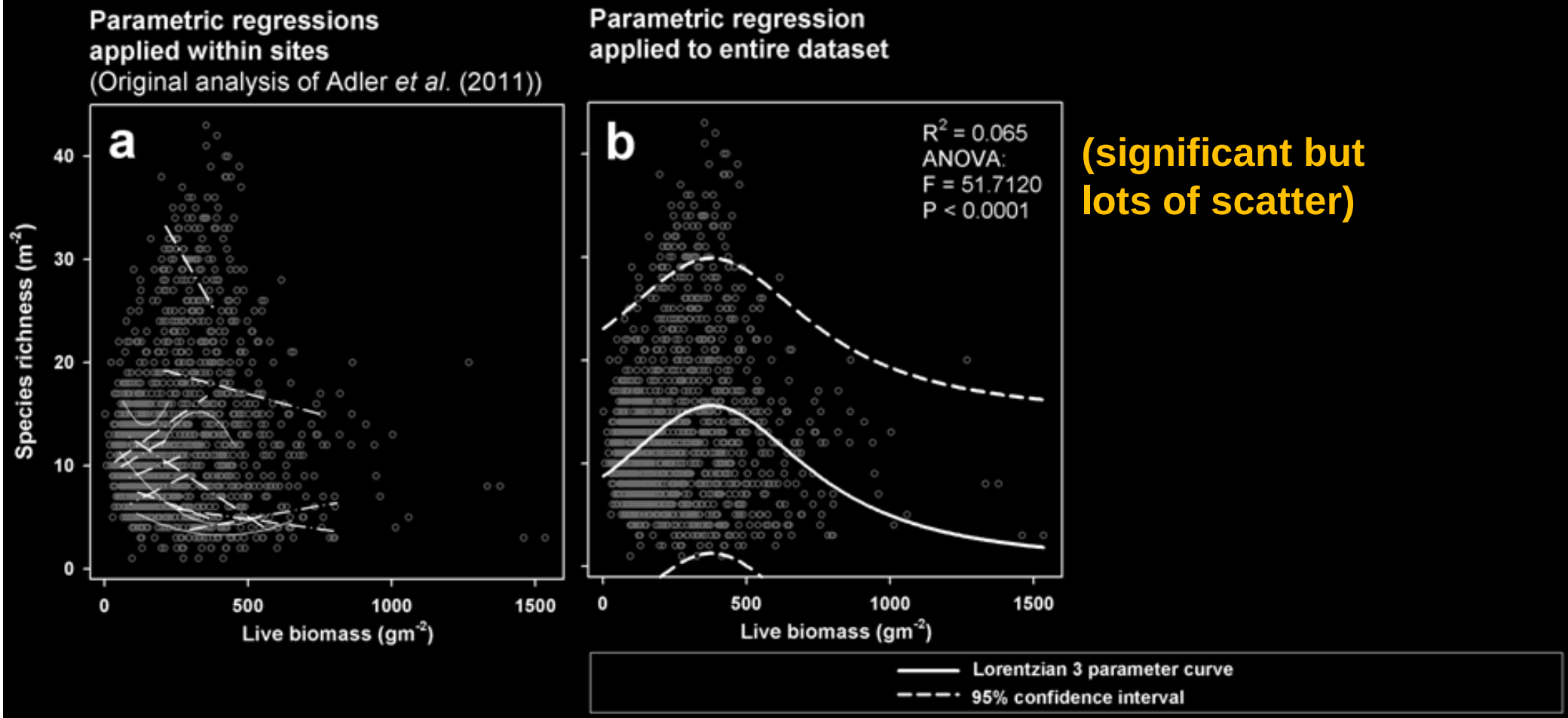


"It is unfortunate that Adler et al. dismiss such sites, because one of the main applications of the HBM is to show how eutrophication reduces local richness in terrestrial communities, which has been of much import to the conservation community."

Fridley *et al*. 2012. *Science* 335(6075): 1441

Independent analysis demonstrates the humped-back curve in this dataset

Pierce S. 2014. *Functional Ecology* 28: 253–257



(significant but lots of scatter)

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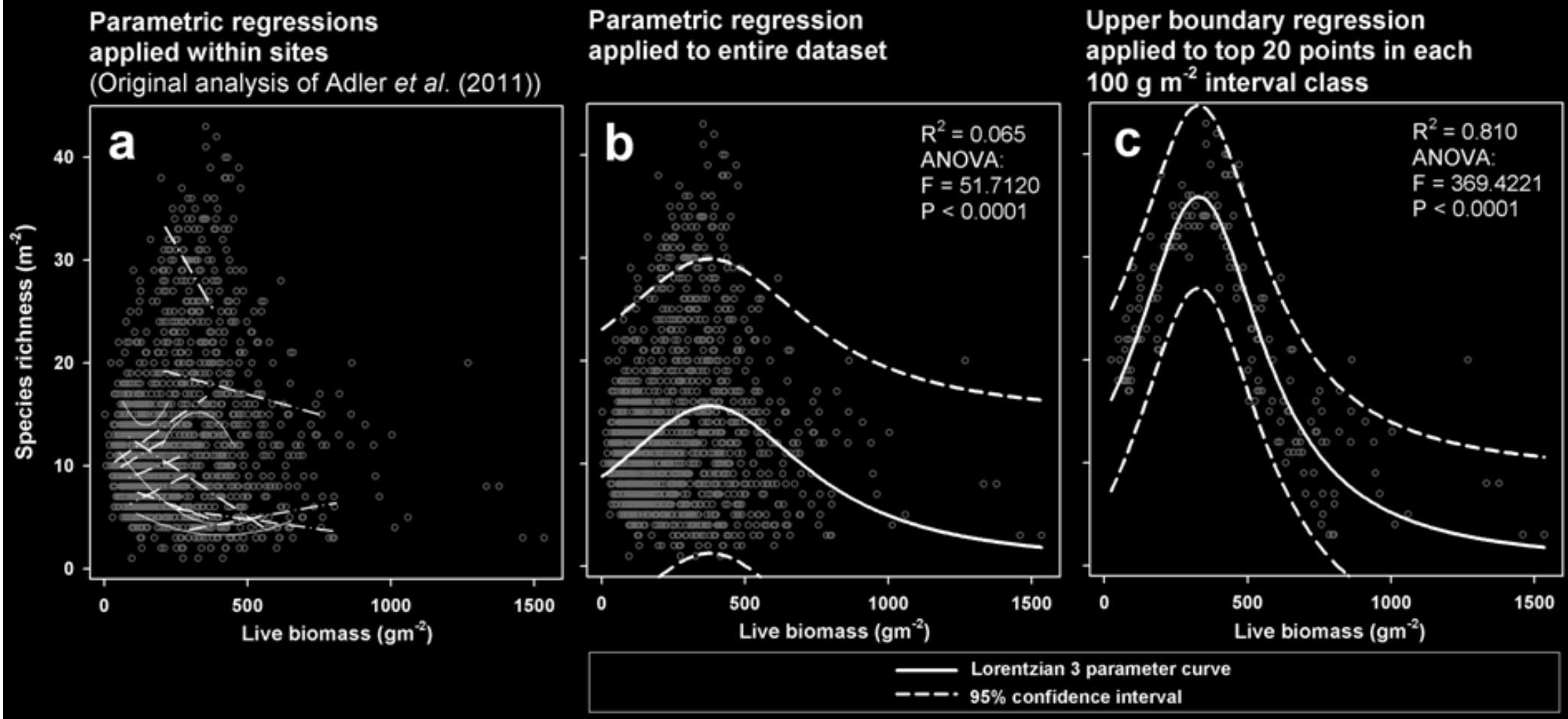
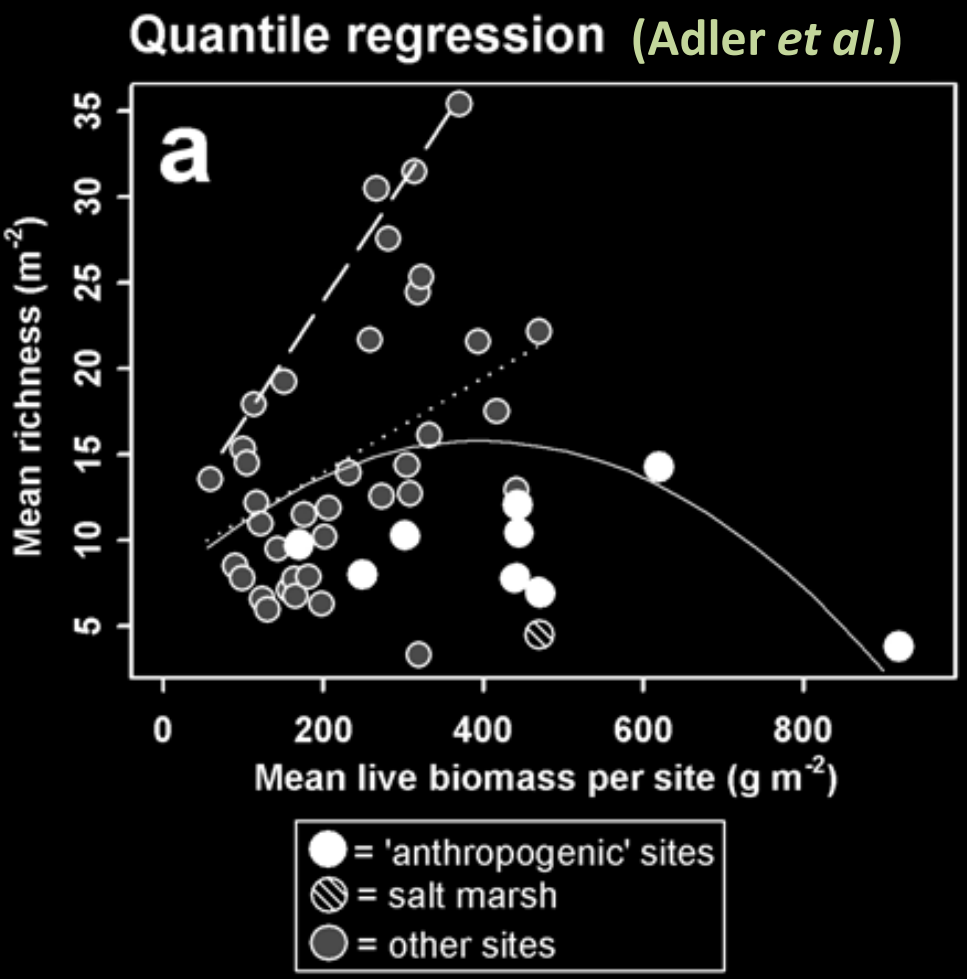
Pierce S. 2014. *Functional Ecology* 28: 253–257



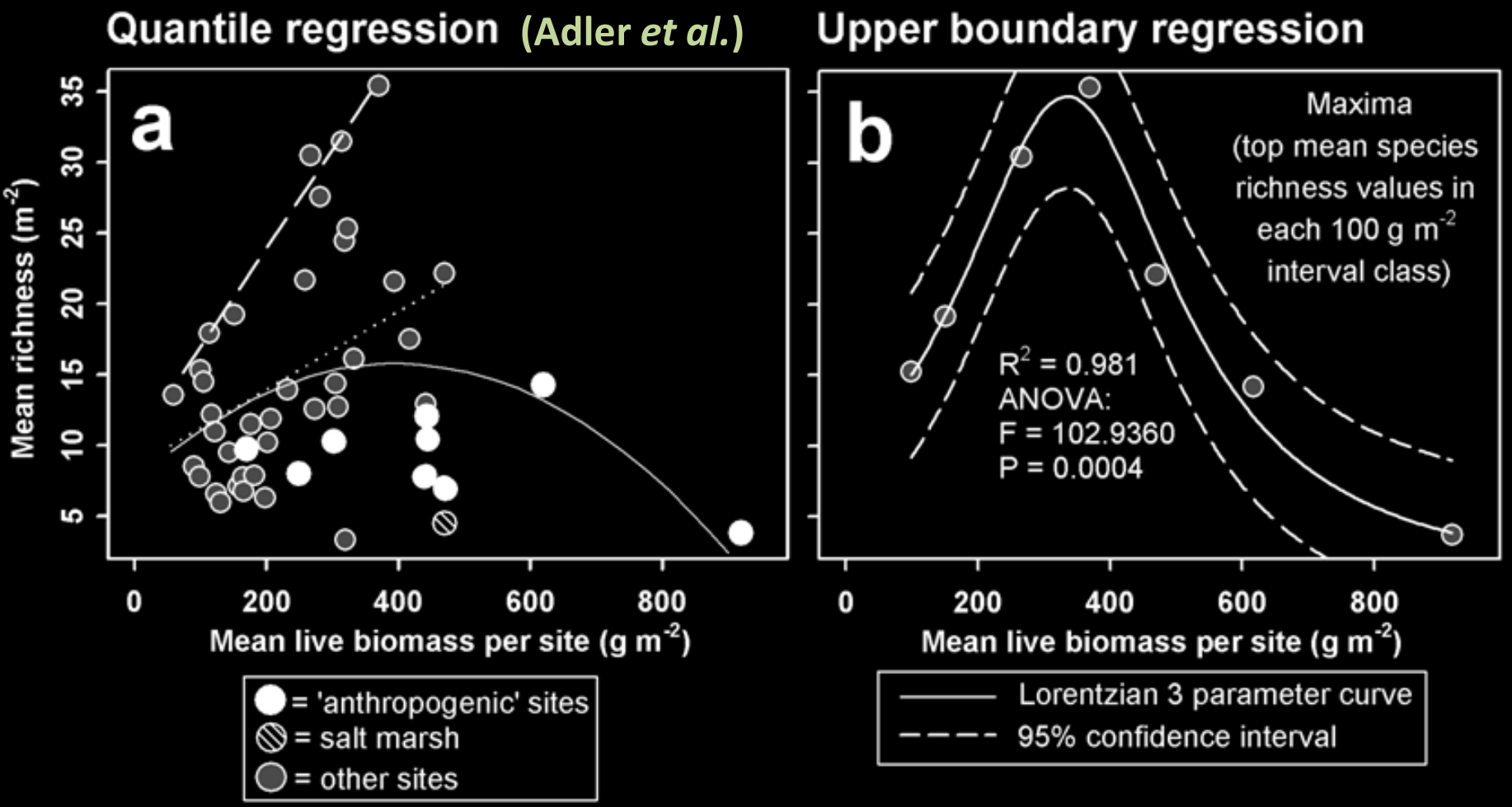
Eliminating sites from the analysis removes the humped-back curve…



(anthropogenic sites ● were included in the non-linear regression but were removed before linear quantile regression)

When all sites are included a humped upper limit to species richness emerges

Pierce S. 2014. *Functional Ecology* 28: 253–257



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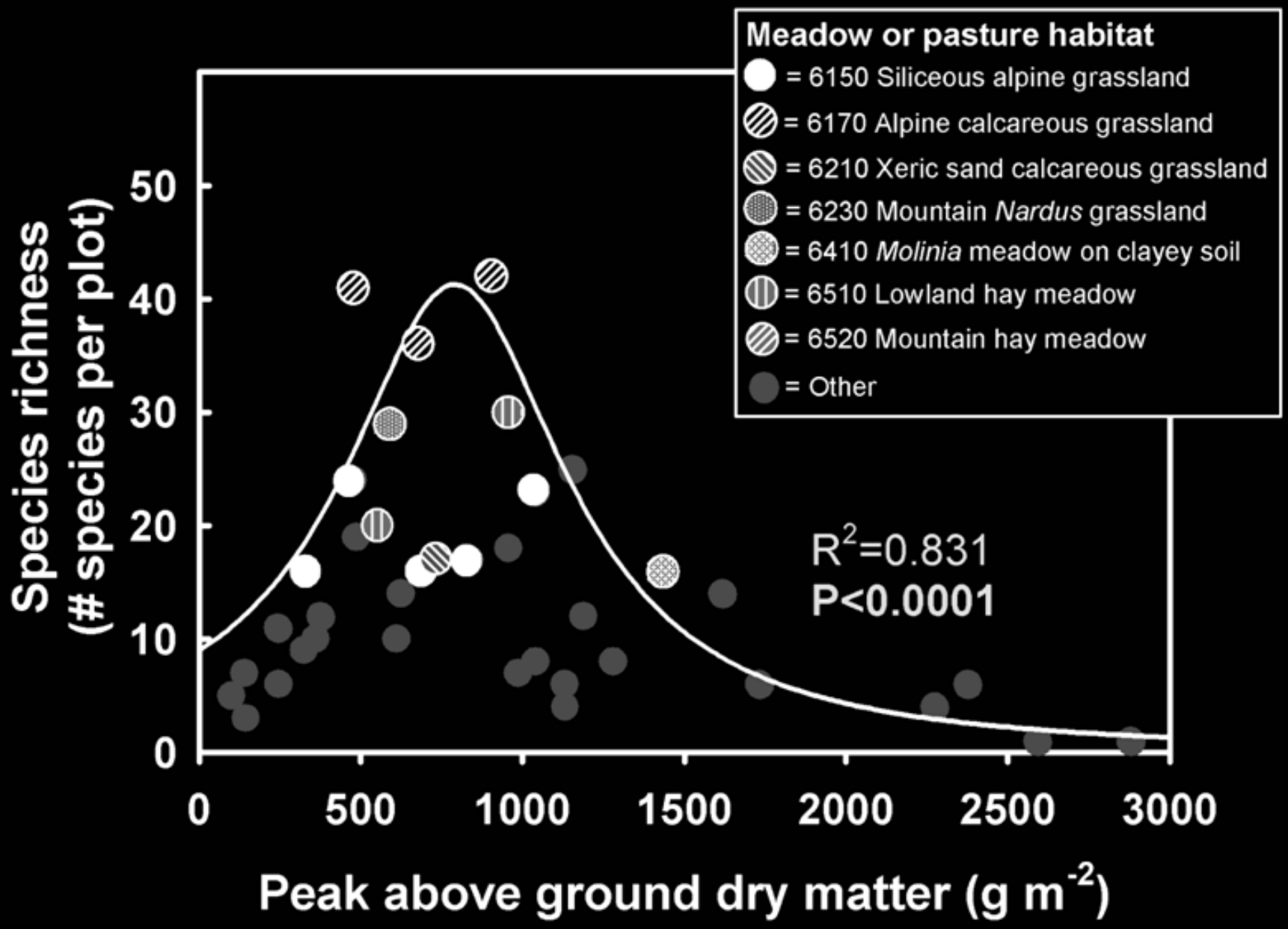
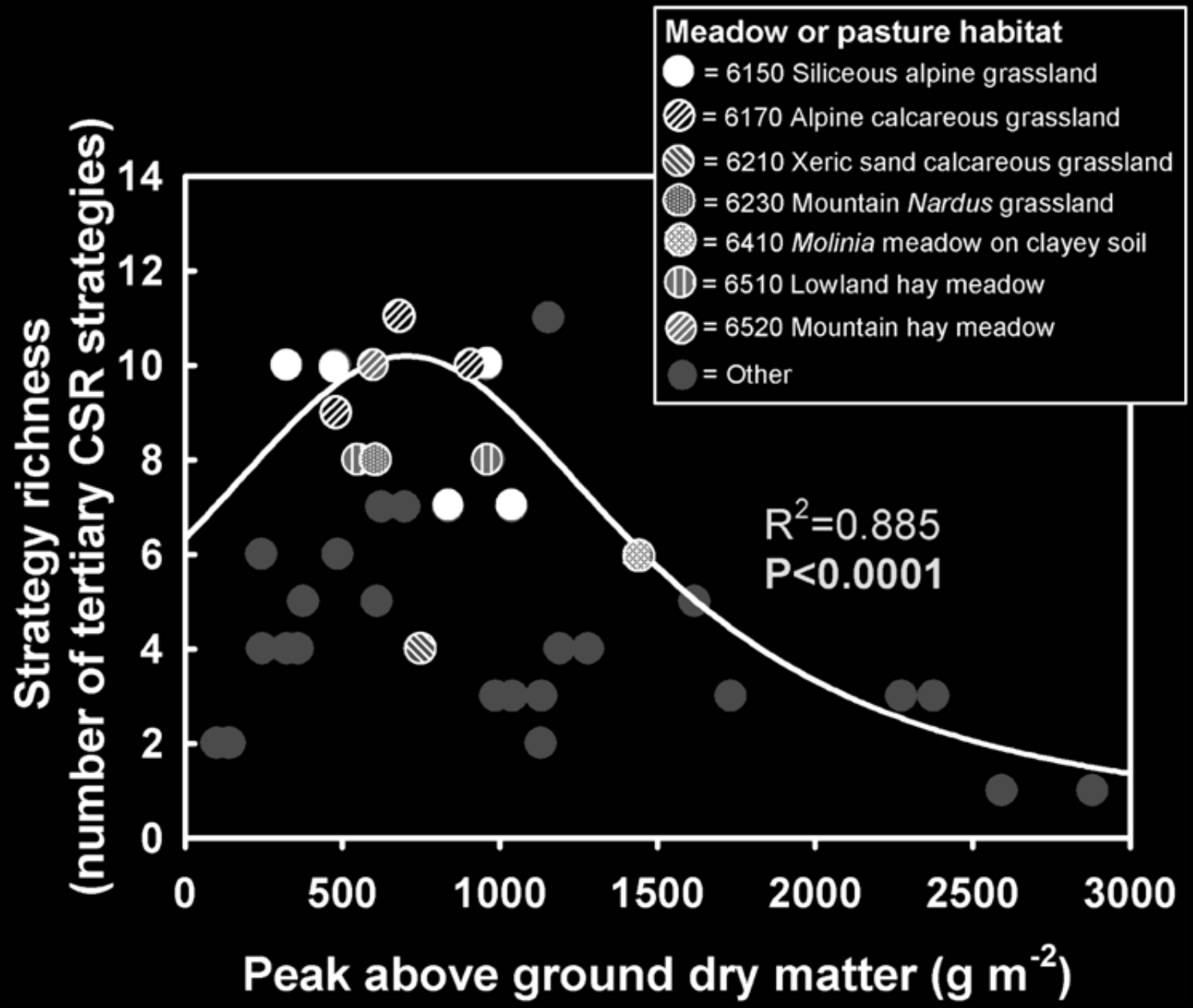
Yes

WHY?



Cerabolini *et al.* 2014. *Plant Biosystems* (submitted)

Greater productivity encourages competition and dominance by a few specialised species



Cerabolini *et al.* 2014. *Plant Biosystems* (submitted)

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Yes

BUT with the humped-back model we can predict:

1). where higher richnesses can be promoted and thus where conservation will be particularly effective,

Conclusions

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1). where higher richnesses can be promoted and thus where conservation will be particularly effective,

2). how plant communities will change in response to altered environmental stresses and soil fertility
(resulting from land use change or climate change)

Conclusions

BUT with the humped-back model we can predict:

1). where higher richnesses can be promoted and thus where conservation will be particularly effective,

2). how plant communities will change in response to altered environmental stresses and soil fertility
(resulting from land use change or climate change)

3). Because species richness and the degree of dominance are linked to ecosystem functioning, the HBM provides a context in which we can understand how ecosystem services and ecosystem functions (e.g. carbon cycling, nitrogen mineralisation) will change in response to environmental changes

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