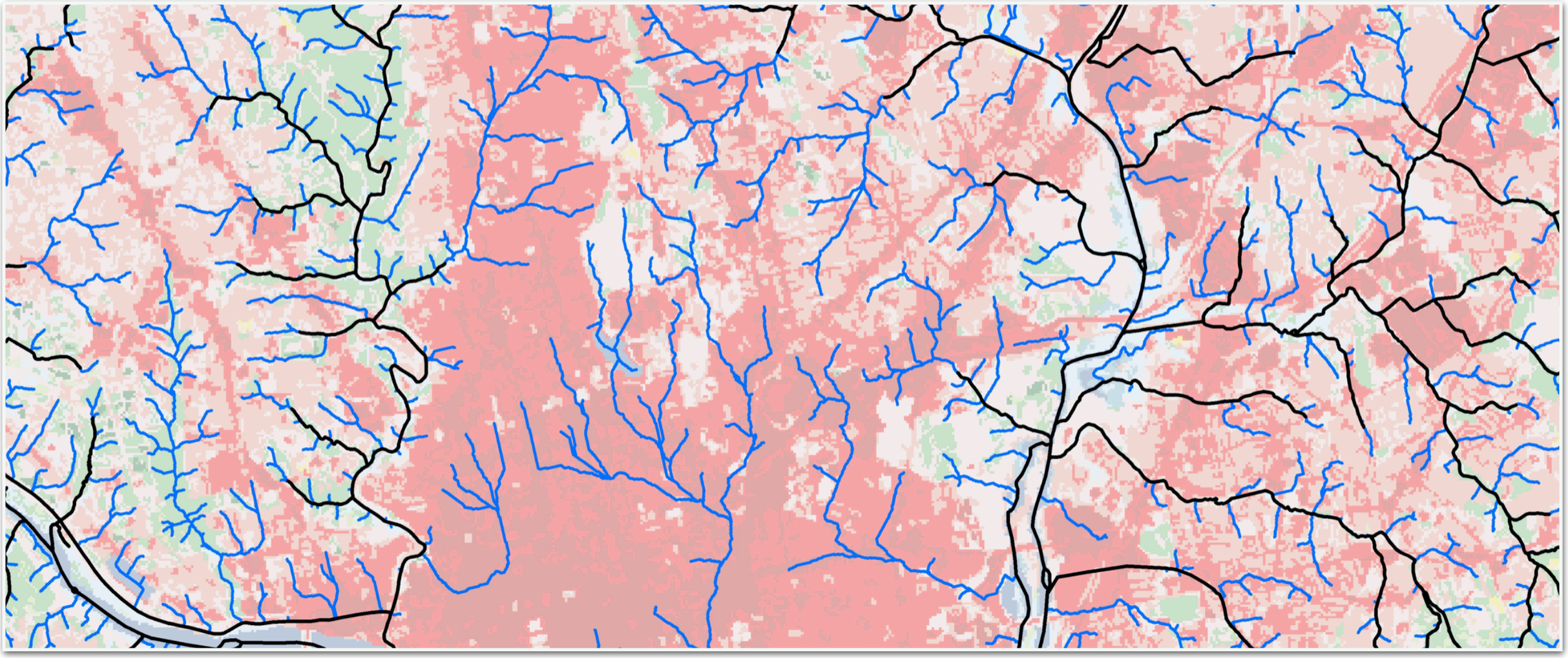
GF / GDM Application I: Modeling and mapping stream biodiversity

Goal: A biologically-optimized stream classification for Maryland

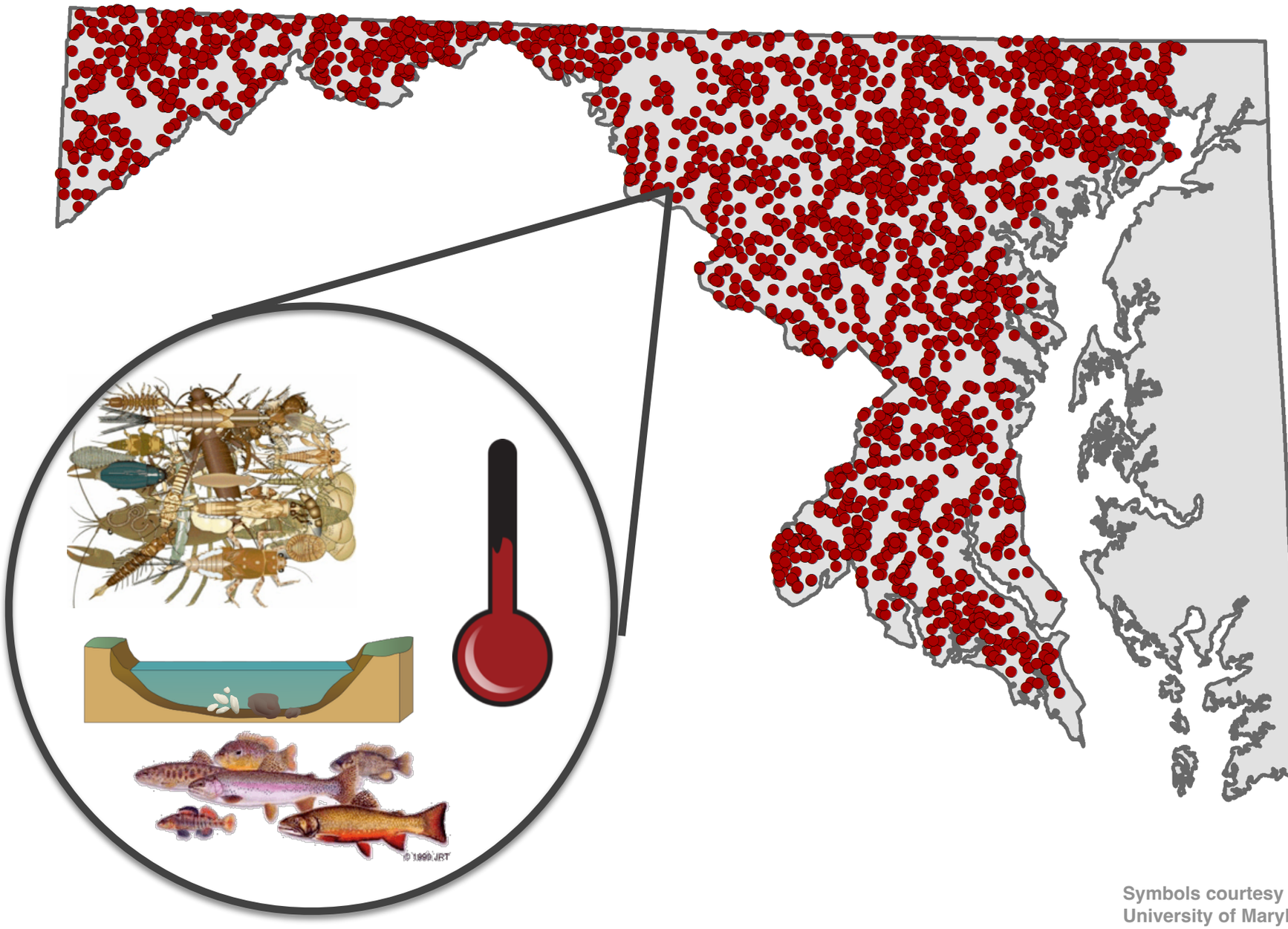


NHD flow lines

Streams

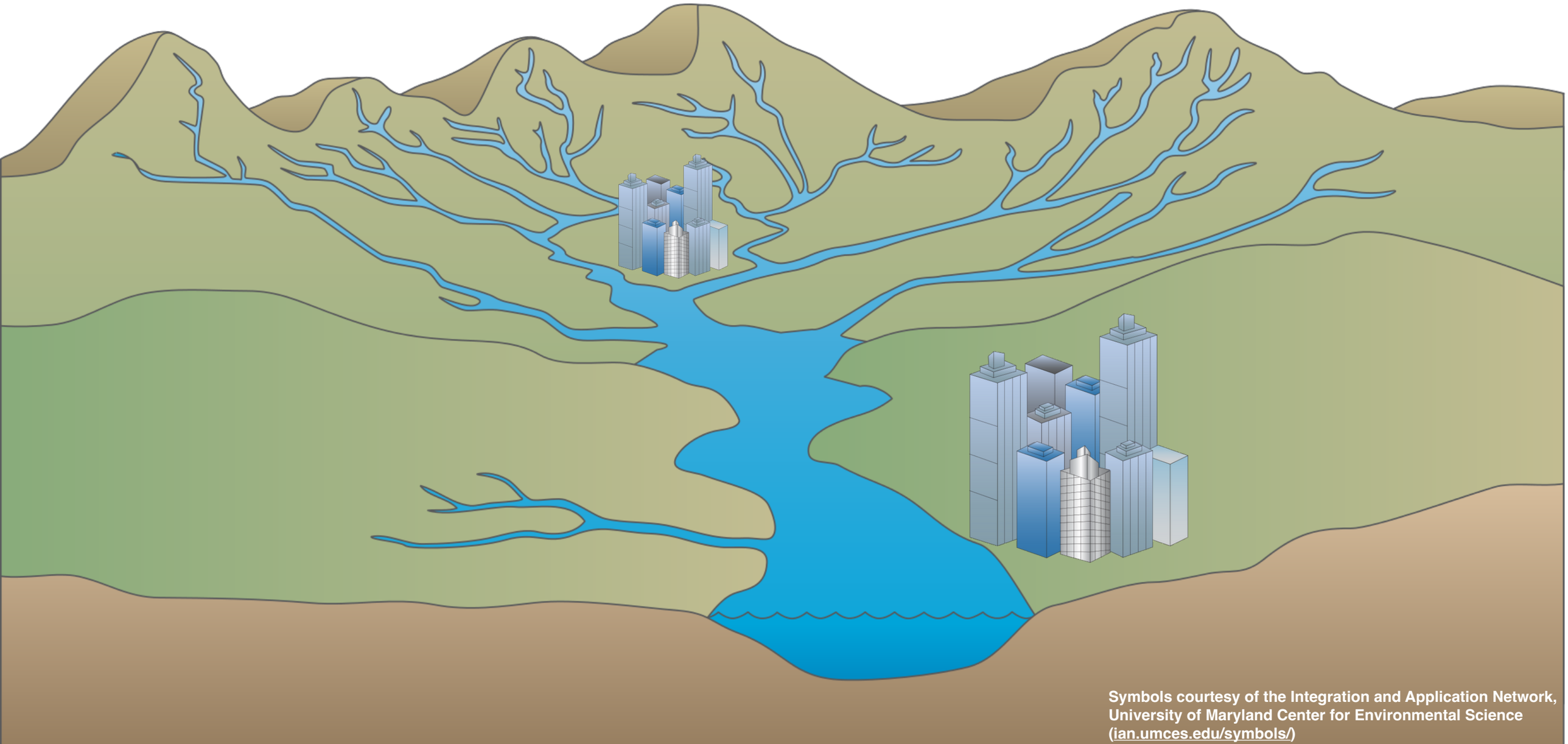
Elmore et al. (2013) *PLOS One*

Maryland Biological Stream Survey



Symbols courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/)

Local & landscape environmental predictors



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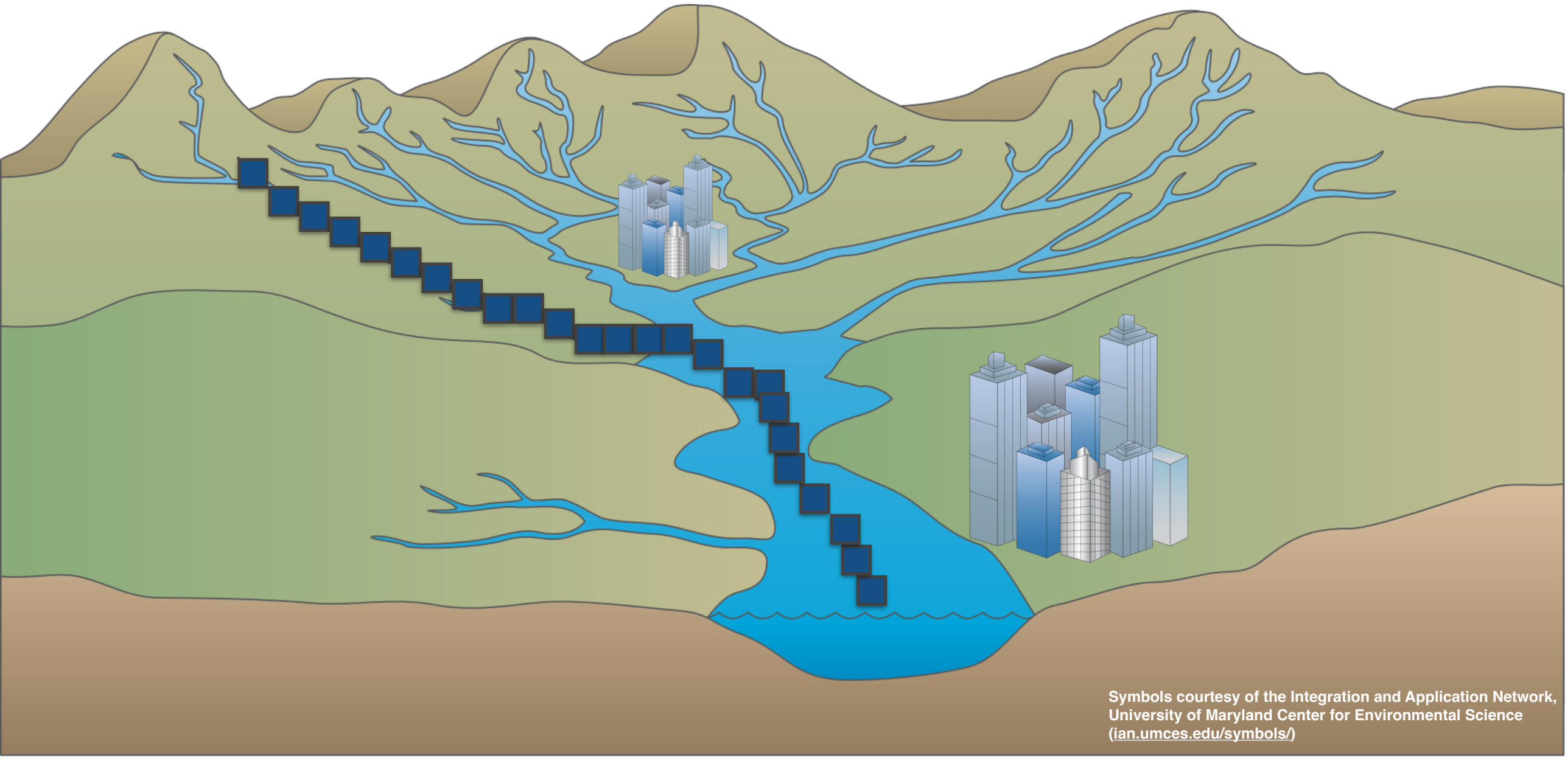
Local & landscape environmental predictors



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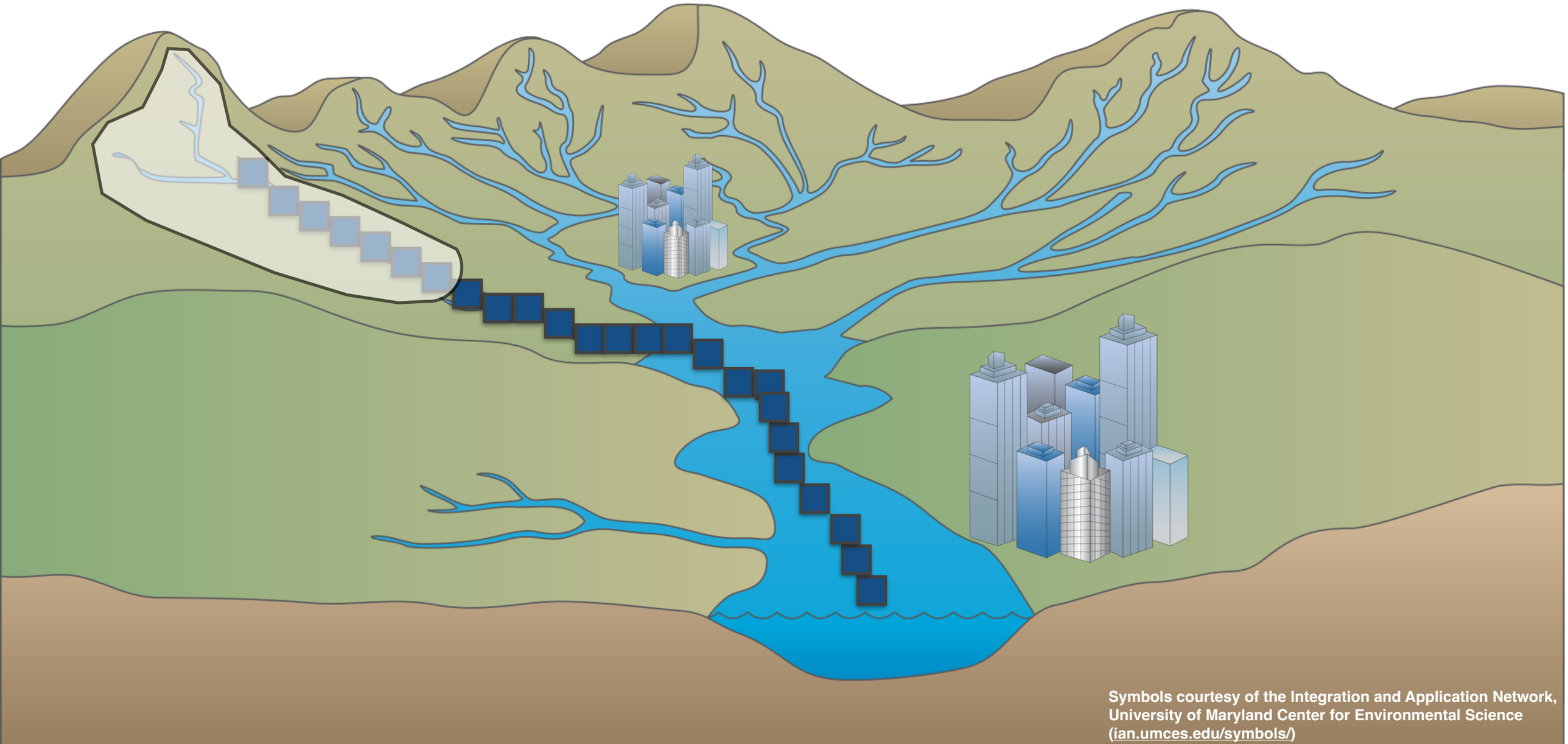
Local & landscape environmental predictors



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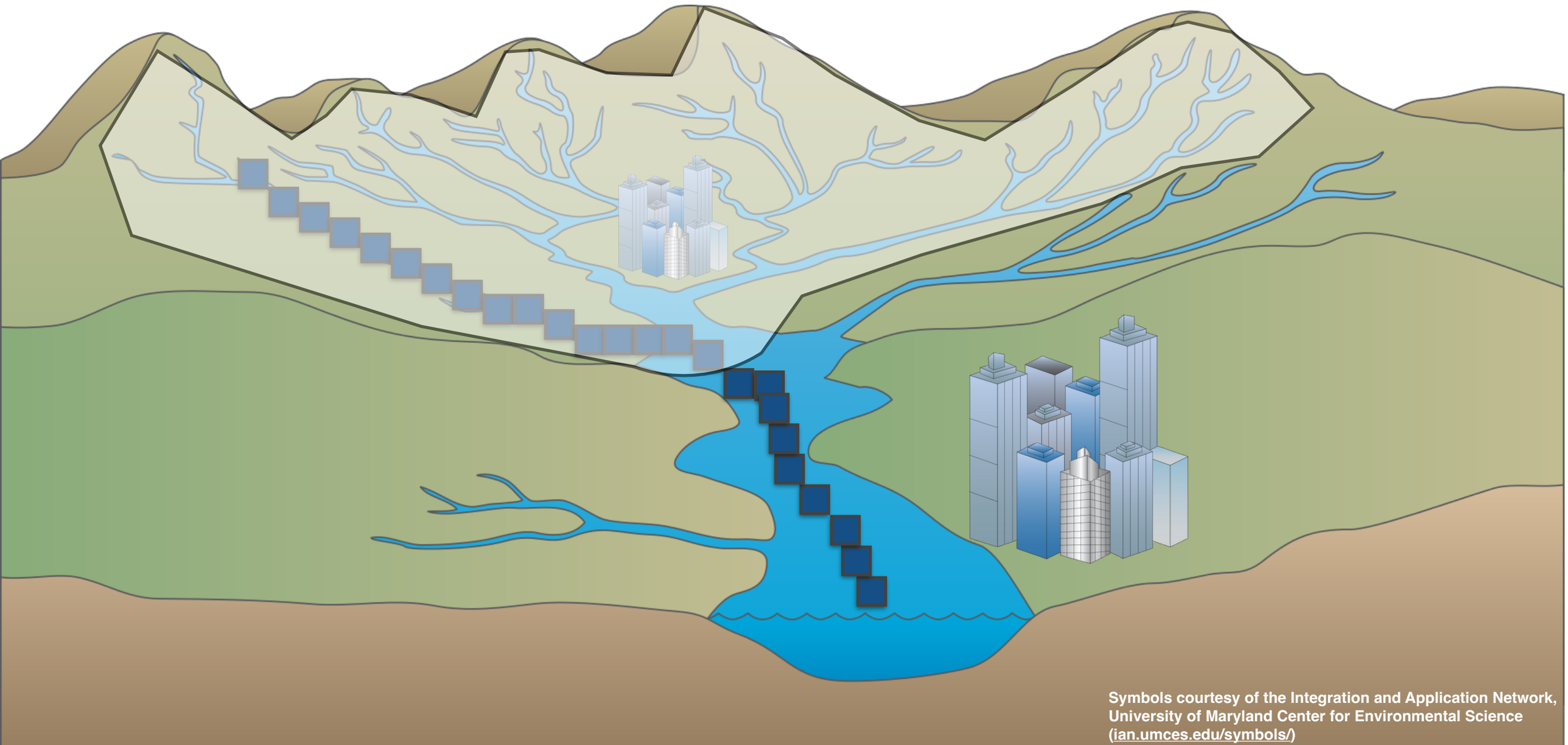
Local & landscape environmental predictors



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Accumulated variables

Stream environmental variables

Land use

- impervious surface
- forest
- wetlands
- agriculture

Topographic

- slope
- curvature

Hydrographic

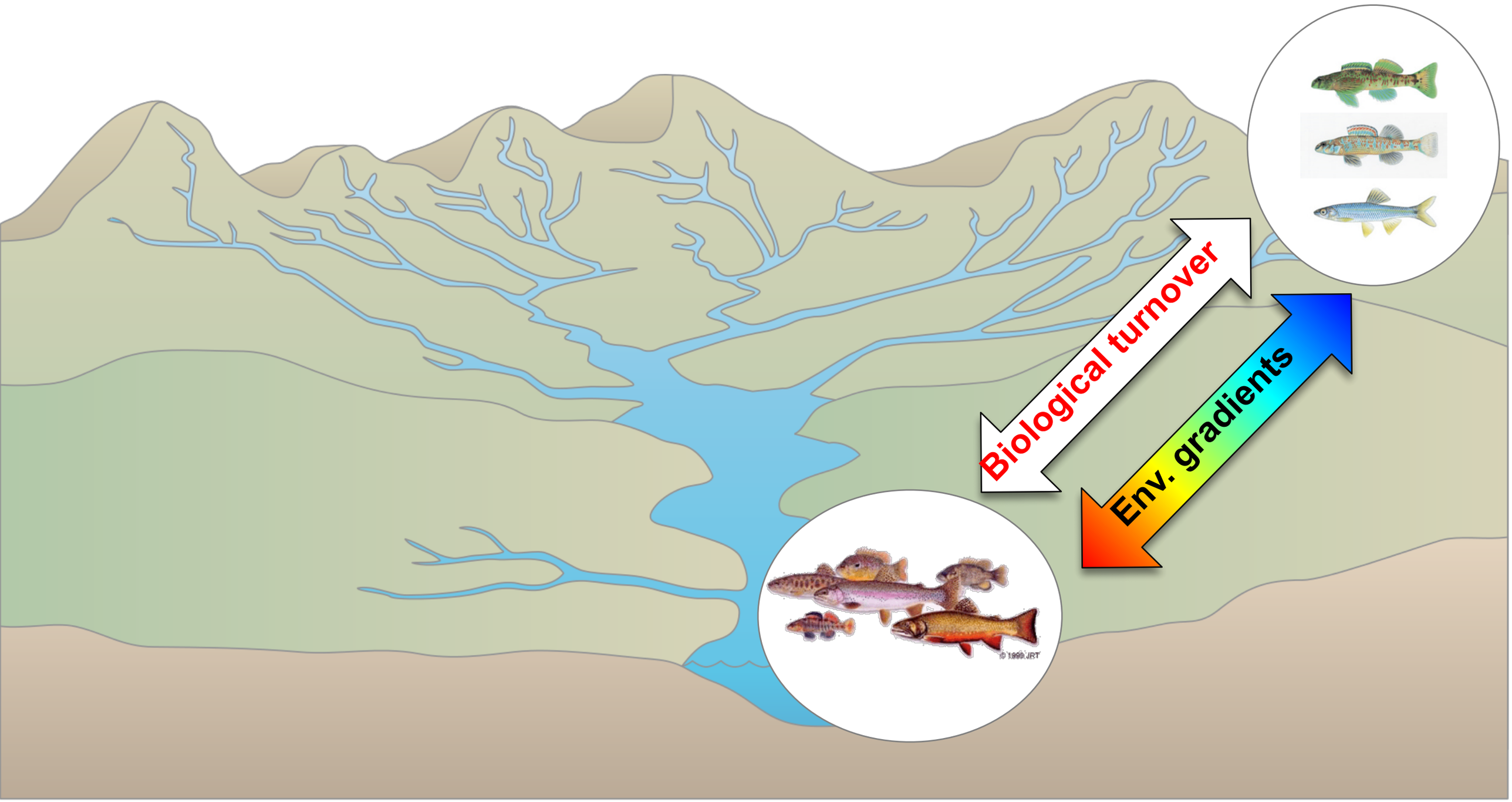
- watershed size
- stream length
- network density
- stream burial

Climate & soils

- air temperature
- soil texture
- soil pH
- bedrock depth
- bulk density

Johnston et al. 2017

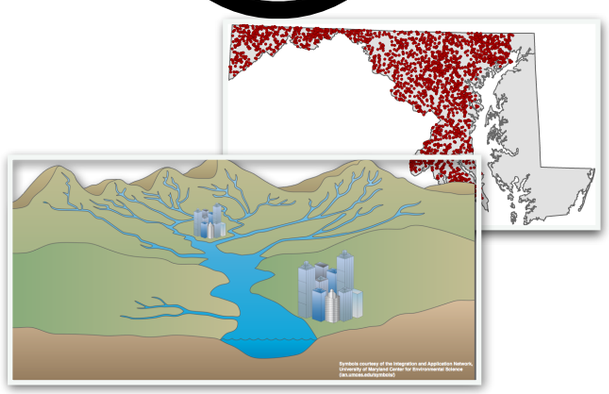
Basic approach: model & map compositional turnover



Biologically-optimized stream classification

Fit GDM / GF models

1



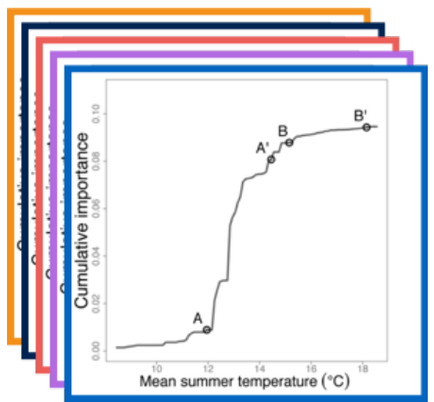
Biologically-optimized stream classification

Fit GDM / GF models

Apply models to stream variables

1

2



Biologically-optimized stream classification

Fit GDM / GF models

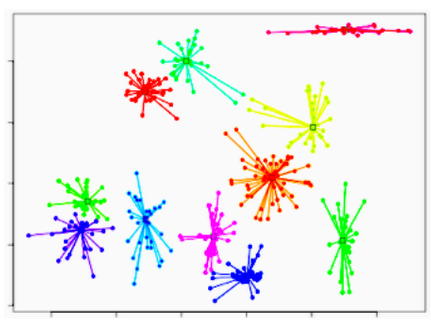
①

Apply models to stream variables

②

Statistical clustering to define assemblage types

③



Biologically-optimized stream classification

Fit GDM / GF models

①

Apply models to stream variables

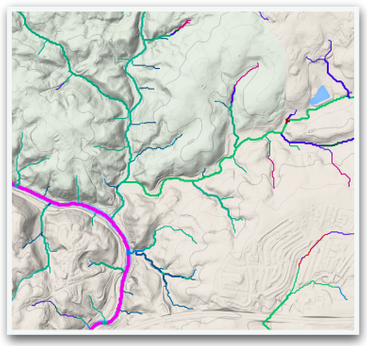
②

Statistical clustering to define assemblage types

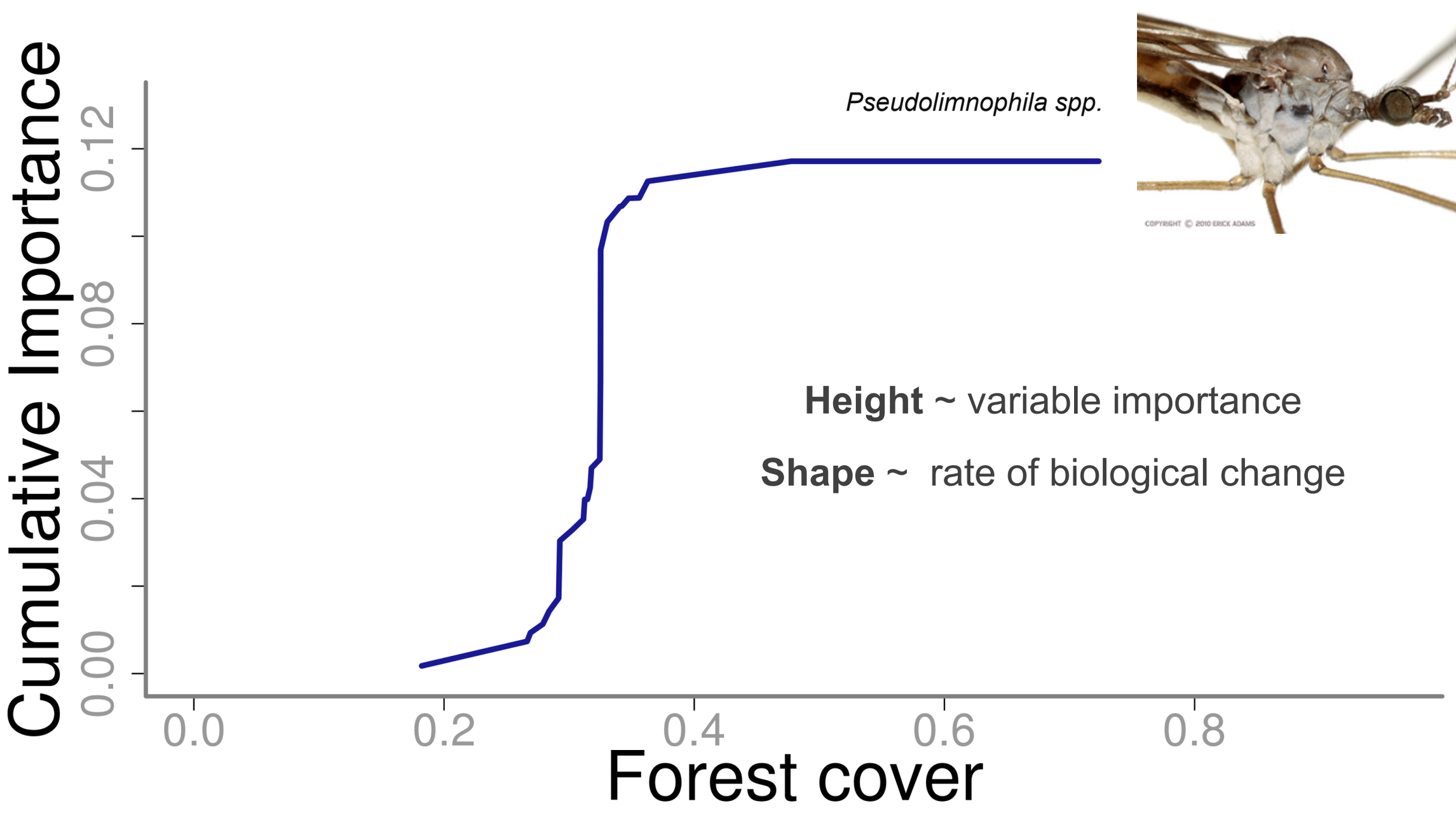
③

Map assemblages to streams

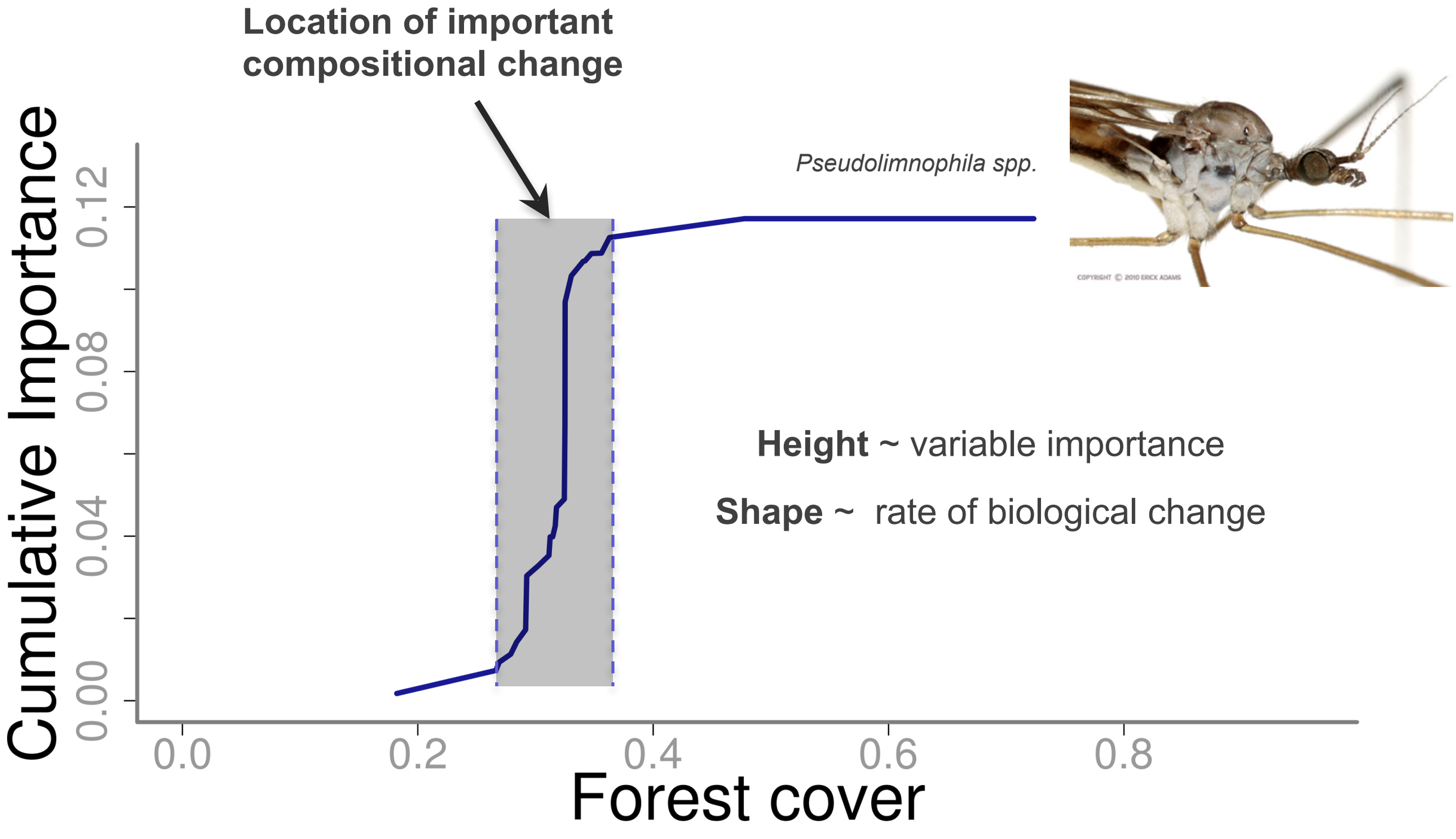
④



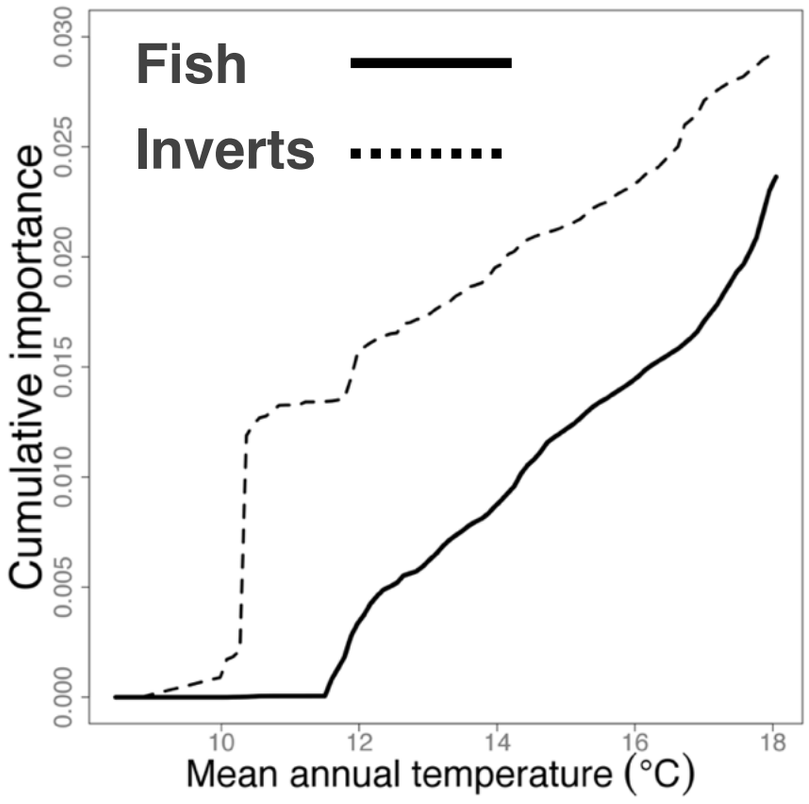
GF: Nonlinear compositional change in abundance



Nonlinear compositional change in abundance



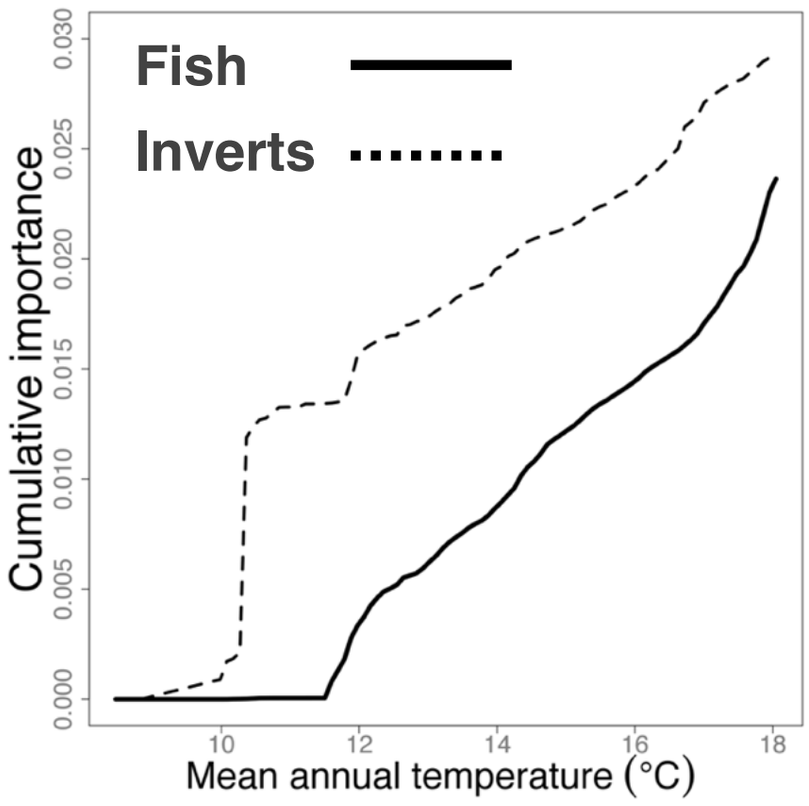
Community-level turnover

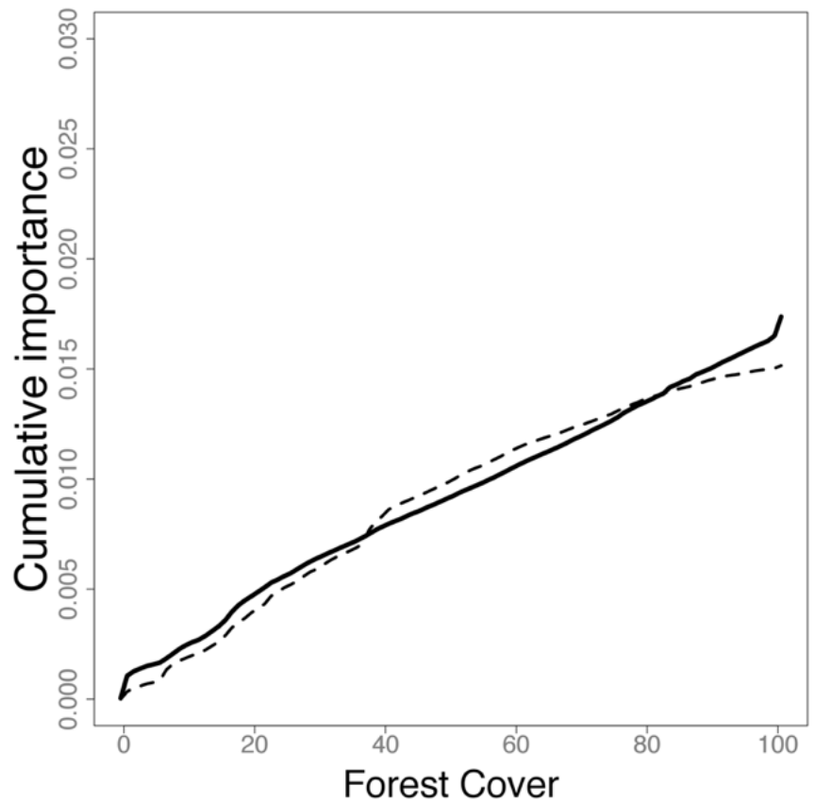


Shape = rate of biological change

Height = relative importance

Community-level turnover





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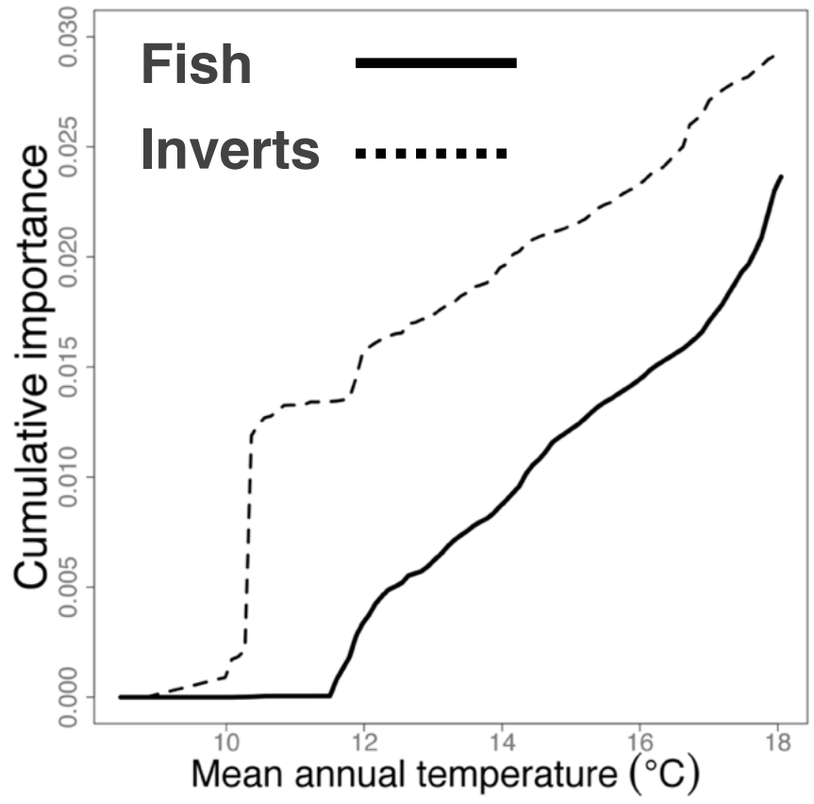
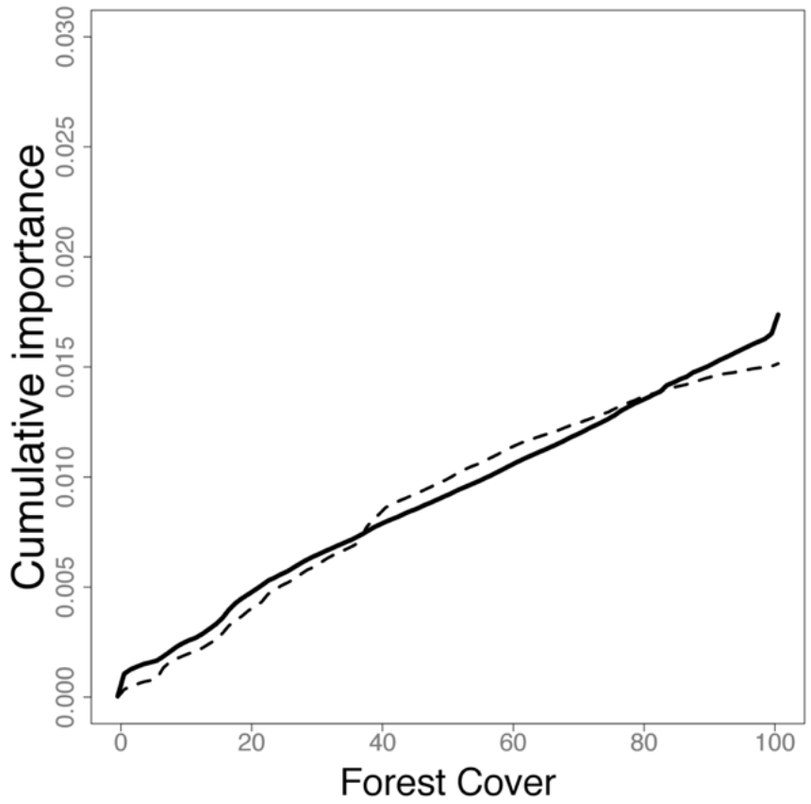
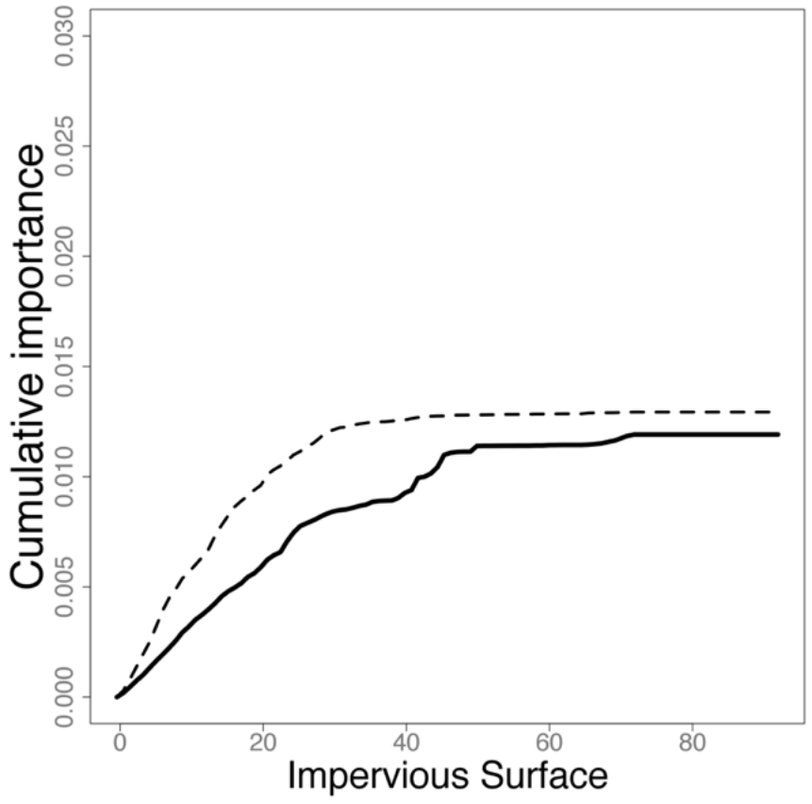
Community-level turnover







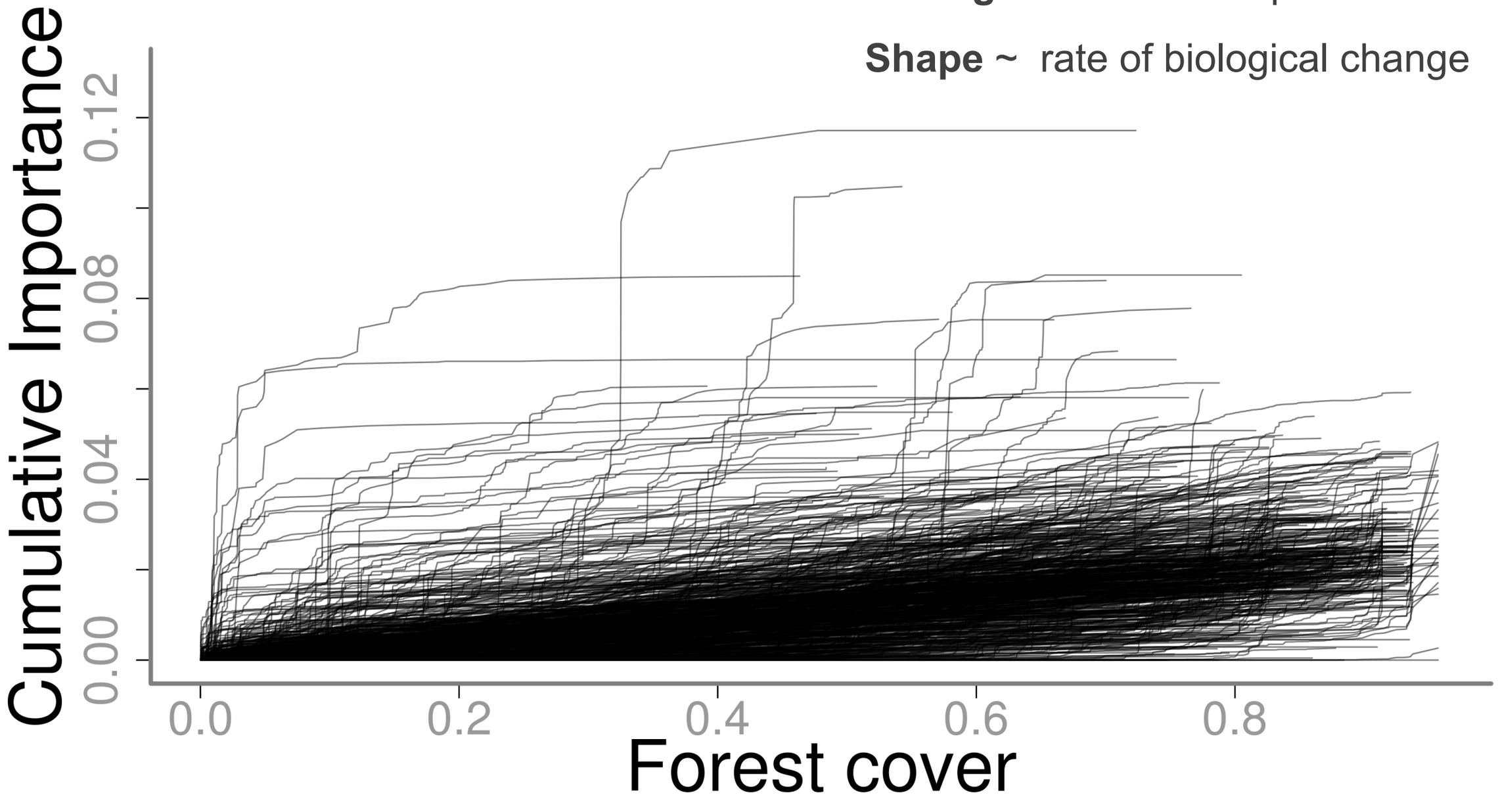
Shape = rate of biological change

Height = relative importance

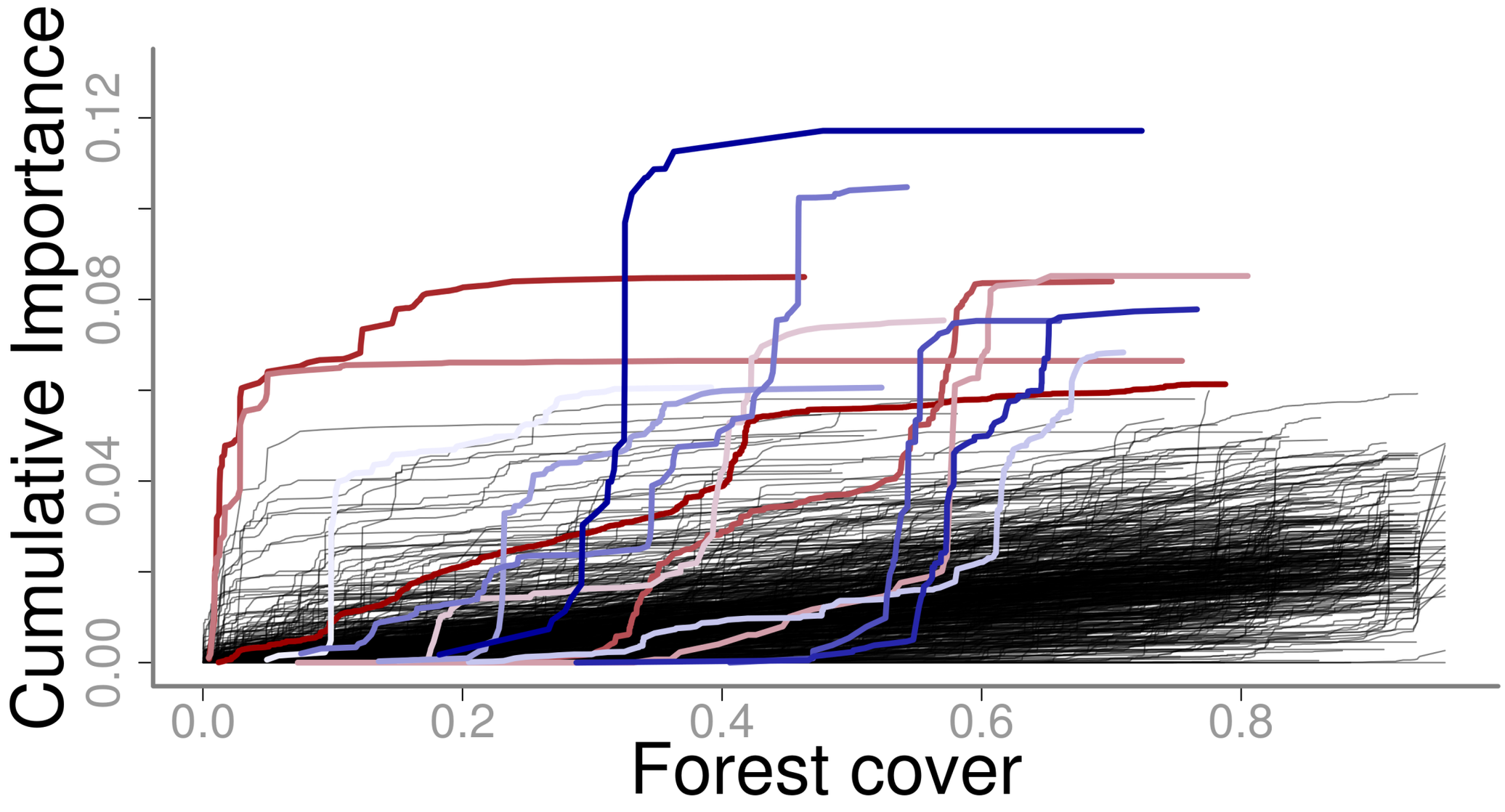
Compositional change for 632 fish & macroinvertebrate taxa

Height ~ variable importance

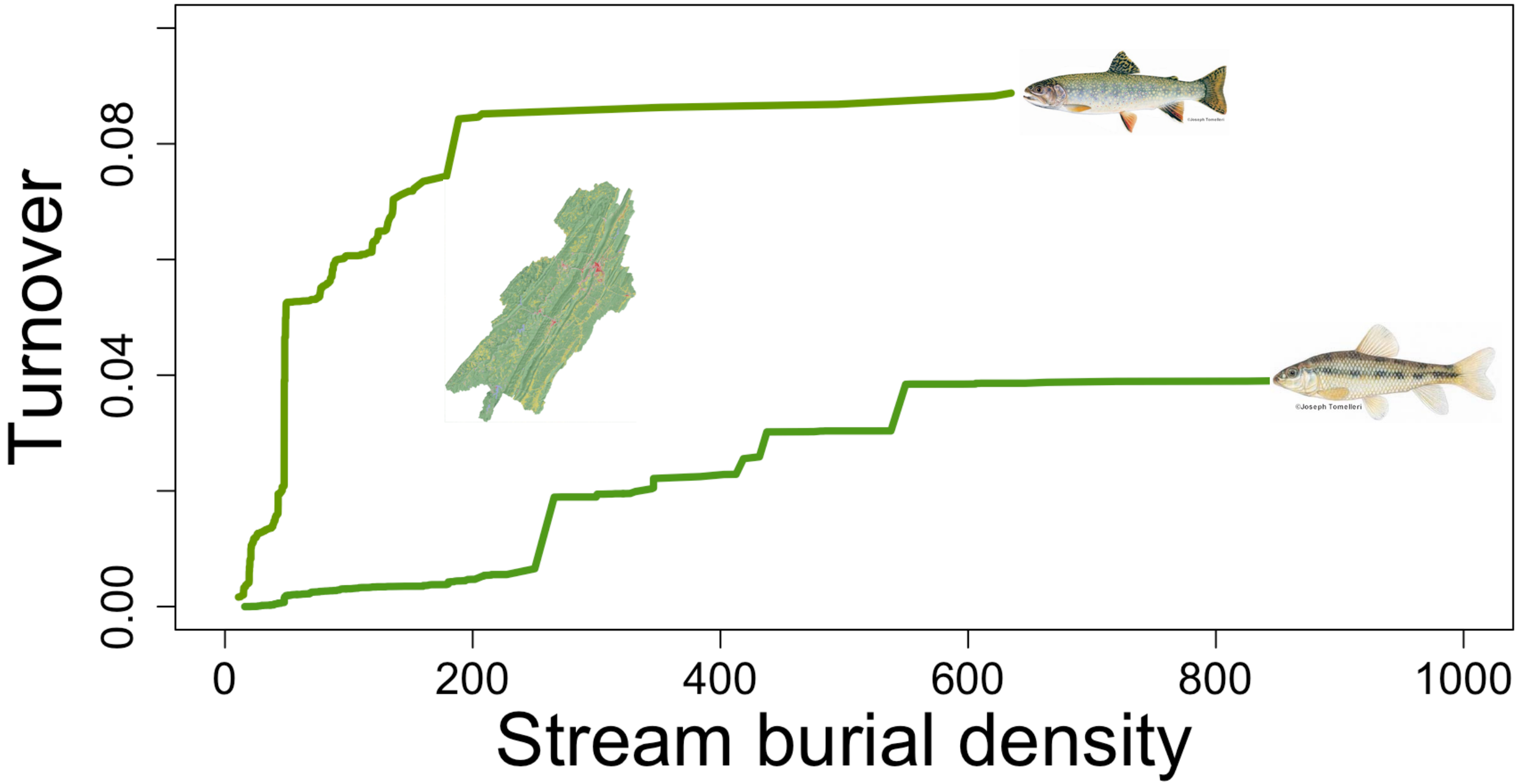
Shape ~ rate of biological change



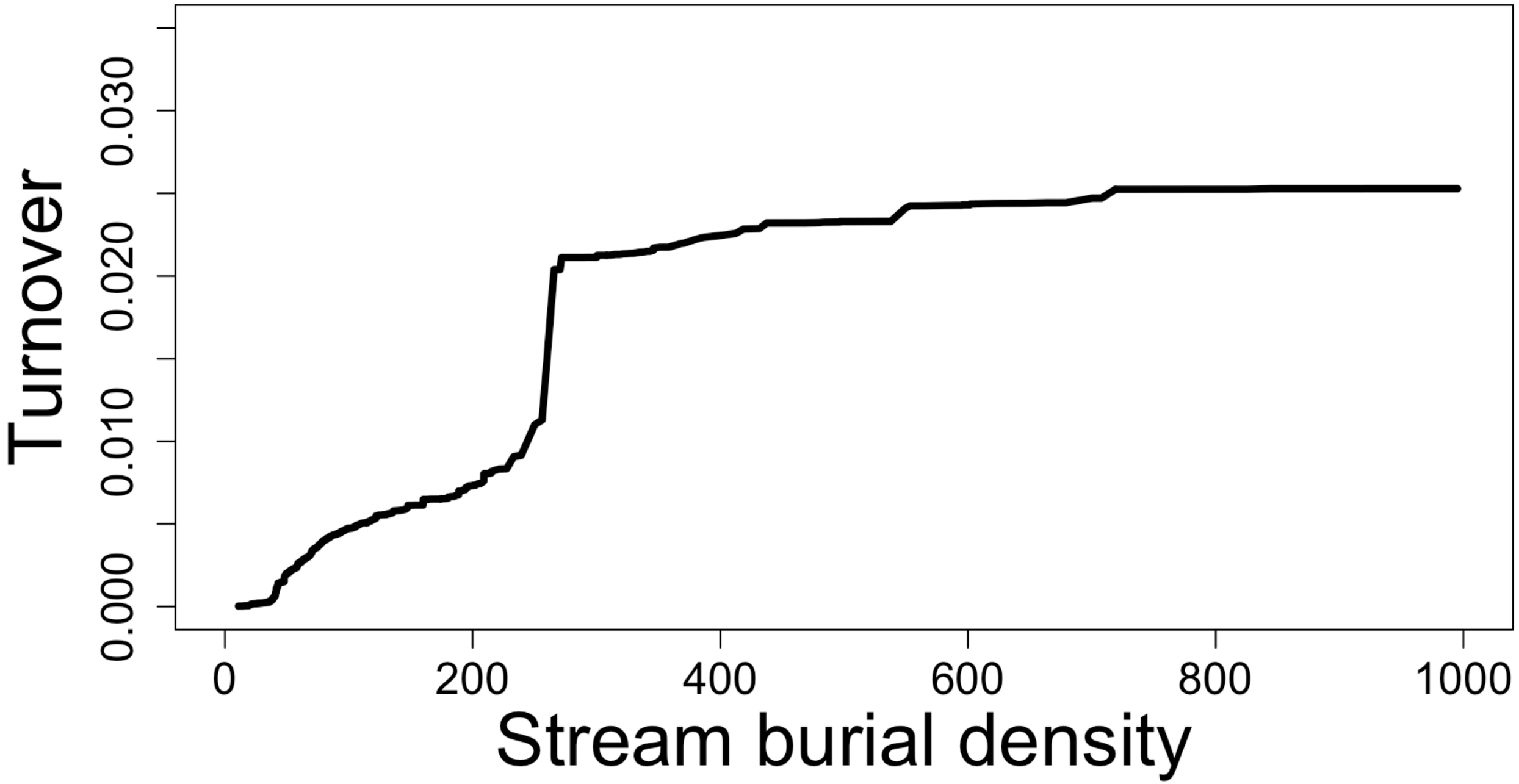
Species-level turnover - some taxa highly responsive



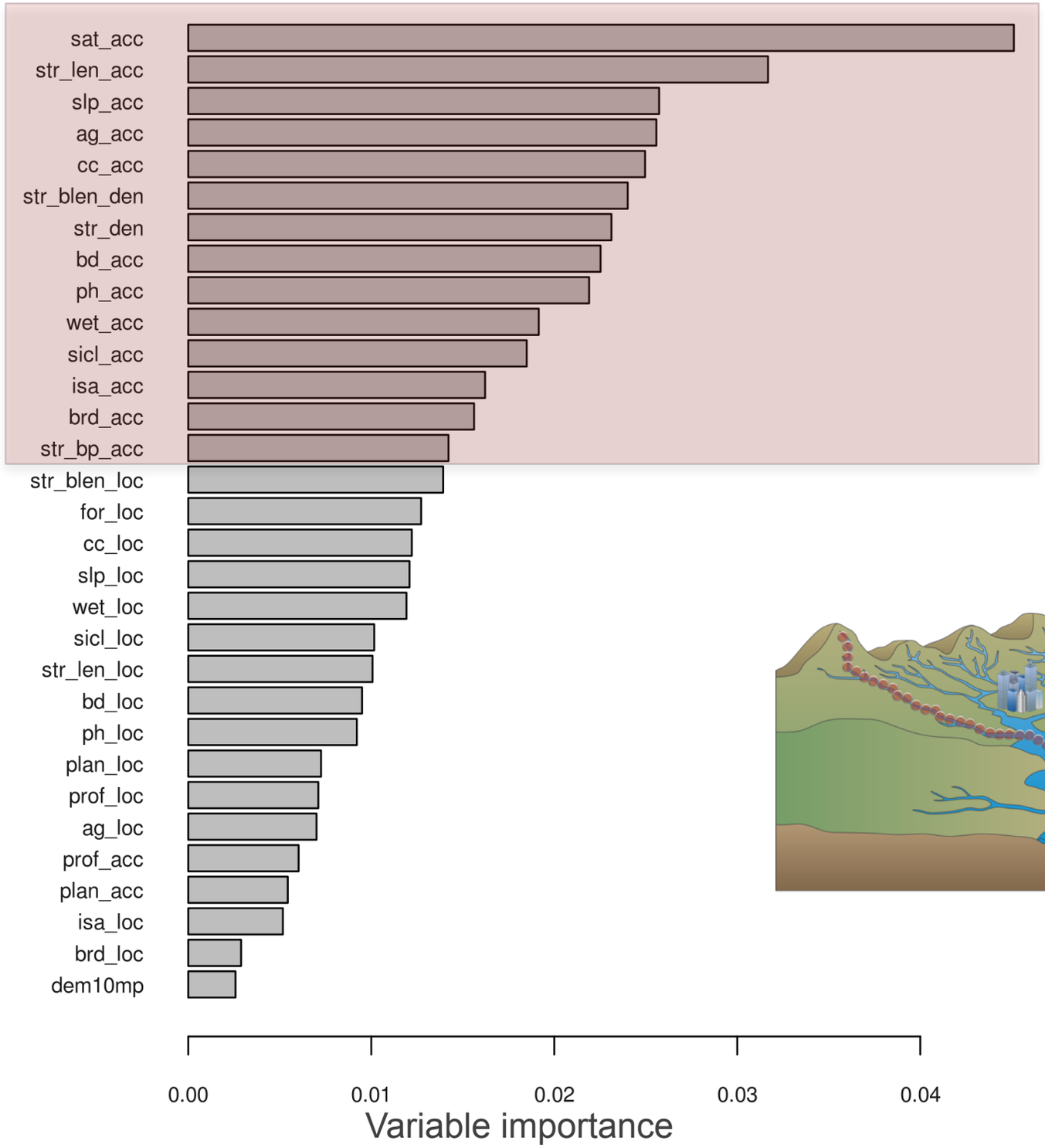
Brook trout exhibit threshold response to low-levels of urbanization

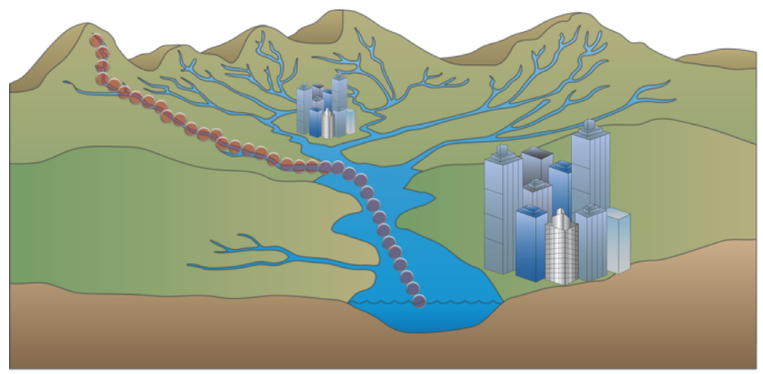


Compositional turnover in fish taxa (averaged response) as a function of stream burial

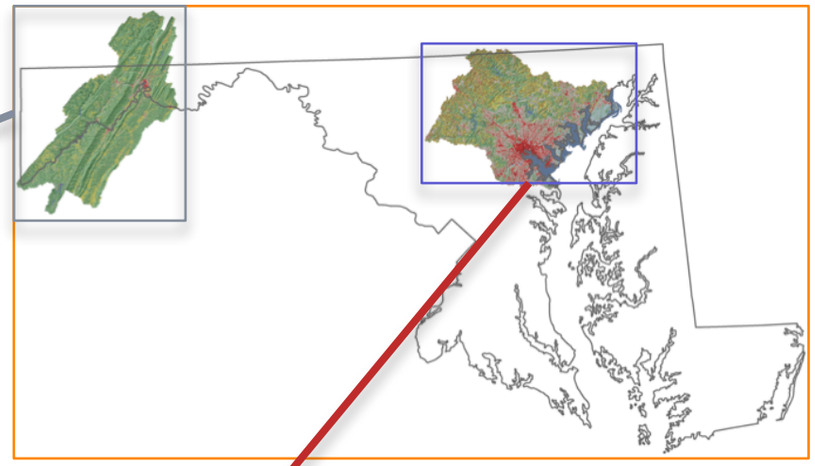


Upstream conditions more important than local conditions



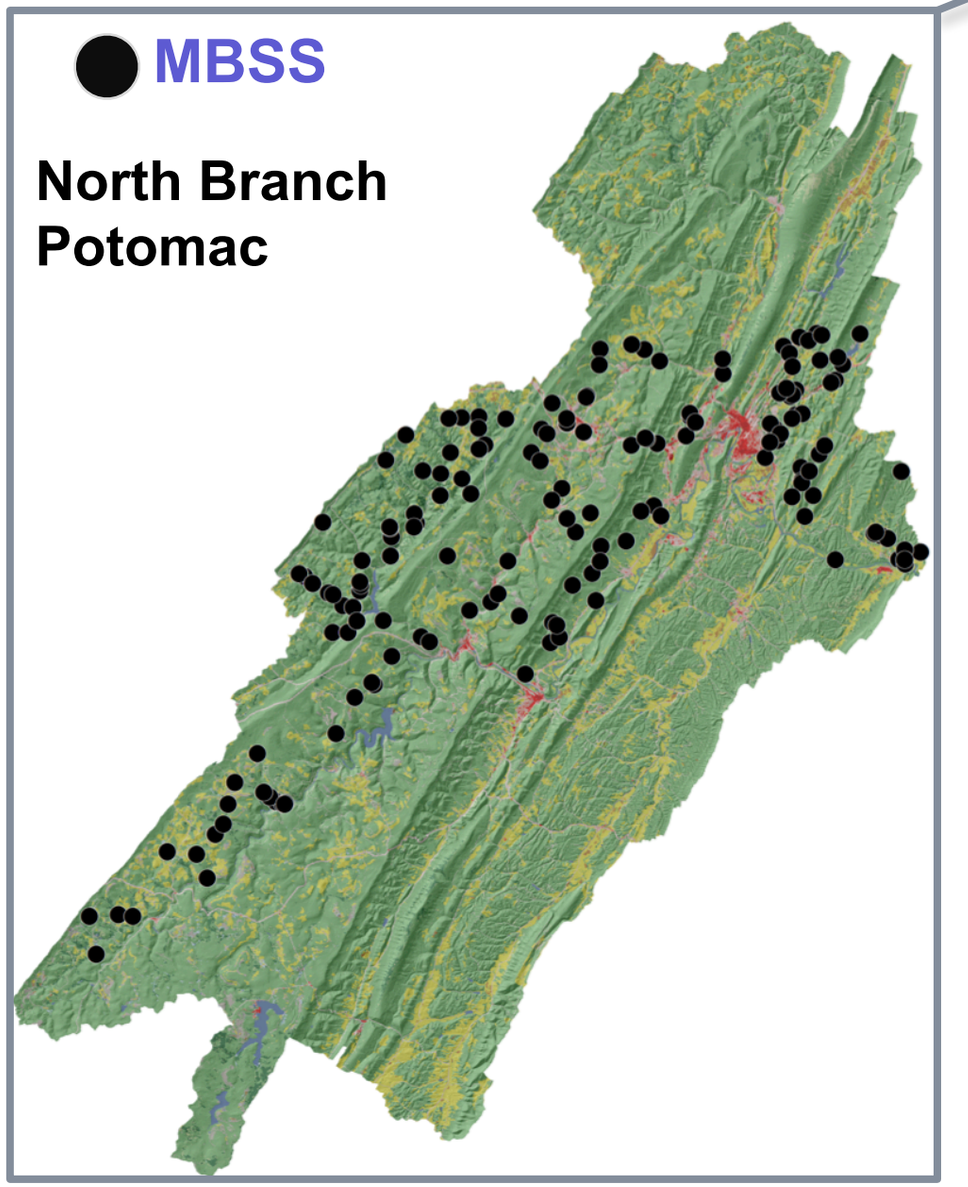


Example watersheds

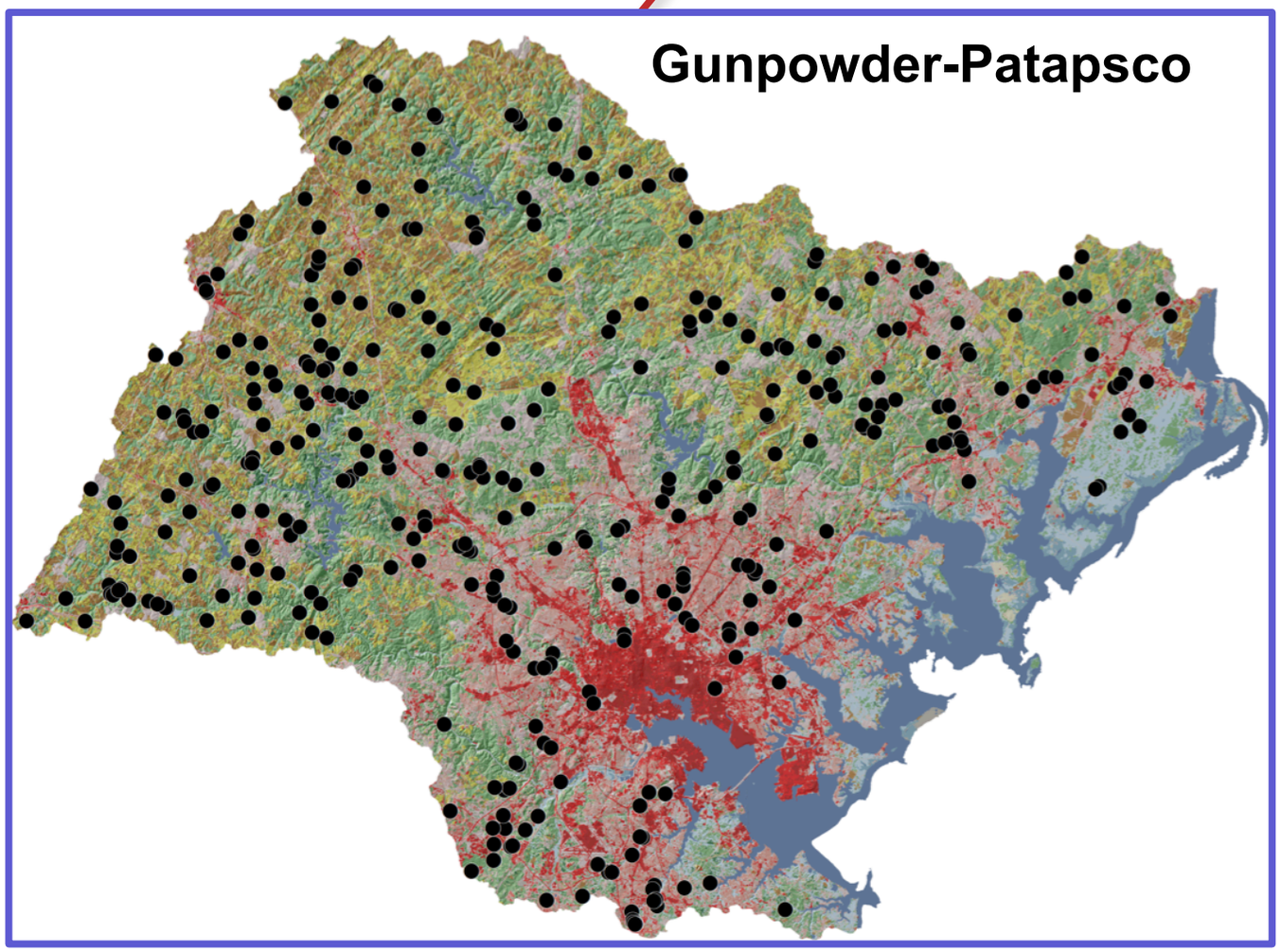


● **MBSS**

North Branch Potomac

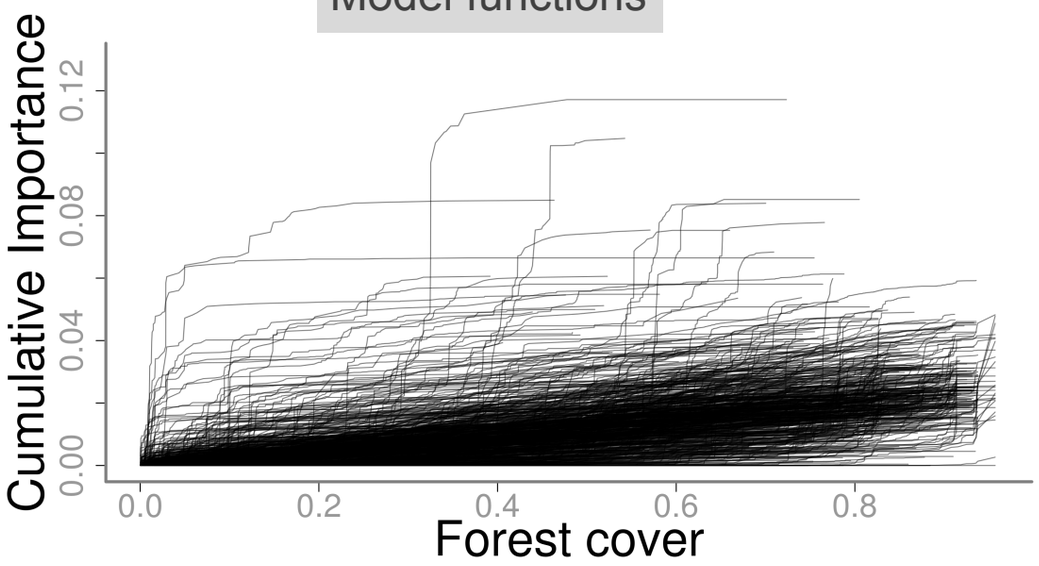


Gunpowder-Patapsco



Model functions transform environmental space into biological space

Model functions



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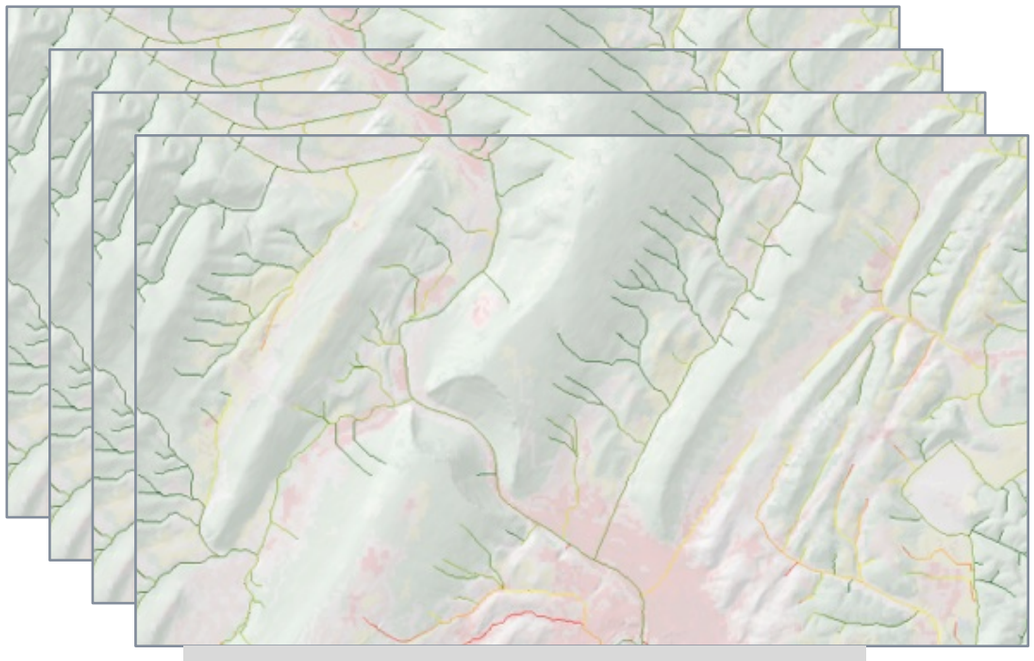
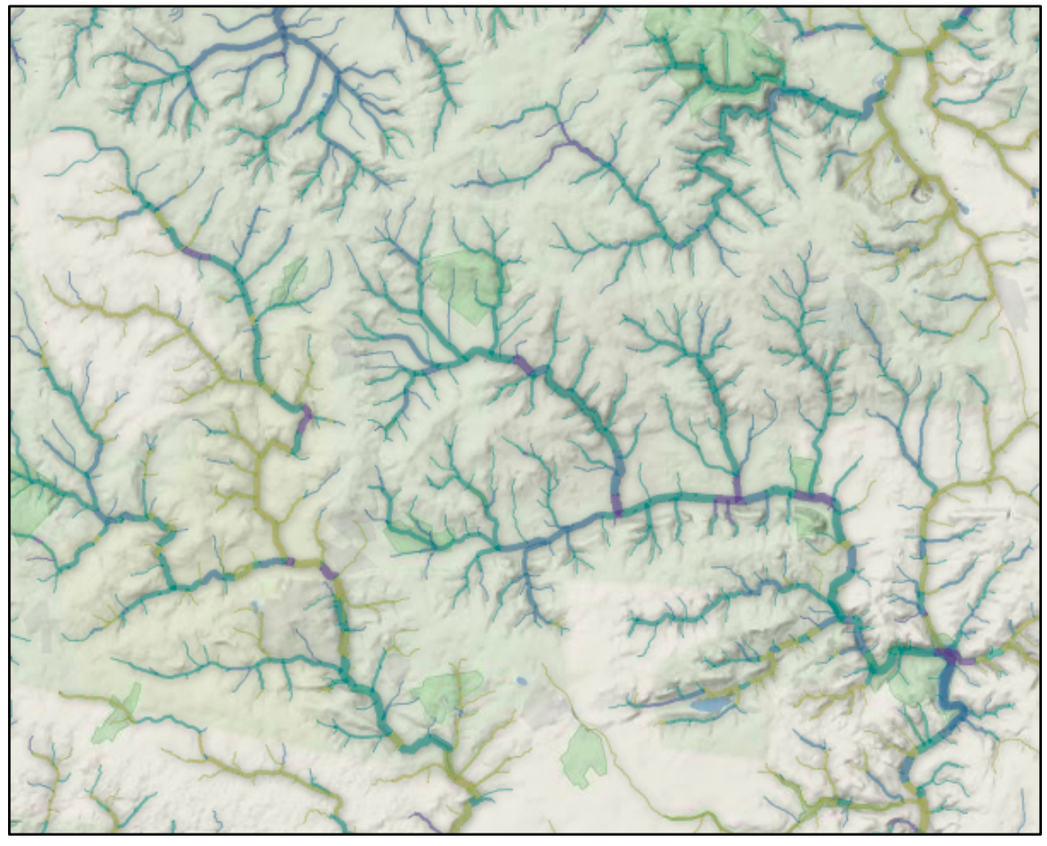
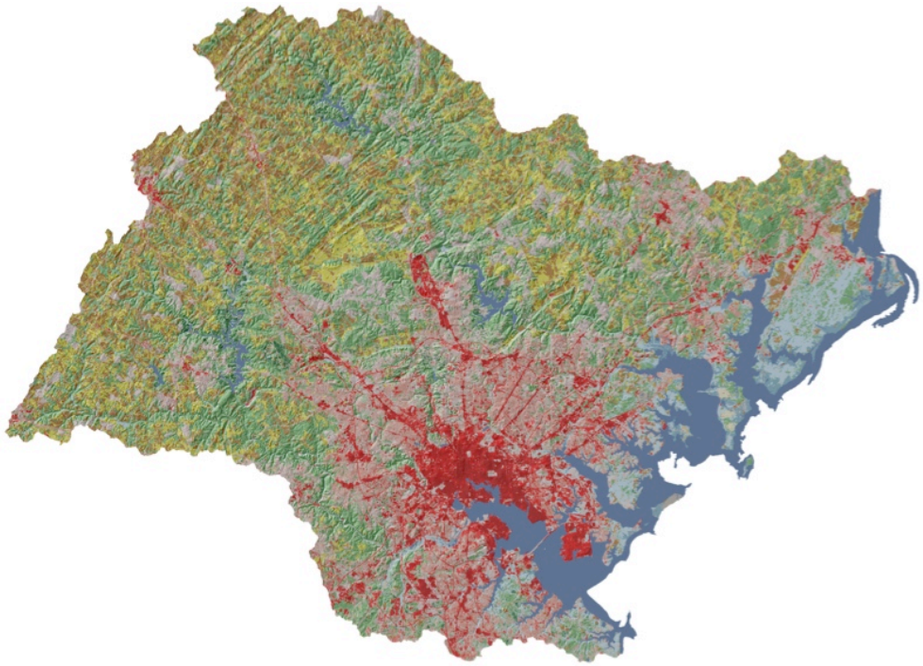


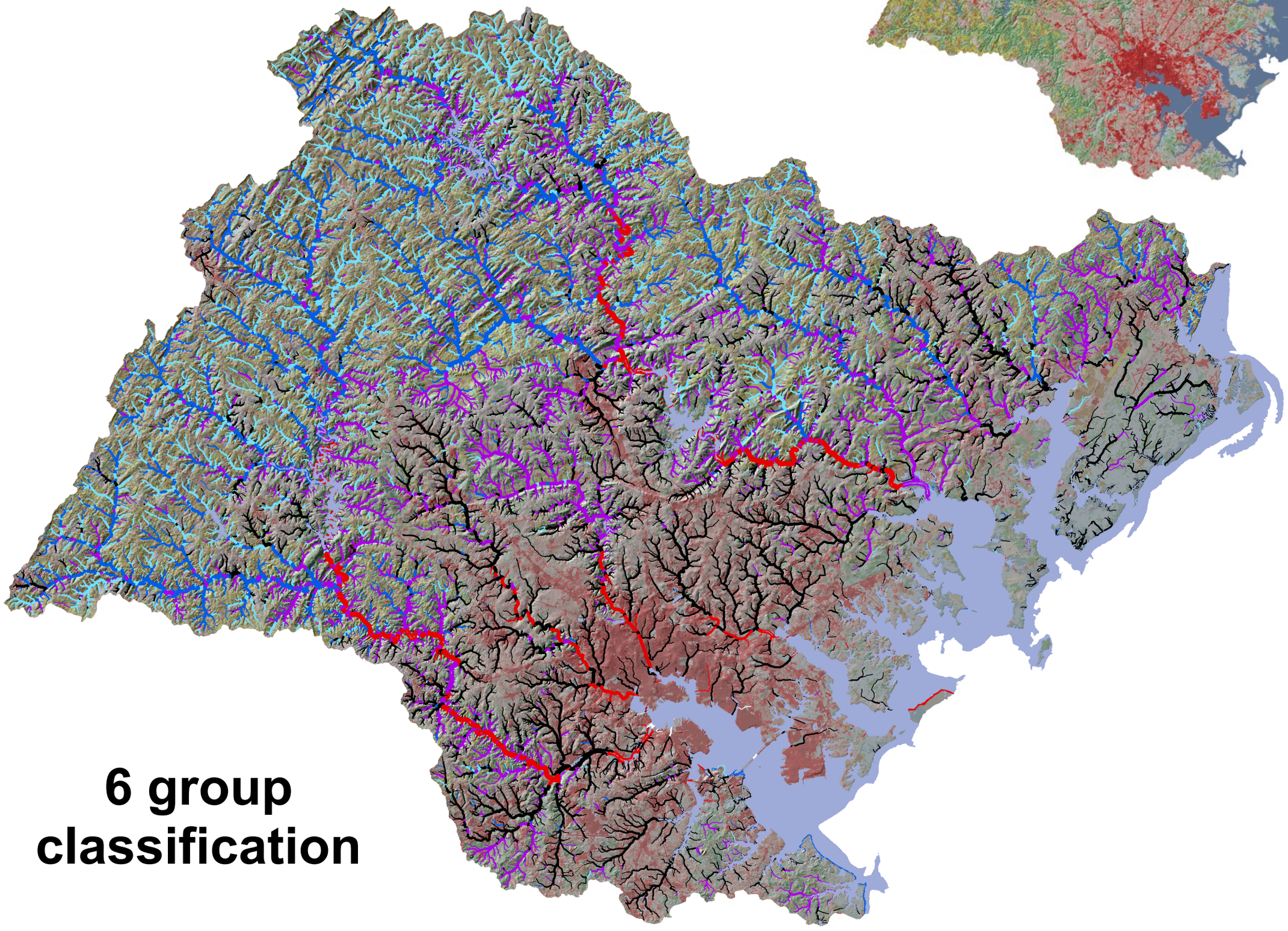
Mapped environmental variables

Mapped multidimensional biological space



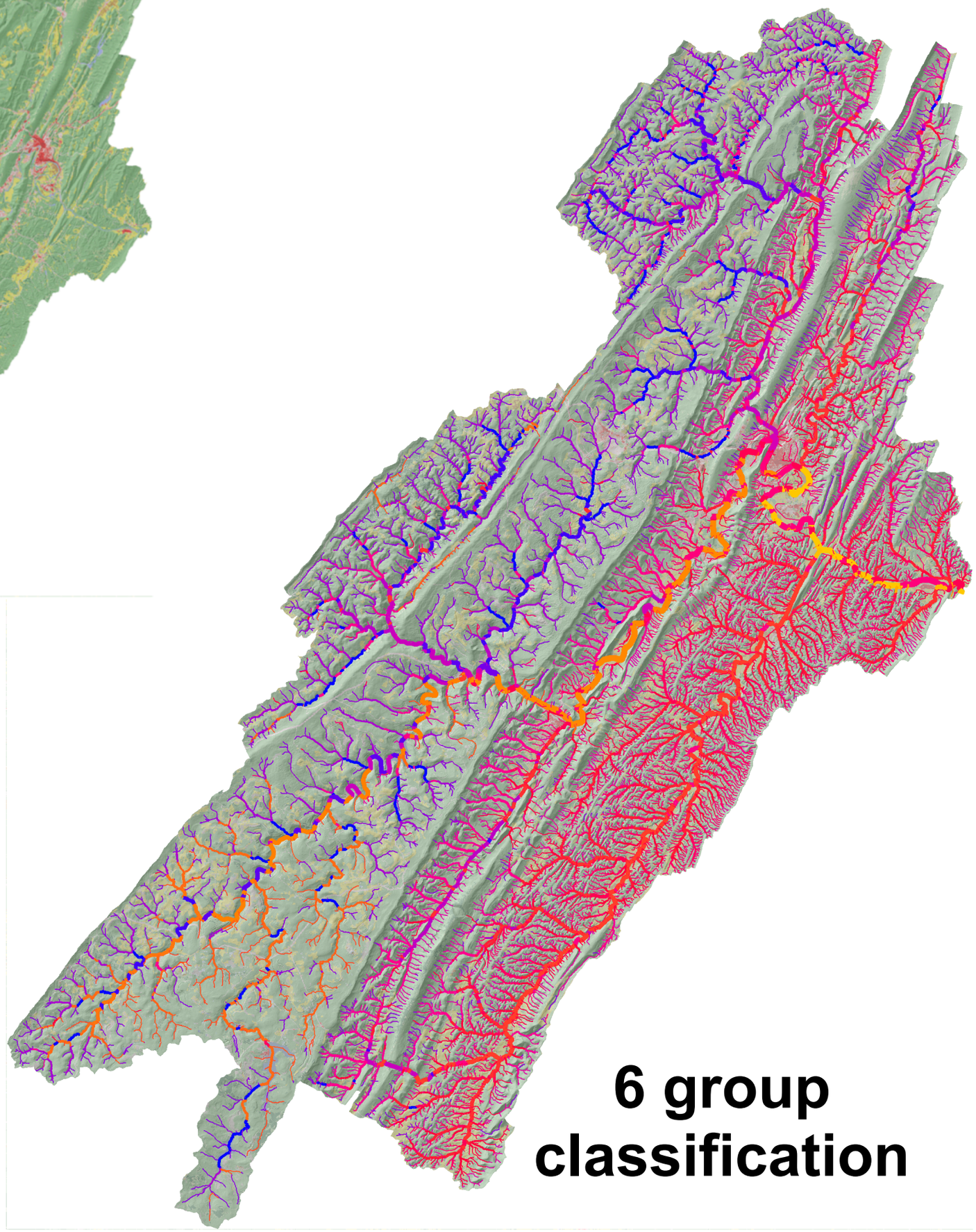
Land cover & order drives composition



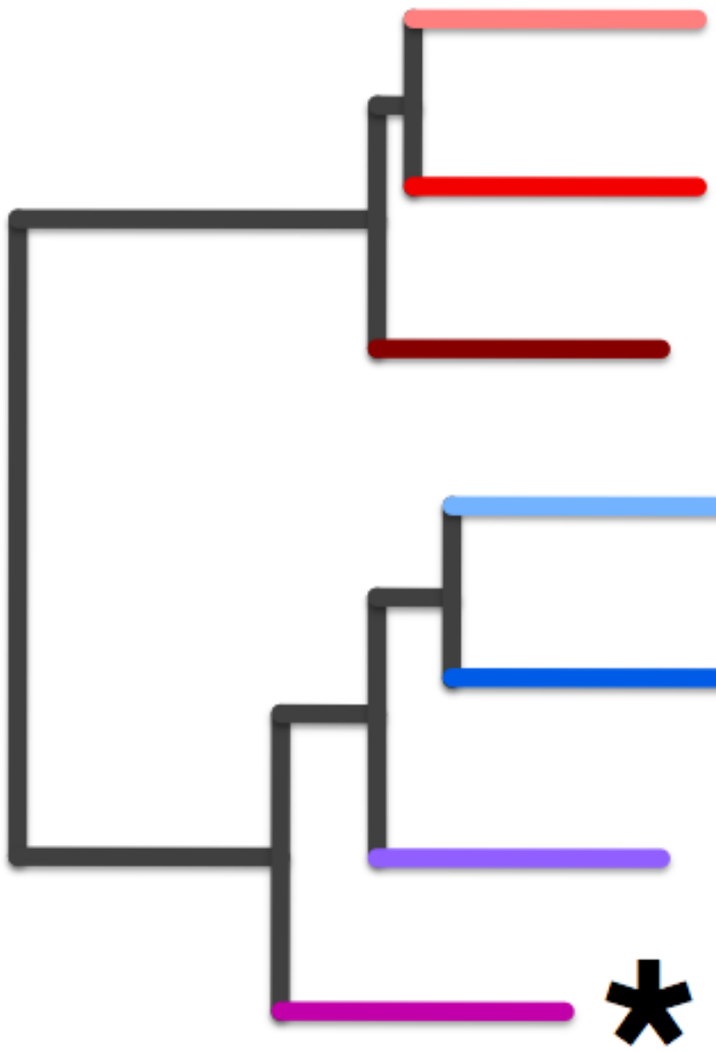


6 group classification

Environment drives composition

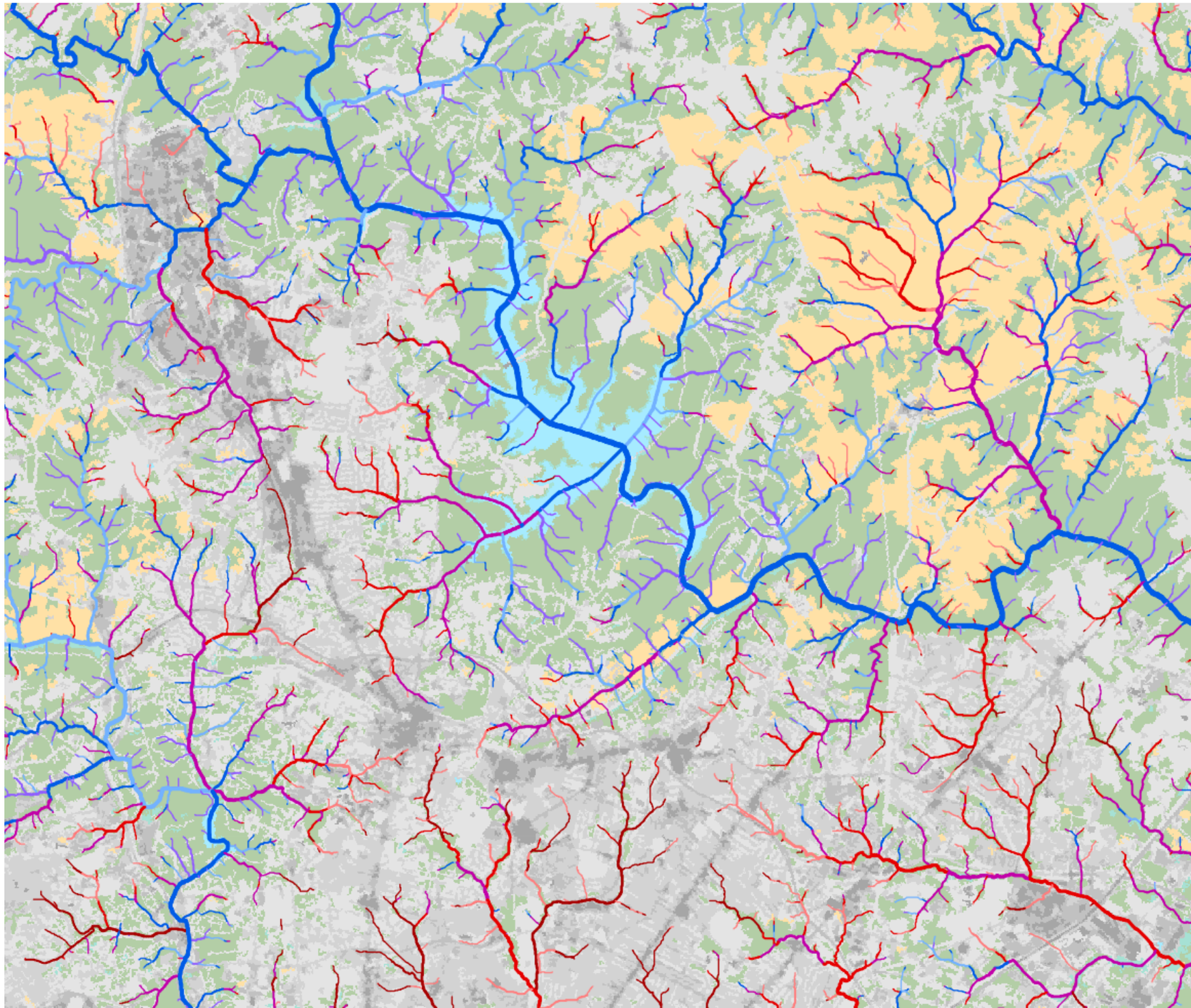


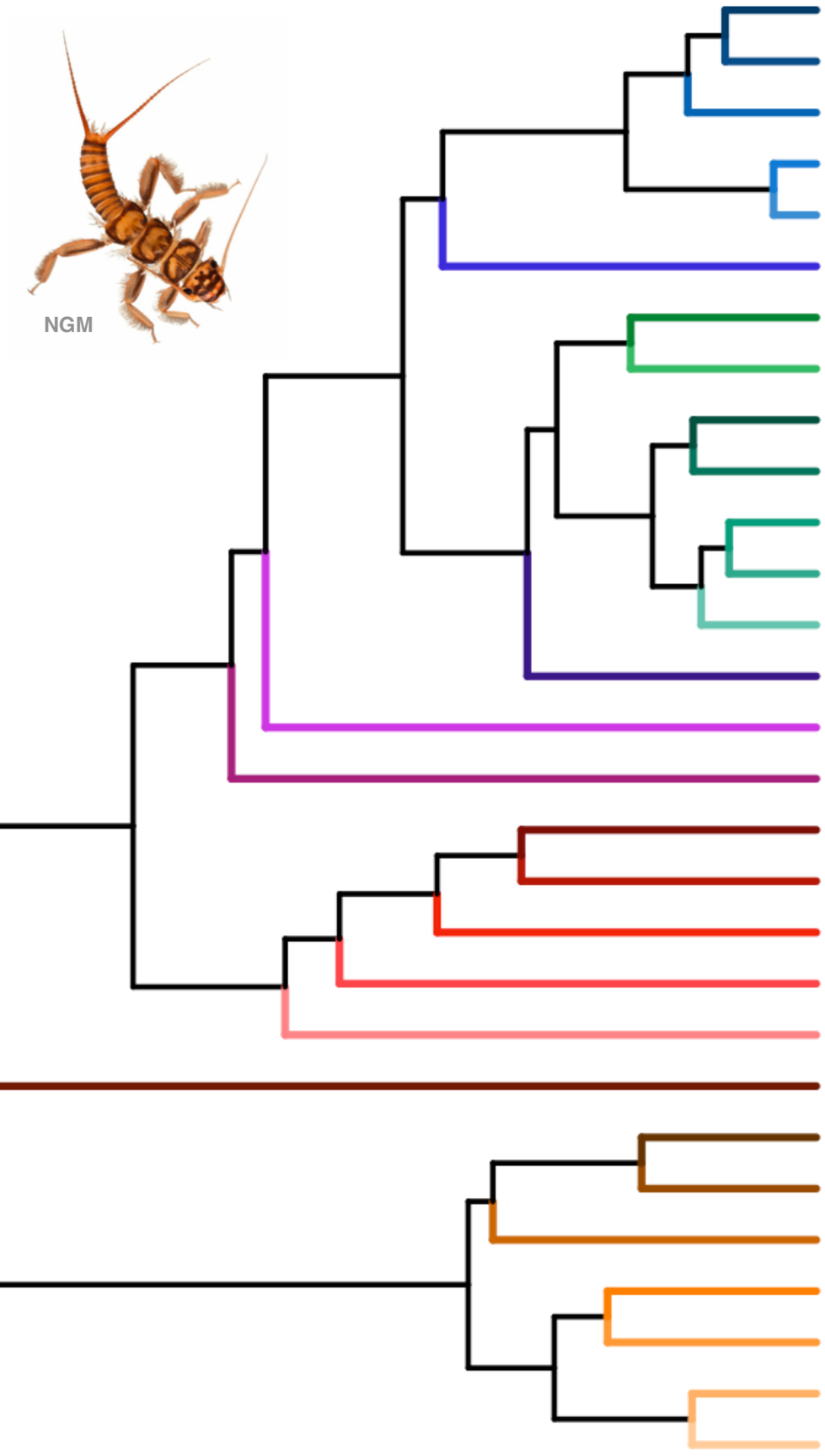
What can group similarity tell us?



Assemblage similarity

urban forest agriculture





Assemblage similarity (inverts)

Cold, forested watersheds

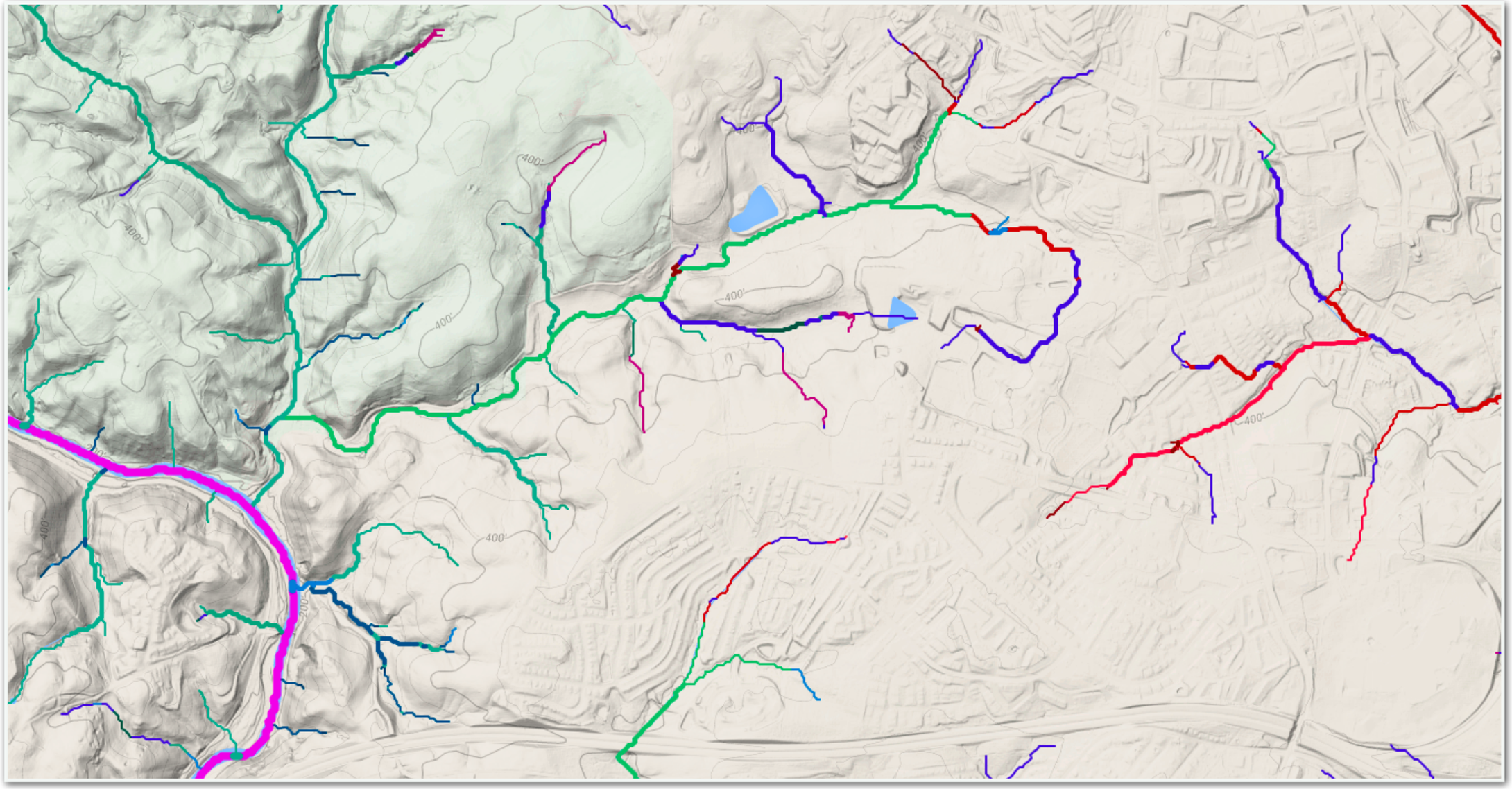
Assemblage similarity (inverts)

Warm, coastal plain


NGM

Cold, forested watersheds
Suburbs
Agriculture
Urban streams
Warm, coastal plain

Stream biodiversity maps



http://streammapper.al.umces.edu/streamsbiodiv.html