RestREco
Restoring Resilient Ecosystems

# *Why restore complexity?*

## *The complexity - ecosystem function relationship*

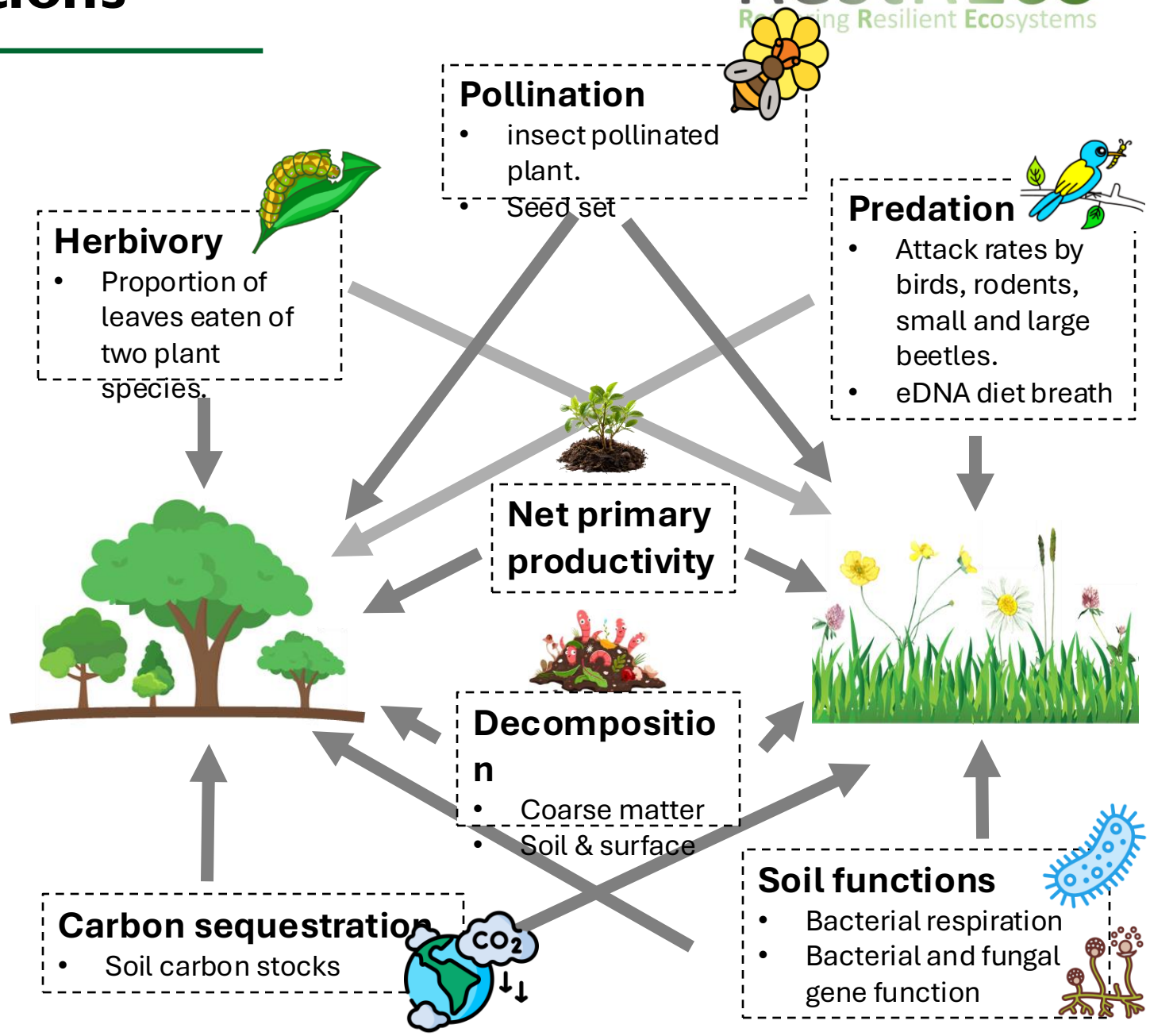
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# What are ecosystem functions

These are the functions that keep ecosystems alive and productive.

- Biological, physical, and chemical
- They drive the movement and transformation of energy and matter.
- The engine behind ecosystem structure and services.



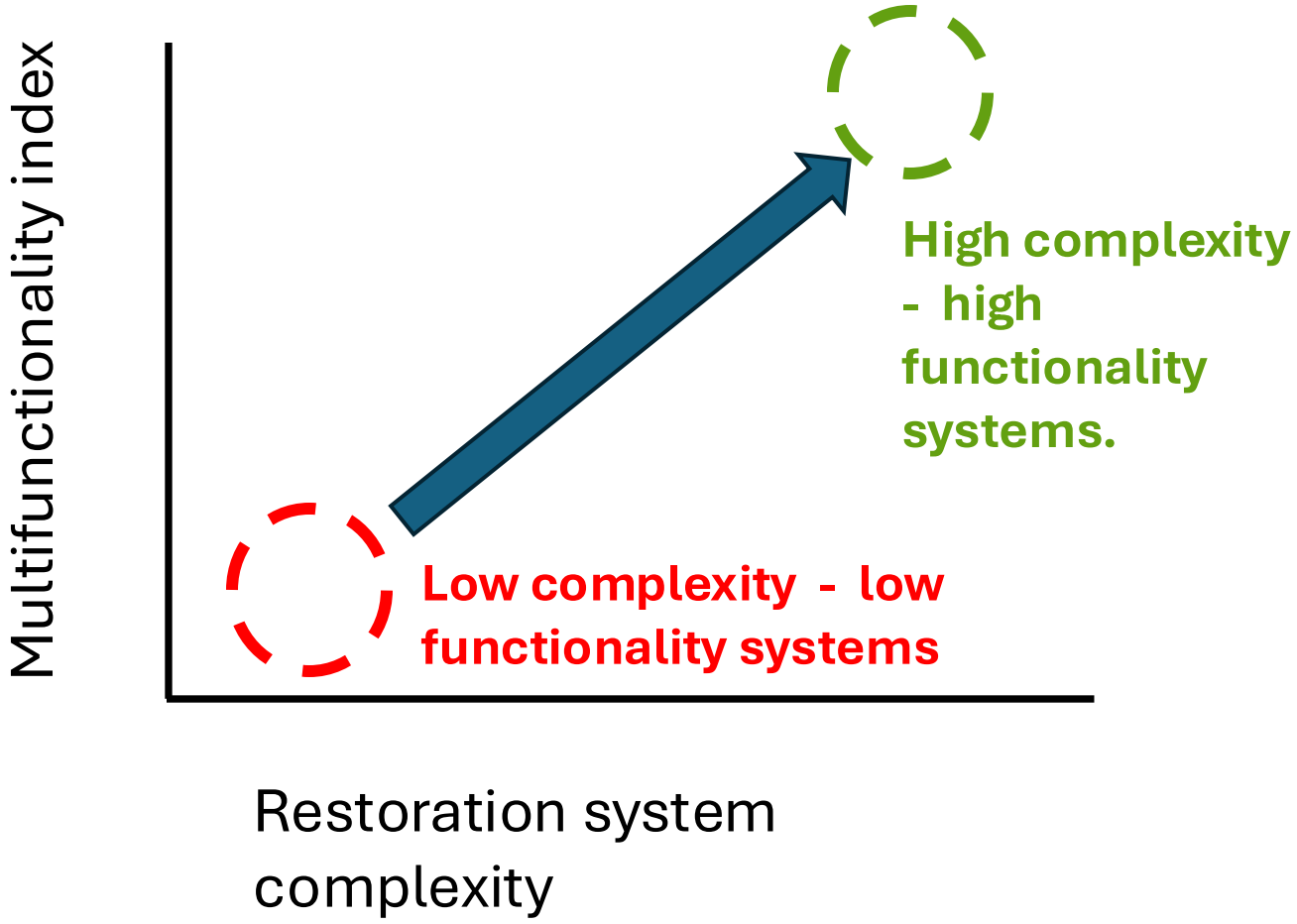
# Measuring system functionality

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**We predict that establishing system complexity in restoration is critical to highly functioning ecosystems.**

How to measure multifunctionality?

- Measures of function have unique characteristics, e.g. units, scale, taxa etc.
- Need a way to combine to produce an index of multifunctionality



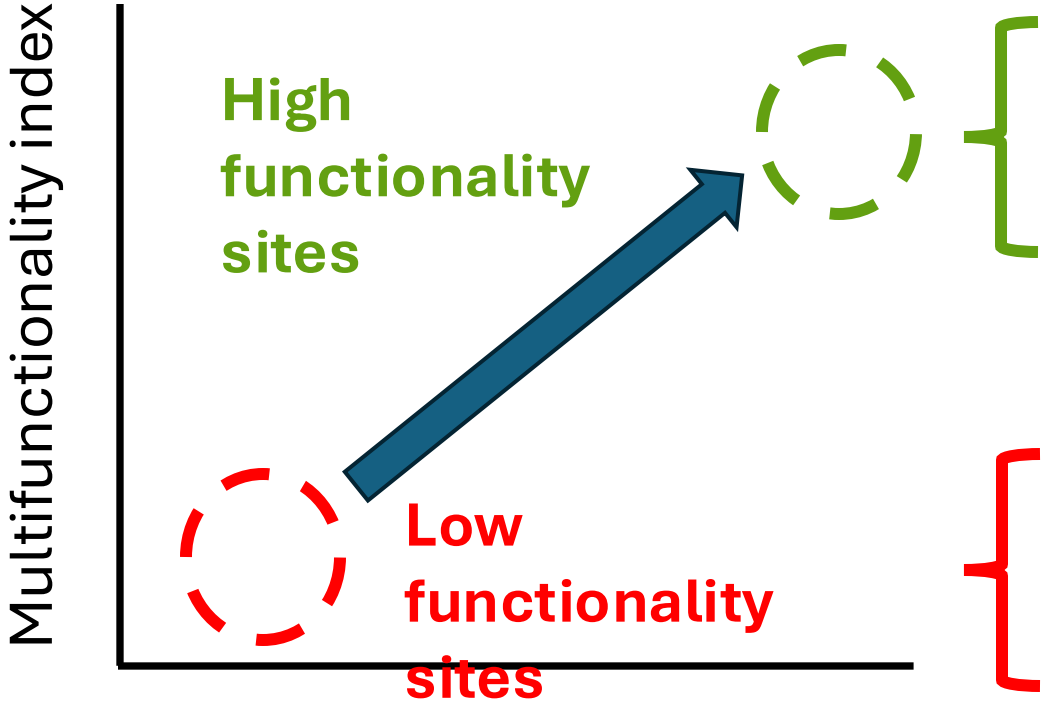

*Manning et al (2018) Nature Ecology & Evolution, 2, 427-436.*

# Measuring system multifunctionality

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**Simplified list of ecosystem functions**

| Soil processes | Decomposition | Carbon sequestration | Net Primary Productivity | Herbivory | Pollination | Predation |
|---|---|---|---|---|---|---|




**High (>75th percentile), moderate (>50th %) or minimum (>25th%) multifunctionality**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Site 5 | -- | -- | >75th % | -- | -- | - | - |

*Manning et al (2018) Nature Ecology & Evolution, 2, 427-436.*

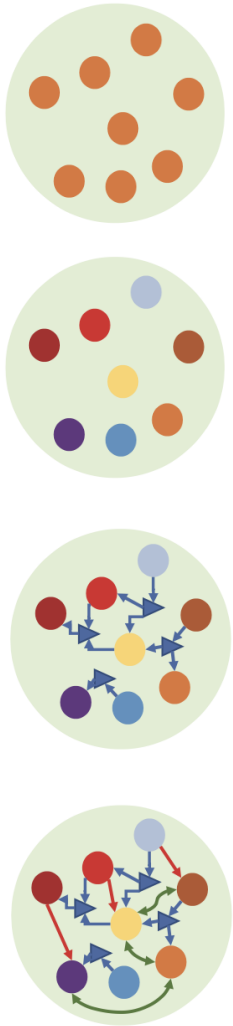
# Measuring complexity

*'the number of components in a system and the number of connections among them' (Bullock et al., 2022)*

Single species with no trophic links.

Increasing complexity

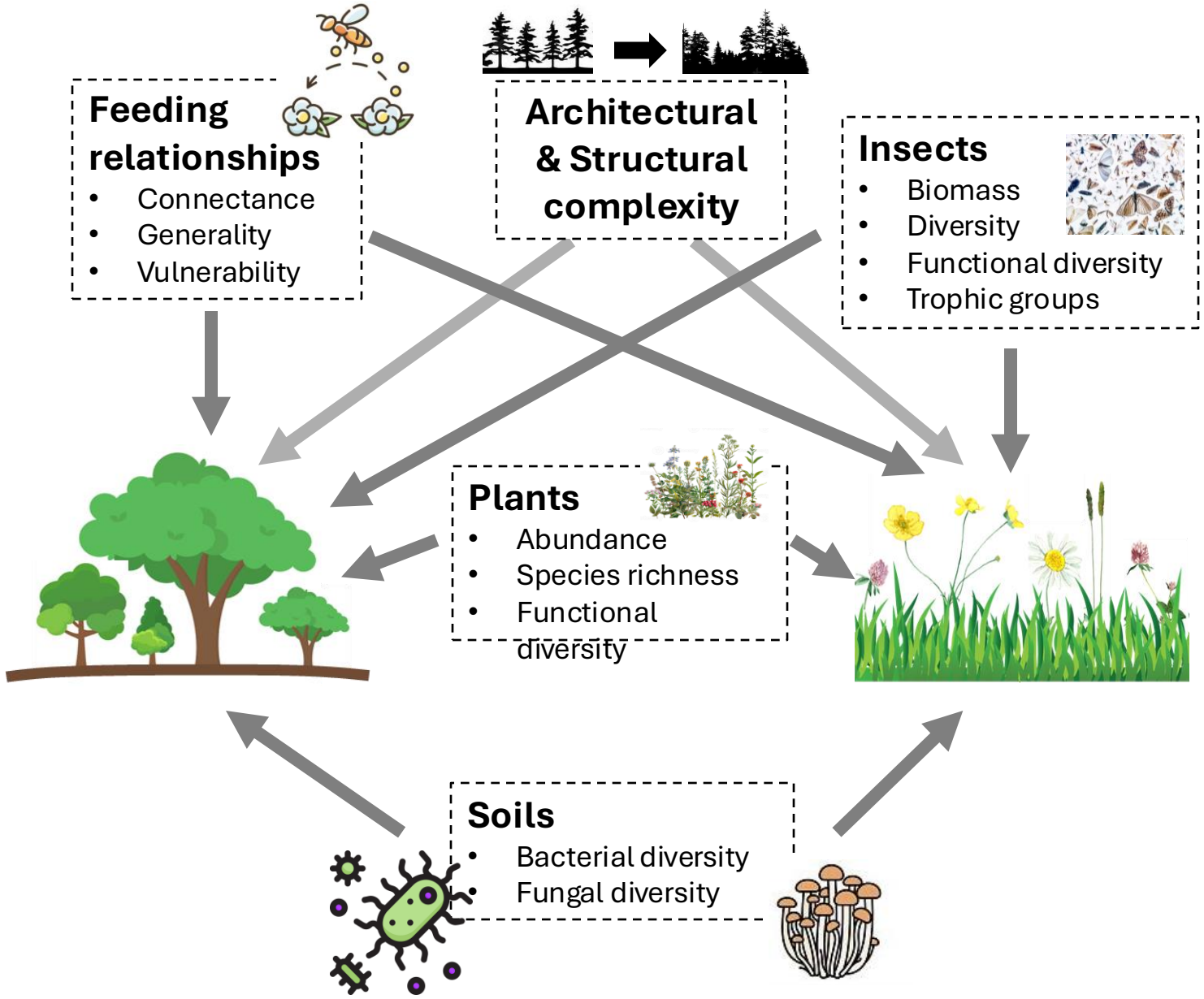
High diversity, complex trophic interactions within a physically complex habitat.



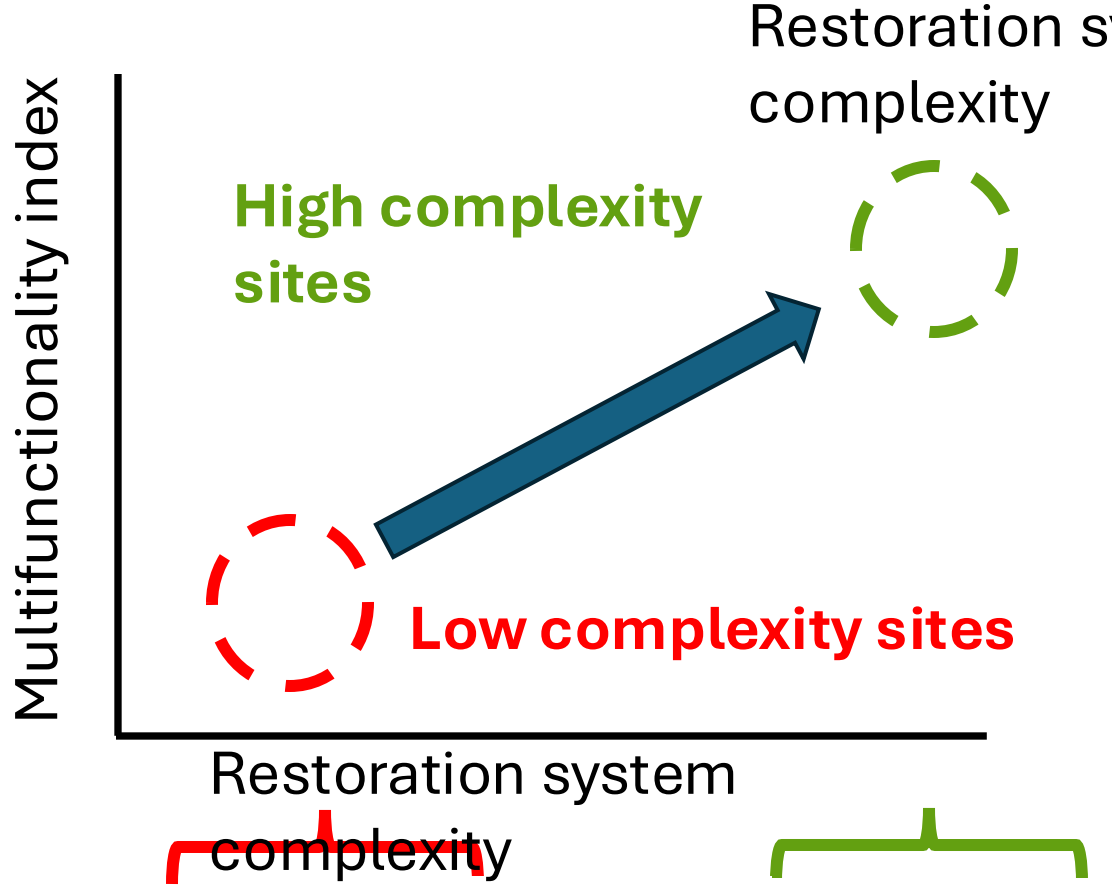
**Legend:** Species; Indirect connection e.g. exuded resource; Direct connection e.g. predation; Direct connection e.g. symbiosis-mutualism.

# Measuring complexity

*'the number of components in a system and the number of connections among them' (Bullock et al., 2022)*



**Applying the same approach to complexity to get an overall index**




**Simplified list of complexity metrics**

- Soil diversity
- Plant diversity
- Invertebrate diversity
- Architecture

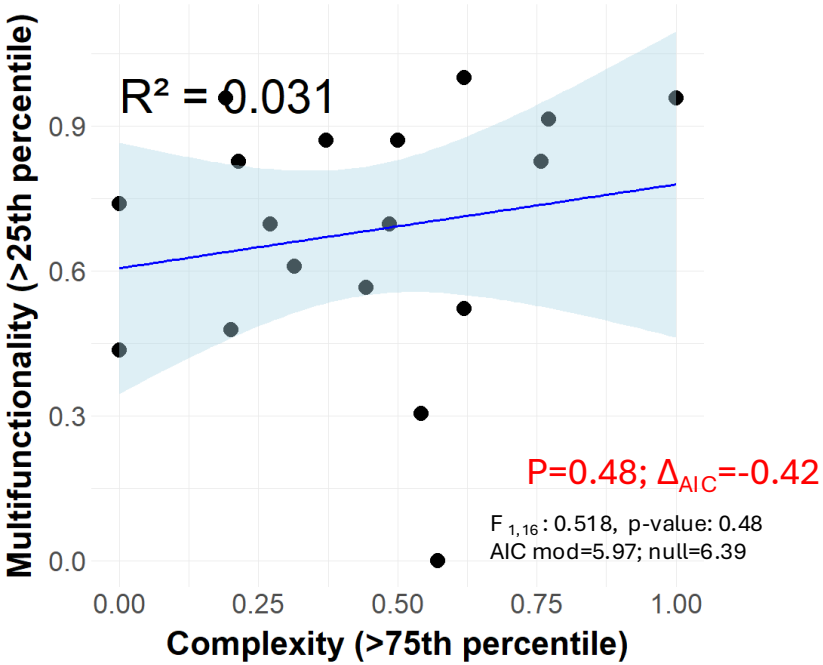


# Woodlands



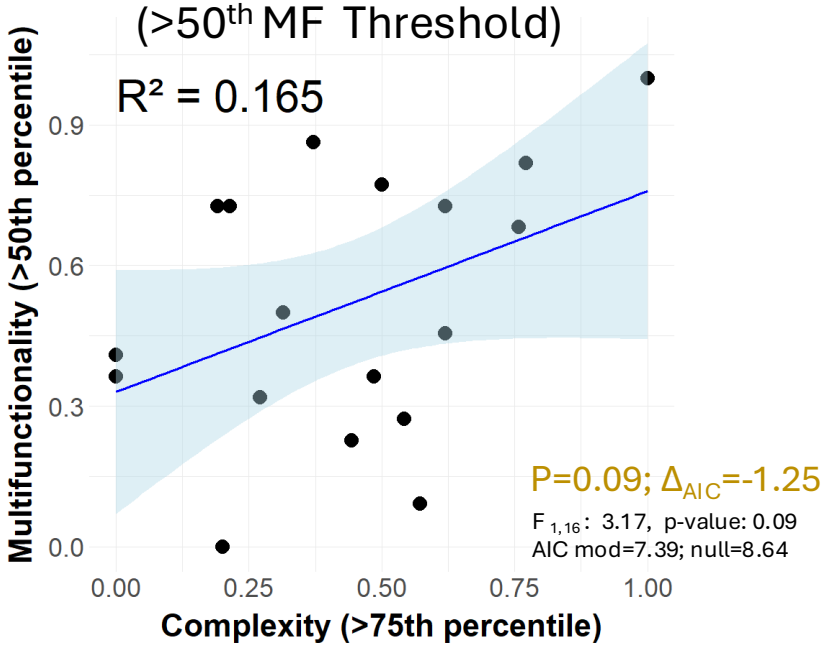
## Minimum level multifunctionality

(>25th MF Threshold)



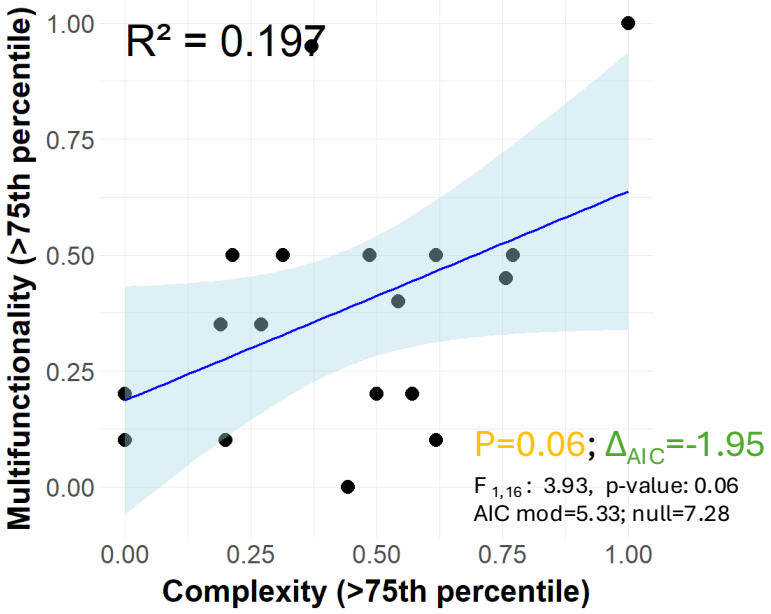

## Moderate above average multifunctionality

(>50th MF Threshold)




## High multifunctionality communities

(>75th MF Threshold)




**High complexity is important for delivering high multifunctionality**

Note for AIC lower is better. So positive $\Delta_{AIC}$ values indicate a better fit than an intercept only model. Around 2 is pretty good

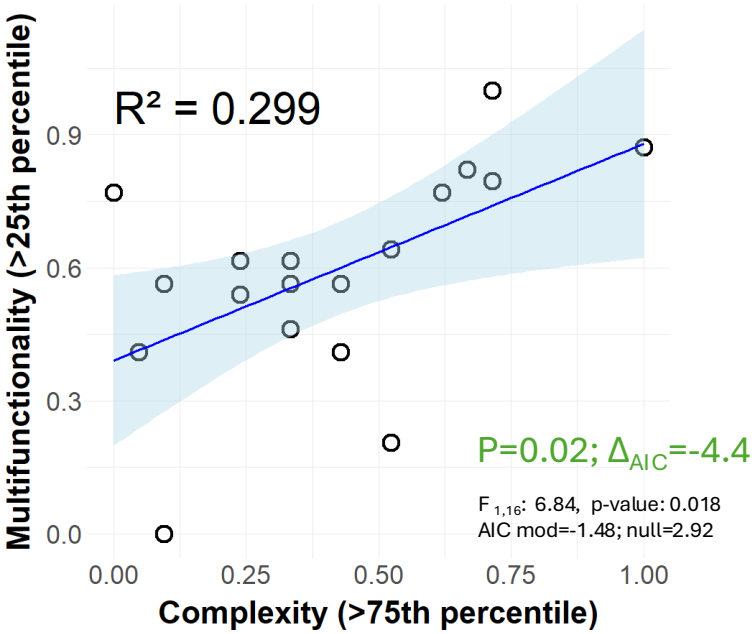


# Grasslands



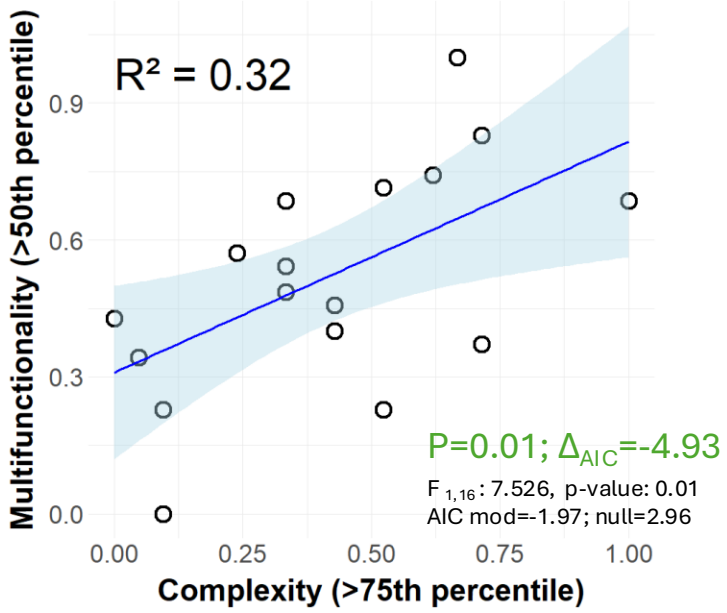
## Minimum level multifunctionality

(>25th MF Threshold)



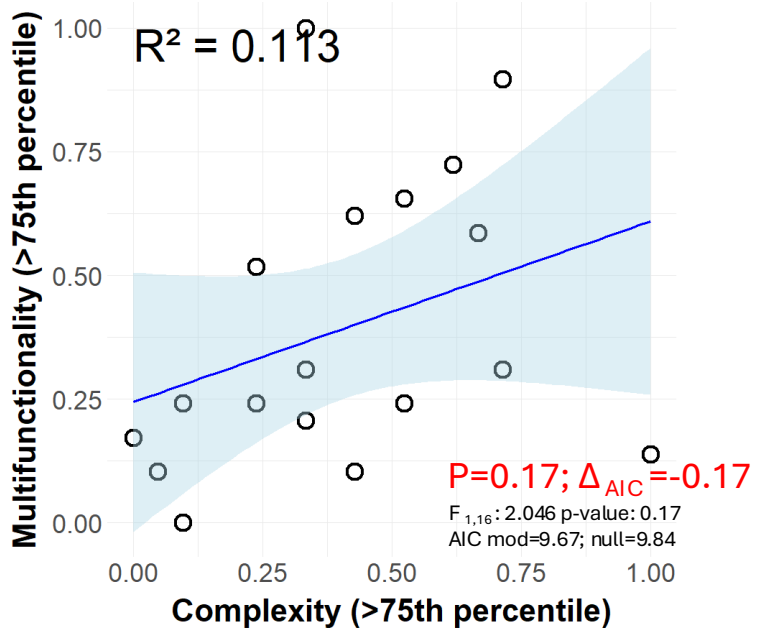

## Moderate above average multifunctionality

(>50th MF Threshold)




## High multifunctionality communities

(>75th MF Threshold)




**High complexity supports minimum to moderate levels of multifunctionality**

Note for AIC lower is better. So positive $\Delta_{AIC}$ values indicate a better fit than an intercept only model. Around 2 is pretty good



# Combined



## Minimum level multifunctionality

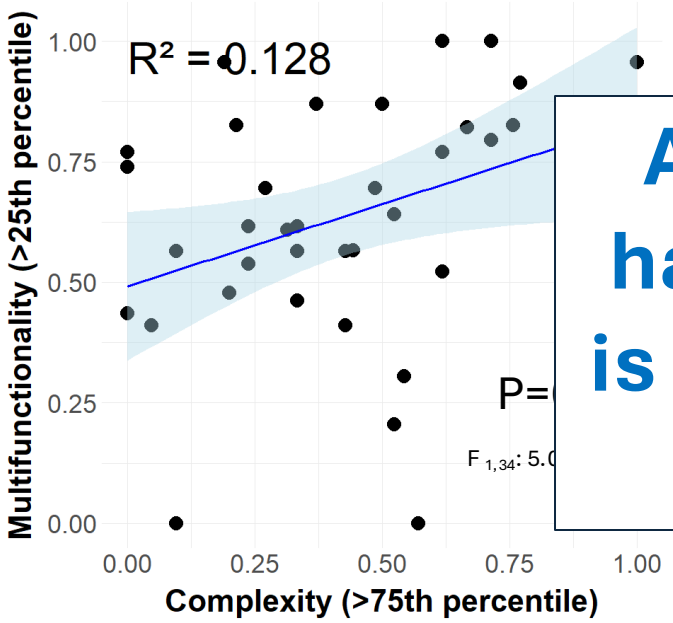
(>25th MF Threshold)

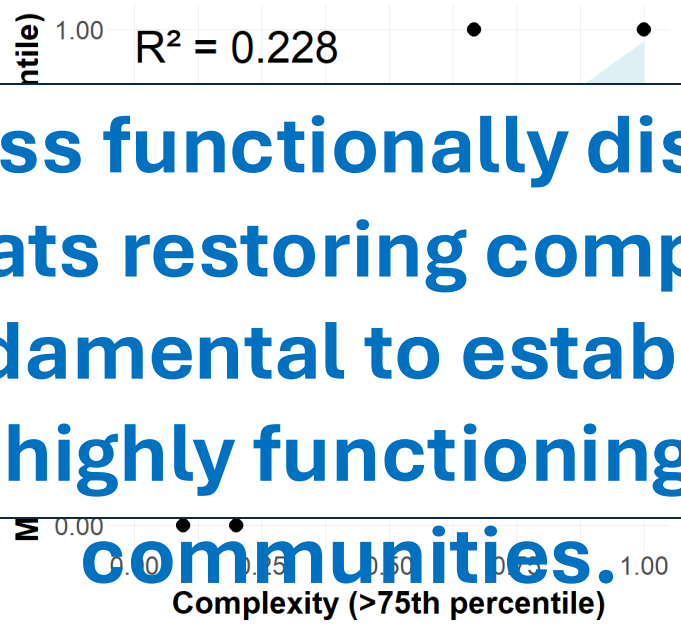
## Moderate above average multifunctionality

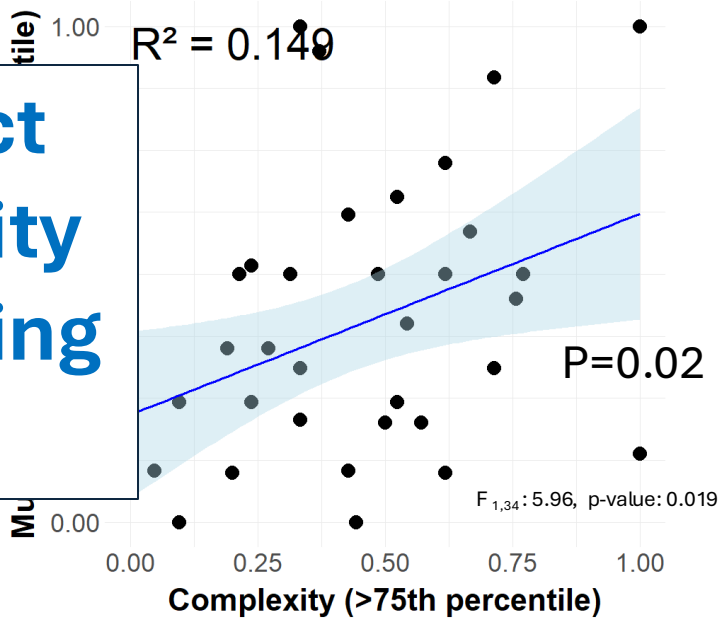
(>50th MF Threshold)

## High multifunctionality communities

(>75th MF Threshold)




**Across functionally distinct habitats restoring complexity is fundamental to establishing highly functioning communities.**



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# What is the endpoint for restoration - a functional ecosystems or a best guess to what ‘used’ to be there?

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