Riparian soil nitrogen cycling and isotopic enrichment in response to a long-term salmon carcass manipulation experiment

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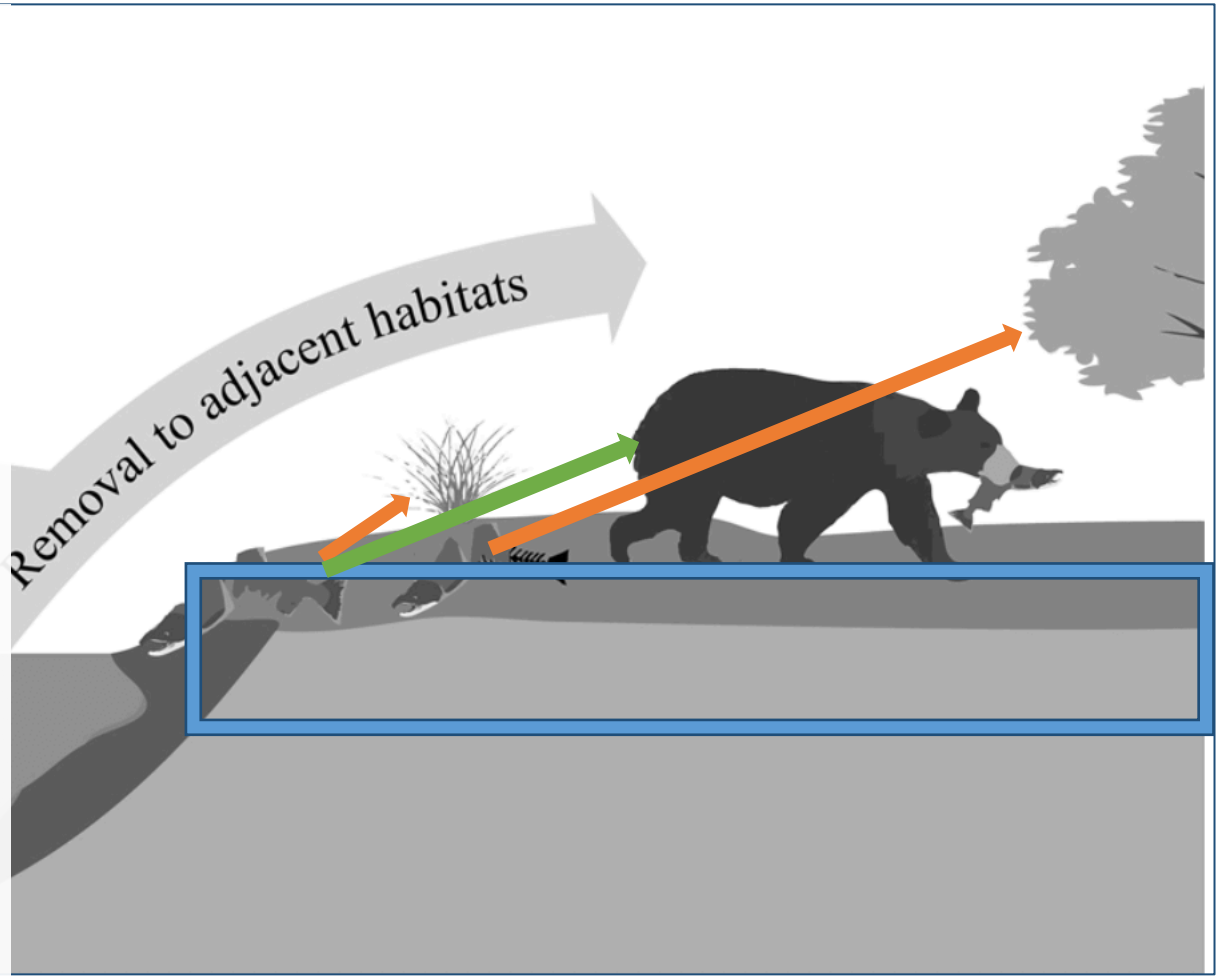
Salmon subsidies directly and indirectly influence aquatic and terrestrial systems

Assumption:

1. If 100% of nitrogen in vegetation is from salmon, it will have the same $\delta^{15}N$ signature as the salmon

2. Consistent biogeochemical similarity

3. Nitrogen retained in the system



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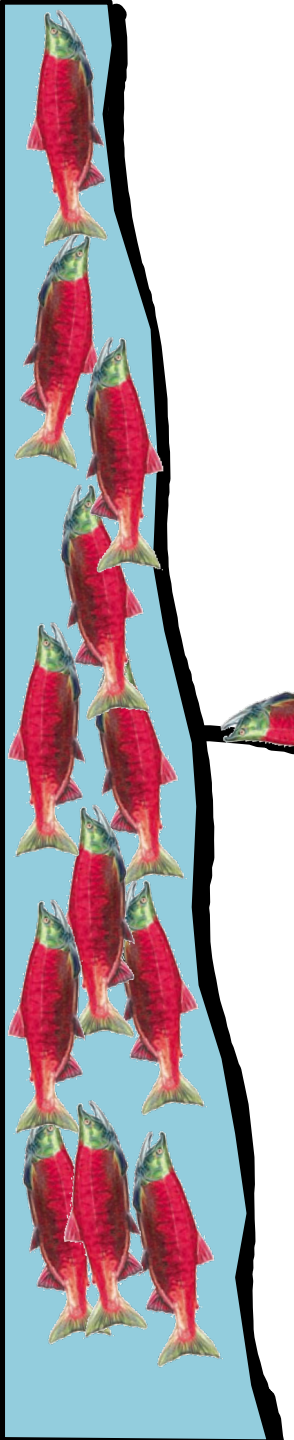
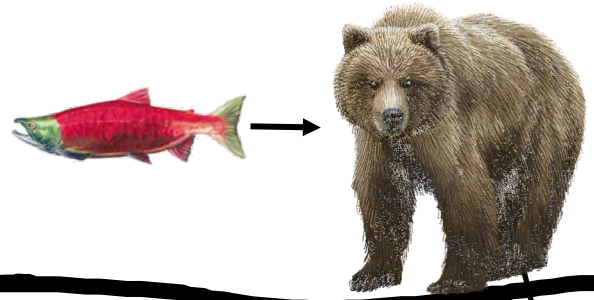
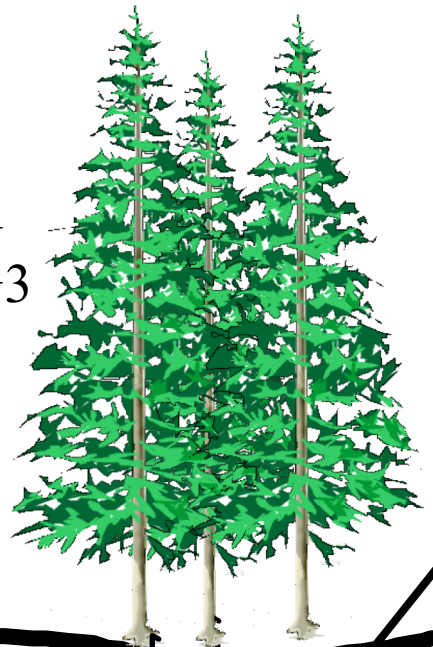
“Simplified” Soil N Cycle







NH_3

N_2O

N_2

Soil Organic Matter

Depolymerization

Amino Acids

NH_4^+

NO_3^-

N_2O

N_2

Mineralization

Nitrification

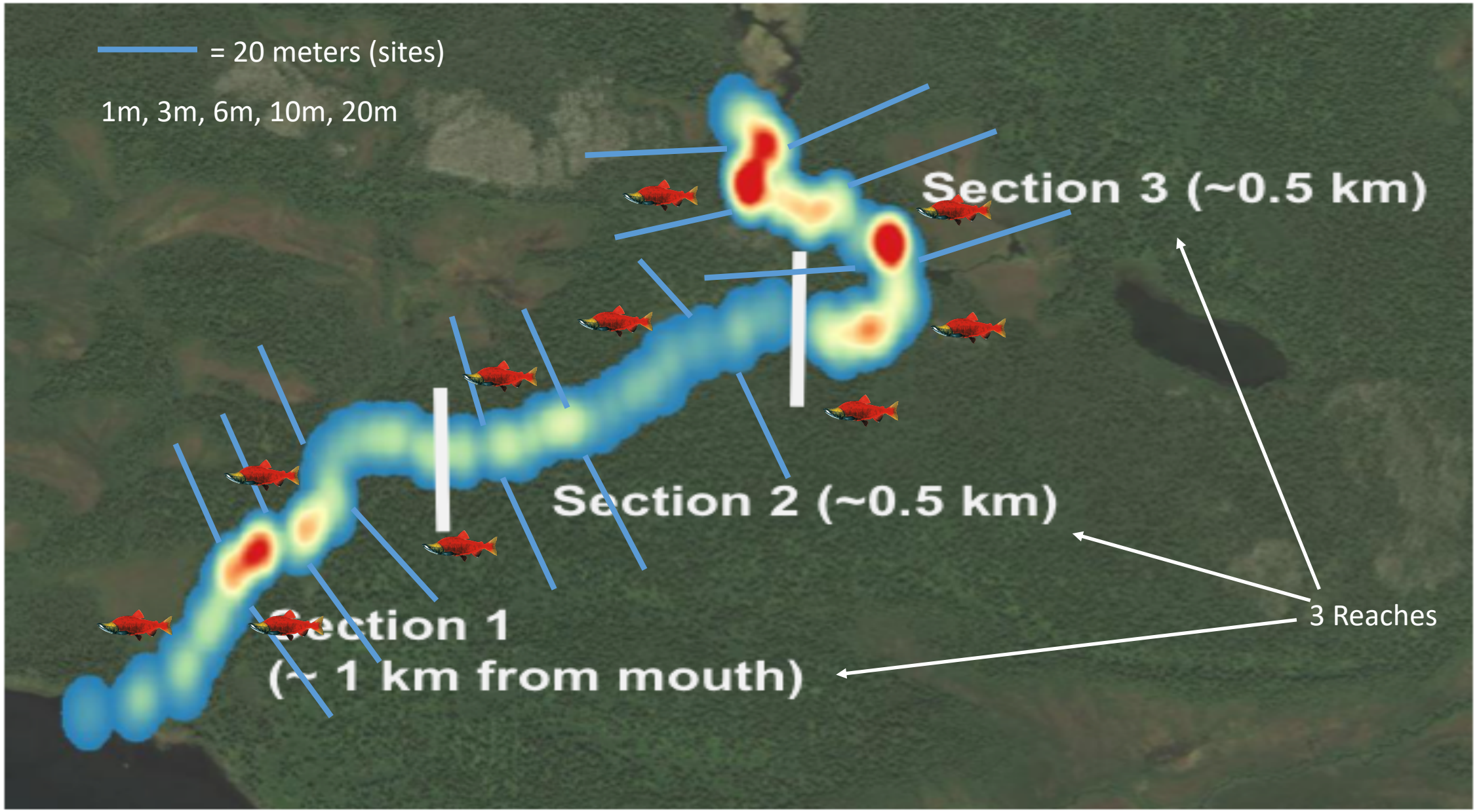
Denitrification

Leaching

Leaching

Objectives

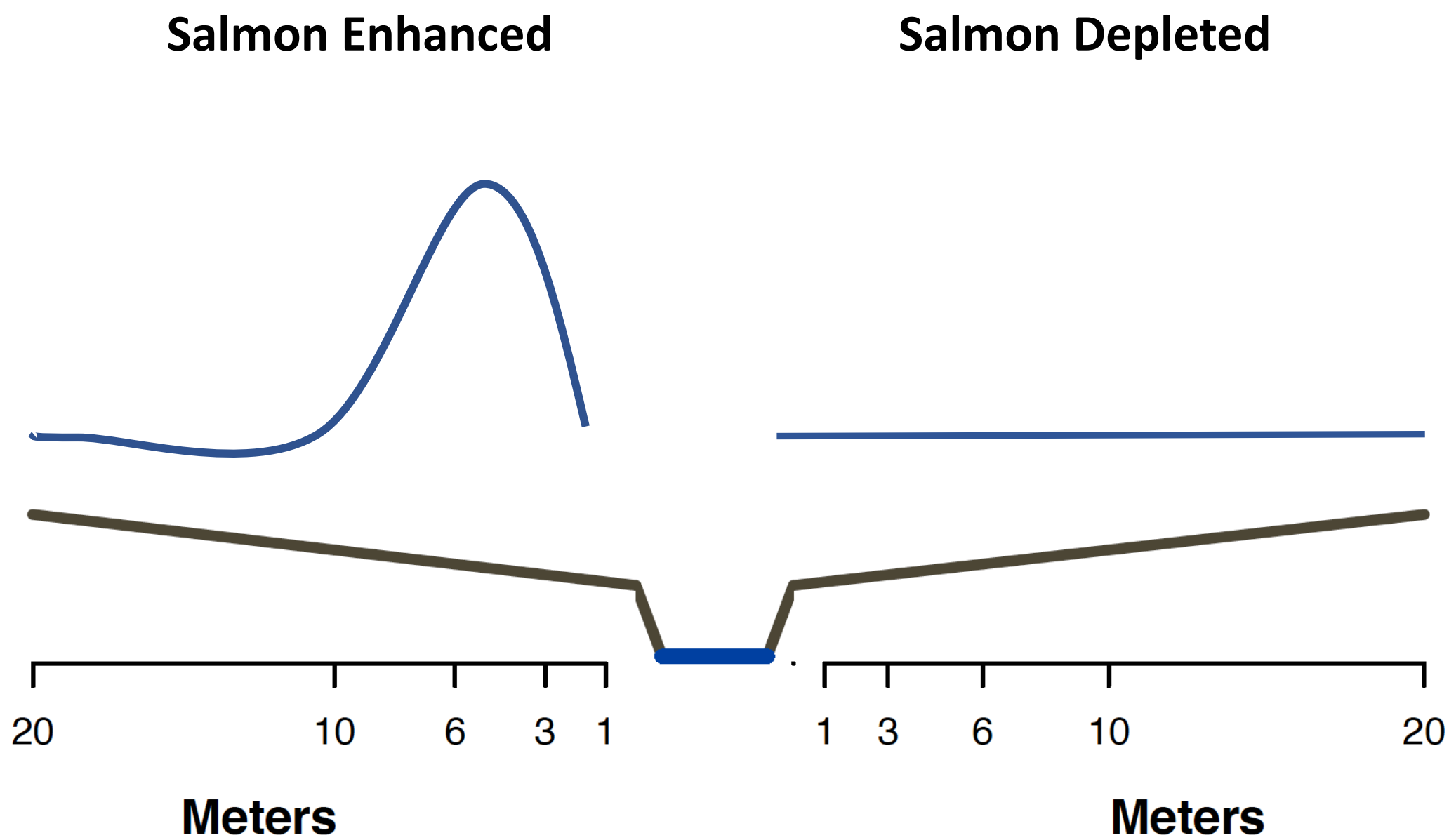
- Determine effects of salmon verse site variability on $\delta^{15}N$ of plant available nitrogen pools (NH_4^+ and NO_3^-).
- Determine the long-term legacy of salmon on nitrogen transformation rates (net mineralization and net nitrification).
- Test how nitrogen enrichment from transformations in soils impacts mixing model estimates for salmon contributions to riparian vegetation.


= 20 meters (sites)
1m, 3m, 6m, 10m, 20m
Section 3 (~0.5 km)
Section 2 (~0.5 km)
ection 1
(~ 1 km from mouth)
3 Reaches

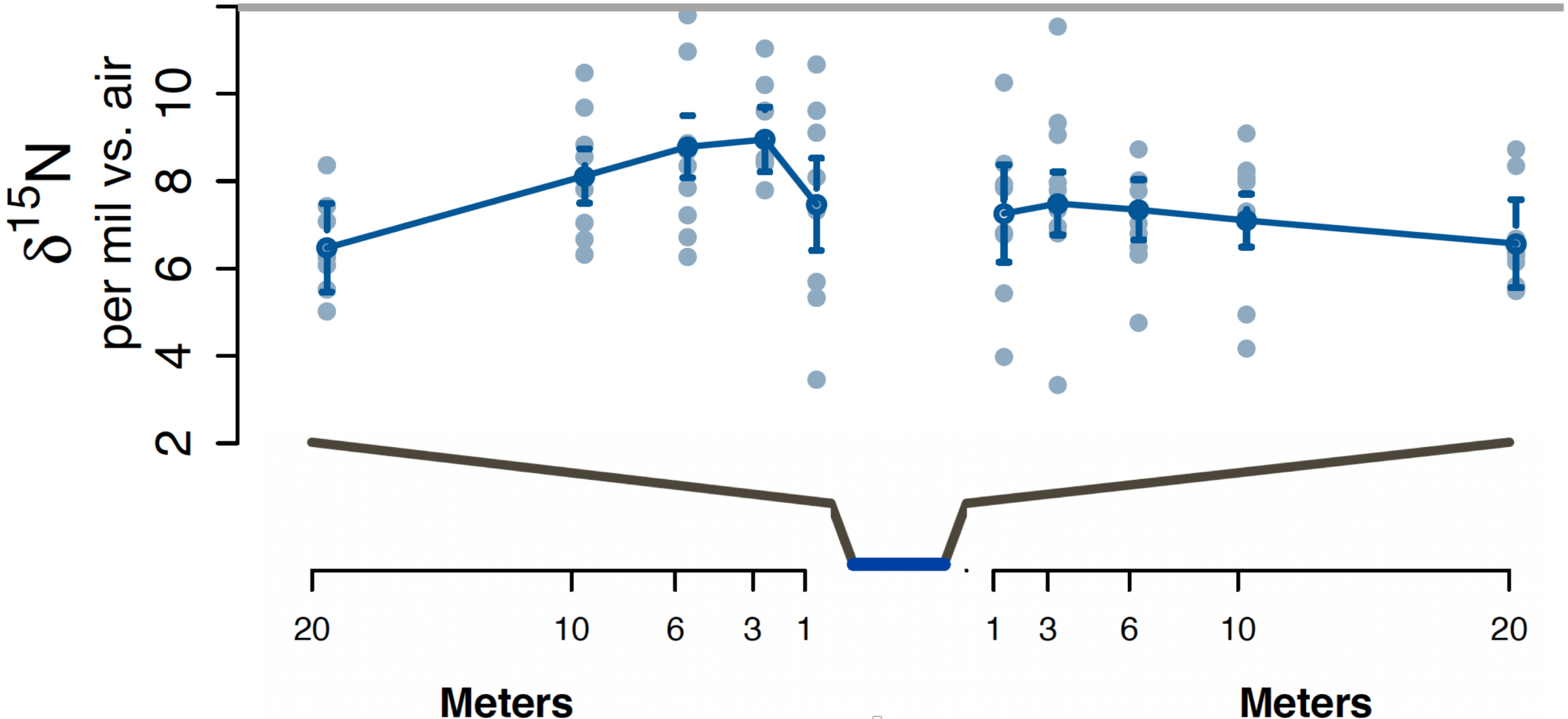
Variables

- $\delta^{15}N$ of bulk isotopes (Organic nitrogen) – *Presence of marine derived nitrogen*
- $\delta^{15}N$ of plant available nitrogen pools NH_4^+ and NO_3^- – *Fractionation in soils*
- NH_4^+ and NO_3^- concentration – *Availability of plant available nitrogen pools*
- Nitrogen transformations – *Availability of plant available nitrogen pools*
  - Net mineralization (conversion of organic material to NH_4^+)
  - Net nitrification (conversion of NH_4^+ into NO_3^-)
- Gravimetric water content – *Site variability that can limit plant growth*

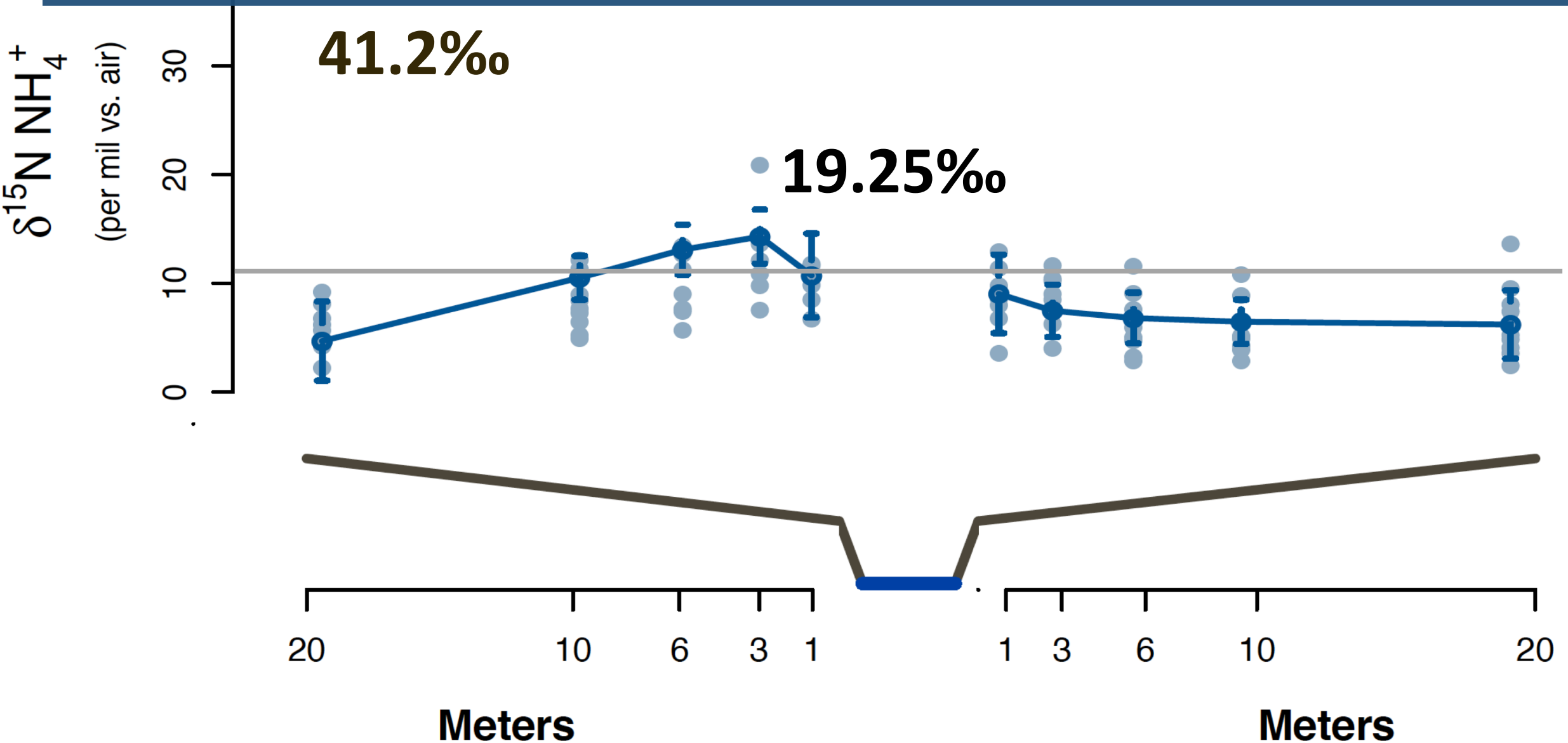
Salmon Effect: Bank:ln(Distance)^2



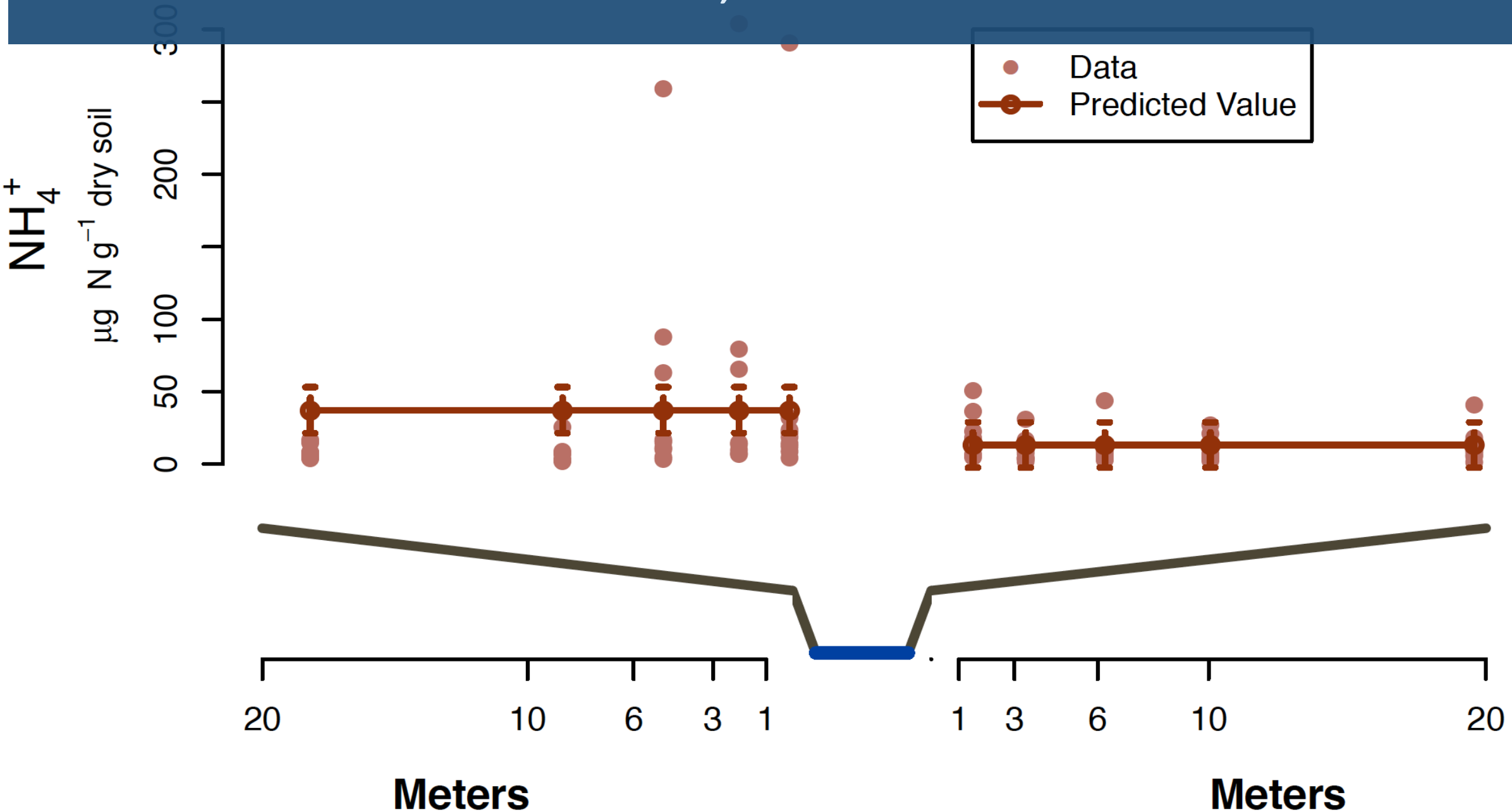
Bank, Distance, Bank:Distance, Bank:Distcance^2 =



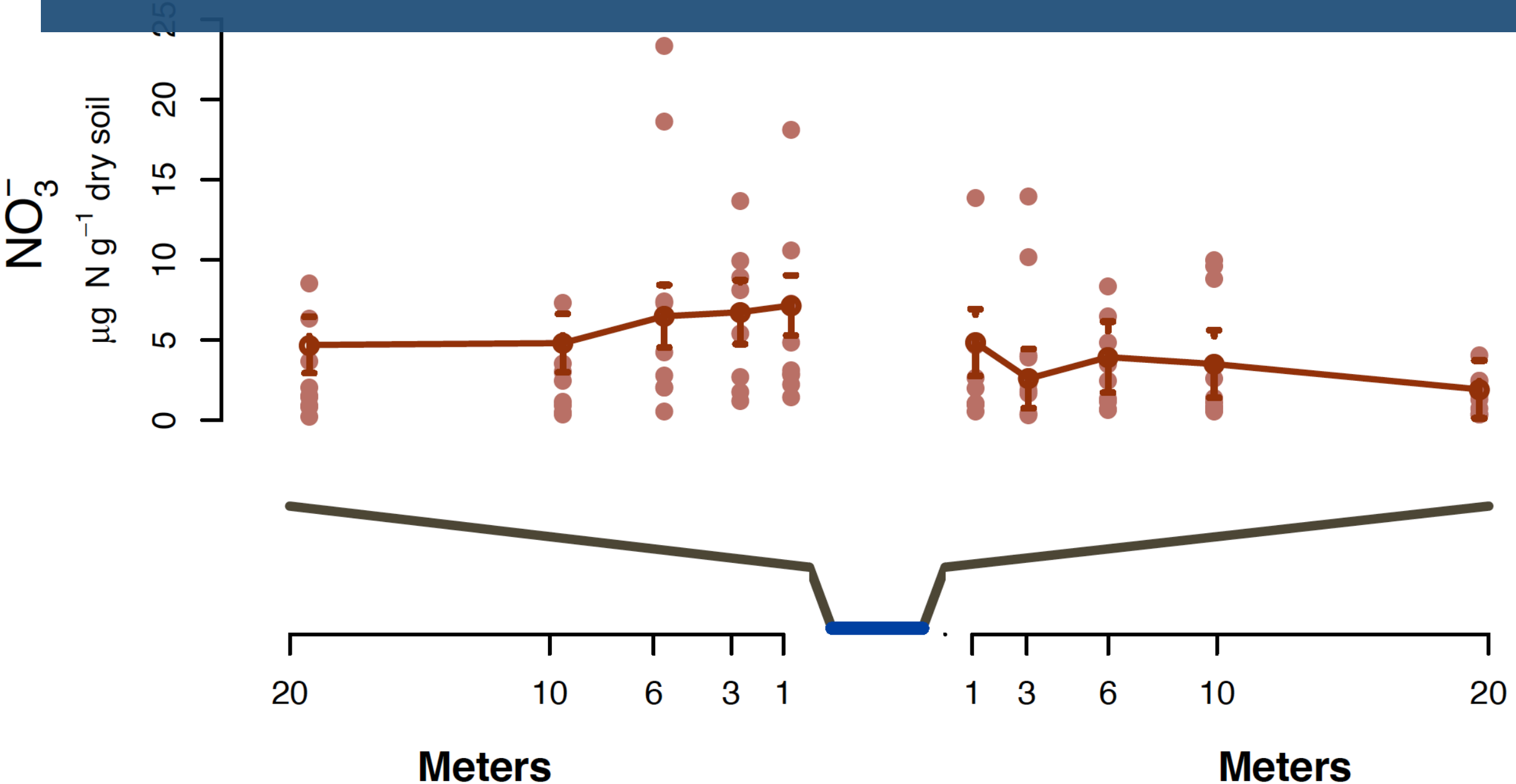
Bank, Distance, Bank:Distance, Bank:Distcance^2 =



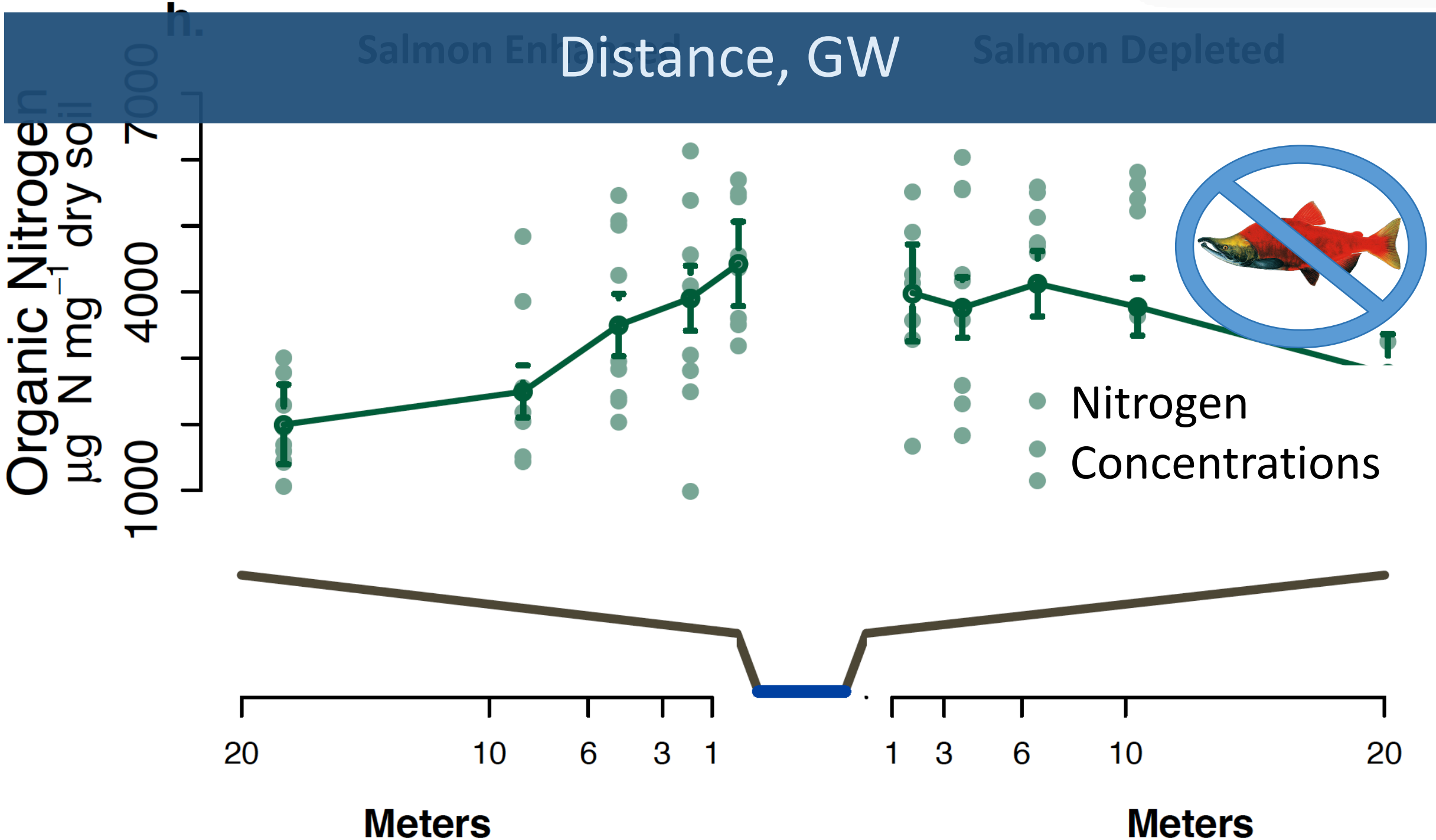
Bank, Distance



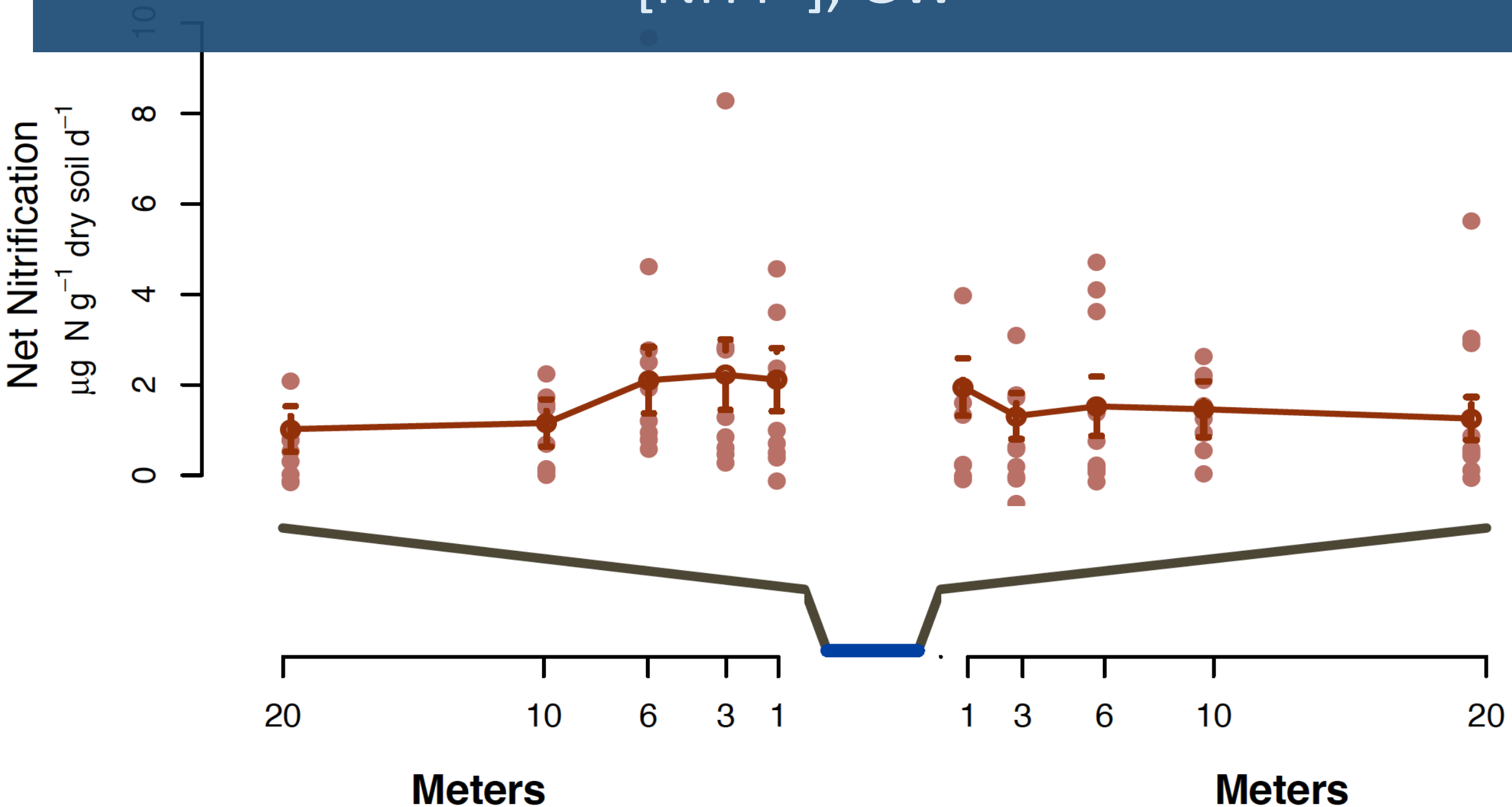
Bank, GW


e.
Salmon Enhanced
Salmon Depleted
NO_3^-
µg N g^{-1} dry soil
0
5
10
15
20
25
20
10
6
3
1
1
3
6
10
20
Meters
Meters

Distance, GW


Organic Nitrogen
µg N mg⁻¹ dry soil
1000
4000
7000
Nitrogen
Concentrations
20
10
6
3
1
1
3
6
10
20
Meters
Meters

[NH4+], GW


g.
Salmon Enhanced
Salmon Depleted
Net Nitrification
µg N g⁻¹ dry soil d⁻¹
0
2
4
6
8
10
20
10
6
3
1
1
3
6
10
20
Meters
Meters

f.

Salmon Enhanced [N_{Org}] Salmon Depleted

Net Mineralization
$\mu g\ N\ g^{-1}$ dry soil d^{-1}

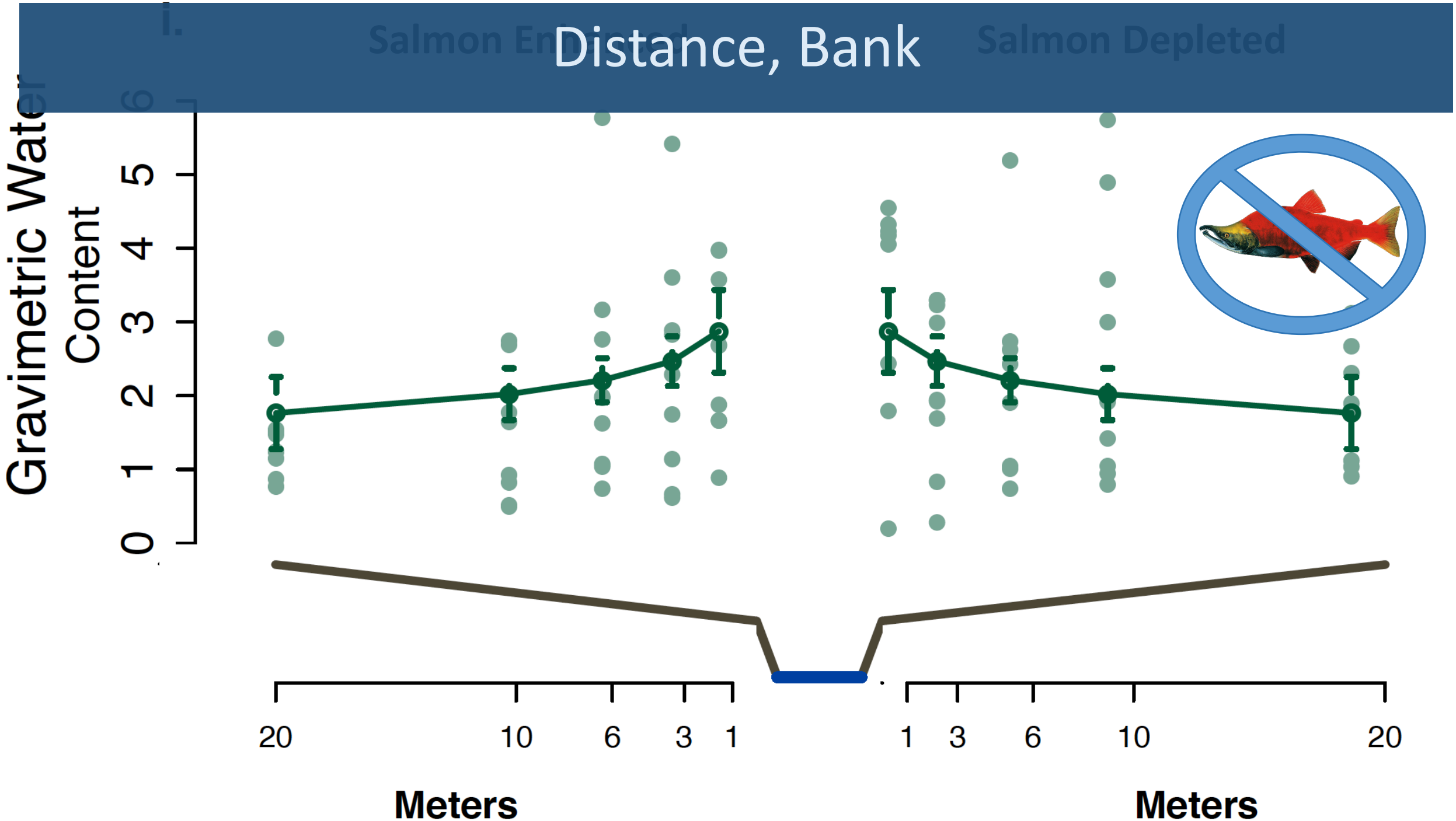
0 2 4 6 8 10

Nitrogen Transformations

20 10 6 3 1 1 3 6 10 20

Meters Meters

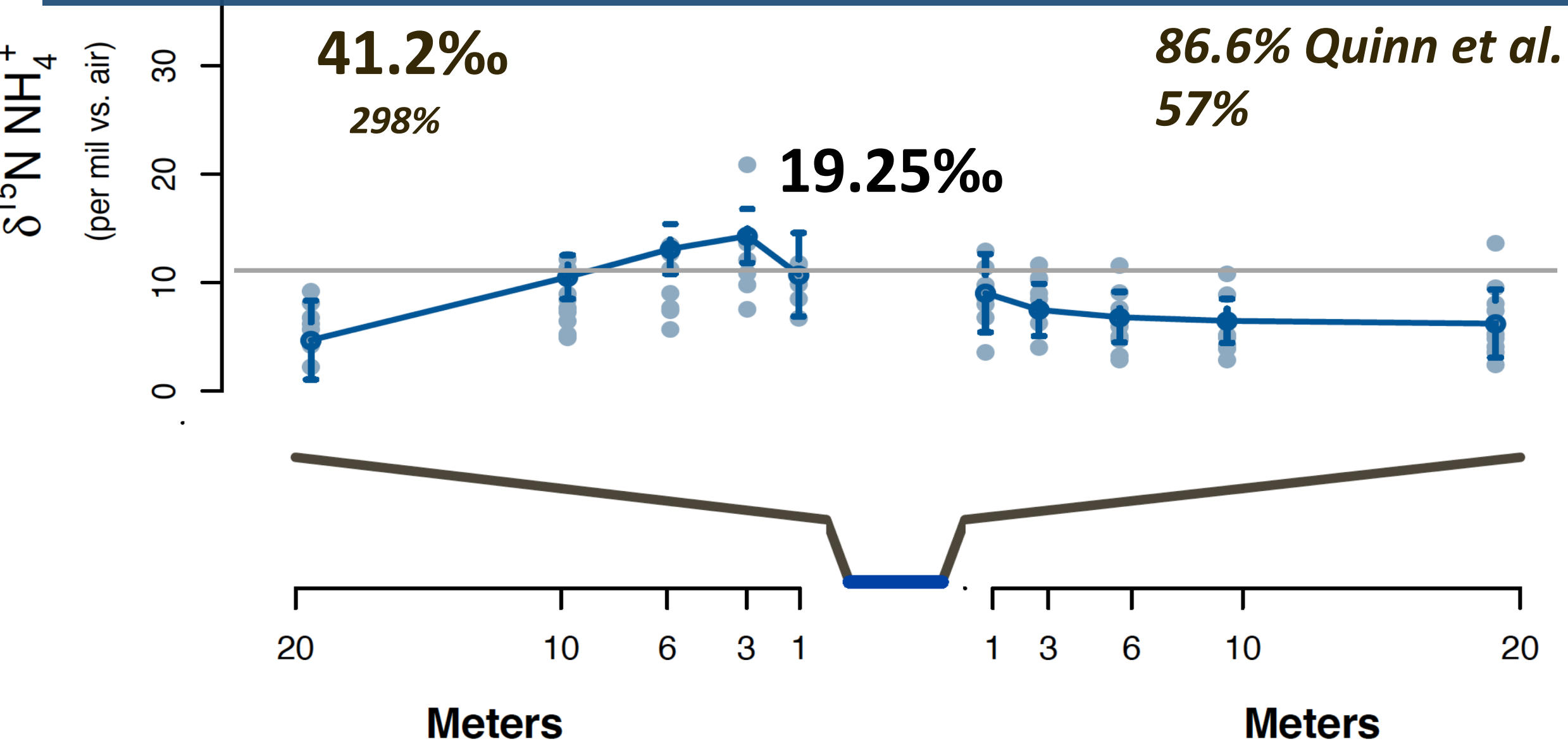
Distance, Bank



Interpretation

- Salmon enrich soil isotopes
- Soils do not exhibit an ecological response to the presence/absence of salmon (inorganic and organic N concentrations and transformations)
- *Soil biogeochemistry is highly variable even within 20m of a stream. Consideration of biogeochemical similarity is integral to selection of control sites when assessing salmon contributions to vegetation*
- *Using salmon as a mixing model end member overestimates the contribution of salmon and ignores the significance of biogeochemical pathways to isotope enrichment*

Bank, Distance, Bank:Distance, Bank:Distcance^2 =



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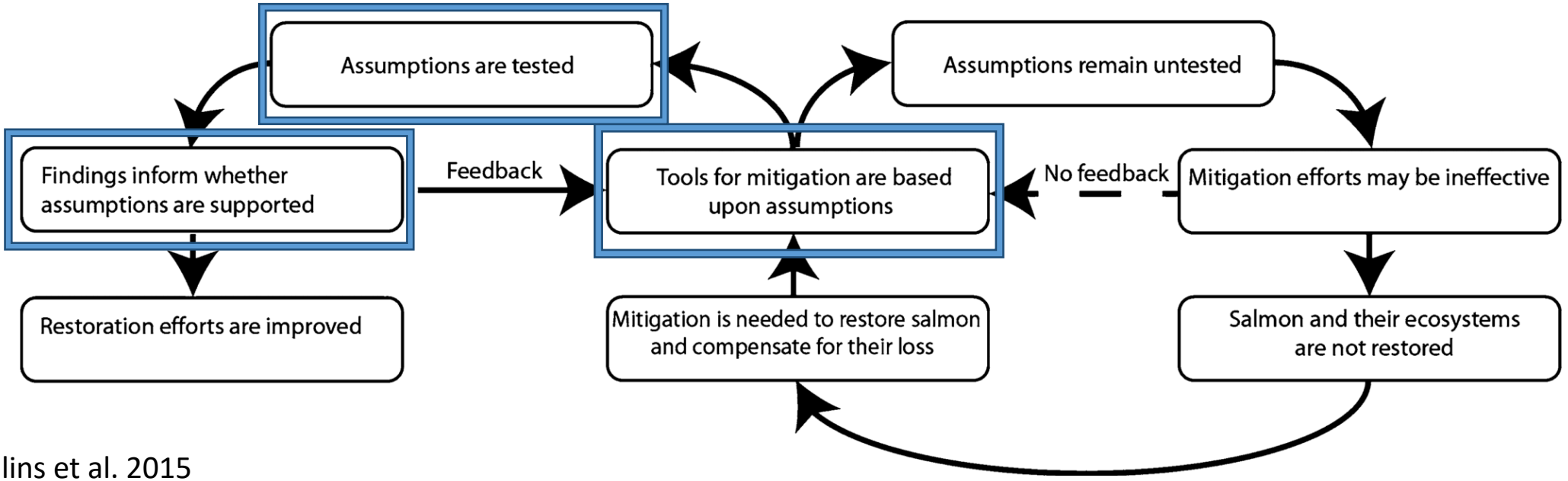
Development of Mitigation Tools



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