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| CENTRE FOR APPLIED
WATER SCIENCE

Not just flow: multiple drivers of ecosystem metabolism in a regulated river

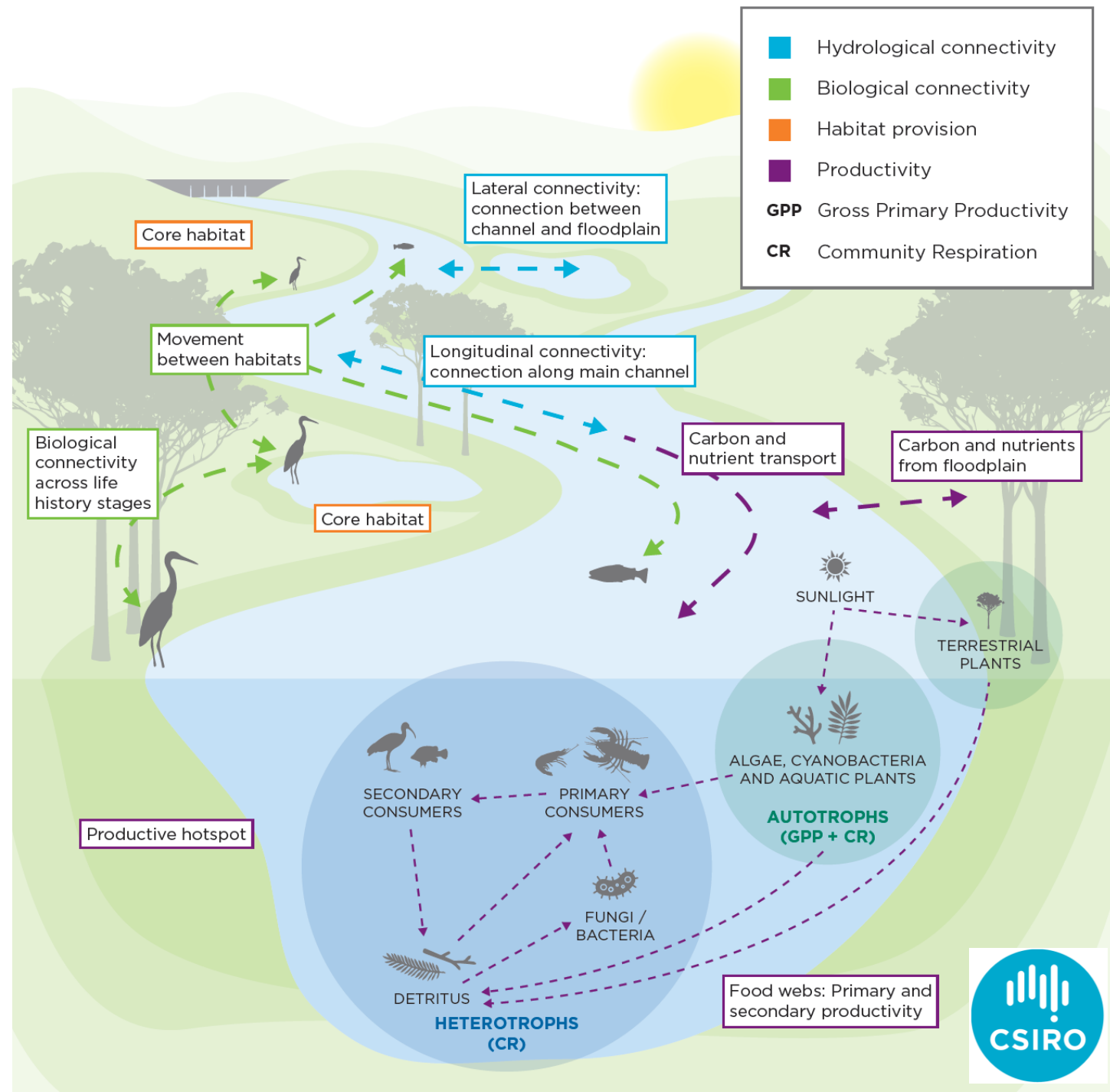
Darren Giling, Ben Broadhurst, Fiona Dyer, Michael Grace, Klaus Joehnk, Paul McInerney, Carmel Pollino, Gavin Rees, Ashmita Sengupta, Alica Tschierschke and Ross M. Thompson

Productivity Theme | November 2022

Productivity is the rate of biomass generated in an ecosystem, expressed as mass per unit area per unit time

Two types:

- Primary productivity
- Secondary productivity



Ecosystem metabolism is a term that describes two fundamental metabolic processes:

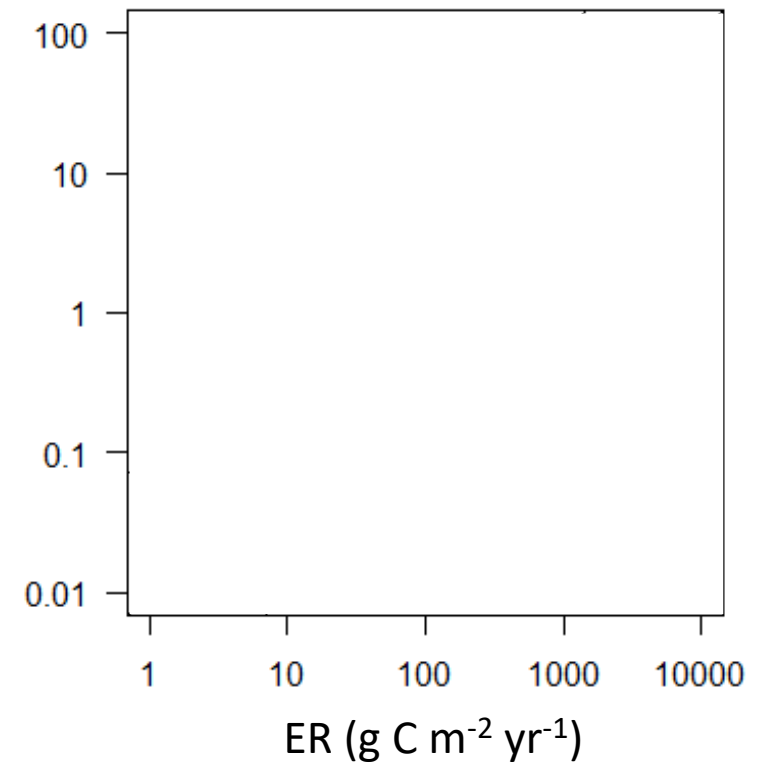
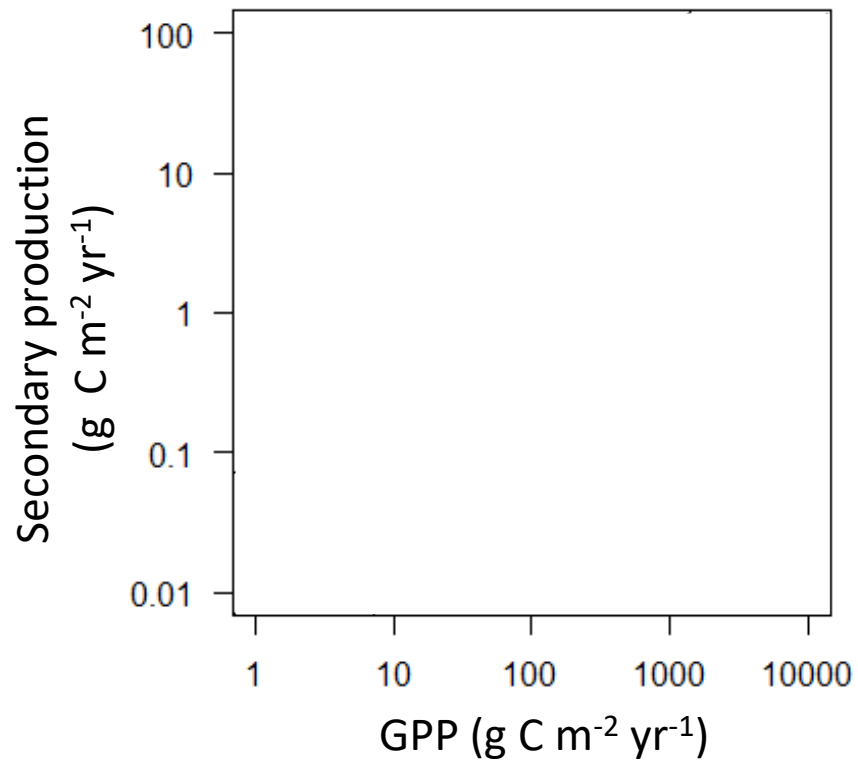
Gross primary productivity (GPP)



Ecosystem respiration (ER)



Secondary production is expected to be correlated with *ecosystem metabolism*



Modified from Rügge et al. 2021



Photo: Rhian Clear



Photo: Ross Thompson

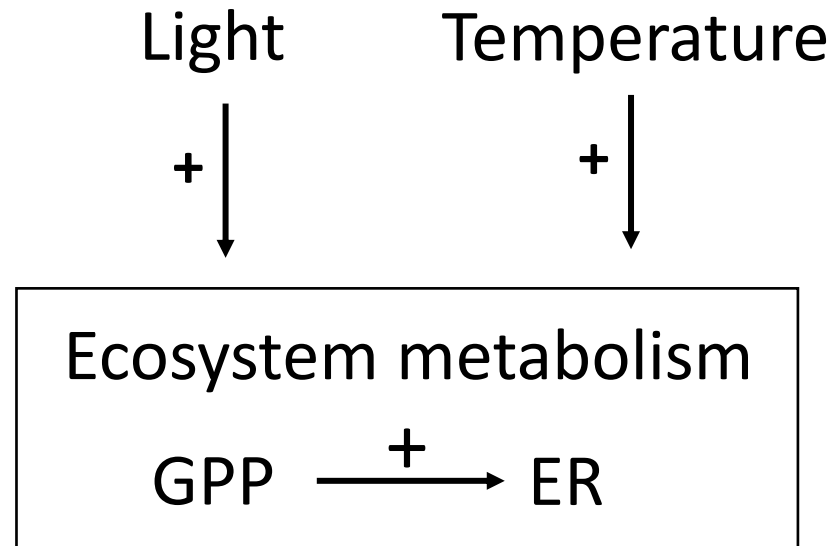




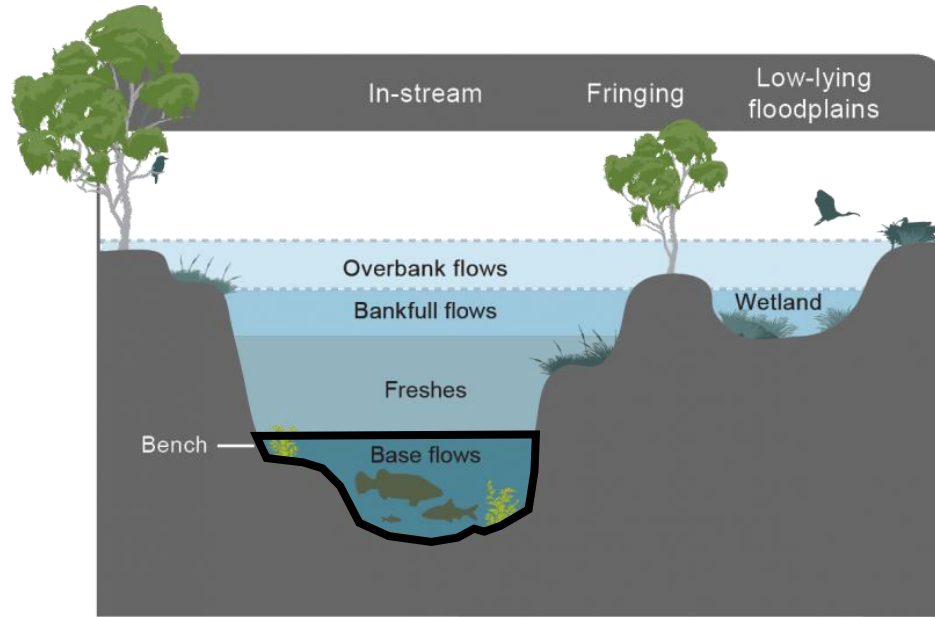
Aims

1. Disentangle the seasonal and flow-related drivers of ecosystem metabolism
2. Extrapolate patterns in ecosystem metabolism to an entire catchment using spatial modelling

Hypotheses



Baseflow



Bankfull flow

- ↑ depth
- ↑ velocity
- ↑ connectivity

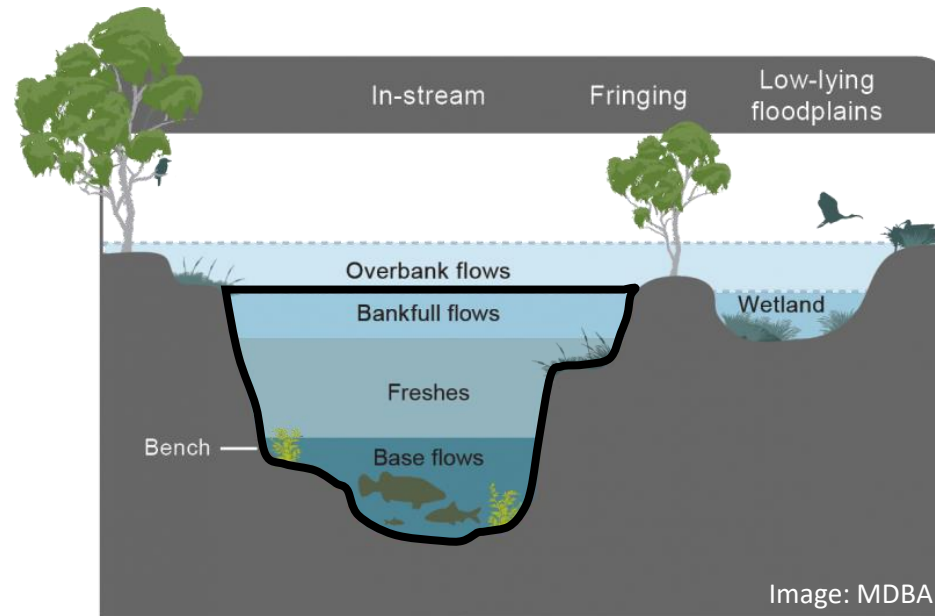
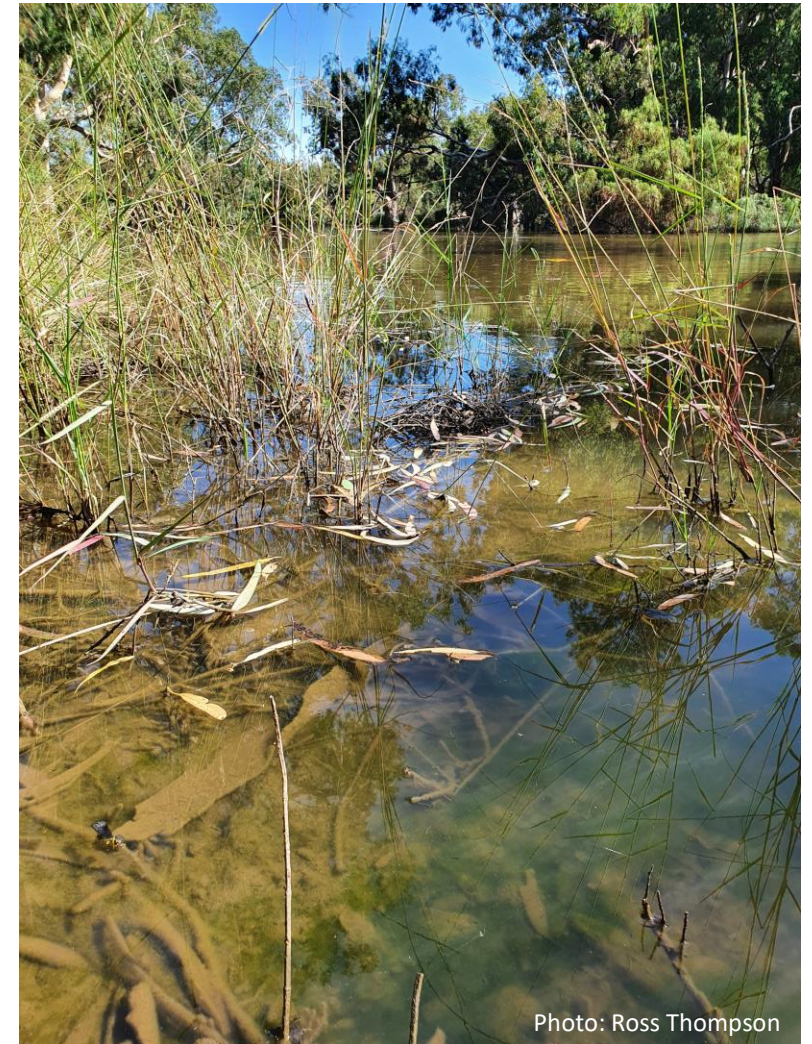
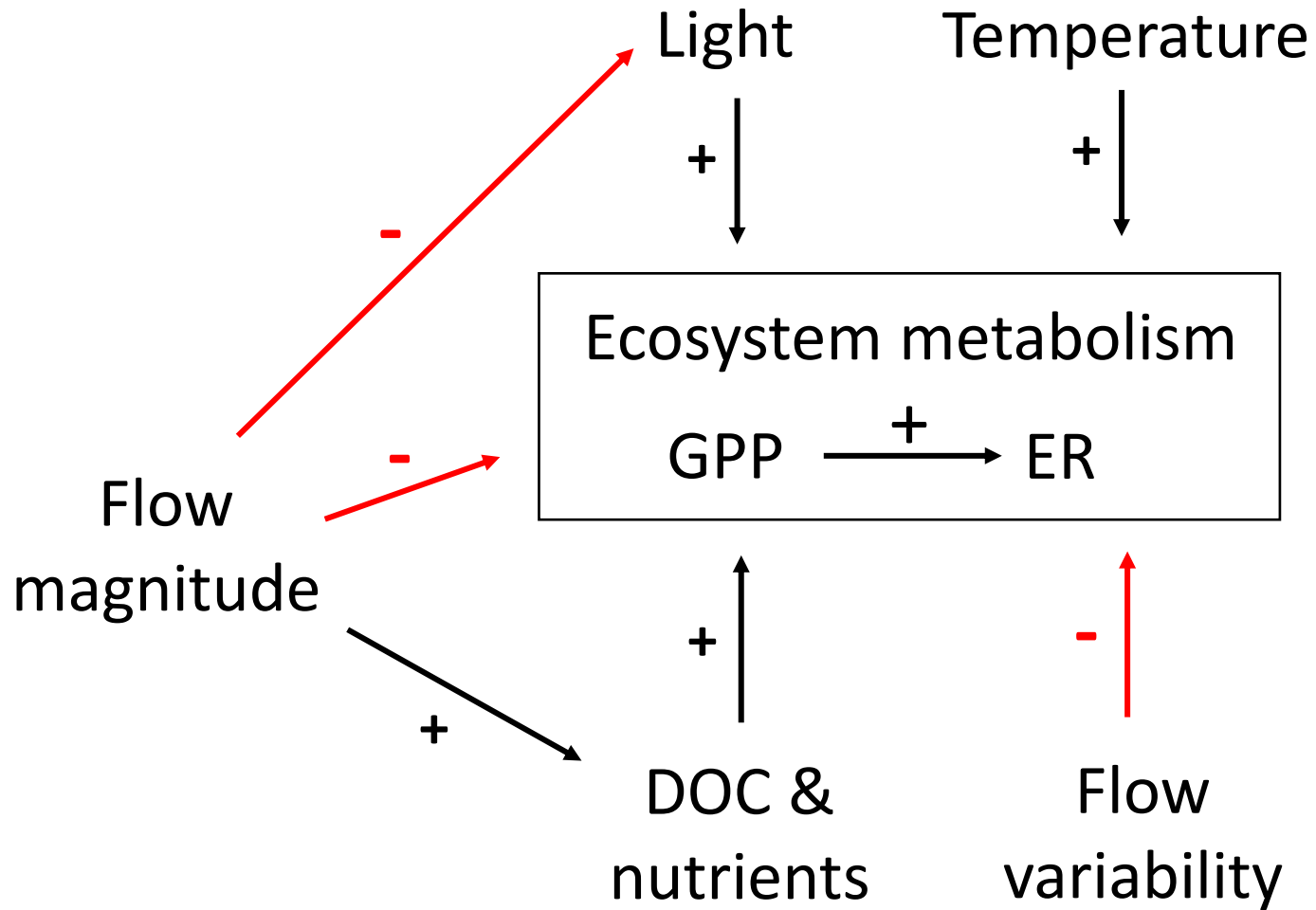


Image: MDBA



Hypotheses



Methods

Response variables:

Daily GPP and ER from 8 sites
(July 2018 – July 2019)

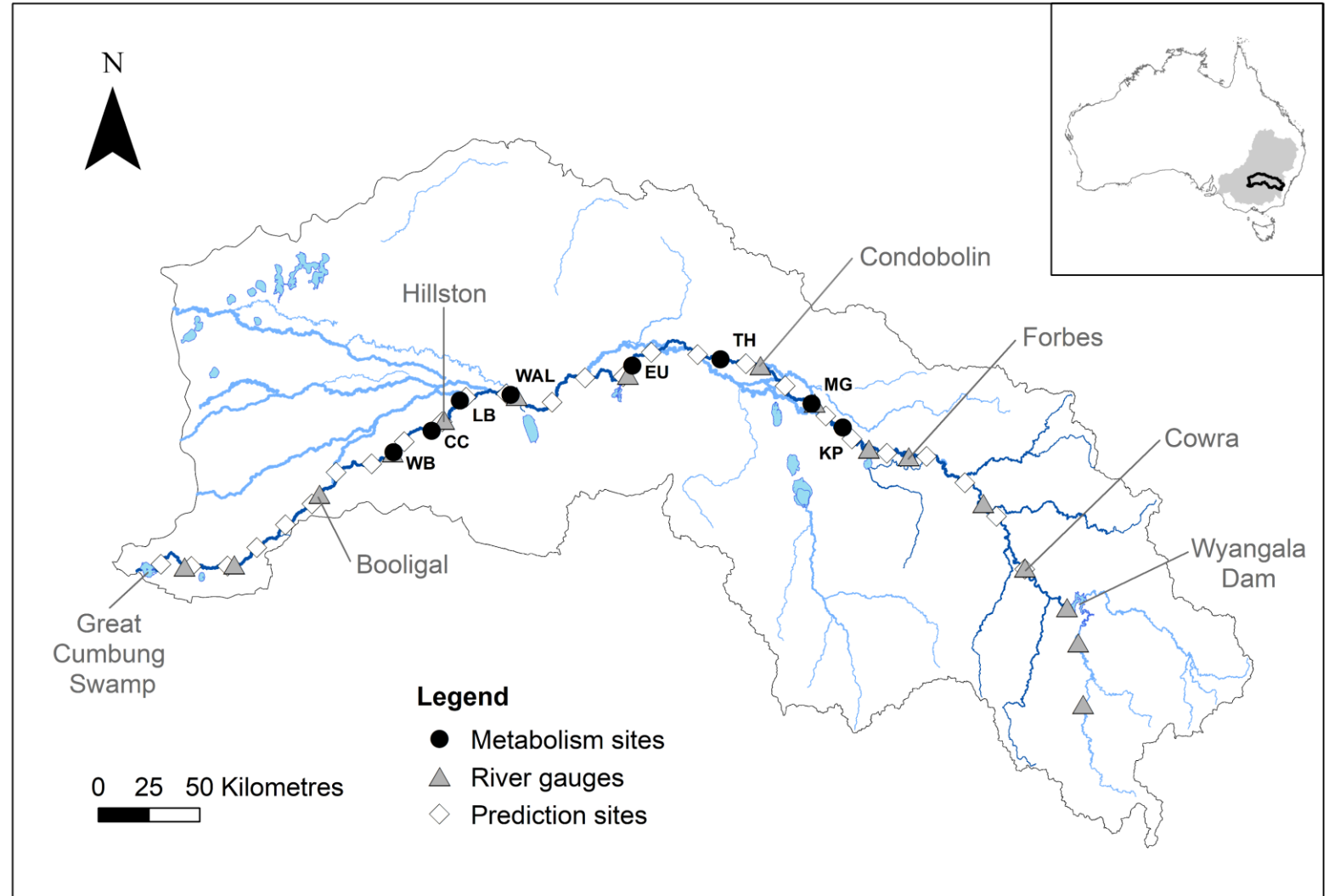
Predictor variables:

Geofabric v3.2, NSW Water gauges, BOM Solar exposure

Model:

Bayesian spatio-temporal
stream network

(Santos-Fernández *et al.* 2022)



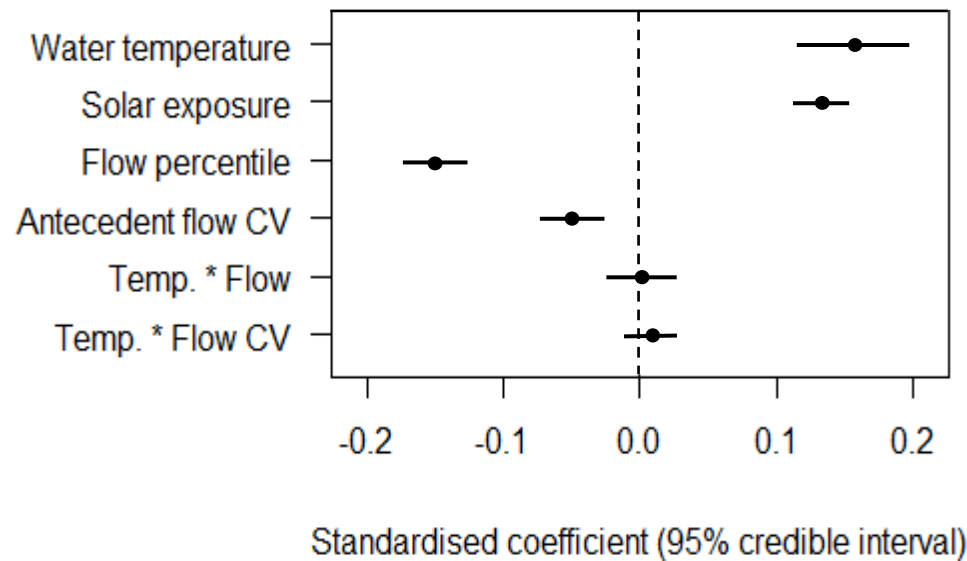
Australian Government
Commonwealth Environmental Water Office

Long Term Intervention Monitoring Project

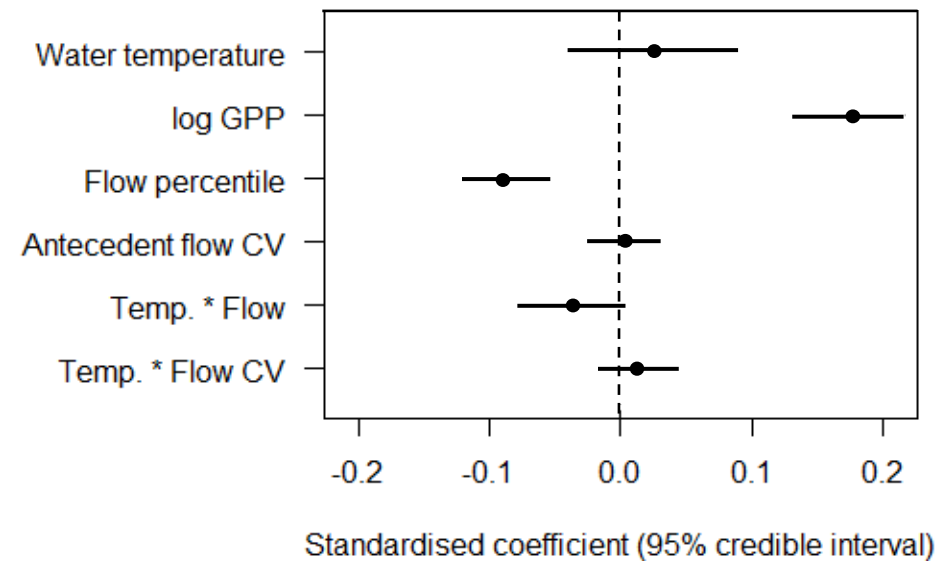


Results: Estimated coefficients

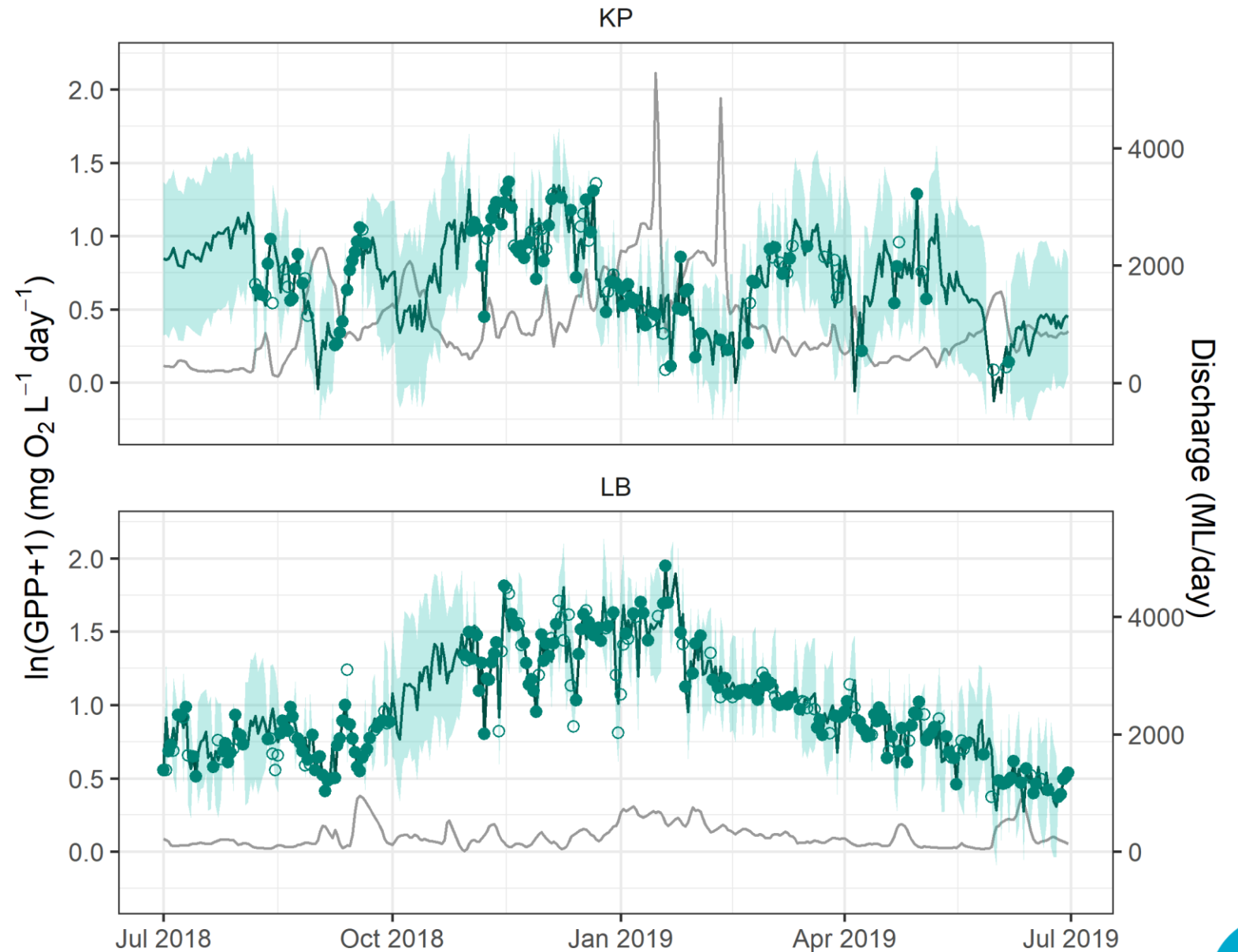
log GPP



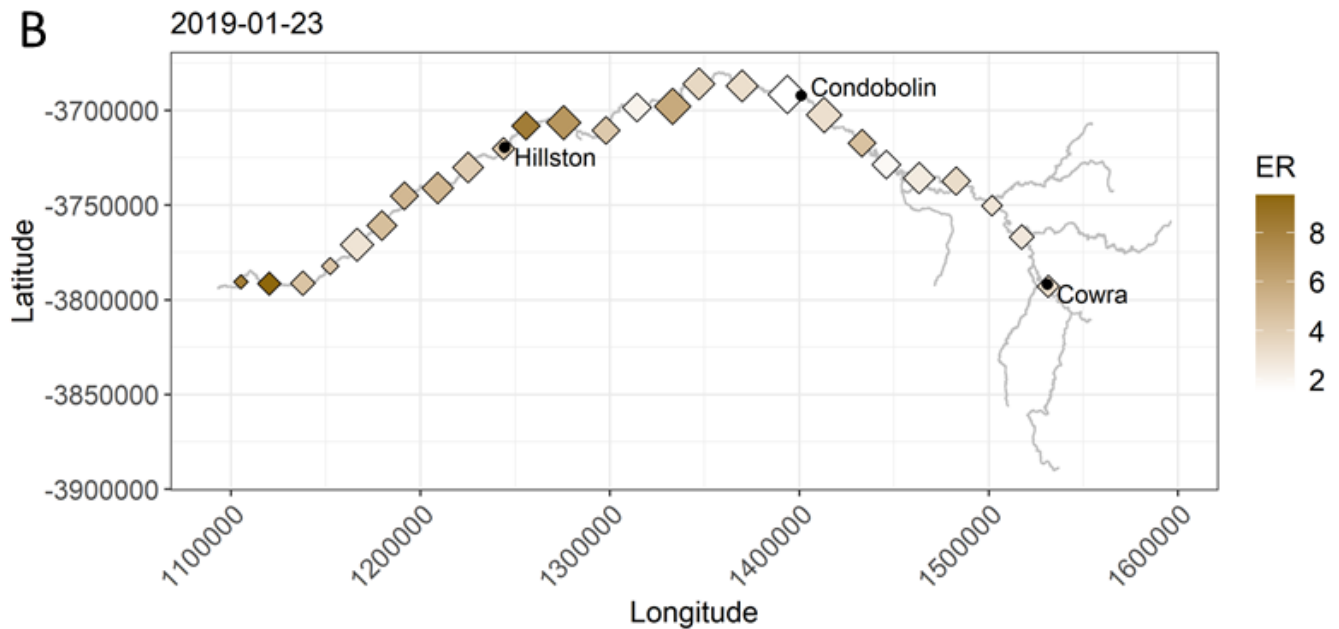
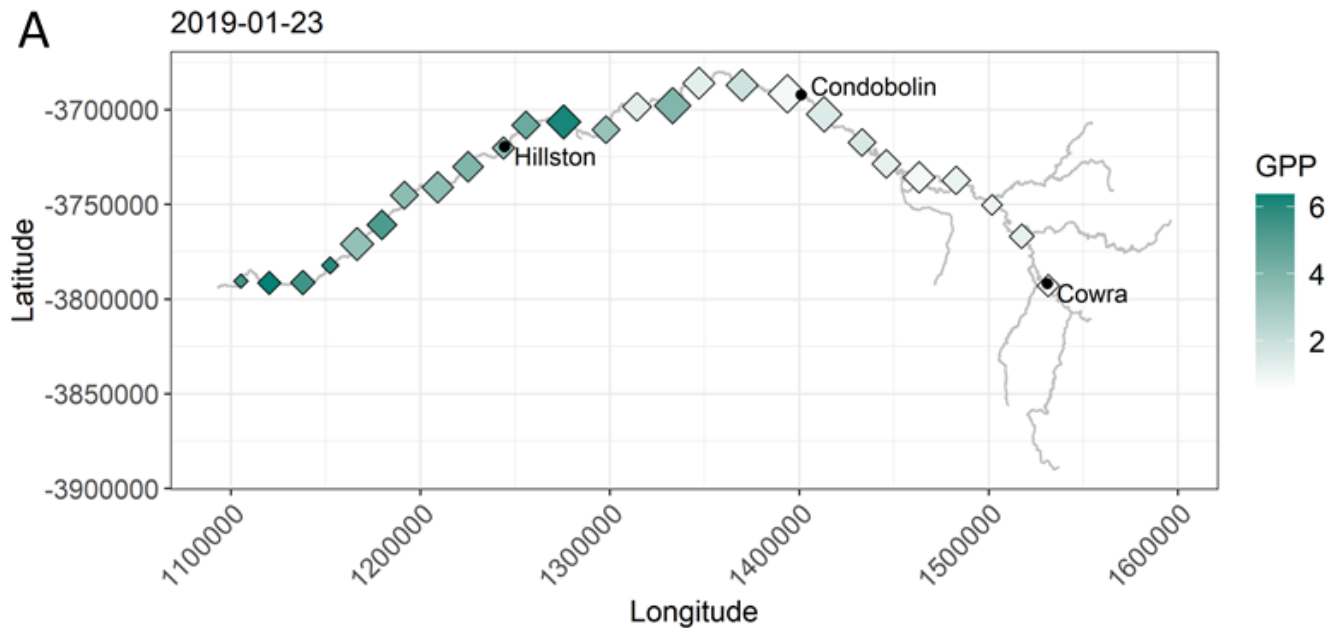
log ER



Results: Variability through time



Results: Variability in space



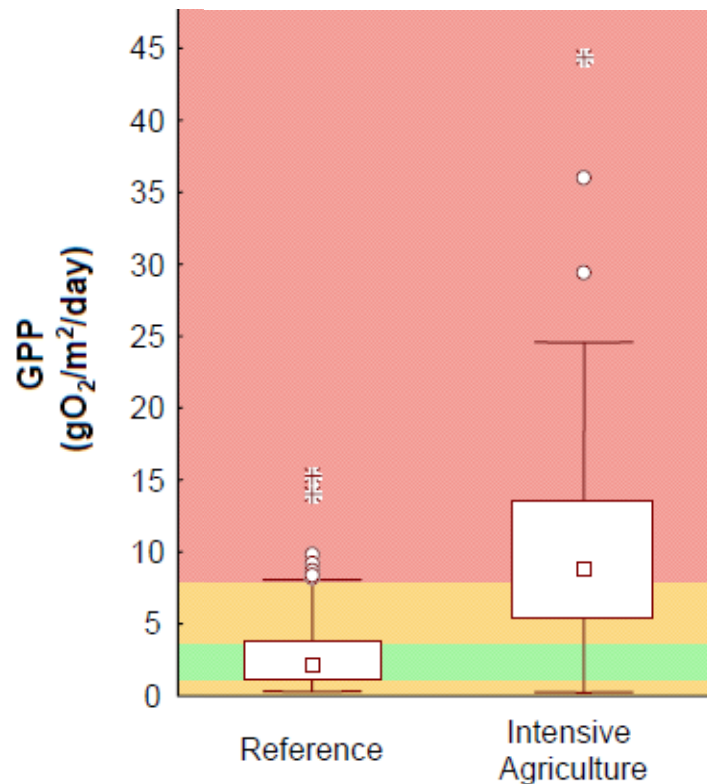
Implications

- We detected effects of flow magnitude and variability on ecosystem metabolism against strong seasonal variation
- Water management in this catchment has likely affected the aquatic productivity regime
- Environmental flows could target productivity outcomes and be used to manage risks associated with very high productivity
- The spatial network model had greater predictive ability than non-spatial models



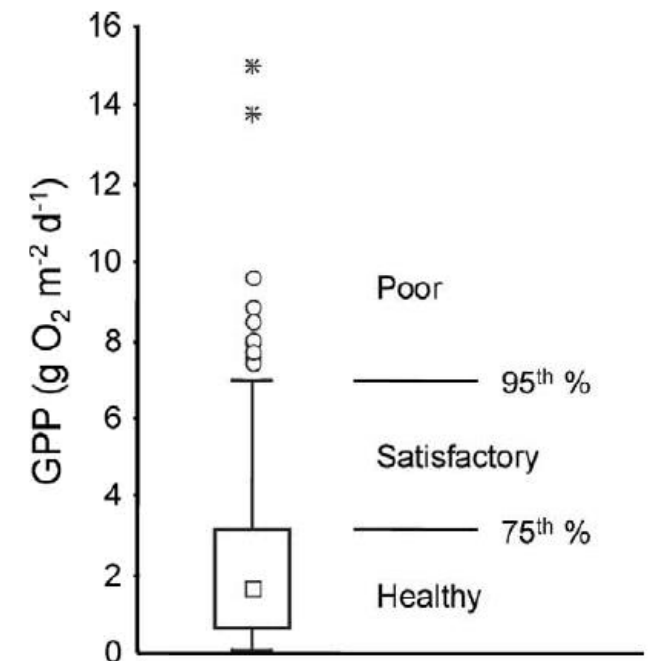
Management & policy application: towards productivity outcomes

Comparison to reference

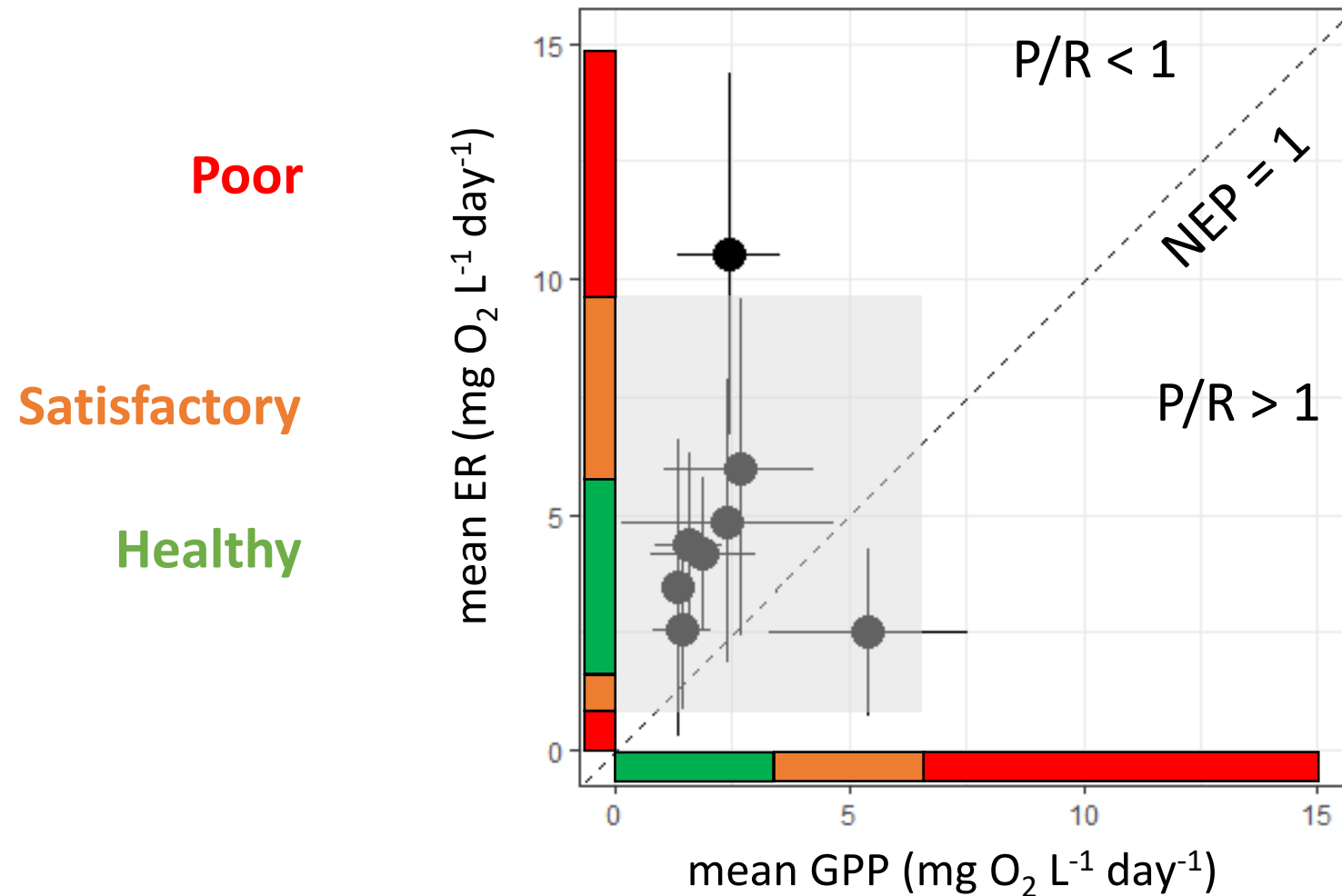


Absolute value

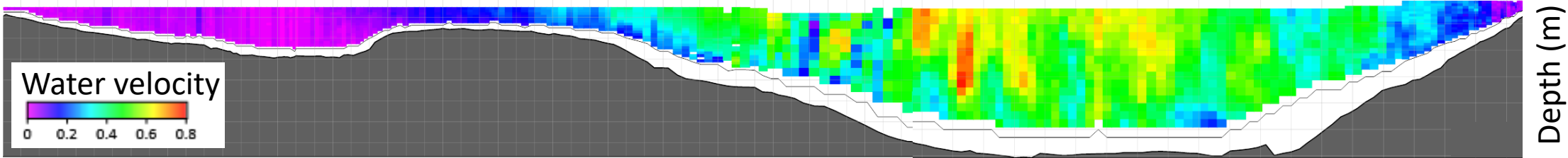
Gross Primary Production	
Site	GPP
West Hoe	0.05
Rangitopuni	0.60
Mahurangi	2.06
Kaipara	2.61
Ararimu	2.70
Wairoa	2.73
Kaukapakapa	2.96
Ngakaroa	3.17
Vaughan	4.01
Hoteo	4.02
Kumeu	7.95
Waitangi	9.27
Puhinui	13.43



Management & policy application: towards productivity outcomes



Future directions: Floodplain productivity





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Thank you