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Assessing the sources of suspended sediments in the streams of an agricultural watershed in the Canadian prairies using ^{137}Cs as a tracer

P.N. Owens – University of Northern British Columbia, Canada – owensp@unbc.ca
A.J. Koiter – University of Northern British Columbia, Canada
D.A. Lobb – University of Manitoba, Canada
E.L. Petticrew – University of Northern British Columbia, Canada
K.D. Tiessen – International Development Resource Centre, Canada
S. Li – Agriculture and Agri-Food Canada, Canada

Lake Winnipeg Water Quality Issues

- Declining water quality over the past few decades
- 30-40% of Manitoba's contribution of N and P to the lake comes from agriculture

Blue-green algal bloom at Grand Beach

Satellite image of algal bloom

Lake Winnipeg Water Stewardship Board (2006)

South Tobacco Creek Watershed

- Located in south-central Manitoba
- Primarily agricultural land use
- Drops ~ 200m in elevation as it drains off the escarpment into the lowlands of the Red River Valley
- Part of a national project aimed at measuring the economic and water quality impacts of different agricultural practices

Sampling Locations

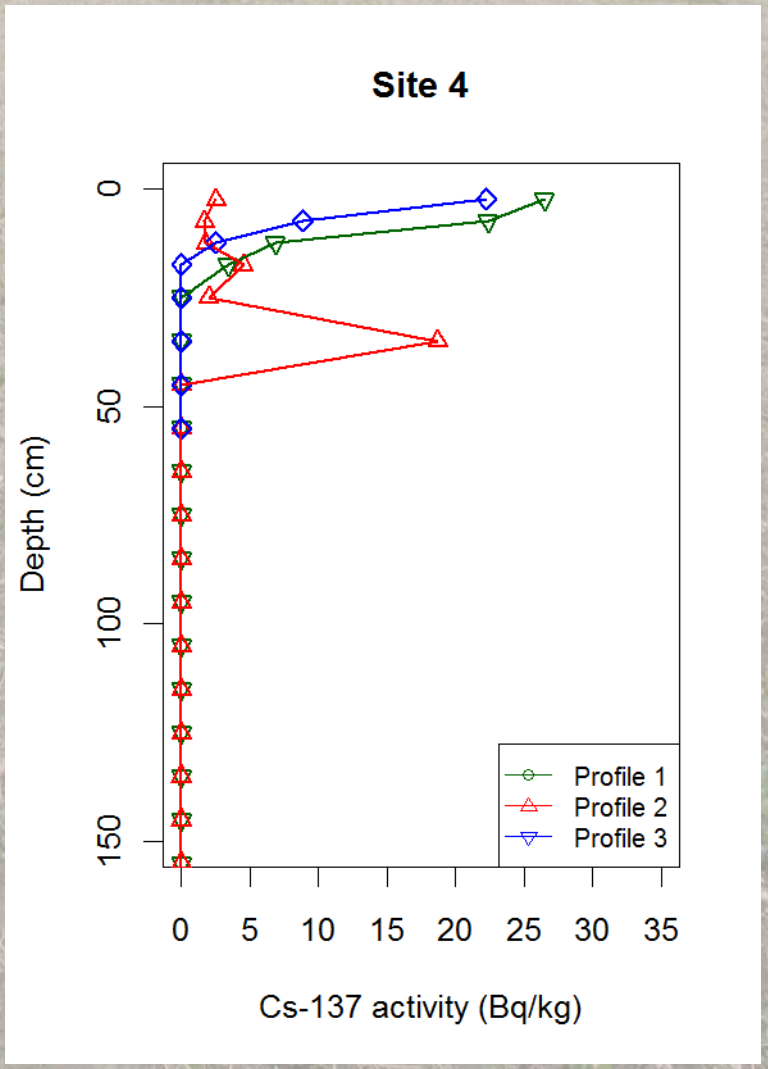
Google Maps (2012)

Sampling

- At each site we sampled:
  - Sources: streambanks, fields and riparian areas
  - Sediment: suspended and bed
- All samples were dried and sieved to <2 mm to remove stones
- Samples were analyzed for ^{137}Cs using gamma ray spectroscopy

Streambank Sources

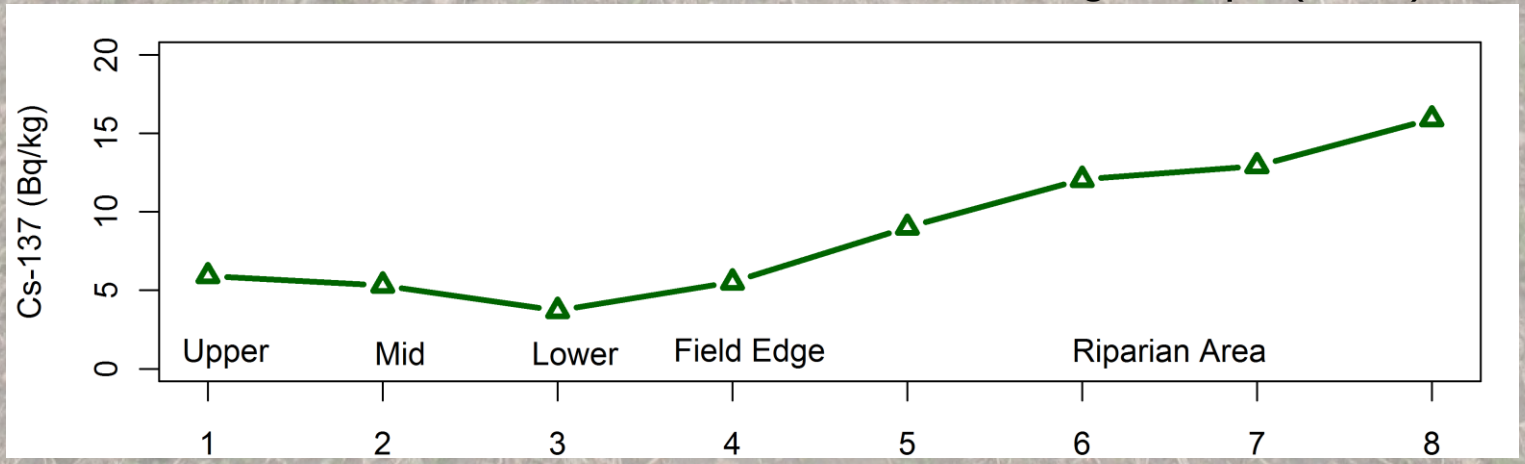
- 3 profiles at each sampling site
- 10 cm increments



Field and Riparian Sources

- Transects were used to characterize the field and riparian sources

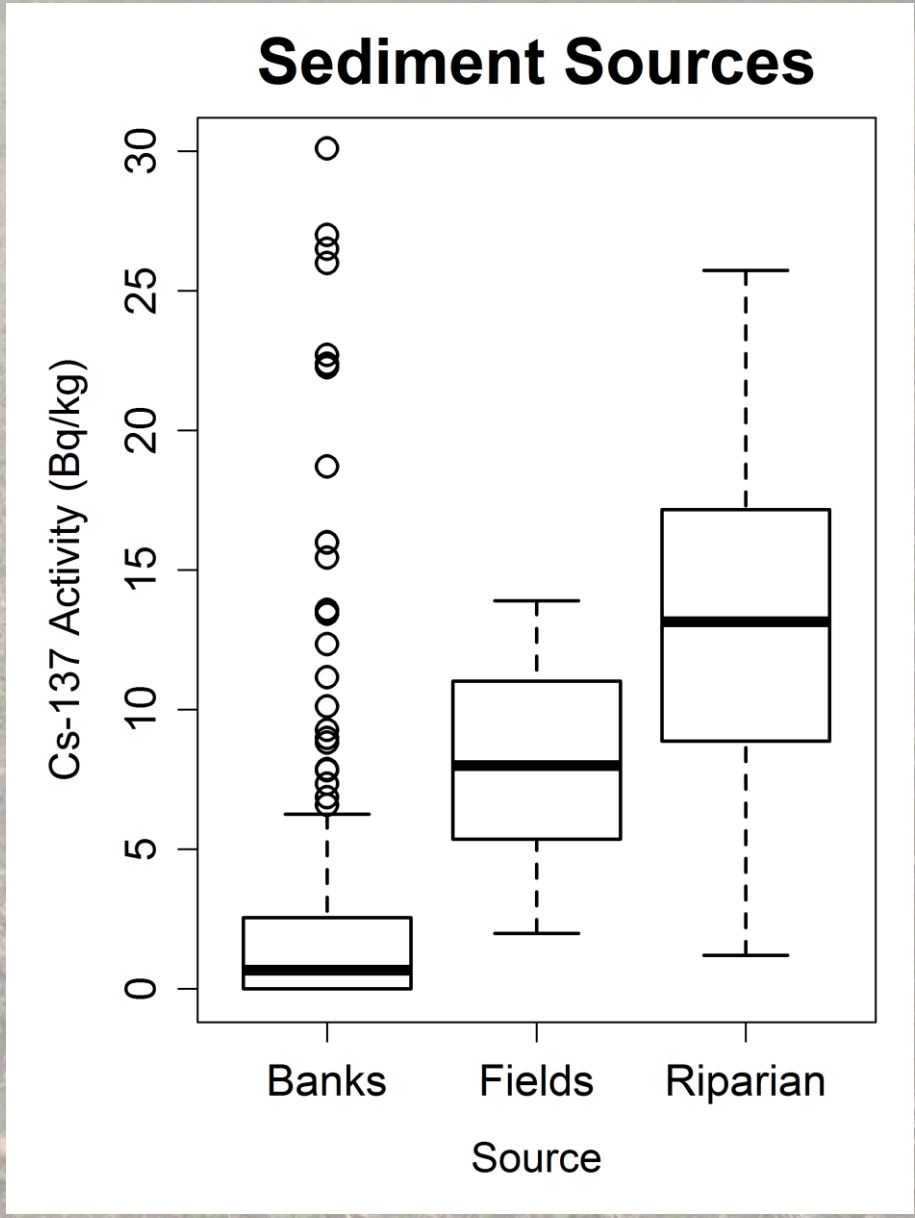
Google Maps (2012)



Characterization of Sediment Sources

- Low ^{137}Cs activity in bank sources with some interesting outlying points
- Increasing ^{137}Cs activity as we move from the fields towards the riparian areas

^{137}Cs provides good discrimination between upland and stream bank sources



Suspended Sediment

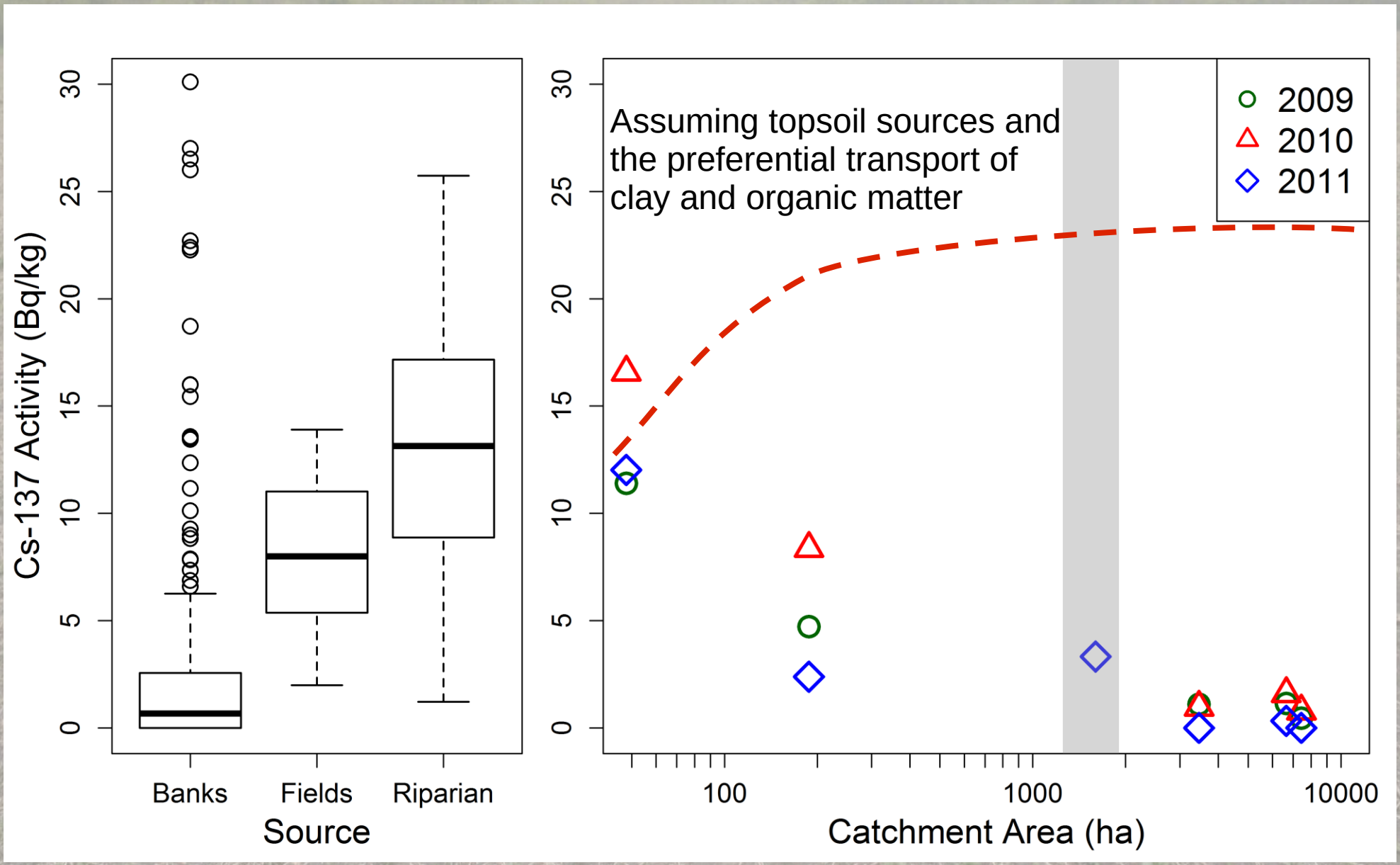
- Paired time-integrated samplers fixed to the stream bed
- Collected periodically over the year

Bed Sediments

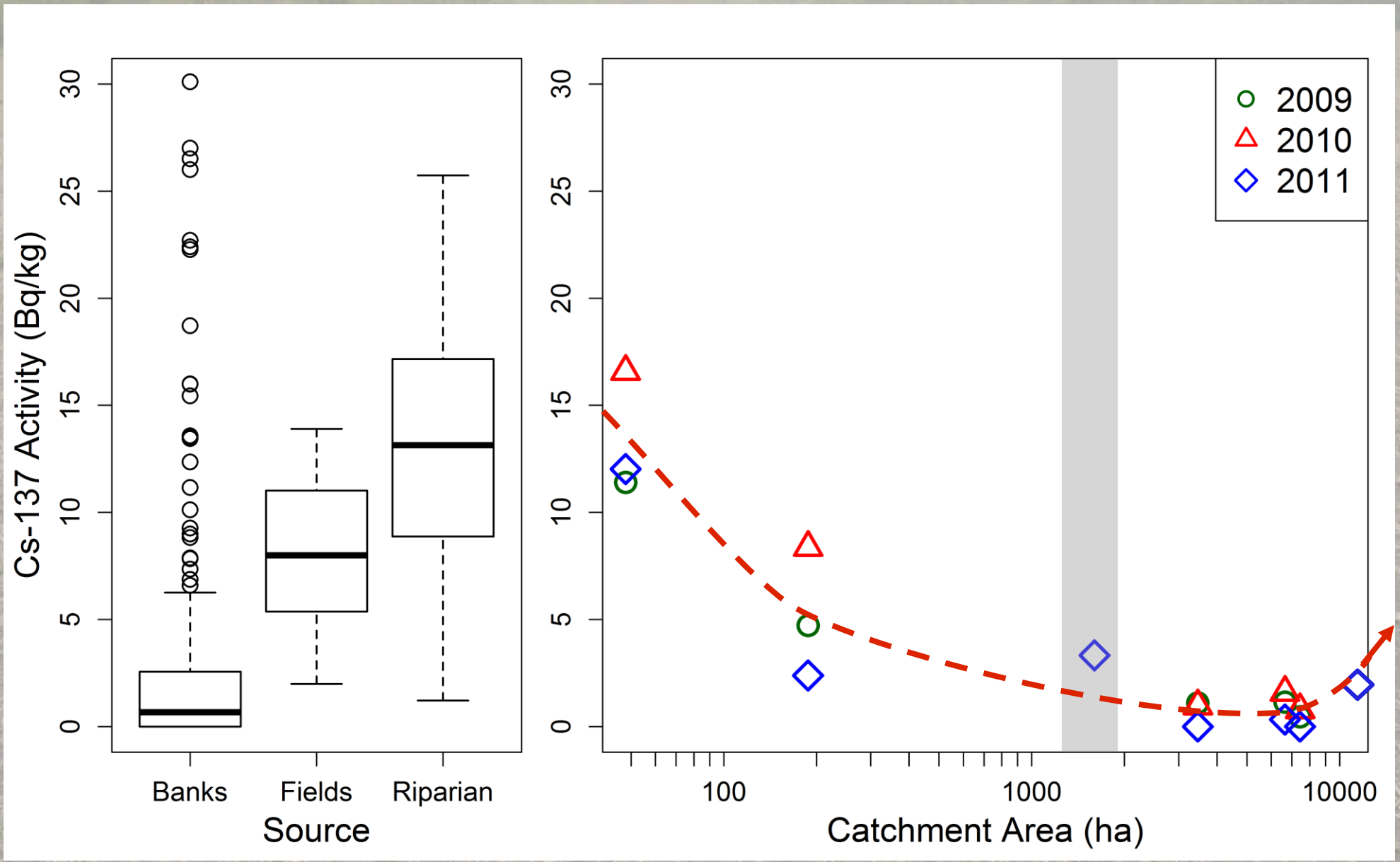
- Collected at each site

Shoals of bed sediment

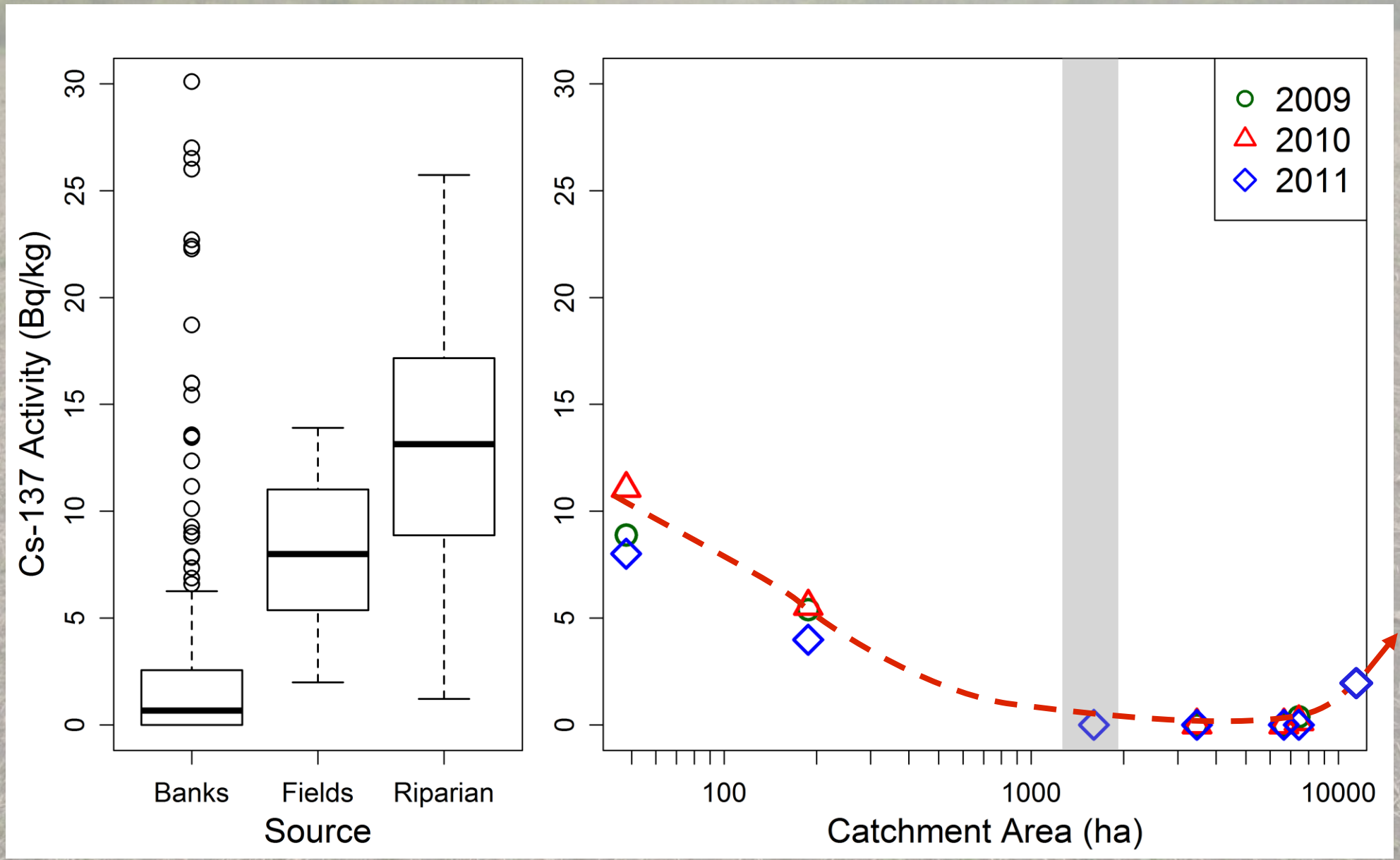
Suspended Sediment



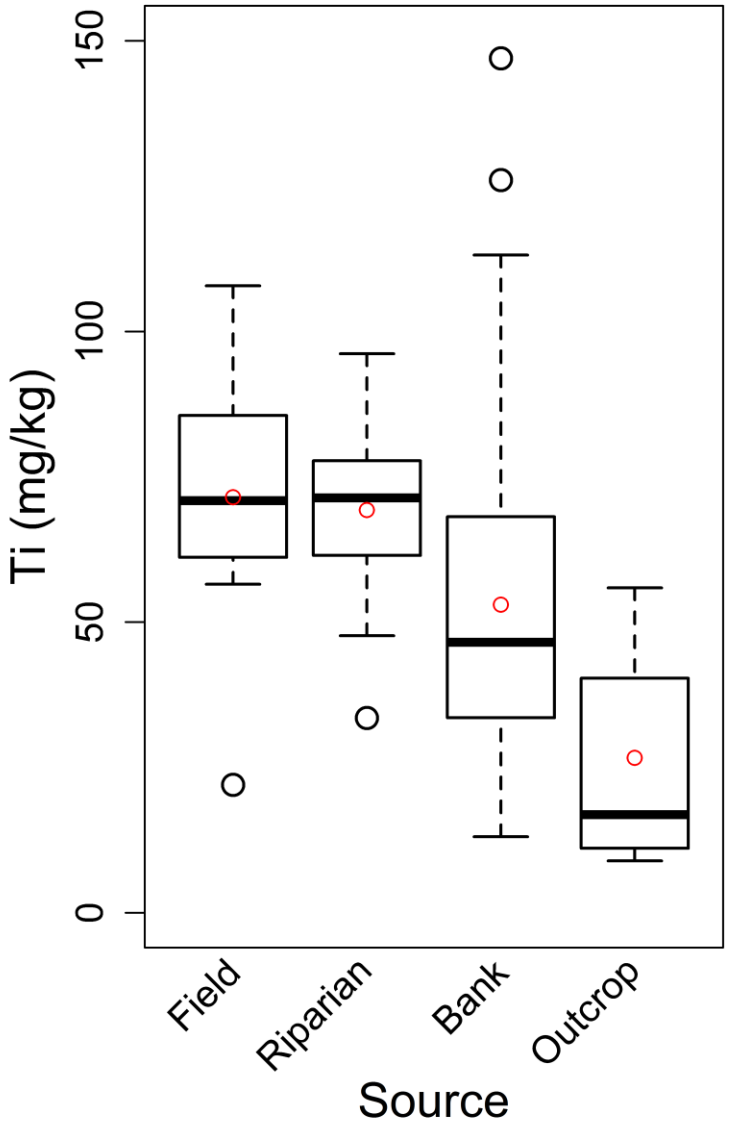
Suspended Sediment

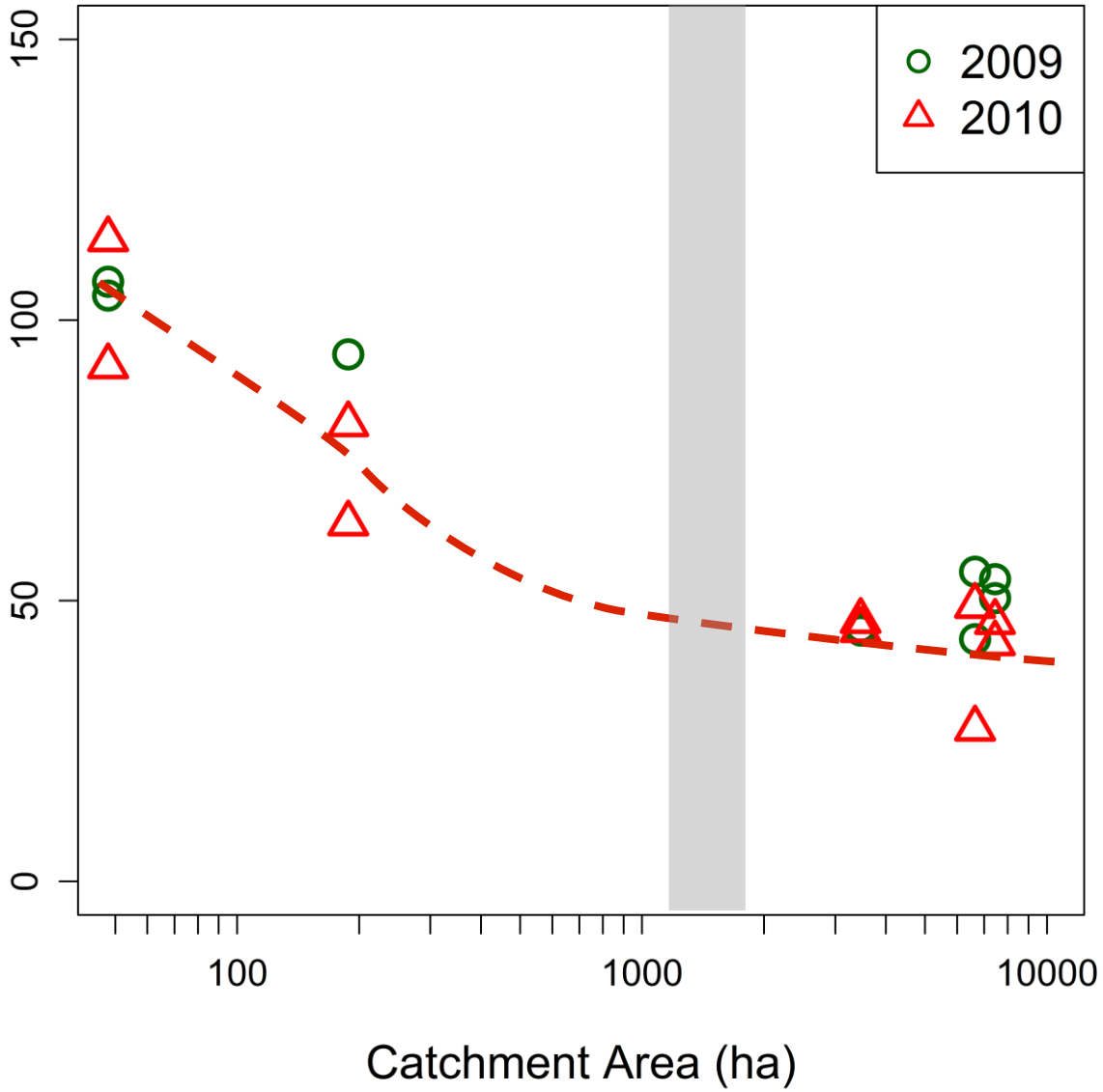


Bed Sediment

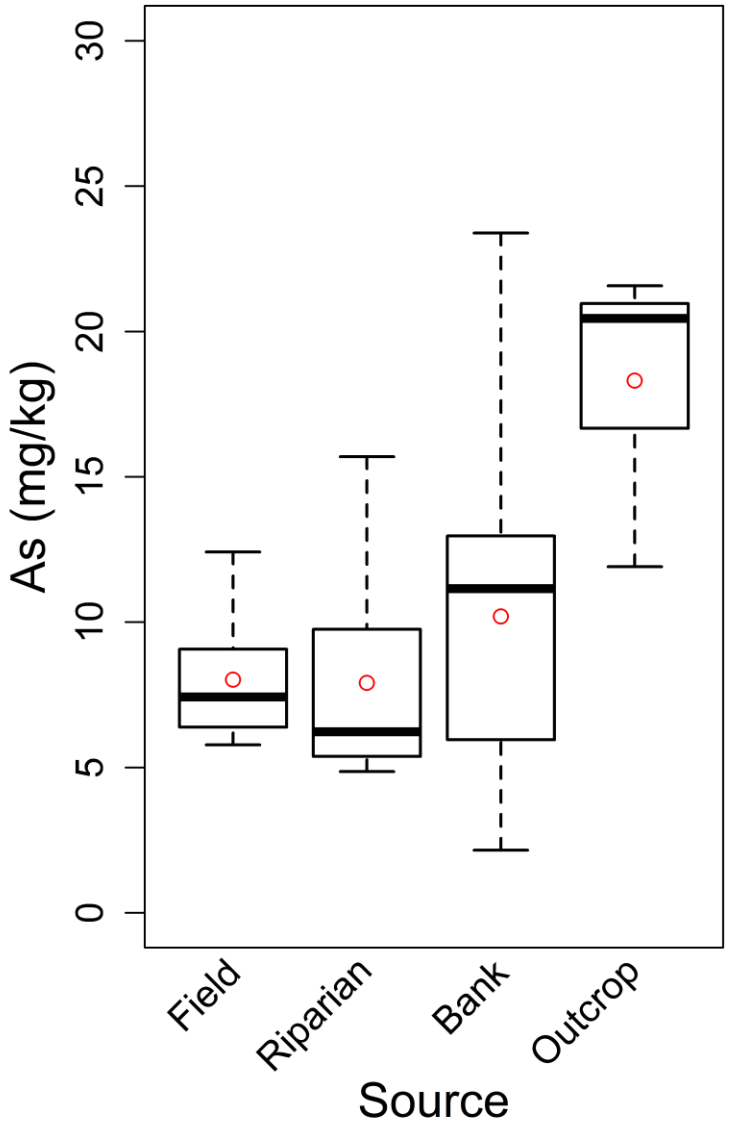


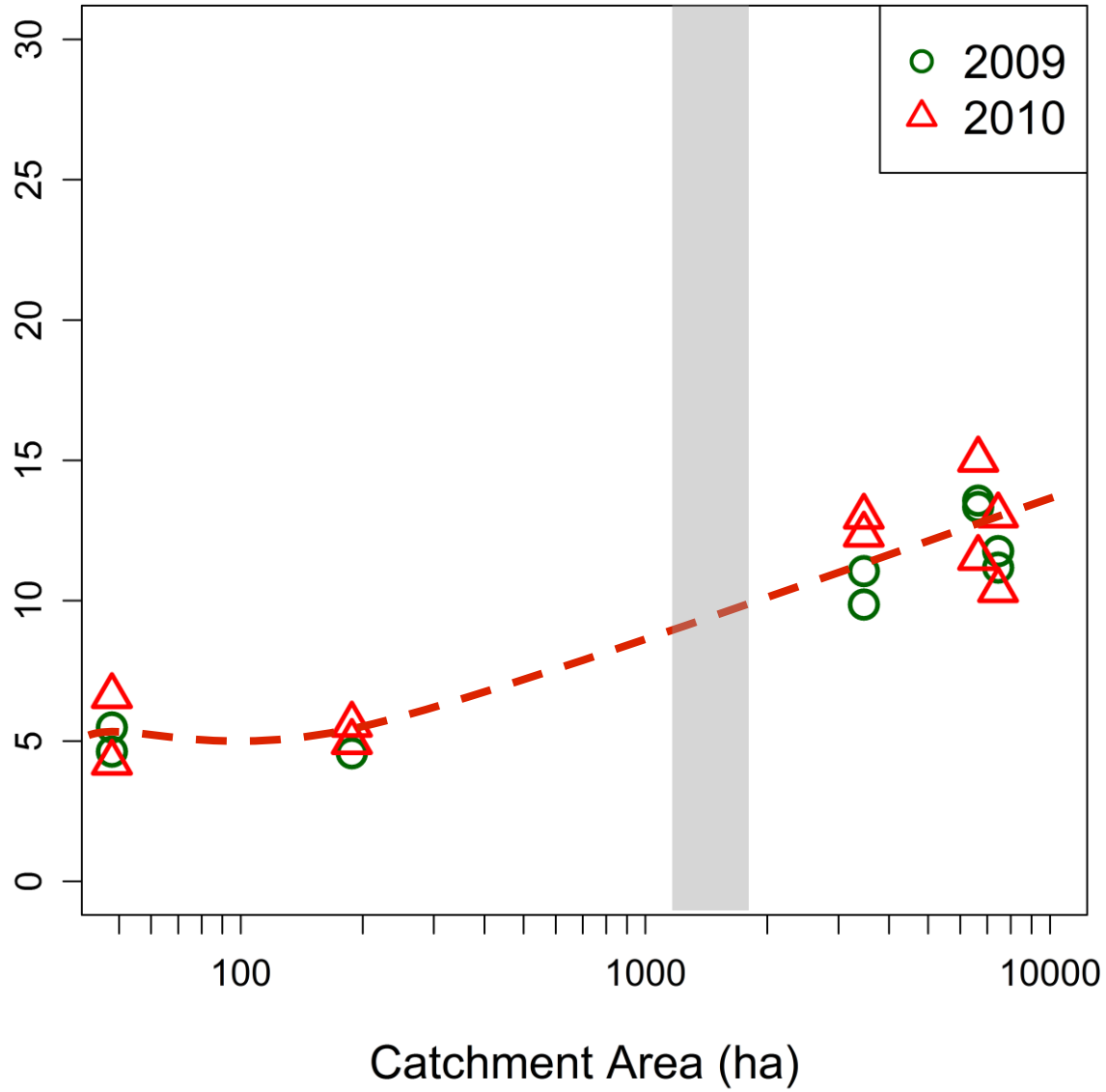
Geochemistry – Titanium





Geochemistry – Arsenic





Sediment Colour

- Visually see a change in the sources of sediment as reflect by a change in the colour of the sediment

Headwaters → Outlet

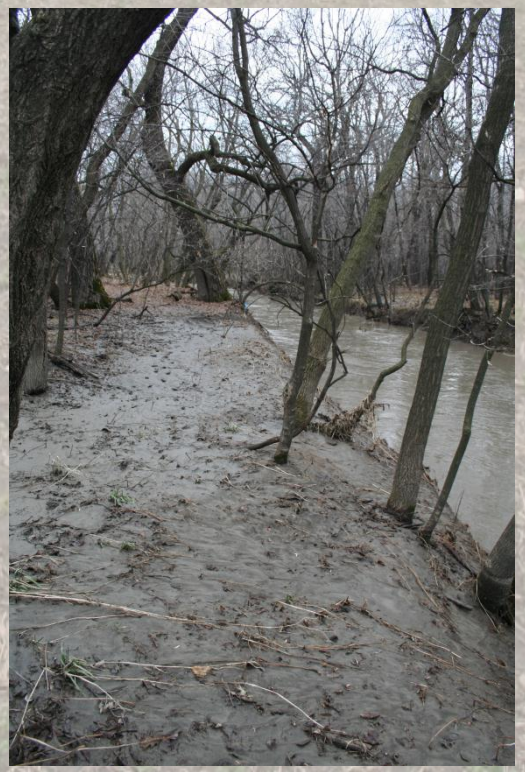
Collected suspended sediments

Changes in Sediment Sources

- Within the transition zone from the top to the bottom of the escarpment we see steep banks and bank failure
- High input from channel bank sources may overwhelm the ^{137}Cs signal

Sediment Storage

- Sediment storage within the watershed
  - Floodplain deposits
  - Beaver dams



Conclusions

- ^{137}Cs results show a switch in sediment sources
- Upper reaches – field and riparian sources
- Lower reaches – streambank sources

Headwaters → Outlet

Conclusions

- Beyond the watershed there is some evidence that the source of sediments may switch back to being dominated by field and riparian sources

Future Work and Challenges

- Continue sampling throughout 2012 and beyond
- Un-mixing model to estimate contributions
- Nutrient dynamics
- Understanding
  - the role of scale – emergent processes?
  - role of the escarpment – influence of geomorphology?