

Stream habitat characteristics and fish

Which scale is relevant?

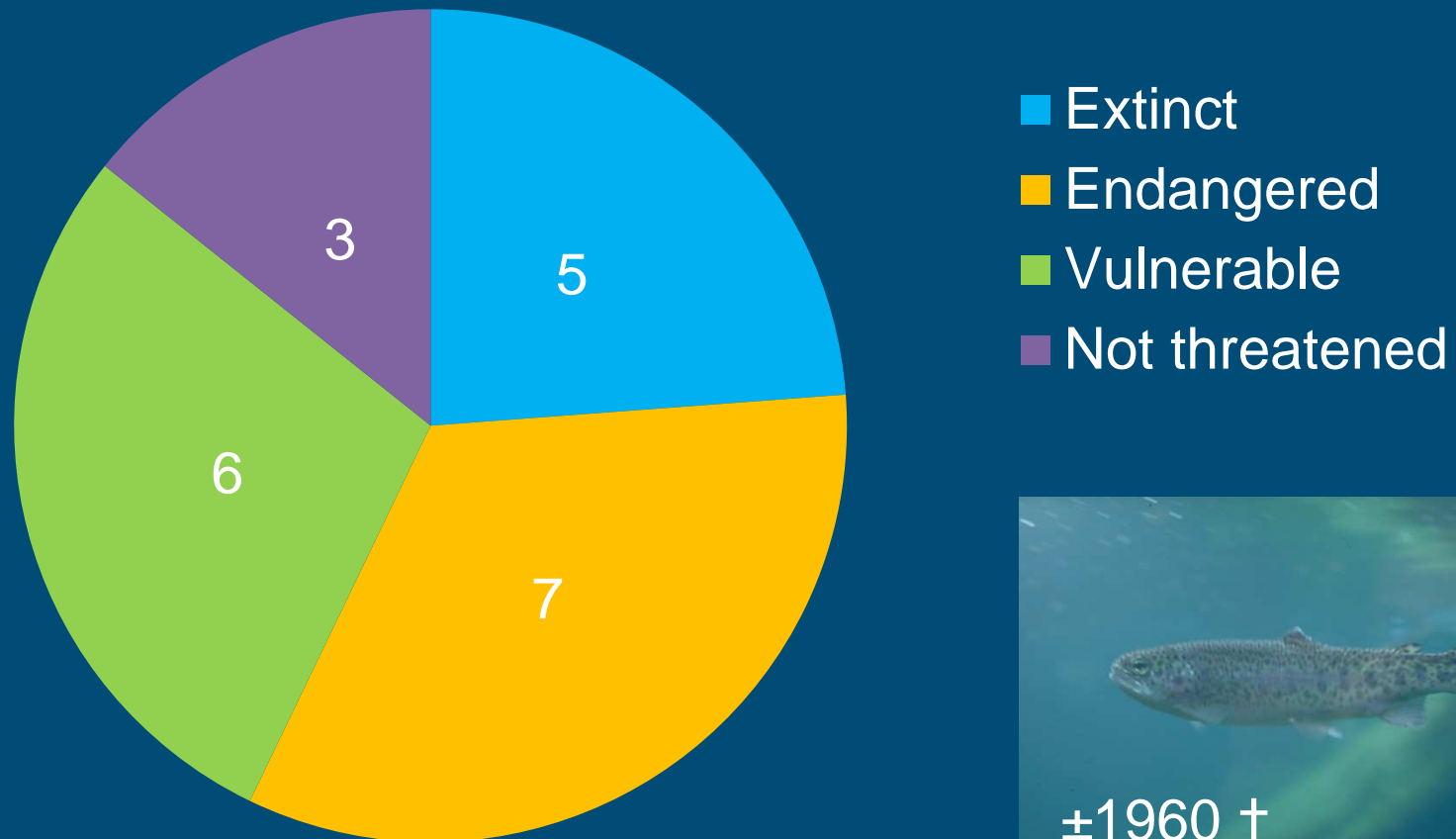
Ralf Verdonschot
Dept. of Freshwater Ecology

ralf.verdonschot@wur.nl

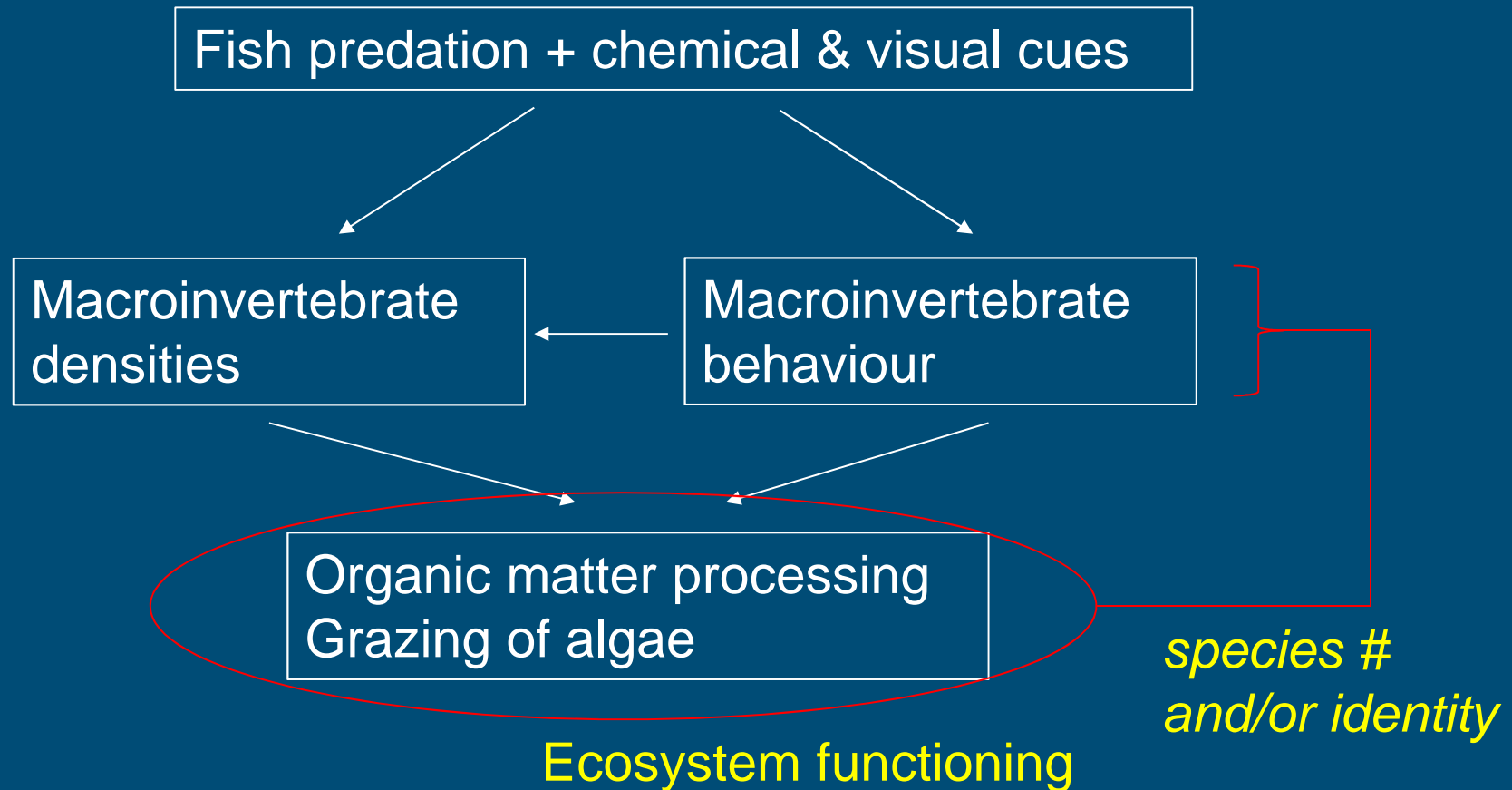


Fish in Dutch lowland streams and rivers

Dutch rheophilic fish species (n = 21)



Diminishing fish populations = loss of “ecosystem engineers”



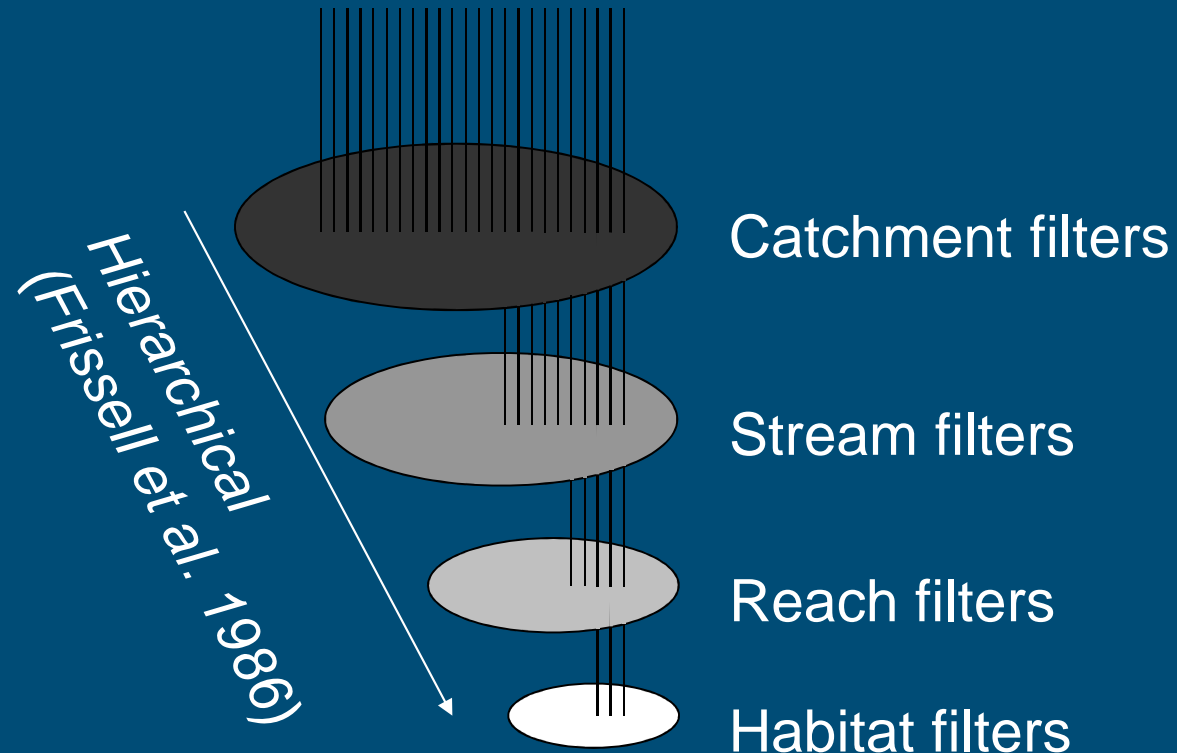
Why is biodiversity loss so profound in stream fish?

Environmental filters concept (Poff 1997)

- Physiological
- Morphological
- Behavioural

Regional pool of fish species
*defined in terms of multiple
species traits*

↕
Environmental
conditions



Environmental filters can be classified according to stream ecosystem components (5-S model; Verdonschot 1995)

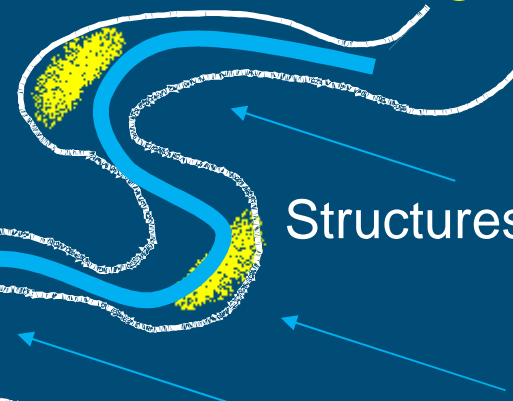
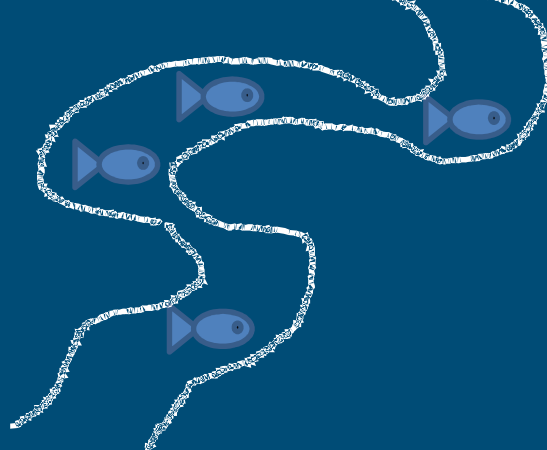
System



Substances

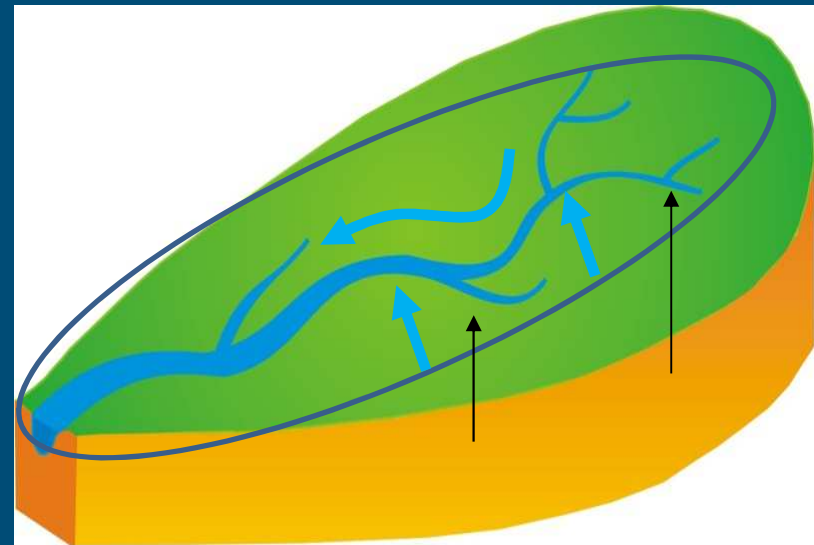


Species



Structures

Stream Hydrology

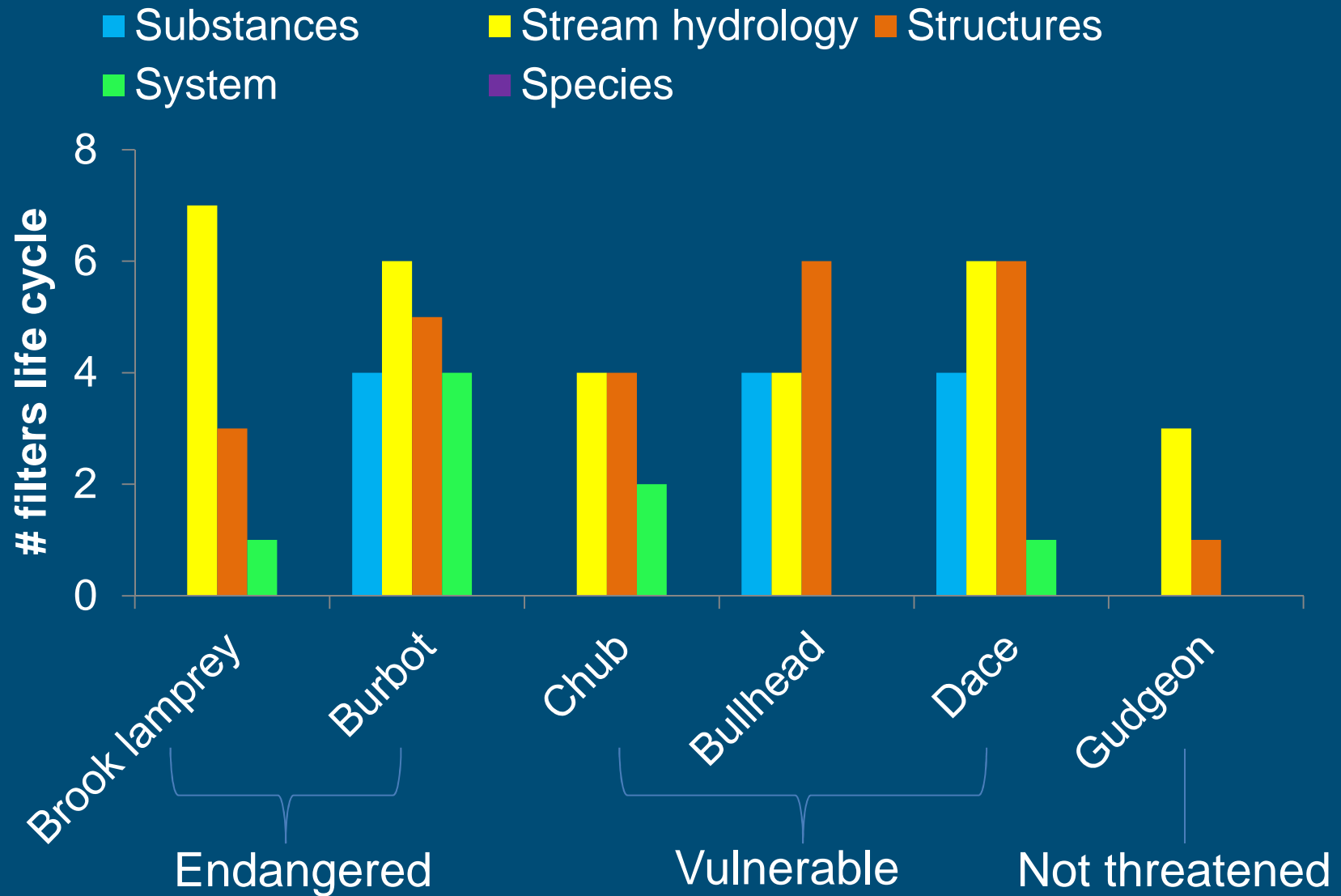


Life history traits of 6 stream fish species:

- Brook lamprey (*Lampetra planeri*)
- Burbot (*Lota lota*)
- Chub (*Squalius cephalus*)
- Bullhead (*Cottus perifretum* & *C. rhenatus* excl. hybrids)
- Dace (*Leuciscus leuciscus*)
- Gudgeon (*Gobio gobio*)



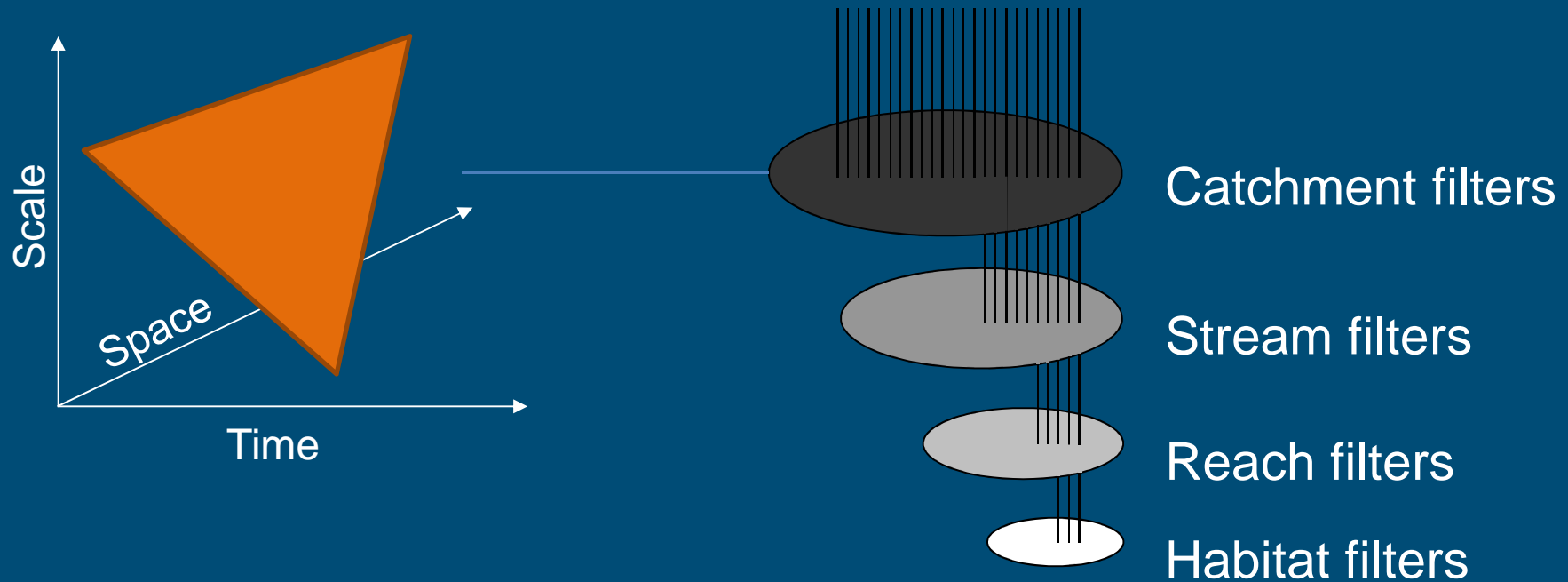
Environmental filters acting on stream fish species



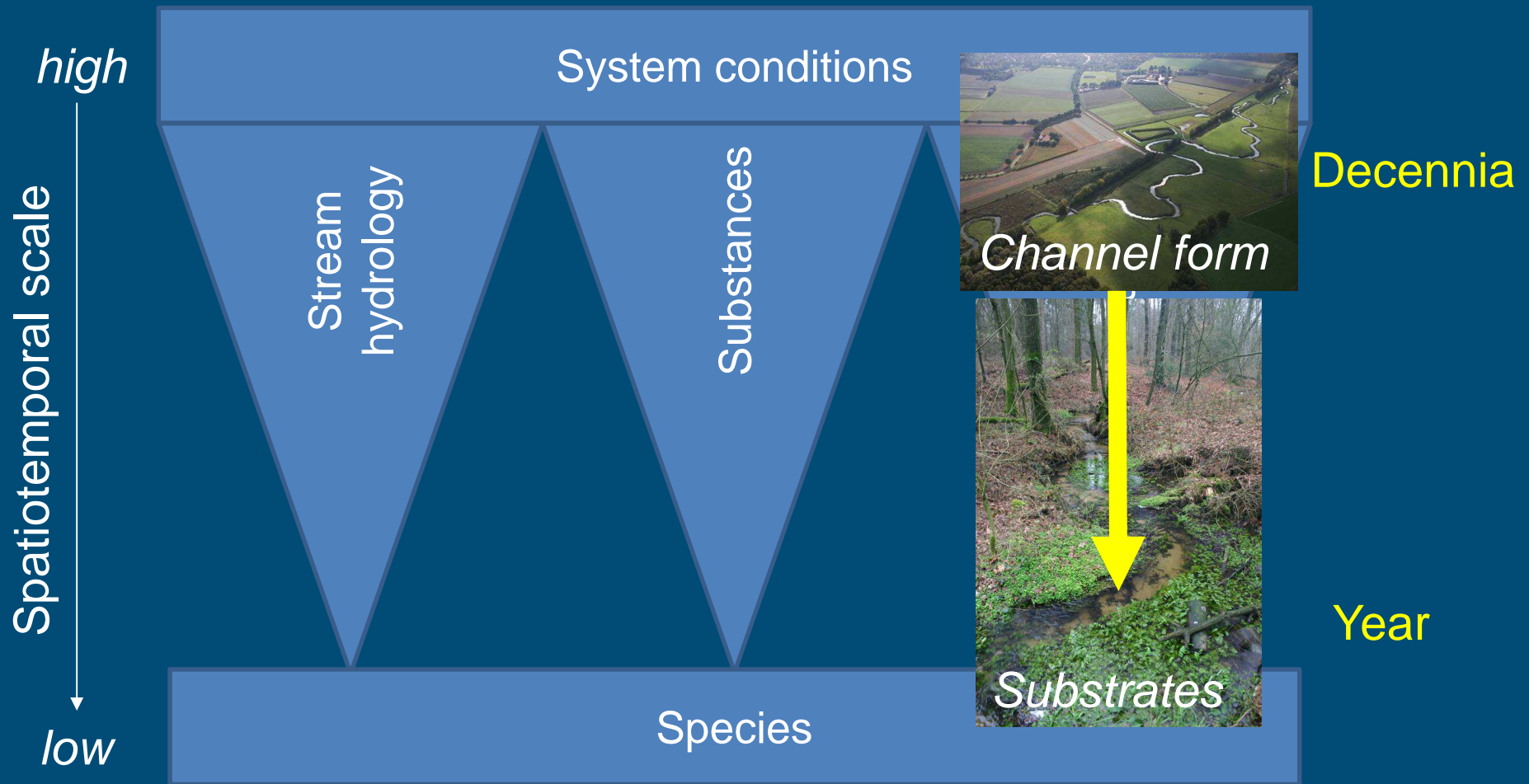
Spatiotemporal component of environmental filters

Habitat template concept (Townsend & Hildrew 1994)

Regional pool of fish species
*defined in terms of multiple
species traits*

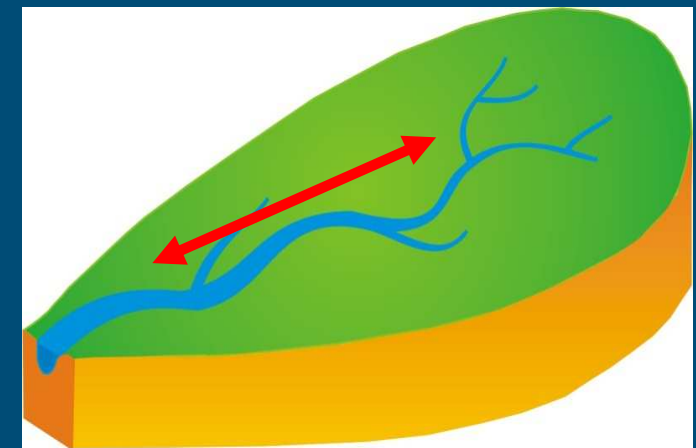
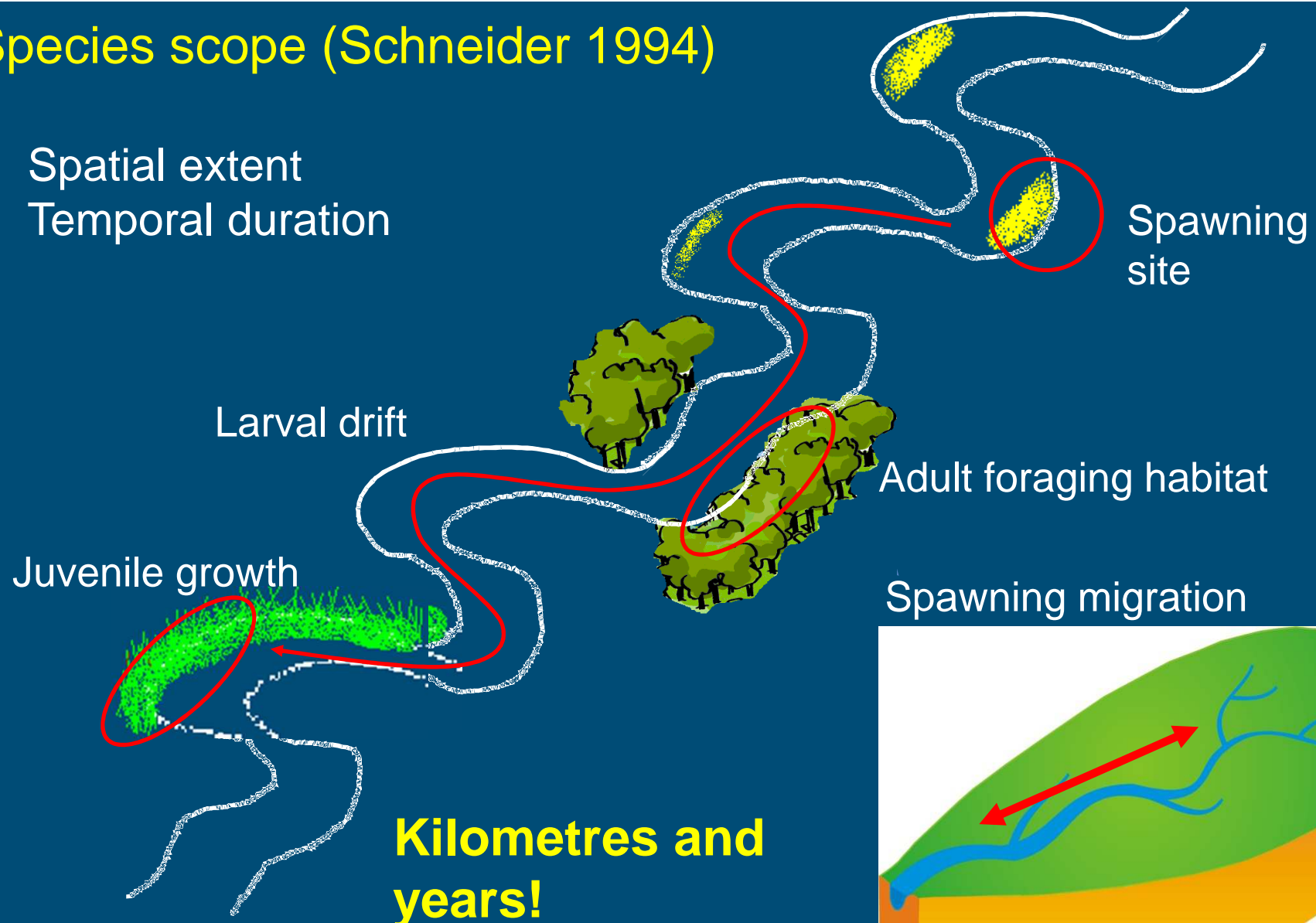


Stream ecosystem components encompass different spatiotemporal scales

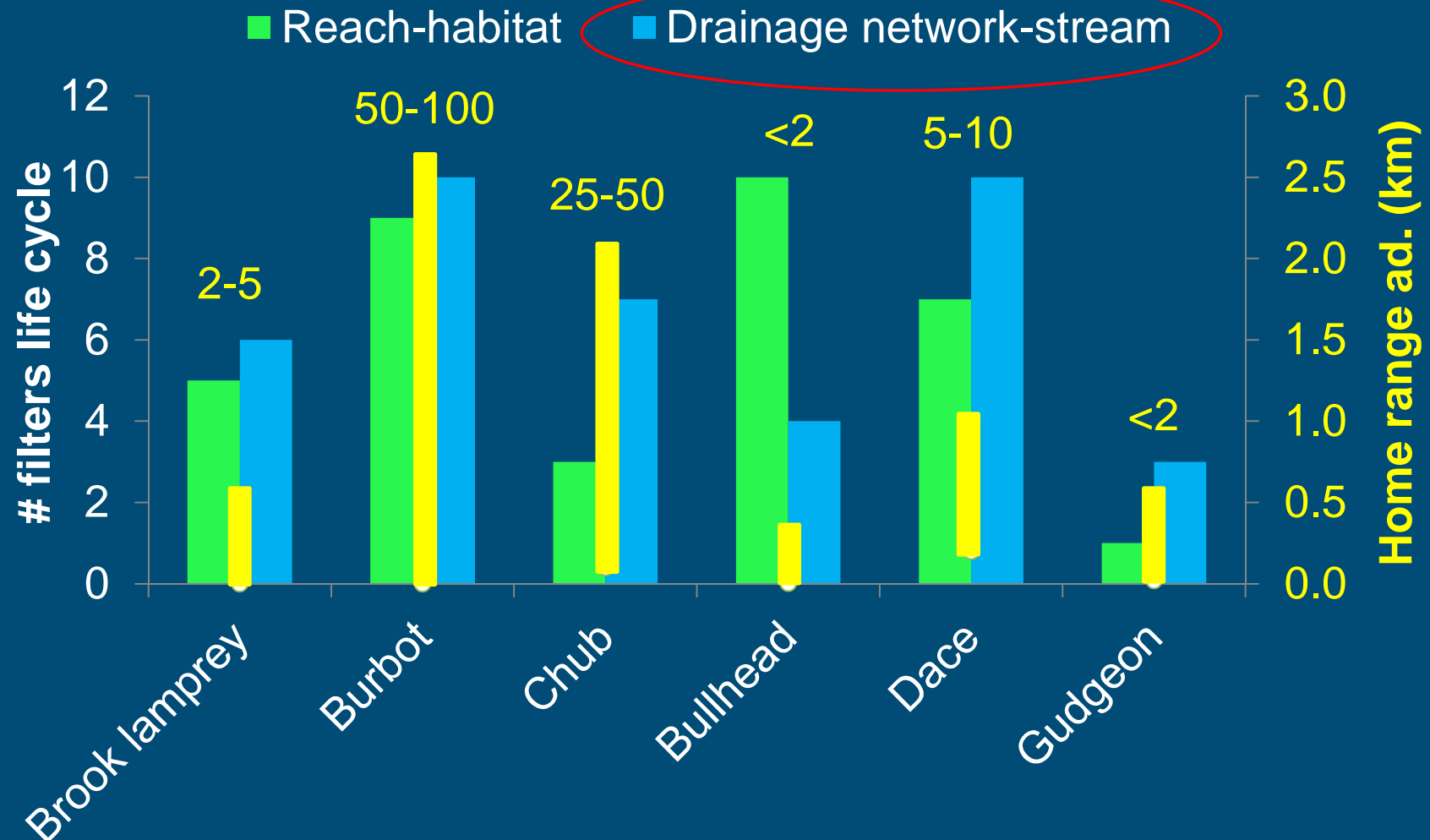


Species scope (Schneider 1994)

- Spatial extent
- Temporal duration

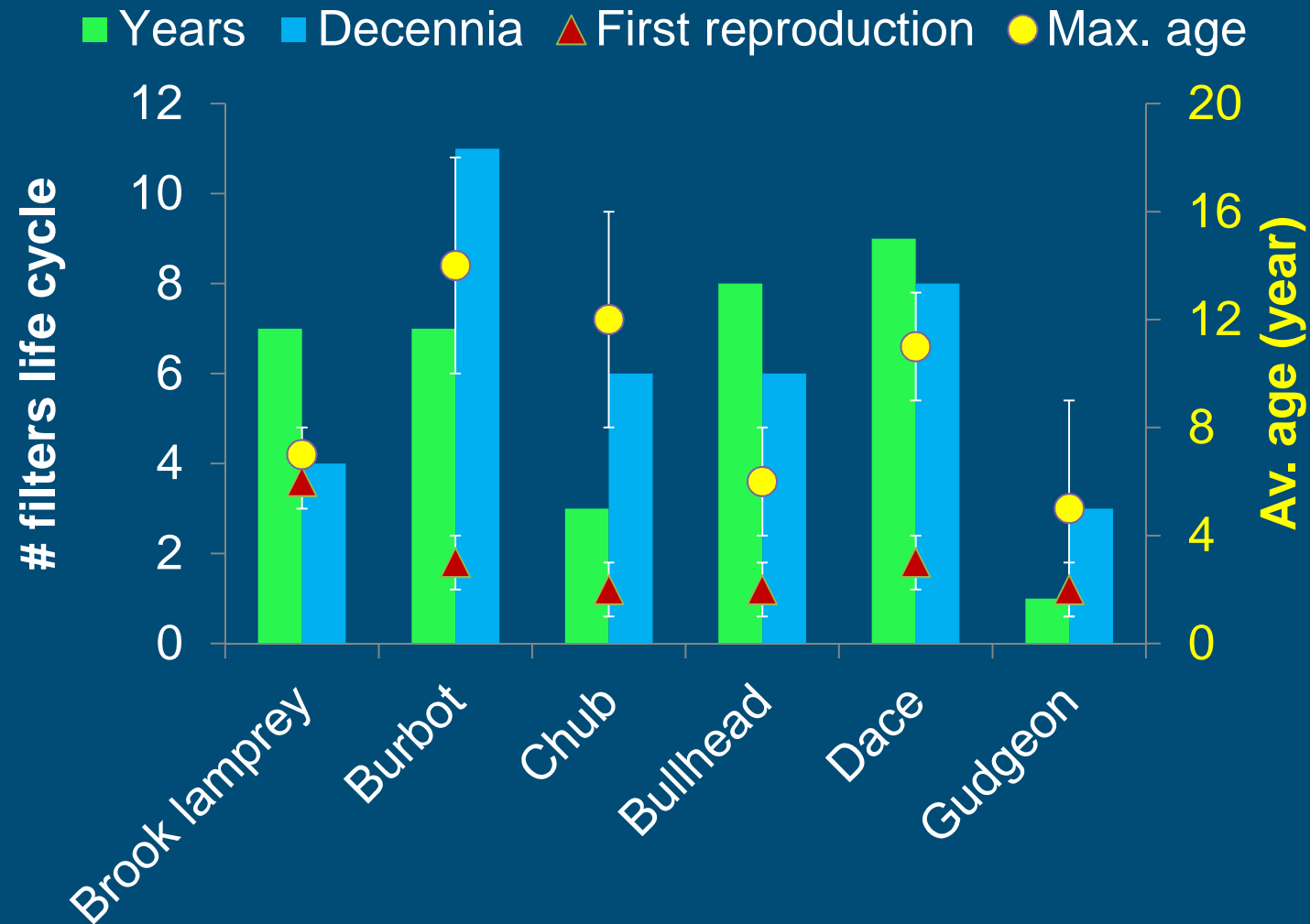


On which spatial scale are these filters generated?



Which spatial scales are relevant to the species?

On which temporal scale do/could env. filters fluctuate?



Which temporal scales are relevant to the species?

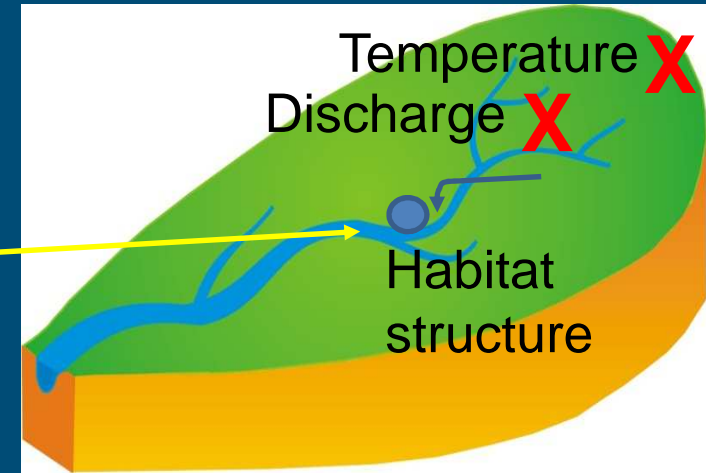
Stream restoration aimed re-establishing stream fish populations

- Stream fish life history reveals many filters
- No. filters \neq vulnerability
- Filters operate on both small and large spatiotemporal scales
- Fish spatiotemporal scope is large

Fish will not benefit from small scale restoration if large scale problems have not been tackled!



Addition of wood

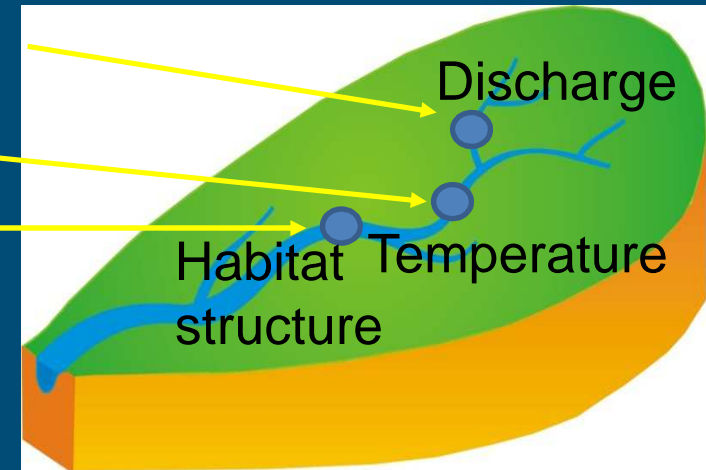


Several small projects in catchment?

Drainage removed

Riparian vegetation development

Addition of wood

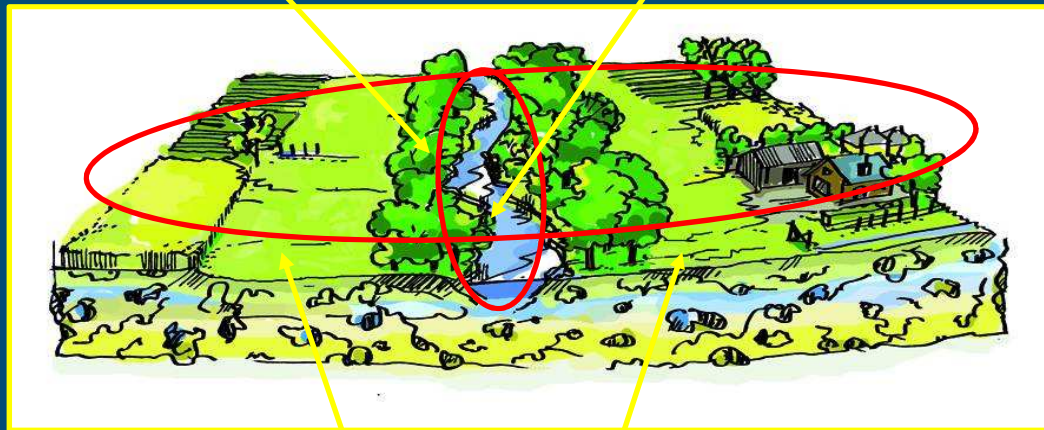


- Connectivity issues
- Movement costs energy!

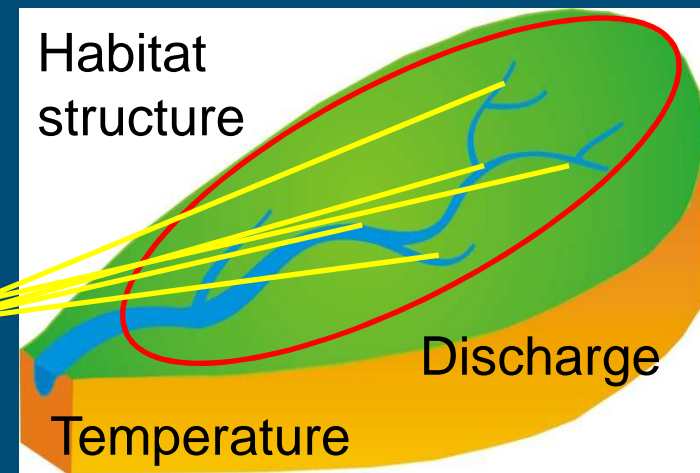
One large-scale integrated project, not several small aimed at specific problems

Riparian vegetation development

Addition of wood



Drainage removed



Habitat structure

Discharge

Temperature

Restoration of (sub-)catchments

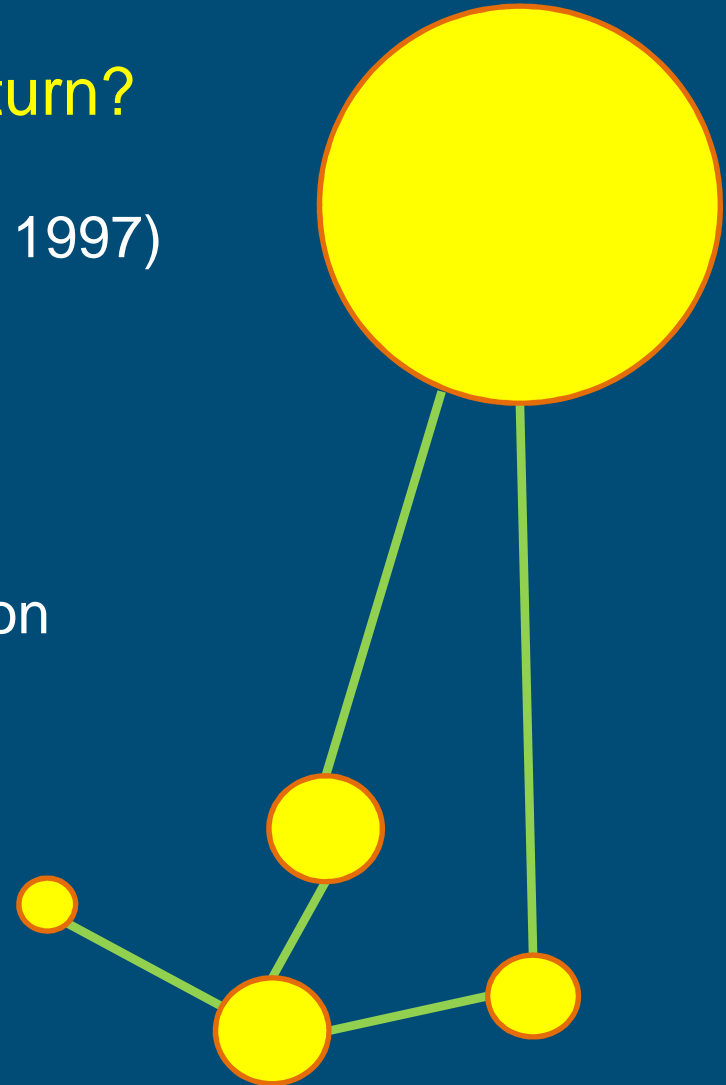
Sub-catchment restored = fish will return?

'Field of dreams' hypothesis (Palmer *et al.* 1997)

Colonisation by dispersing individuals

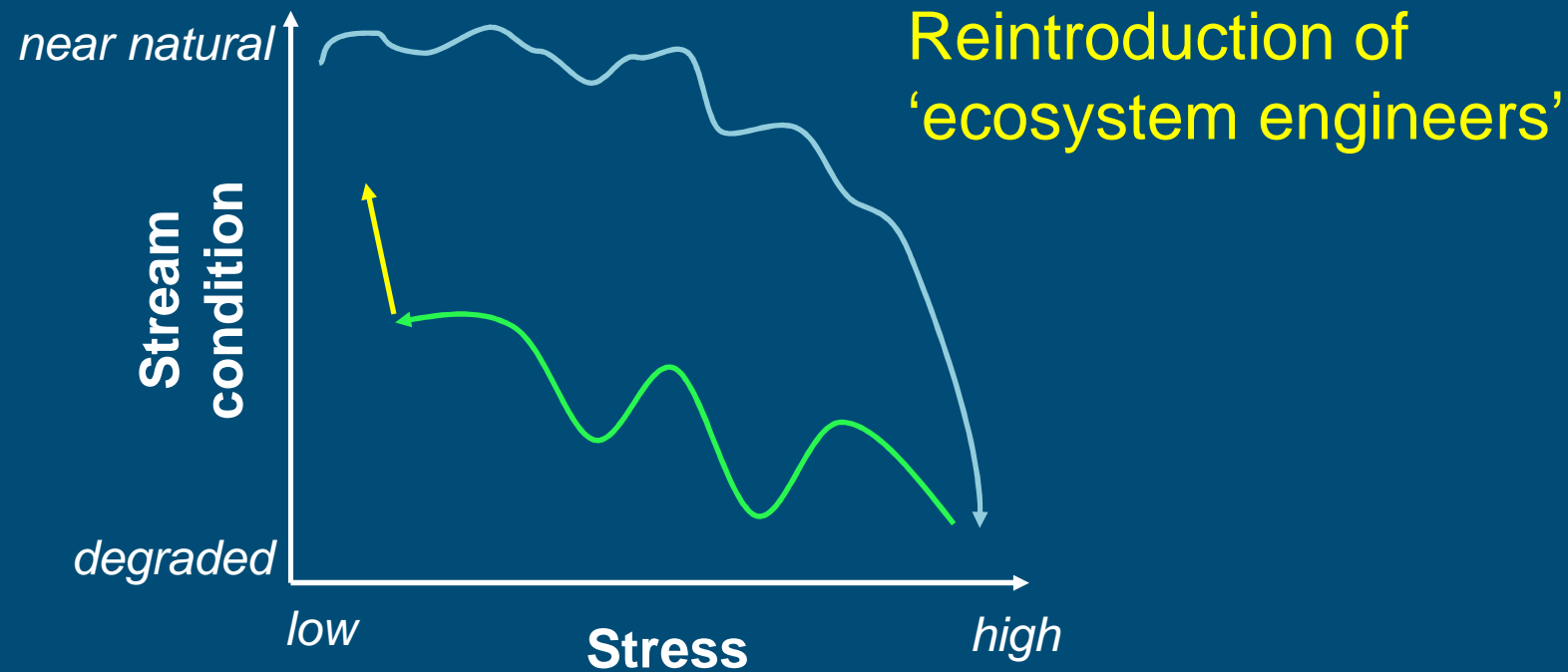
1. Source population sizes and distribution
2. Connectivity

└─ Meta-population structure



Reintroduction of stream fish?

Stream degradation - recovery pathway



Stream ecosystem functioning:

- # species: additive effects
- species identity: keystone species

