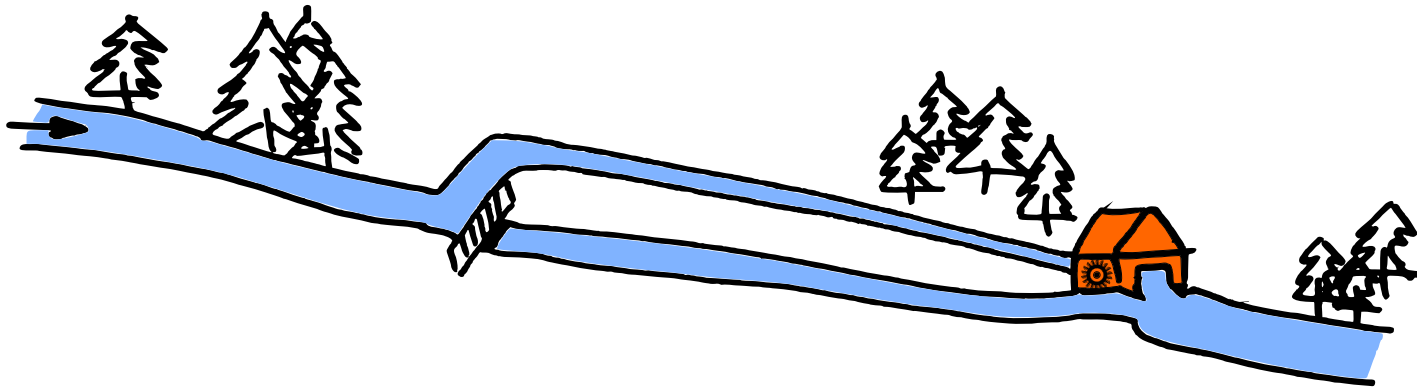




Trading off energy production from small hydropower with biodiversity conservation



Freshwater biodiversity

0.1% of the world's water
harboring 6% of the global biodiversity
and 40% of the global fish diversity

(Dudgeon et al 2006)

Freshwater biodiversity is threatened

Overexploitation

Water pollution

Habitat degradation

Flow modification

Species invasions

(Dudgeon et al 2006)

Small hydropower is booming

BUT we know very little about their impacts on ecological and evolutionary processes

(Jager et al. 2015; Kibler & Tullos, 2013)

AND there are no spatial planning tools available

(Winemiller et al 2016, Ziv et al 2012)



1) Review article: state-of-knowledge on ecological impacts

Manuscript under review with *Frontiers in Ecology and the Environment*

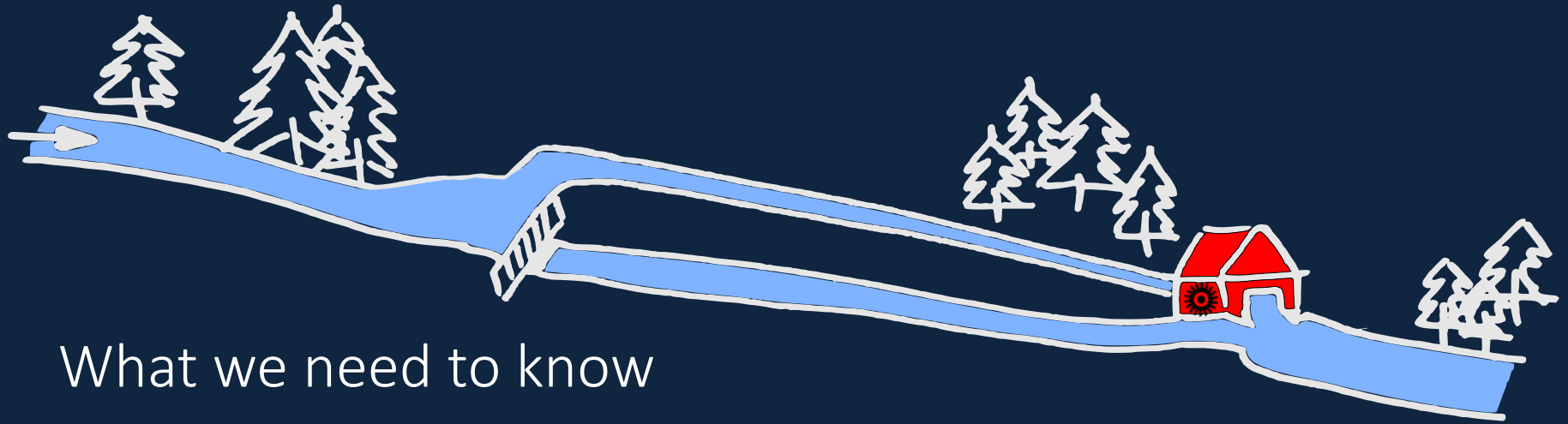
Reach-scale



1) Current activities: fieldwork and modelling

2) Conclusions

Reach-scale impacts



What we need to know

? Propagation of effects

? Impacts on algal and invertebrate communities

(Andersen et al 2015, Mbaka et al 2015)

? Impacts on fundamental ecosystem processes

(Arroita et al 2015)

? Loss of locally-adapted organisms

Basin-scale impacts on biodiversity



Fragmentation by dams causes

- Loss of genetic diversity
(Horreo et al 2011)
- Local extinctions
(Letcher et al 2007)
- Alteration of fish life-history

? Cumulative effects of multiple dams

? Importance of dam spatial arrangement within river networks

Interactions with other stressors



“Ecological surprises“

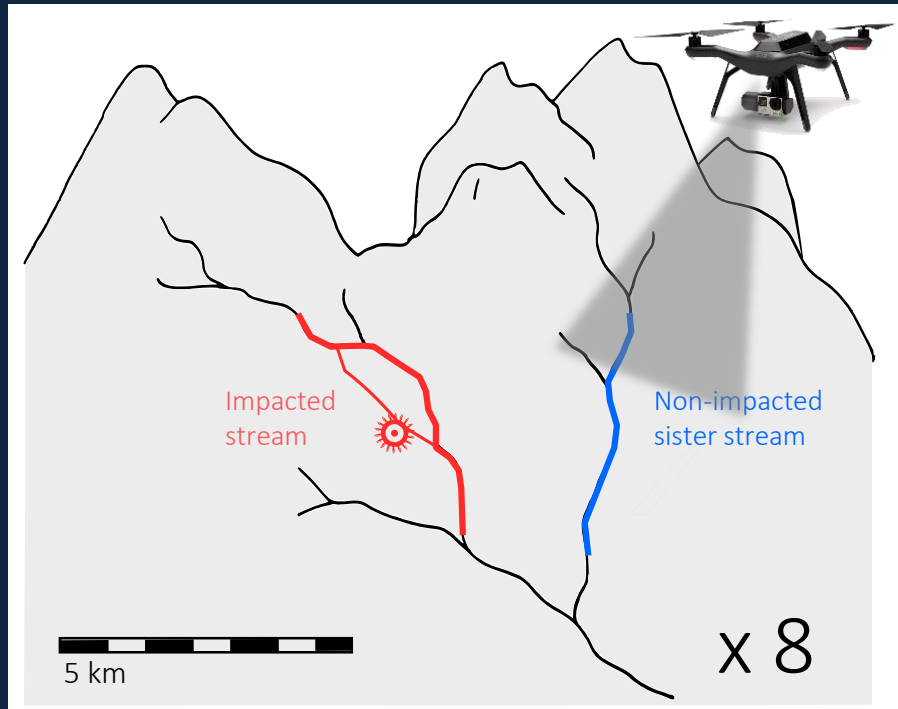
Knowledge on interactions with other stressors crucial for site-selection

Source of great uncertainty:
Lack of knowledge on interactions with climate change

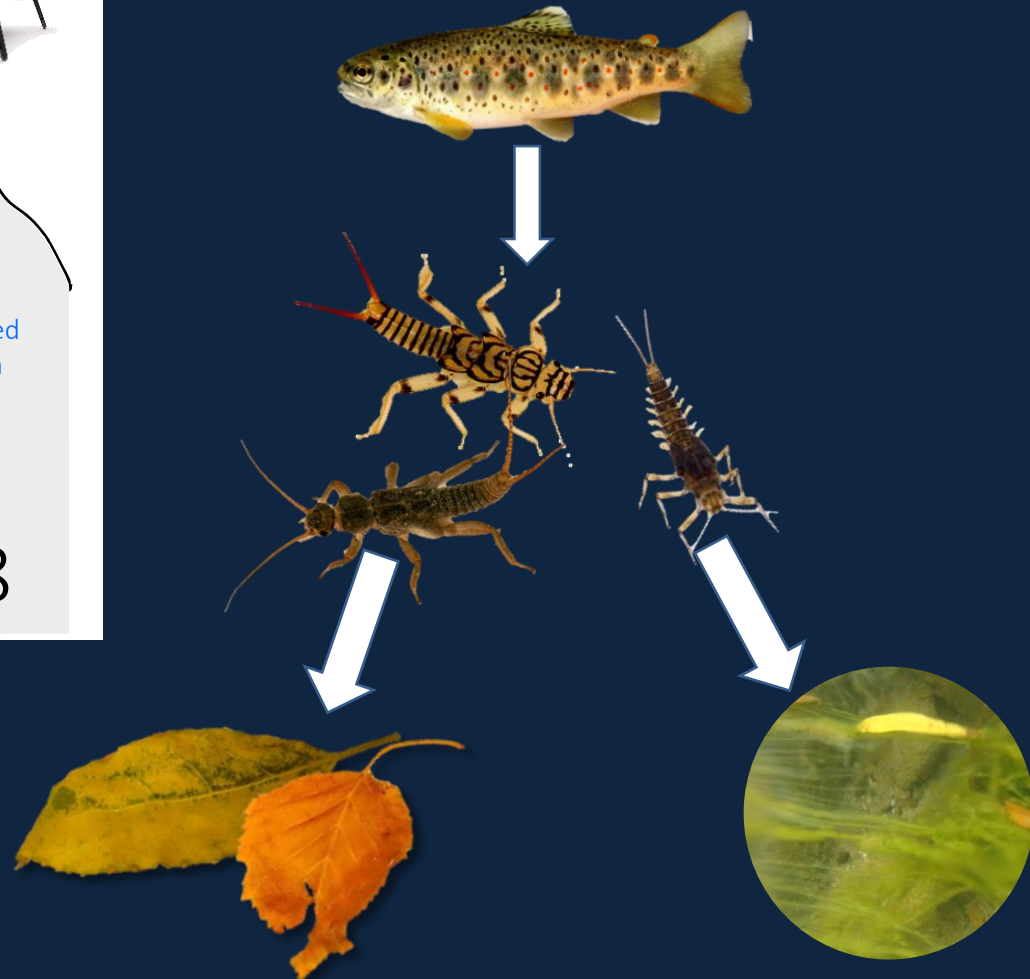
(Martinez et al 2016, Hering et al 2014,
Navarro-Ortega et al 2014)

Current activities

Fieldwork “Beyond the local scale”



Stream food web

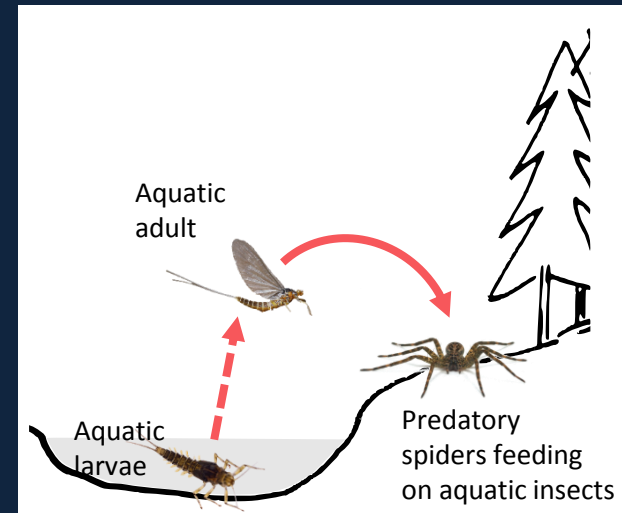


Fieldwork “Beyond the local scale”



Propagation of effects

Downstream propagation
Aquatic-terrestrial interactions

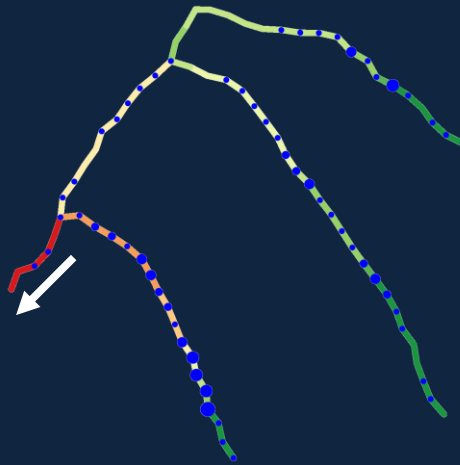


Development of spatial planning tools

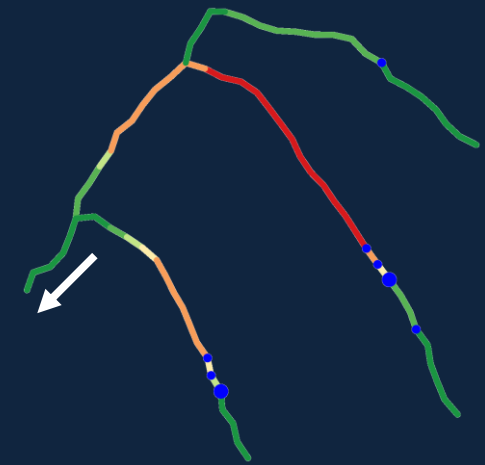


Metapopulation capacity

Equilibrium between colonization and extinction
Viability of single species within in river networks
Used for ranking configurations of power plants



All possible locations



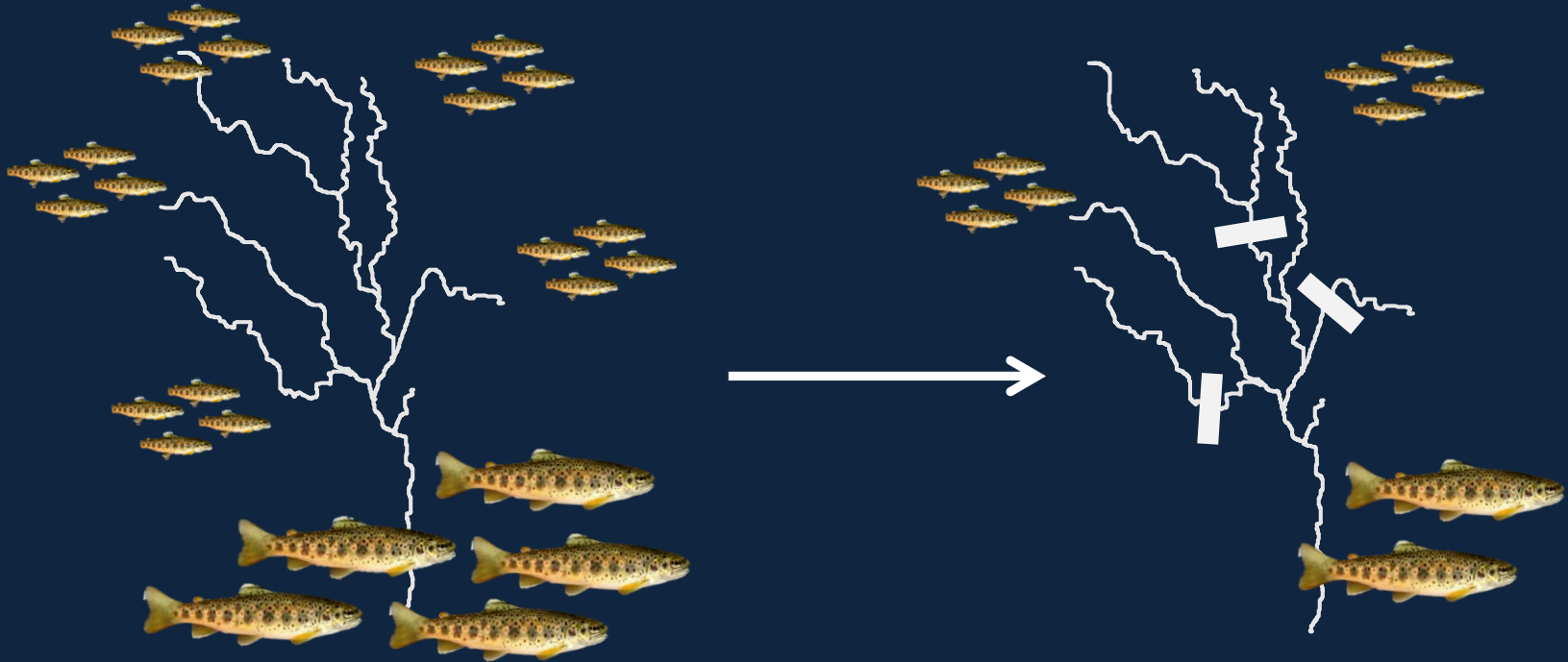
High metapopulation capacity

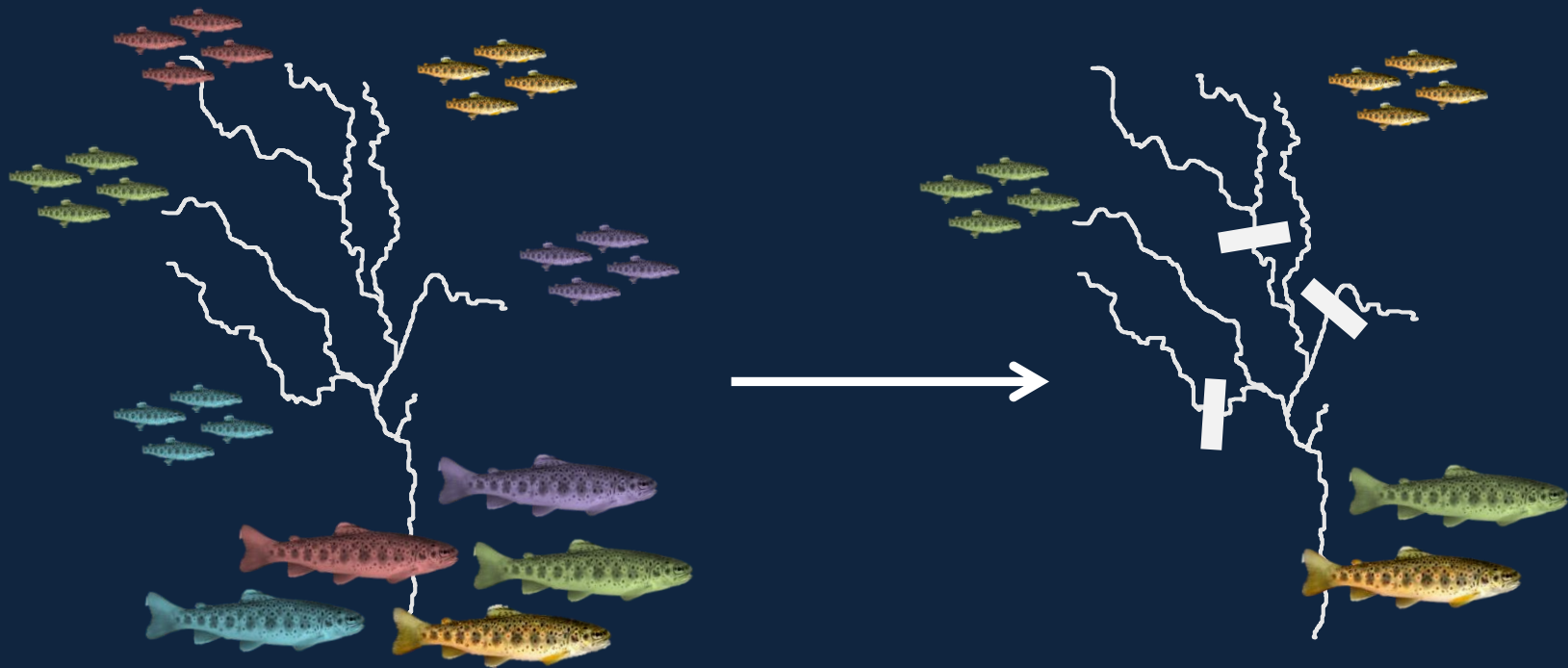
Conclusions

Conclusions

- > Spatially explicit tools important for calculating trade-offs
- > Multiple drivers of biodiversity need to be considered and expressed as indicators, e.g.
 - % of unique habitats/populations
 - Species-specific habitat-size requirements
 - Importance of specific river reaches for spawning/rearing
- > Interactions with other stressors may modify the habitat template
 - ➔ Invaluable for policy makers and resource managers
 - ➔ Assist stakeholders and decision makers to develop a shared view and negotiate policies

Fish populations consist of multiple meta-populations





Reach-scale impacts (2014-2015)

