Impact of invasive alien plants on riparian habitats

@ZarahPattison & @AlexSeeney
with Robin Whytock, Philip Boon, Colin Bull & Nigel Willby
Invasive species: beauty or beast?

“...the two great destroyers of biodiversity are, first habitat destruction and, second, invasion by exotic species.” – E.O. Wilson
The exponential growth of invasive species denialism

The environment is changing
The environment is changing

27%↑ in mean annual flow

Average daily mean flows on R Teith since 1970
Can the environment negate invasion impact?

- Variations in river flows mobilize, transport and deposit mineral sediment, but also invasive plants?! *Gurnell et al. 2006 etc.*

- Links between sediment and seed deposition *Goodson et al. 2003*
Can the environment negate invasion impact?

- What is the main driver of native vegetation? Sediment or invasion?
- Invasion = reduce native plant diversity BUT sediment may increase native diversity!
Methods: veg. surveys & germination experiment

Vegetation surveys along 100m stretches of 20 river banks:
• Summer 2013
• Spring 2014
• Summer 2014
Methods: veg. surveys & germination experiment

Vegetation surveys along 100m stretches of 20 river banks:
• Summer 2013
• Spring 2014
• Summer 2014

AstroTurf mats collected sediment over winter
Methods: veg. surveys & germination experiment

Vegetation surveys along 100m stretches of 20 river banks:
• Summer 2013
• Spring 2014
• Summer 2014

AstroTurf mats collected sediment over winter

Propagules in the sediment grown
Can changes in flow and sediment override negative invasion effects on native plant communities?

Regardless of propagule diversity & abundance, invasion reduces native diversity

- Flood frequency
- Flow variability
- Invasive plant cover 2013
- Invasive plant cover 2014
- Sediment
- Number of propagules
- Diversity of propagules

Diversity of aboveground native vegetation
Regardless of propagule diversity & abundance, invasion changes native plant composition

- Flood frequency
- Flow variability
- Invasive plant cover 2013
- Sediment
- Number of propagules
- Diversity of propagules

Greater seasonal change in aboveground native veg. communities

Positive
Negative
Responses of stream macroinvertebrate communities to invasive riparian plants

- Do invasive riparian plants induce ecological changes in rivers?
- Are they cause for concern?
Sampling
Simpson’s diversity index:

– Community score based on number of different species & abundance
– Higher scores = higher diversity
Models

Spatial dissimilarity:

Minimum differentiation

Maximum differentiation

Reproduced from Baselga, 2016
Models

• Model responses:
  – Whalley-Hawkes Paisley Trigg (WHPT) score
Results – Simpson’s diversity index

[Simpson's Macroinvertebrate Diversity chart]

- Channel Shade
- Channel Slope
- Habitat Heterogeneity
- Invasive Cover
- Season
- Substrate Diversity

R^2m = 0.14
R^2c = 0.22
What does this mean?

- Aquatic stressors may interact to become more than just the sum of their parts. *Jackson et al., 2016*
What does this mean?

- Invertebrate samples are more similar at sites with higher invasive cover.

Reproduced from Baselga, 2016
What does this mean?

- Reductions in WHPT score associated with increasing conductivity and invasive cover.
- Supported by loss of several high-scoring taxa in autumn invertebrate samples.

*Wormaldia spp. (11.2)*

*Brachyptera risi (11.3)*

*Ecdyonurus spp. (11.1)*
Conclusion: Invasion does affect riparian habitats, evidenced by:

- Invasion by alien plants reducing native plant diversity

- Rivers with a history of invasion showing a greater change in native community composition

- An increase in invasive cover was associated with:
  - Reduced Simpson’s macroinvertebrate diversity
  - Lower macroinvertebrate WHPT score
  - Reduced spatial dissimilarity between samples (i.e. a homogenising effect)

- These findings offer support for actively managing riparian invasions in a bid to improve the ecological status of low order stream habitats
Thank you!

- Chief Detective Prof Nigel Willby, Dr Colin Bull and the Freshwater Detective Agency
- Professor Phil Boon, Dr Mario Vallejo-Marin and Robbie Whytock
- Field and lab assistants
- Funding: SNH, SEPA, UoStirling