



ROOM TO MOVE:

ACCOMMODATING WOODY DEBRIS IN STREAM CHANNELS AS FISH AND INVERTEBRATE HABITAT

MORPHUM
environmental



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Floods move wood in streams

A natural result of flood

Wood in the channel will move

Some wood is stable

What are the consequences of wood
in streams?

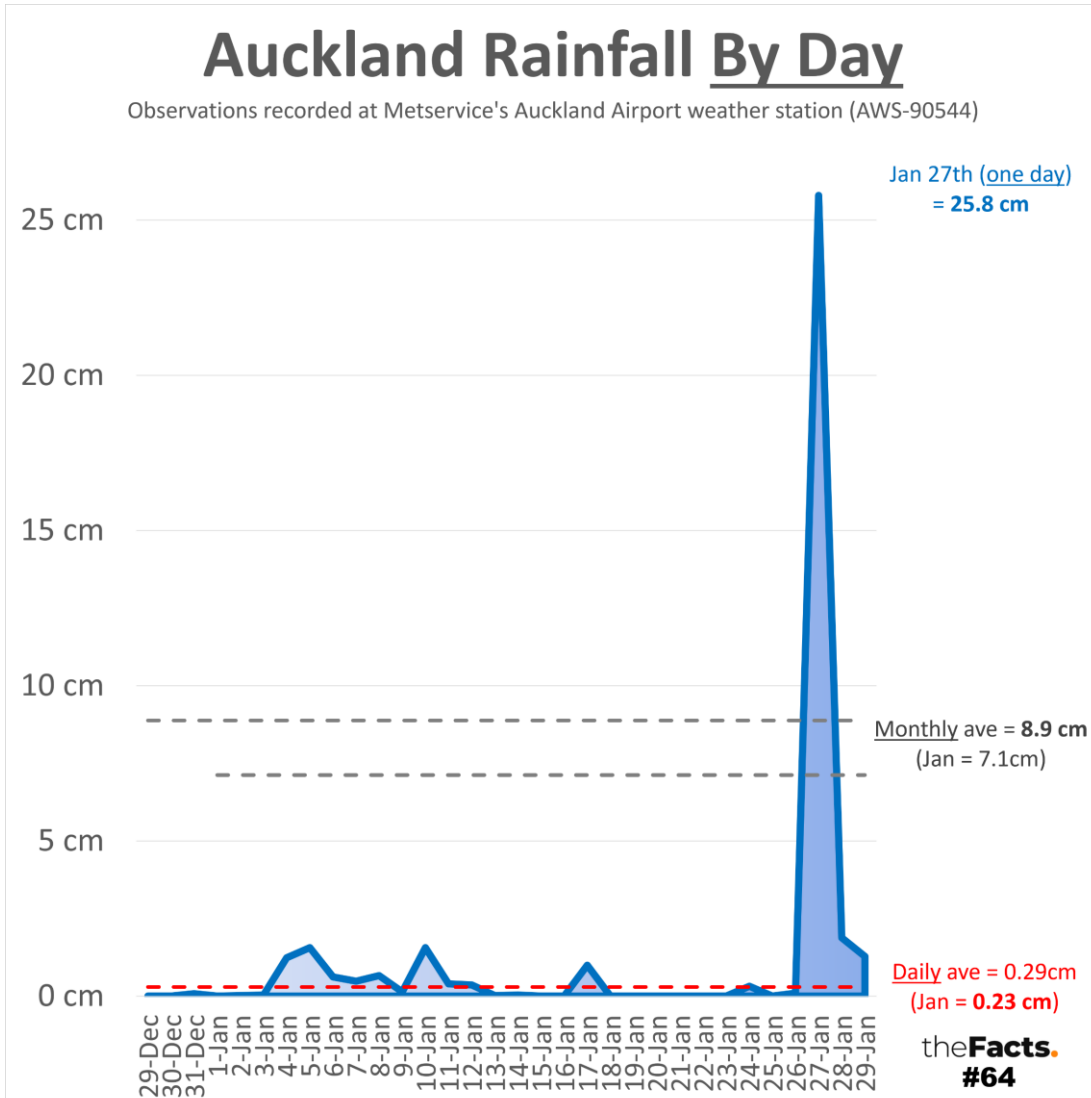
Do we need to remove wood from streams?

Can we distinguish good wood from bad?



Source: <https://wilderness-society.org/wp-content/uploads/2015/09/managing-floods-and-droughts-with-forests.jpg>

27 Jan 2023 flooding



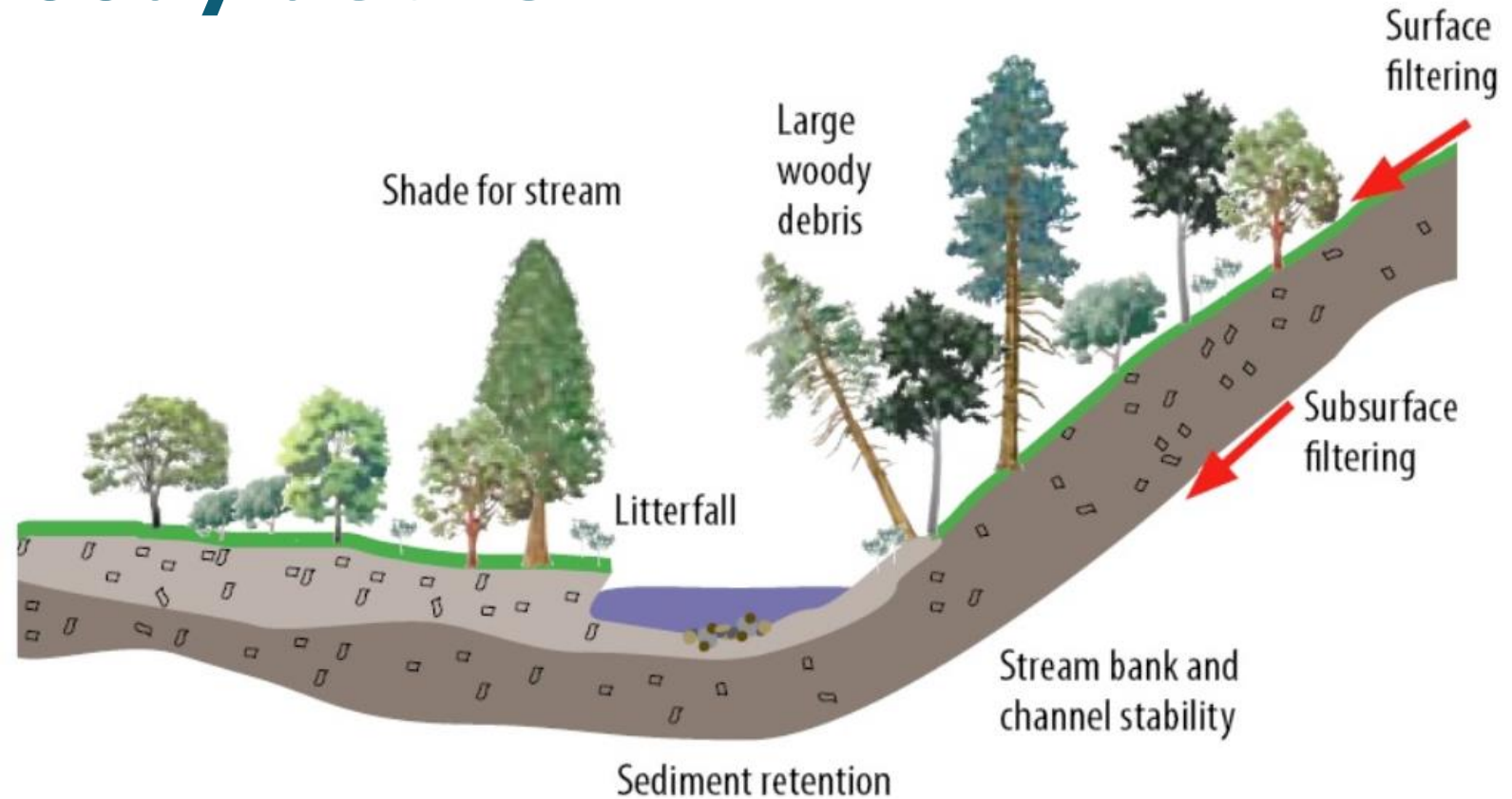
Functions of the riparian zone as a source of leaf litter and woody debris

A stream and its banks

Natural geomorphic units

Riparian zone provides

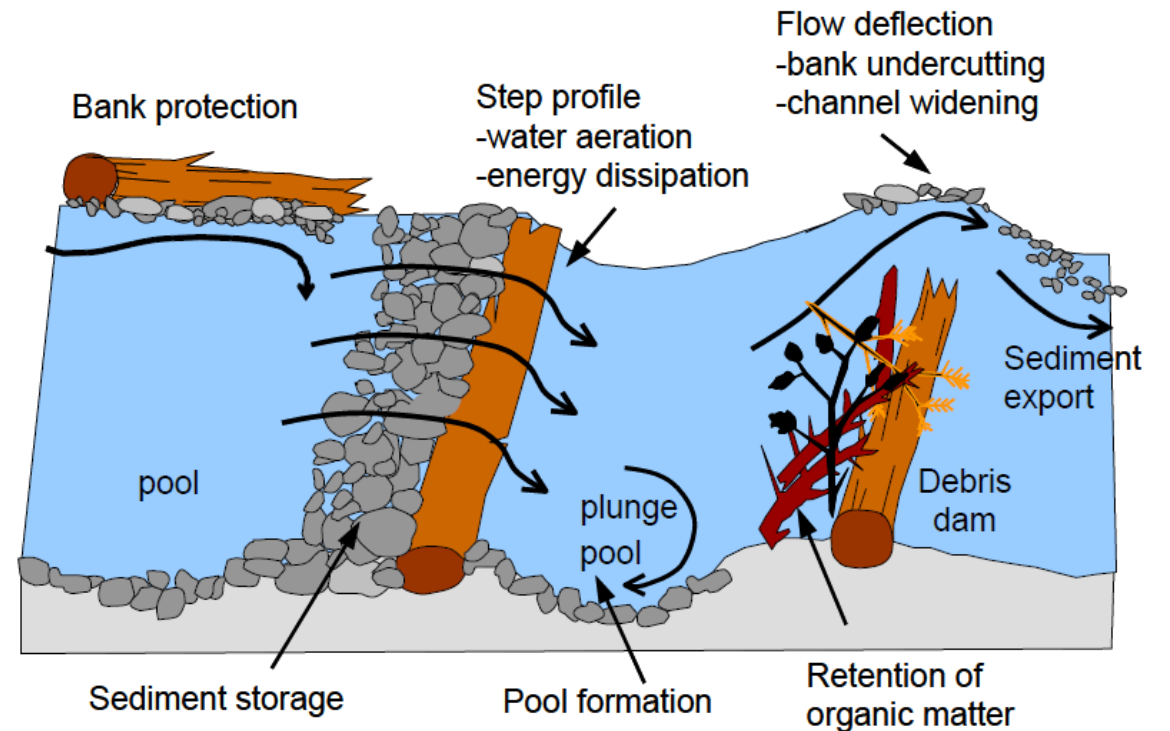
- Shade
- Channel stability
- Leaf litter for energy
- Wood for structure
- Sediment retention



Source: Rogue Valley Council of Governments (RVCOG). <http://rvcog.org/what-we-do/natural-resources/riparian-restoration-invasive-species-removal-and-planting-of-native-species/>

The influence of wood on geomorphic processes in streams

- Routing of water and sediment in channel
- Bank protection
- Aeration of water
- Variation of water depth
- Substrate for fish and invertebrates



Banded kōkopu

These fish live on the stream bed
Often associated with stream wood
Nocturnally active
Eat invertebrates – mostly larval insects



Longfin eel

Migrate from the sea

Live for 50 years or more

in streams

Nocturnally active

Eat invertebrates



Freshwater crayfish (kōura)

Hard-bodied crustaceans

Nocturnally active

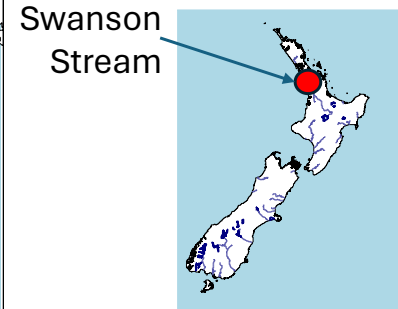
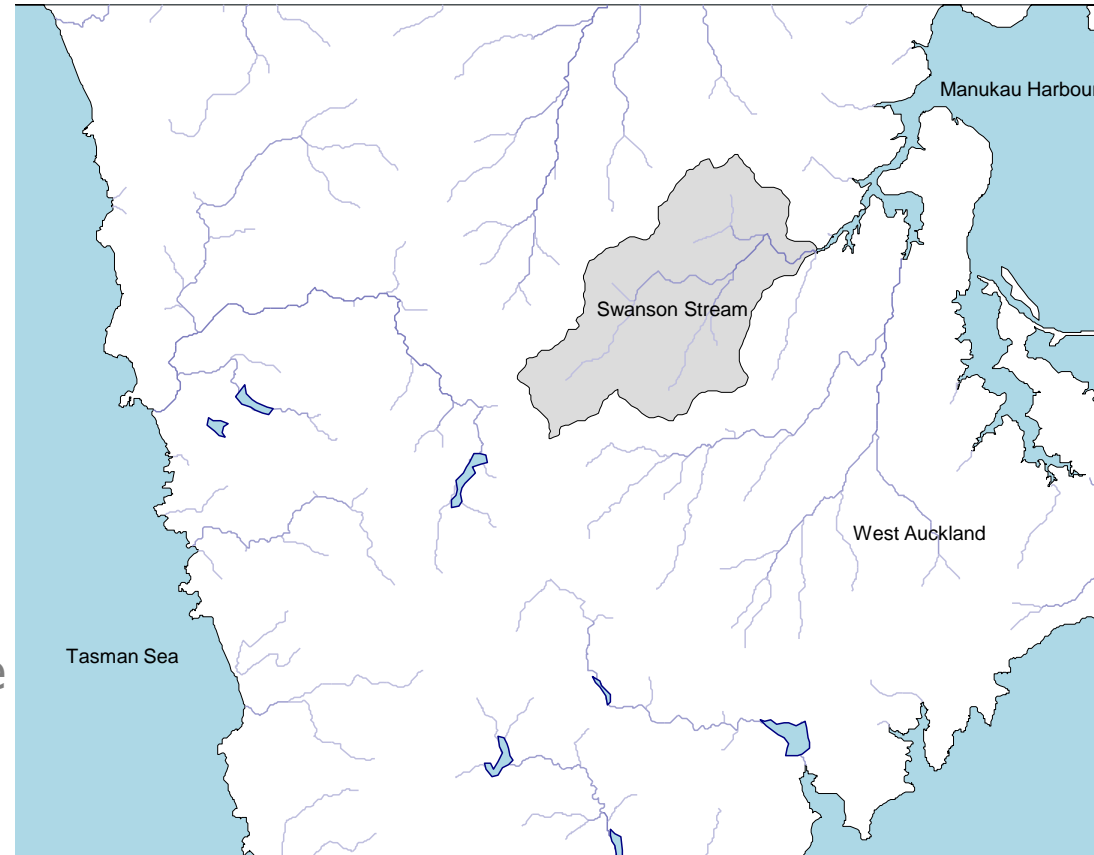
Eat leaf litter and invertebrates

Breed in streams



Swanson Stream, West Auckland

Partly forested 23 km² catchment
in West Auckland
Hit hard by 27 Jan 2023 flooding
A lot of wood accumulated in and
around the stream channel
Created a challenge for Auckland
Council
Prospect of blocking the channel
Damage to bridges and streamside
property



Woody debris on the floodplain

Wood lodged on the floodplain

Photo 15 January 2024



Non-functional coarse woody debris

Woody debris suspended
above Swanson Stream
At high flows it could create
bed scour and channel
deepening
Otherwise of no benefit
to the stream ecosystem



Functional coarse woody debris

Forms potential fish cover
and bank protection
Typical cover for eels



Functional fine woody debris

Fine woody debris

(<15 cm diameter)

Forms stable cover for fish
and invertebrates

Invertebrates are an important
food for fish

Have their own intrinsic
worth as biodiversity and
part of the ecosystem



Functional pool-forming, complex woody debris

- Potential habitat for fish and invertebrates
- Protection from high water velocities
- Protection from predation



How do we know any of this?

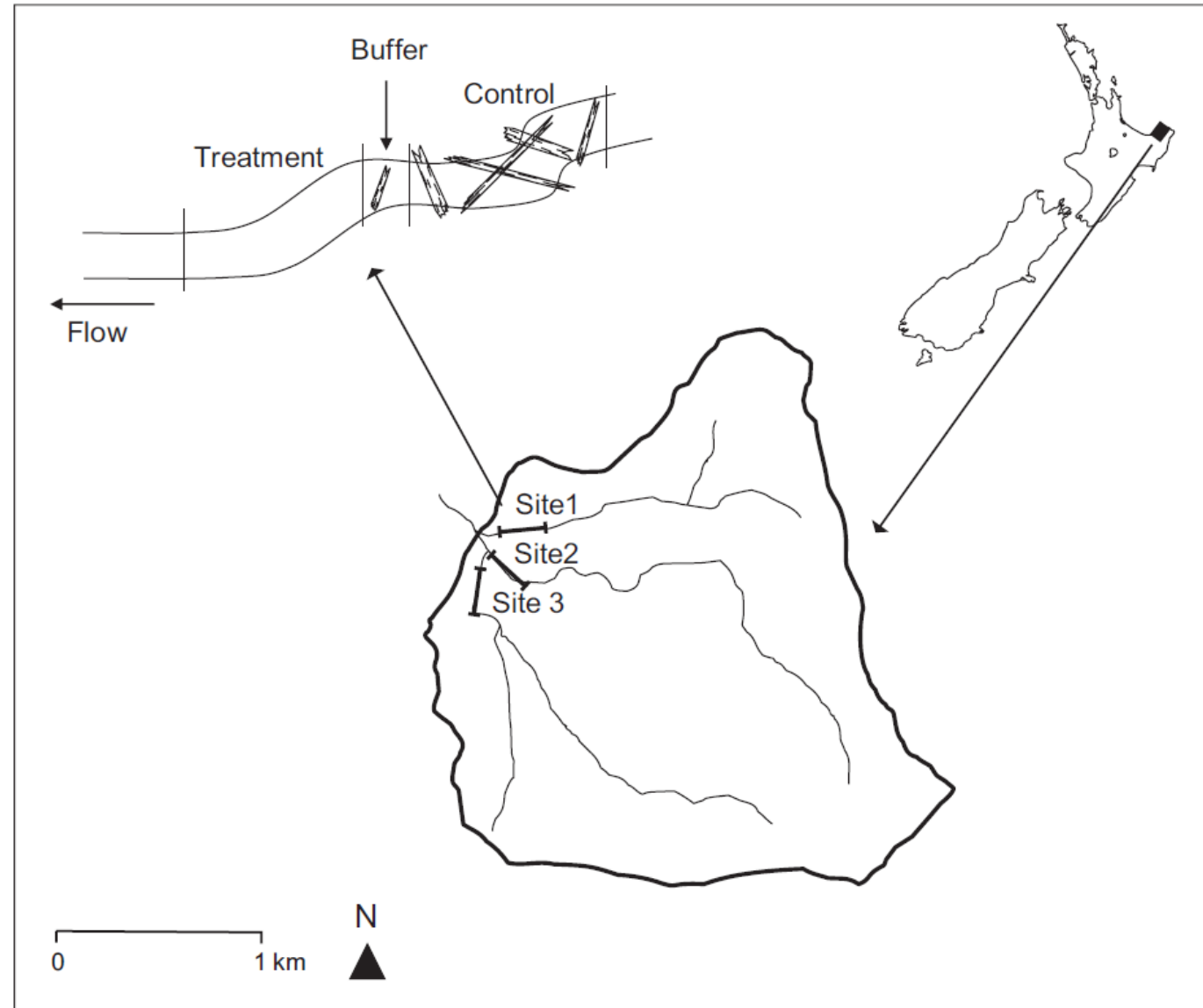
A lot of experience catching fish – anecdotal

Rigorous experiments before-after study, removal from East Cape streams

Brenda Baillie, 2011 U Waikato PhD

“The physical and biological function of wood in New Zealand’s forested stream ecosystems”

Baillie et al. (2011)



Before and after wood removal

Stark difference in aquatic habitat

Gravel movement downstream

Shallower water – pool loss

Degradation of channel

The wood was holding and storing channel substrate

A classic debris dam



Before removal



Immediately after



One year after

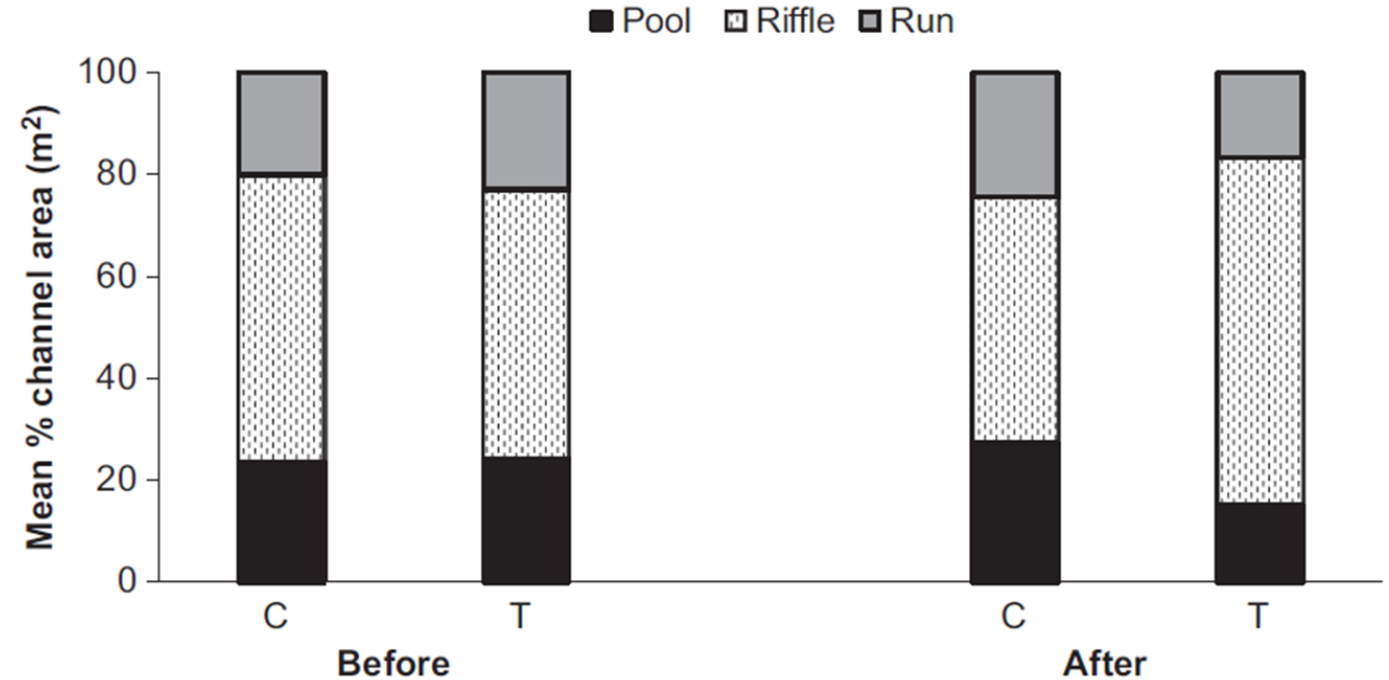
Baillie et al. (2013) *Ecol Freshw Fish* 22: 553–566

After wood removal

Pools fell from 27 to 17%

Runs fell from 27 to 18%

Riffles increased from 50 to 65%

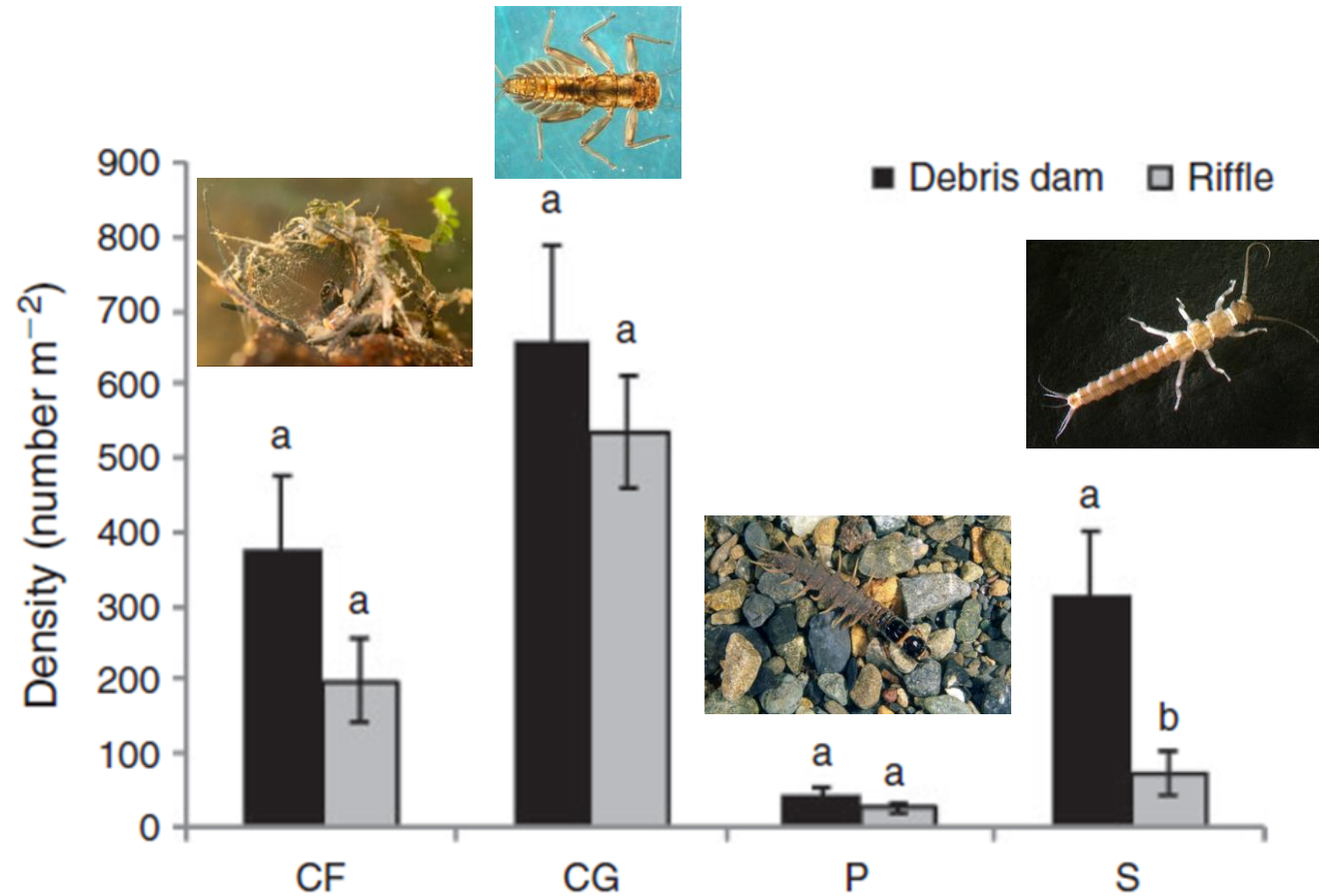


Baillie et al. (2013) Ecol Freshw Fish 22: 553–566

Invertebrates in debris dams cf. riffles

Riffles are typically considered the best habitat for invertebrates
 But woody debris dams are better!

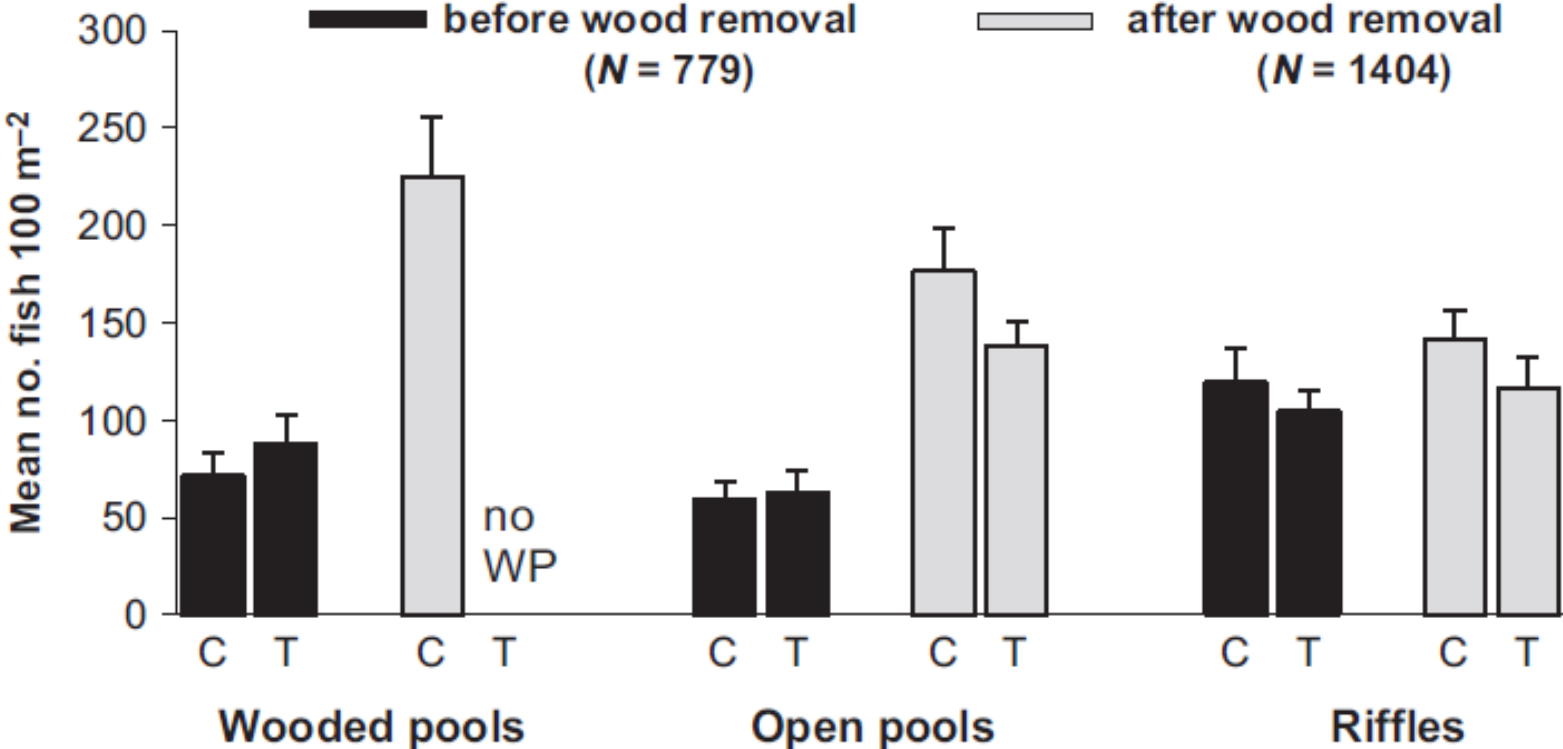
Key: CF, collector-filterers – net-spinning caddis
 CG, collector-gatherers – mayfly
 P, predators – toebiter
 S, shredders – stonefly



Baillie et al. (2019) Mar Freshw Res 70: 734–744

Fish and wood removal

C = control (wood remained)
 T = treatment (no wood)
 Pools with wood
 (wooded pools) had
 most fish
 These were lost with
 wood removal



Baillie et al. (2013) Ecol Freshw Fish 22: 553–566

Conclusions and recommendations

East Cape streams showed that woody debris in the stream channels was effectively holding the stream habitat together

Wood removal resulted in loss of pool and run habitat and a large increase in riffle habitat

The largest effect of wood removal was on banded kōkopu and longfin eels

Invertebrate abundance and diversity also declined with wood removal

So wood can be important habitat and give the channel bed stability

When planning wood removal from streams, wholesale removal should be avoided

In Swanson Stream, the debris removal was undertaken

Aimed at reducing flood risk while being sympathetic to the ecological function of wood in the stream

Acknowledgements

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- the University of Waikato

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Brenda Baillie's huge research effort in the East Cape for her PhD is a cornerstone of understanding the role of woody debris in NZ streams.

We thank the two reviewers provided by Stormwater 2024 for their insightful comments on the long paper

References

Baillie, B.R. (2011) The physical and biological function of wood in New Zealand's forested stream ecosystems. PhD thesis, University of Waikato, Hamilton.

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Baillie B.R. Hicks B.J. Hogg I.D., van den Heuvel M.R. and MO Kimberley. (2019) Debris dams as habitat for aquatic invertebrates in forested headwater streams: a large-scale field experiment. *Marine and Freshwater Research* 70: 734–744. <https://doi.org/10.1071/MF18216>.

Hicks B., Vaughan K., Frederick K., Hall M., McCord J., Rossaak A. 2024. Room to move: accommodating woody debris in stream channels as fish and invertebrate habitat. Stormwater Conference, Wellington.

Thank you!
Questions? Patai?