Riffle crest water depths influence coho outmigration: Developing stream-specific flow recommendations

Russian River watershed, CA

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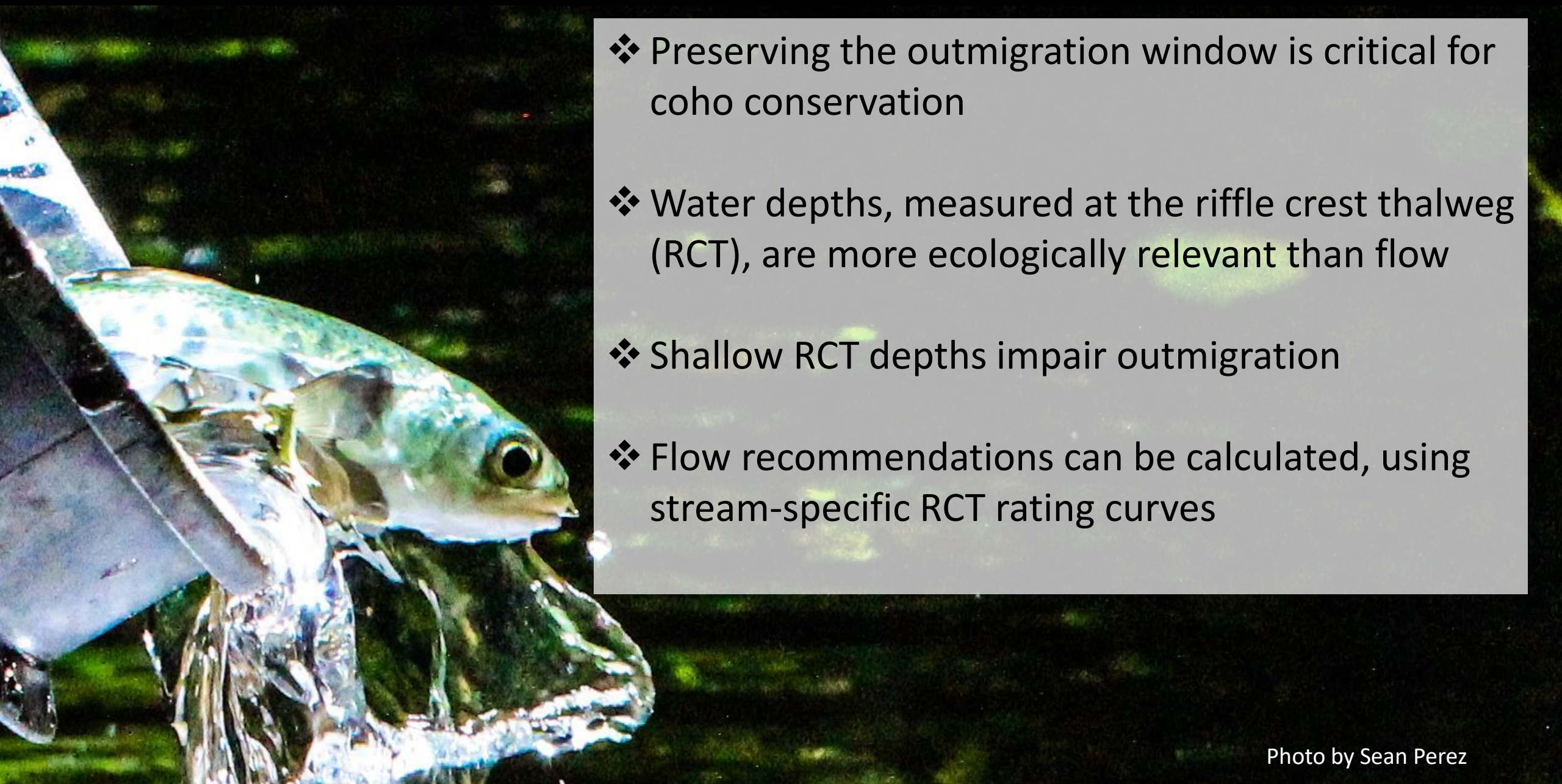
CA Sea Grant Russian River Tributaries Low Flow Monitoring Meeting

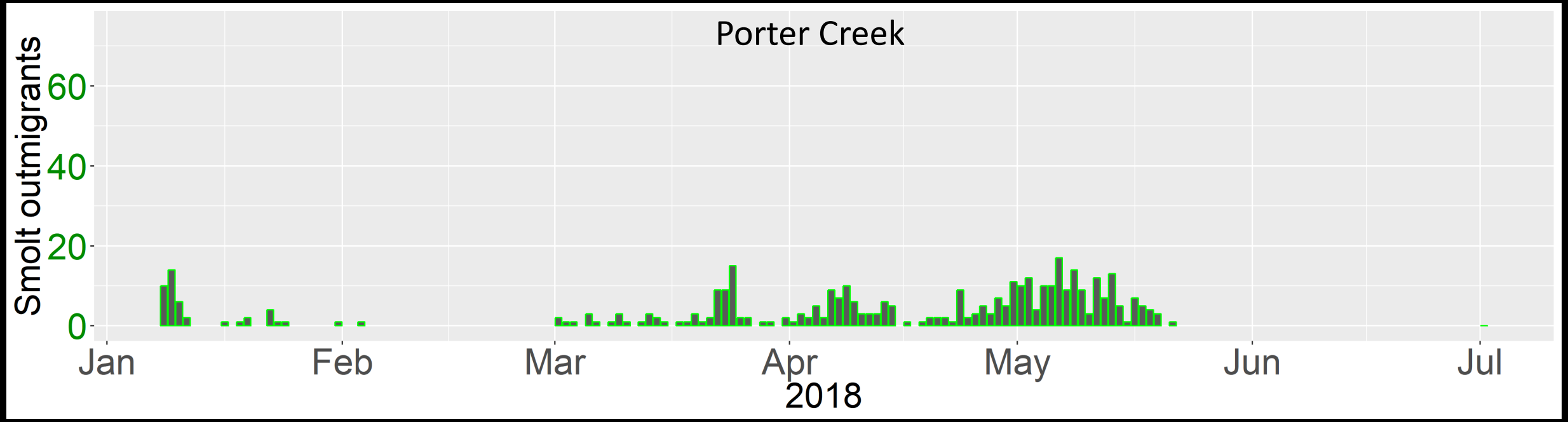
Key messages



- Preserving the outmigration window is critical for coho conservation
- Water depths, measured at the riffle crest thalweg (RCT), are more ecologically relevant than flow
- Shallow RCT depths impair outmigration
- Flow recommendations can be calculated, using stream-specific RCT rating curves

Photo by Sean Perez

What explains outmigration timing?



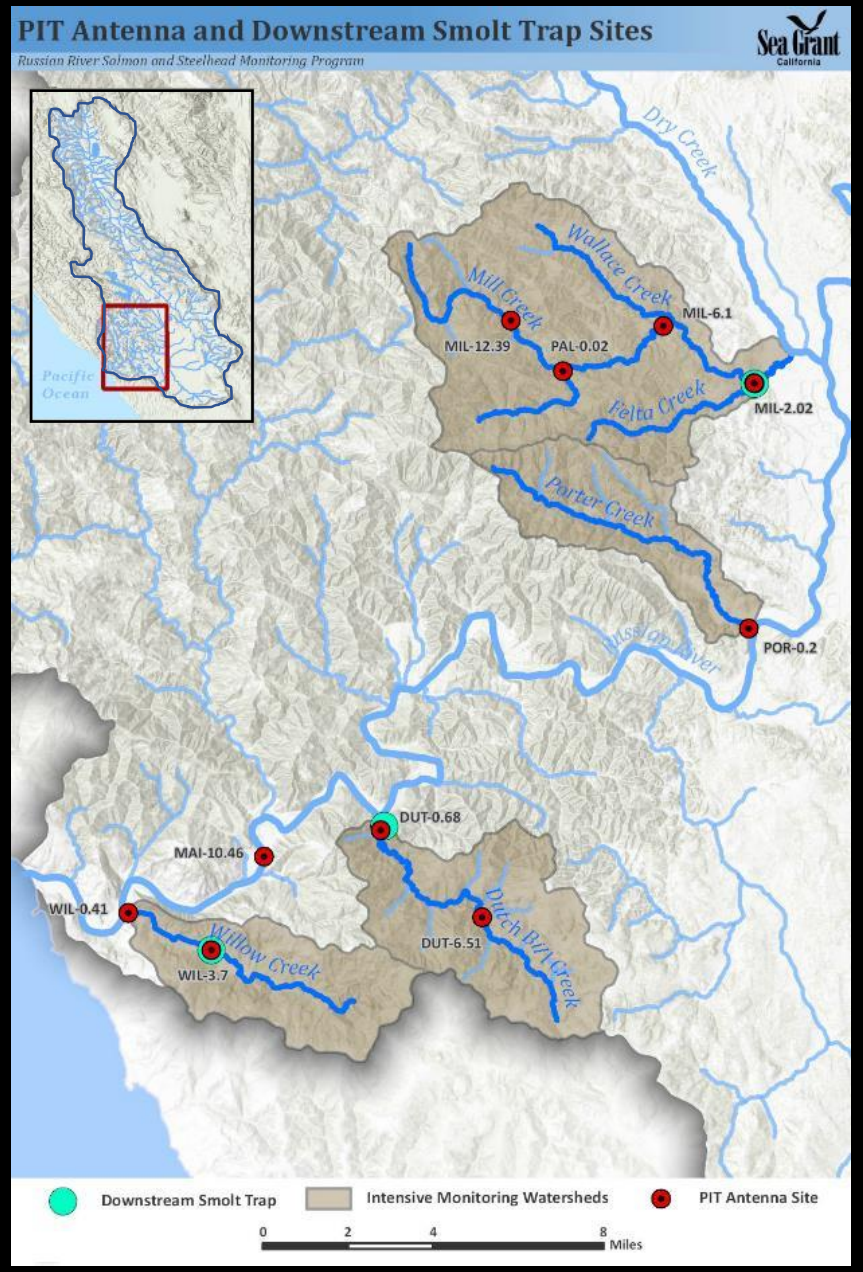
Predictors of outmigration timing

- Peak outmigration March – June
- Endogenous controls
- Environmental drivers:
  - Water temperature[1]
  - Discharge[2]
  - Lunar phase and photoperiod[2]
  - Gradient[3]
  - Productivity[3]

[1] Spence & Dick 2014, Can. J. Fish. Aquatic. Sci.
[2] Moyle 2002
[3] Johnson 2016

Study Area

- 4 streams located in the lower Russian River basin
- Study reaches
  - Lower portions of tributaries
  - 0.5 – 2 km long

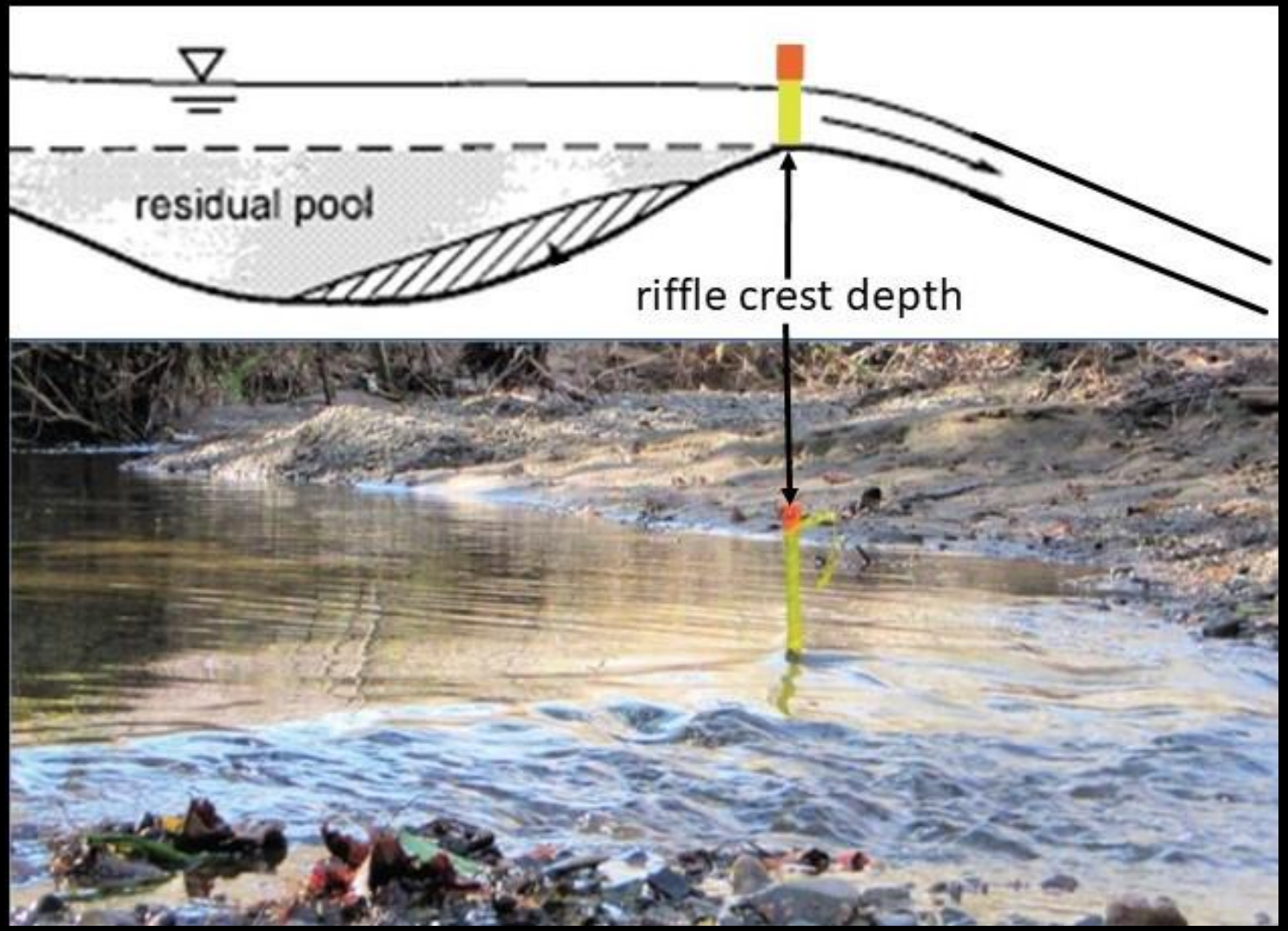


Study design

Passive Integrated Transponders (PIT) tags

Discharge

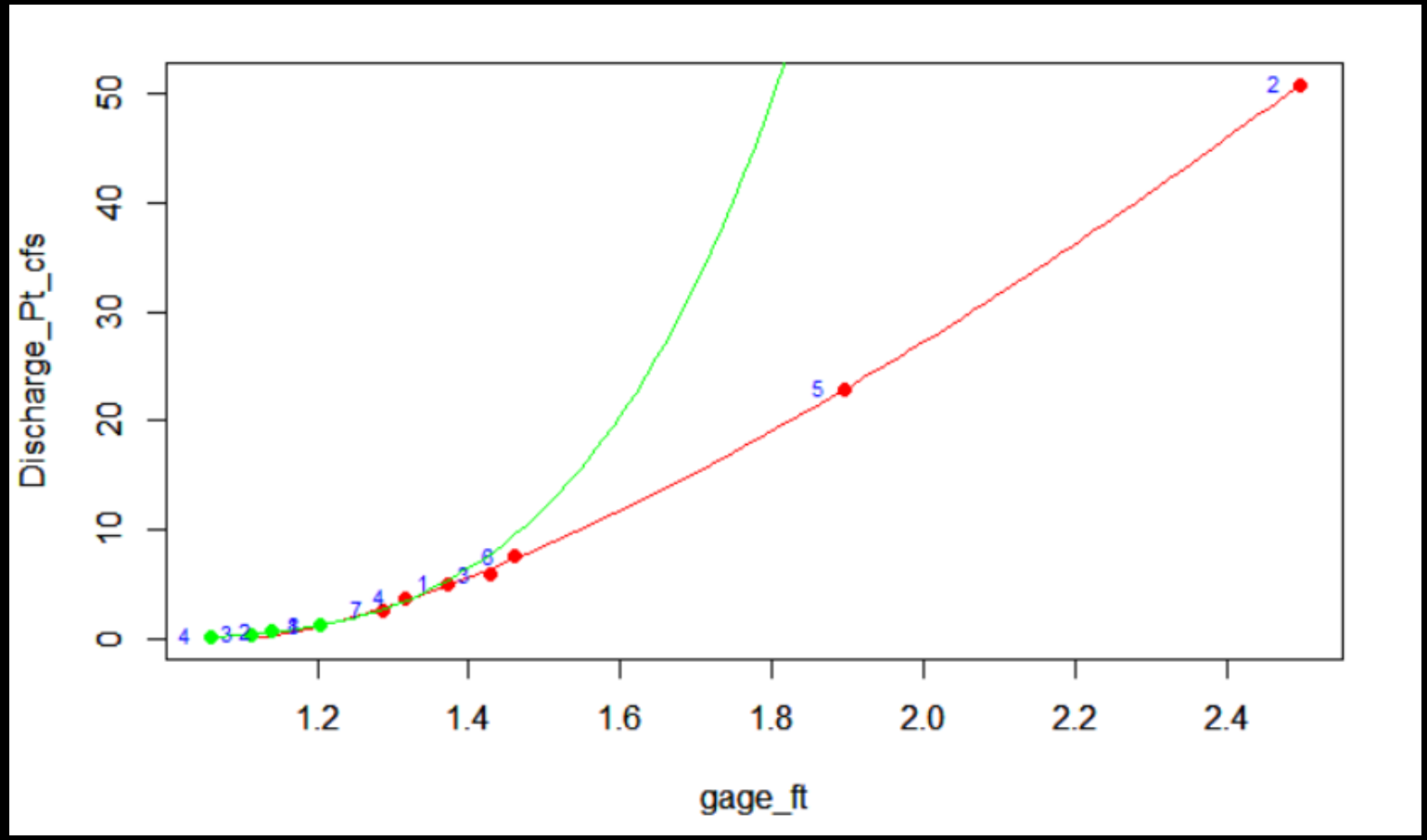
Riffle crest thalweg depth (RCTd)



- 12 riffle crest thalwegs (RCTs) measured per stream-day
- > 16 stream-days per stream

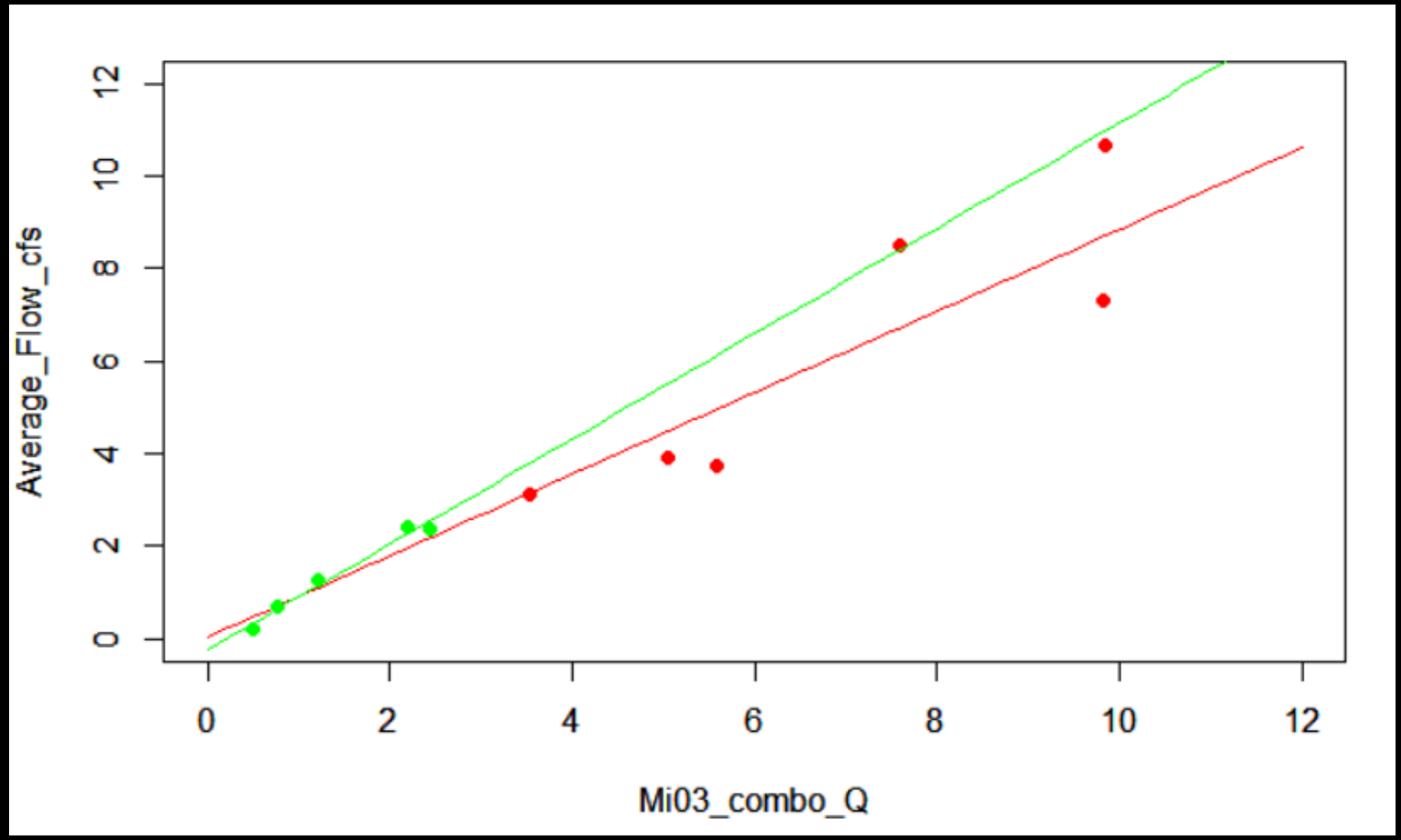
Data & statistical methods

- 8 years of high-flow and low-flow rating curves developed for Willow Creek



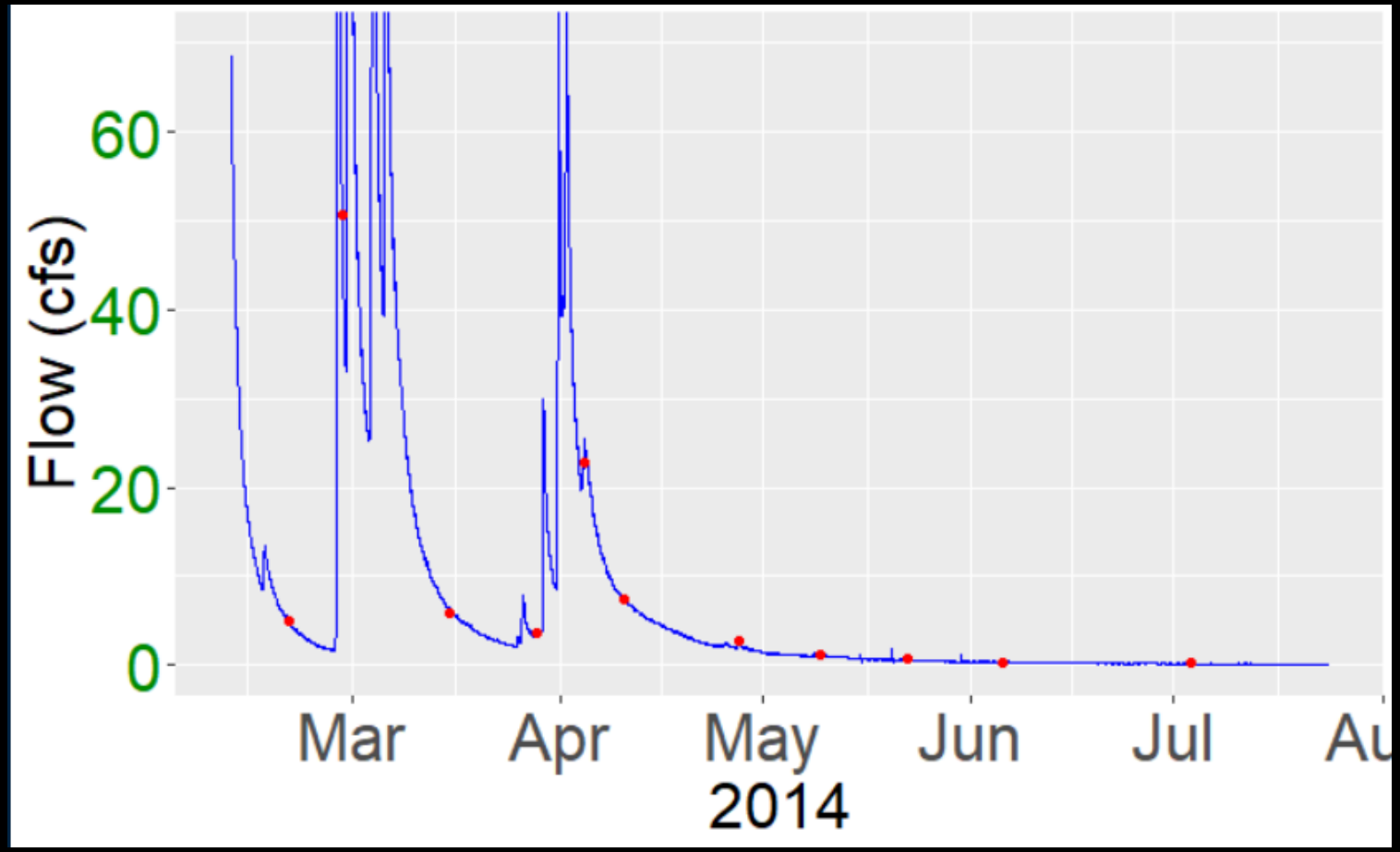
Data & statistical methods

- 37 stream-years of flow records (*thanks, TU & CSG!)* prioritized, based on proximity to downstream-most antenna
- Linear regression applied to convert upstream gage flow records to antenna location
- Separate high-flow and low-flow conversions to account for alluvial infiltration

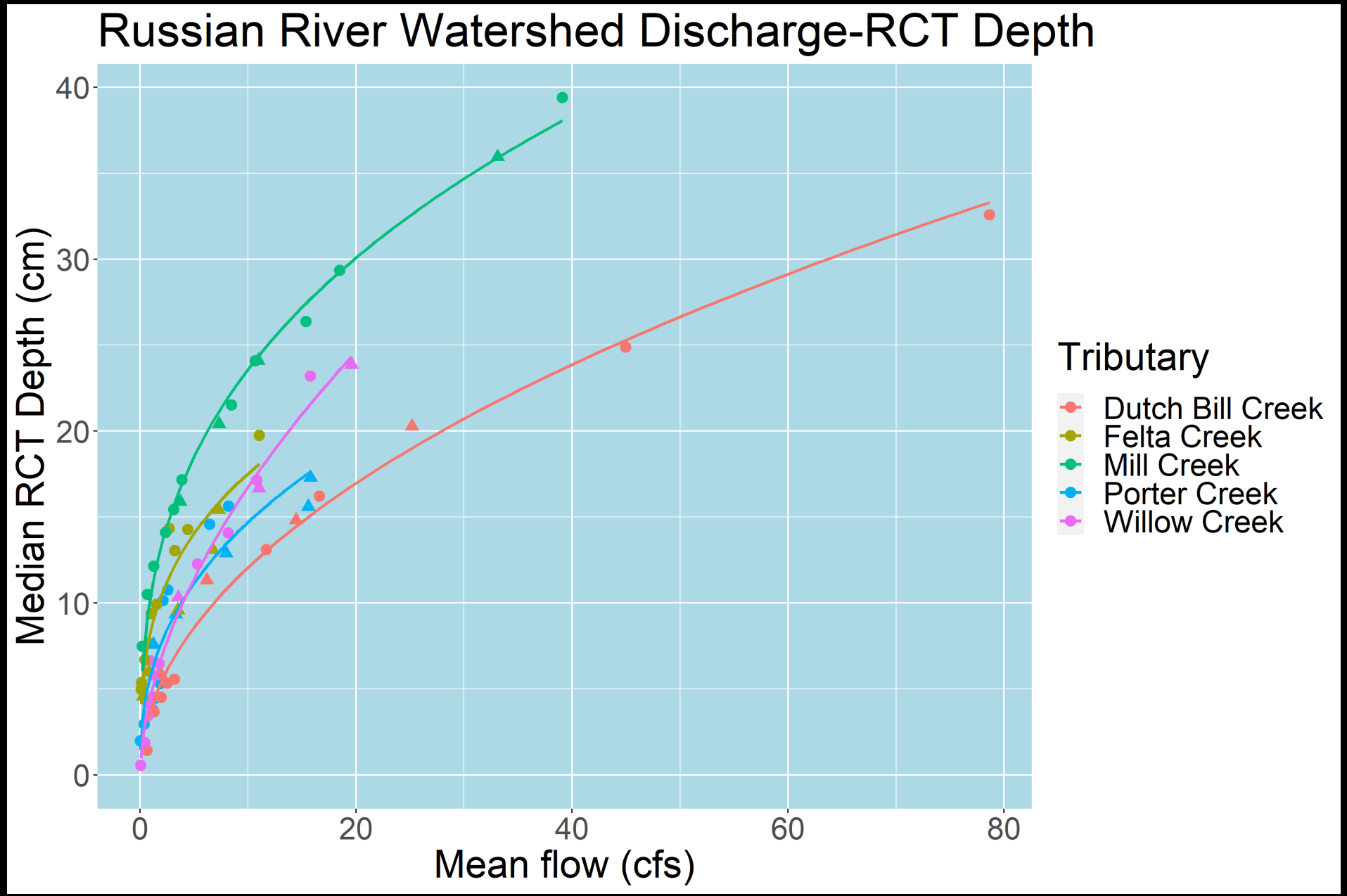


Data & statistical methods

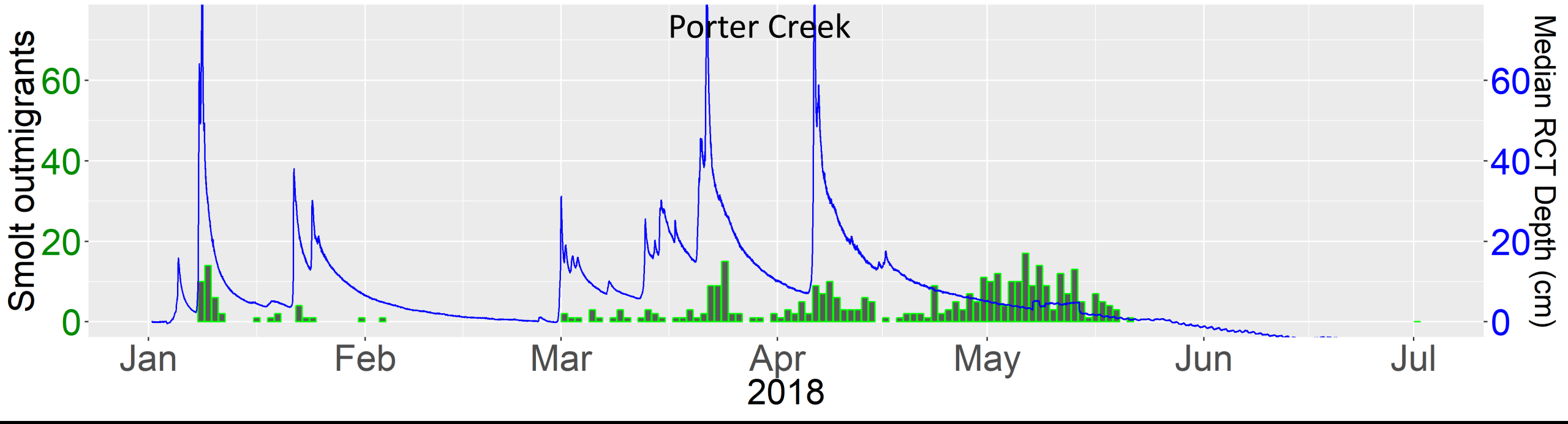
- 30 hybrid stream-years of flow records used in outmigration analysis
- Happy to share data!



RCTd rating curves

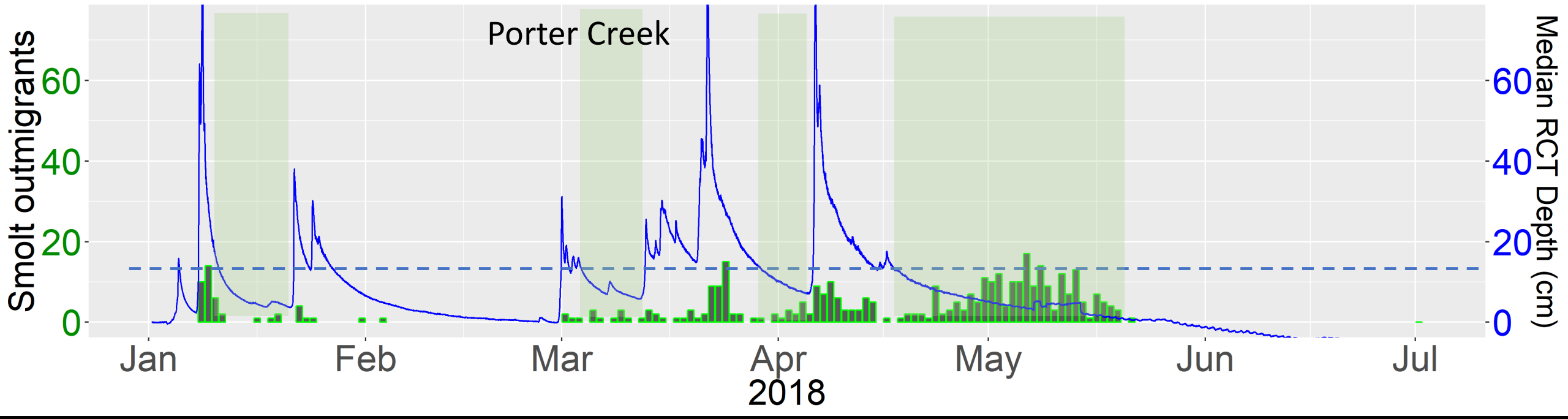


RCT depth limits outmigration duration



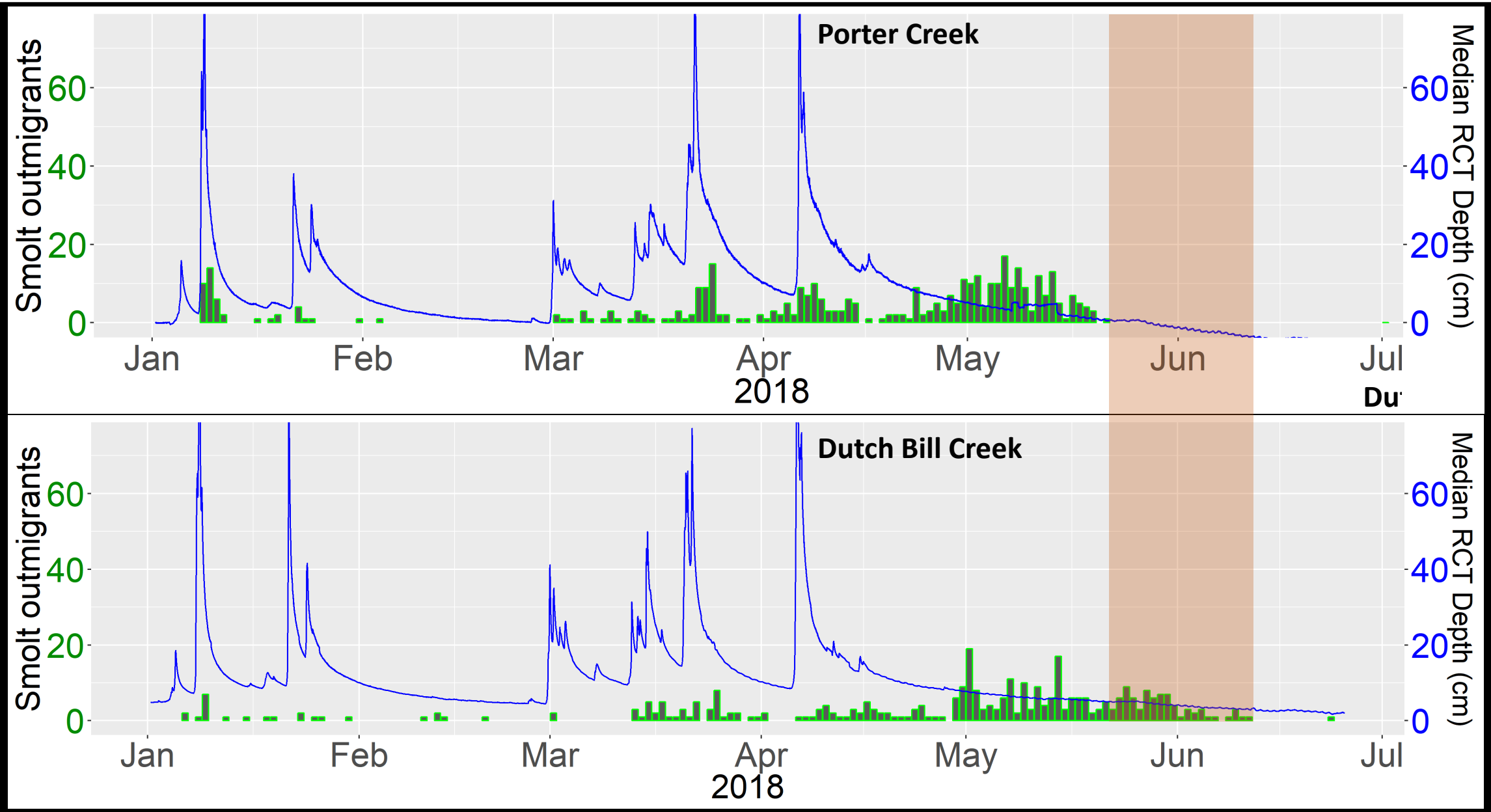
- Outmigration occurs during:
  - High flow (rising and receding limbs of hydrograph)
  - Spring low flow conditions

RCT depth & outmigration

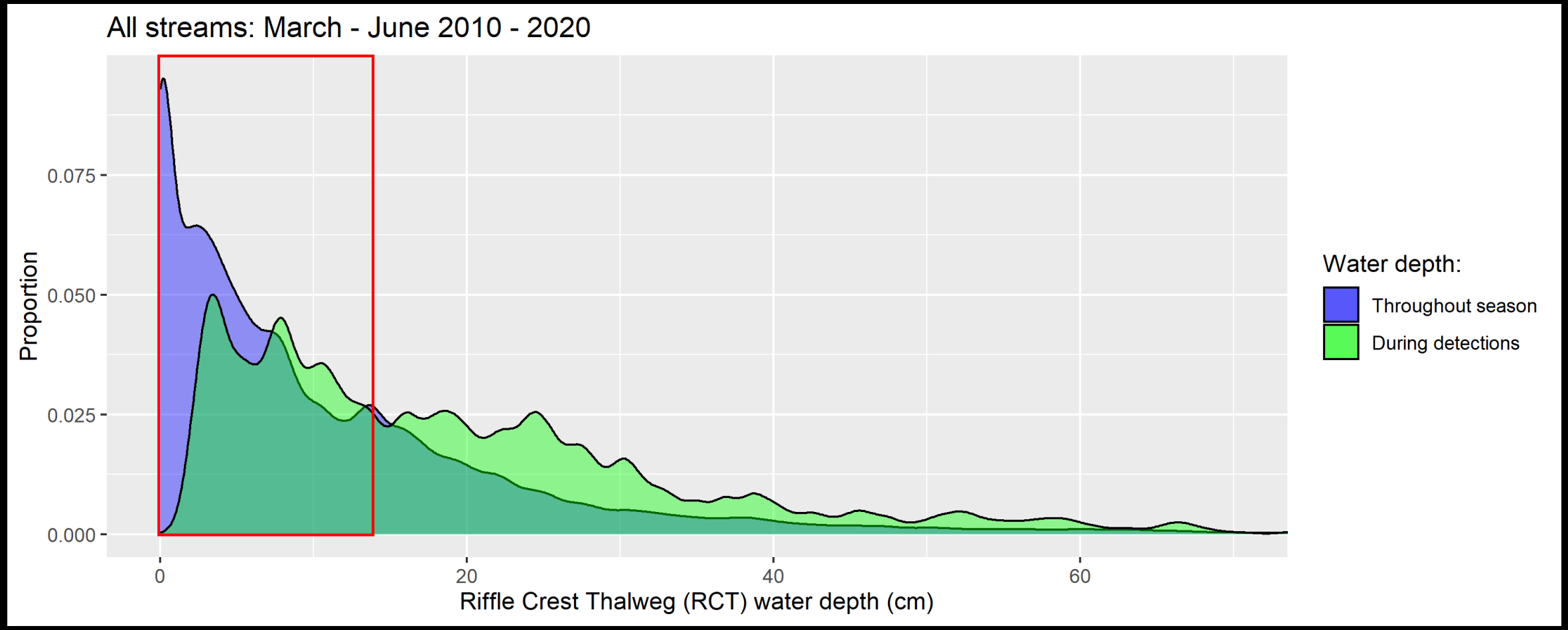


- CDFWs critical riffle assessment method sets 0.4 ft (12 cm) minimum depth criteria (for 1-2 year-old steelhead) at 25% total width and 10% contiguous width
  - Some outmigration above, some below the threshold
  - Critical riffle threshold: almost certain to protect smolt outmigration

RCT depth & outmigration

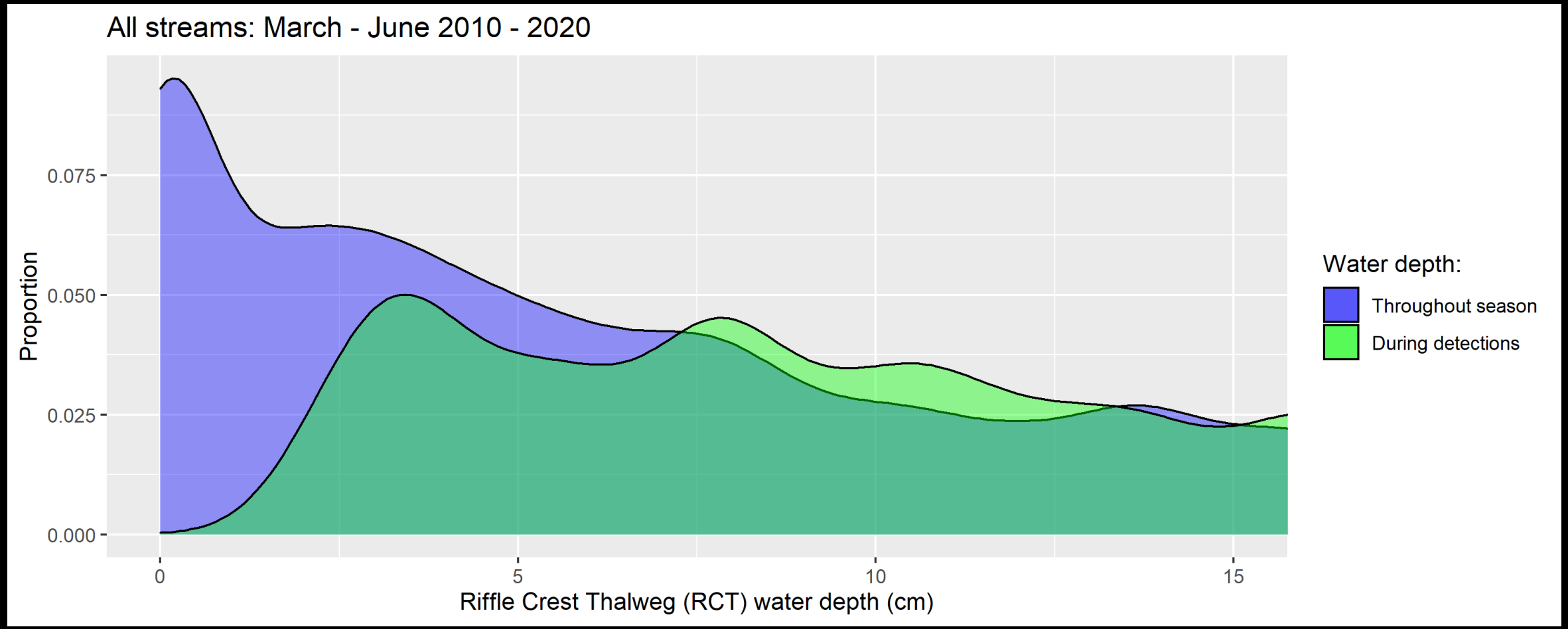


RCT depth & outmigration



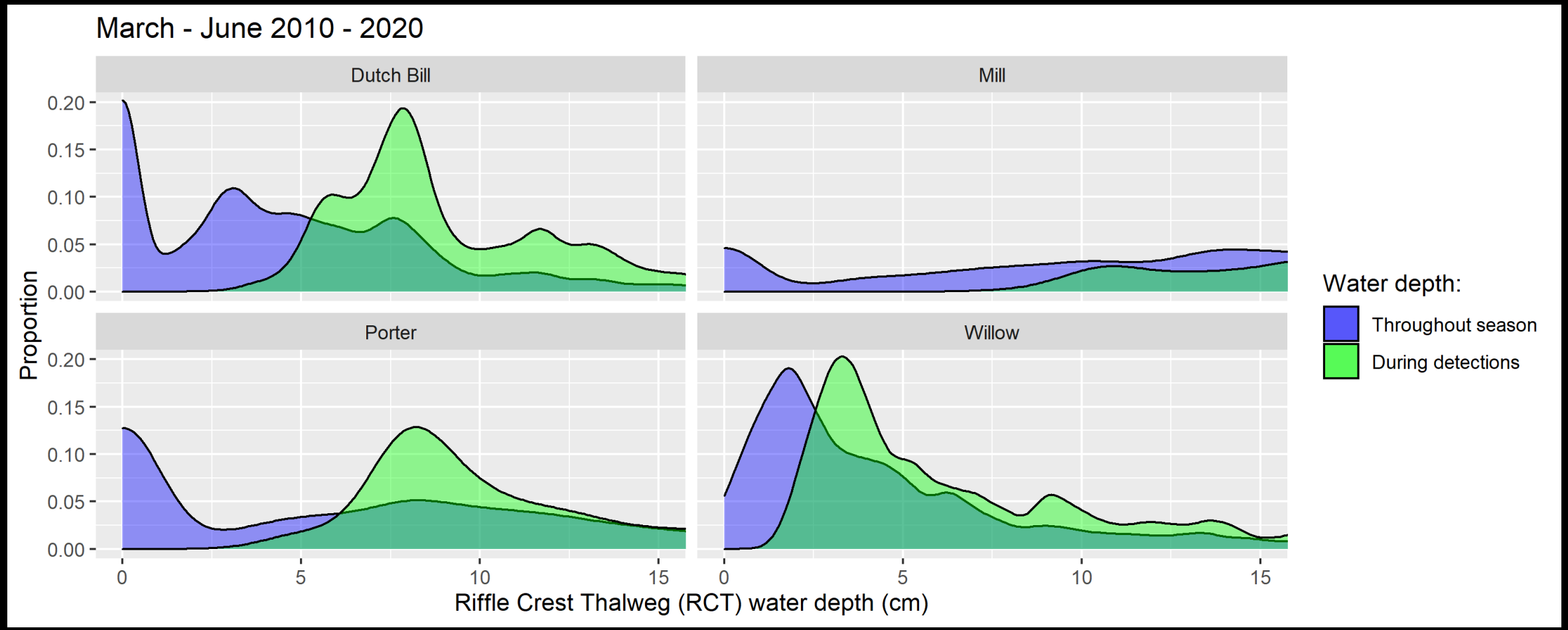
- Shallowest depths occur most frequently
- Yet, outmigration occurs mostly at shallow-to-moderate depths
- Steep drop-off at shallow depths
- Exact depths unimportant

RCT depth & outmigration



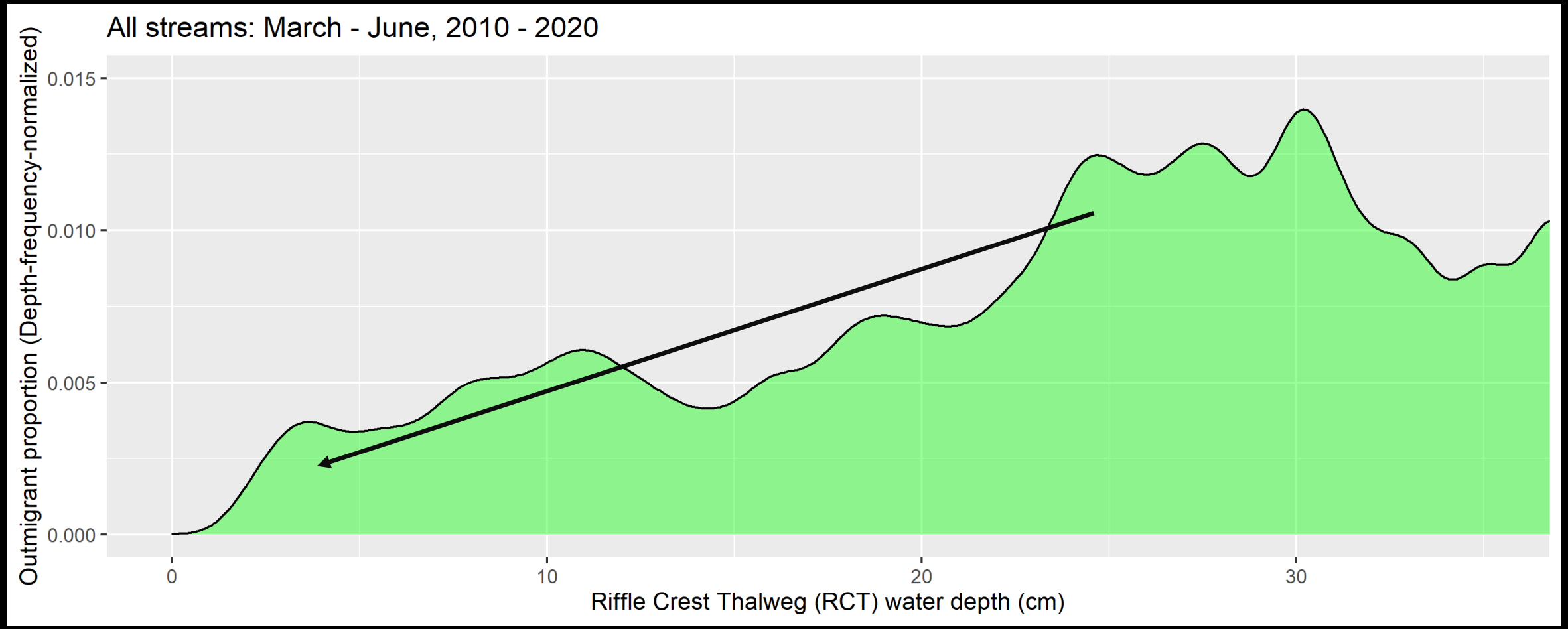
- The shallowest depths have the greatest occurrence
- Yet, outmigration occurs mostly at shallow-to-moderate depths
- Steep drop-off at shallow depths
- Exact depths unimportant

RCT depth & outmigration



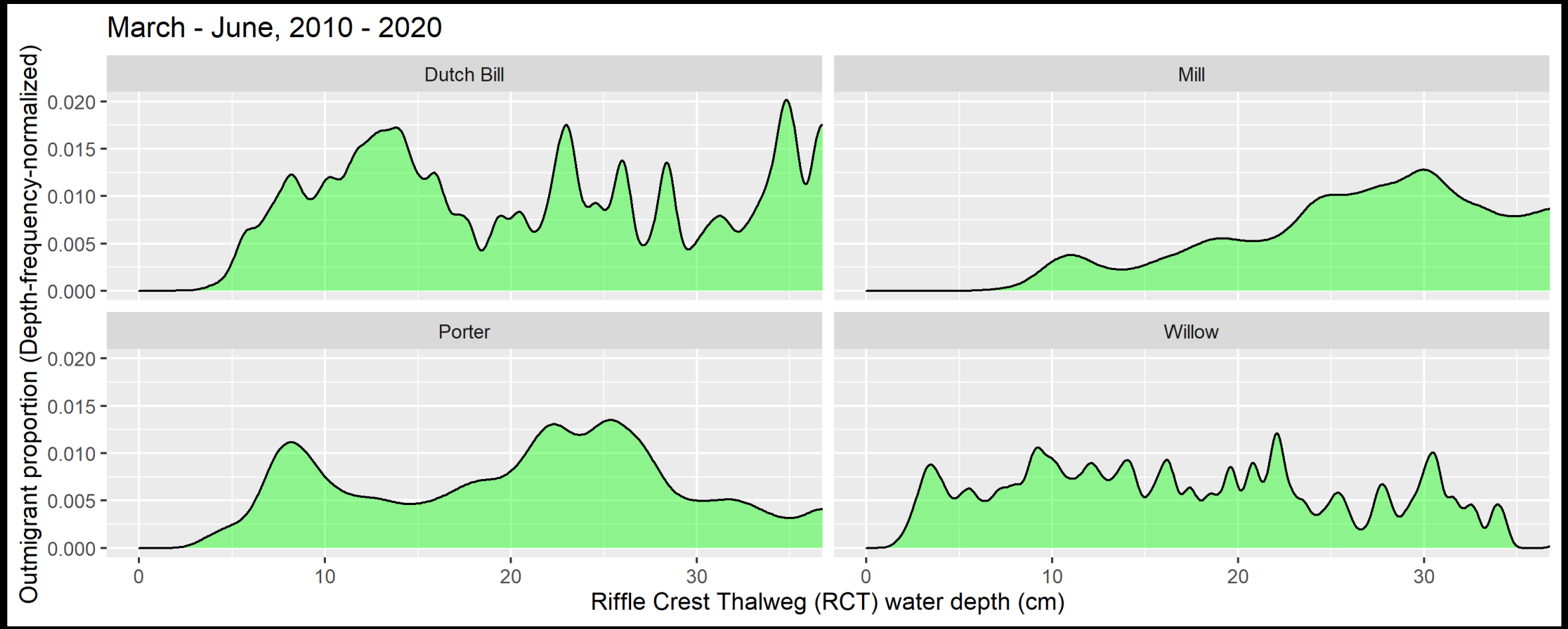
- Depths during outmigration are biased toward most common water depths

RCT depth & outmigration



- Depth-frequency normalized = Detection proportion / Depth proportion

RCT depth & outmigration

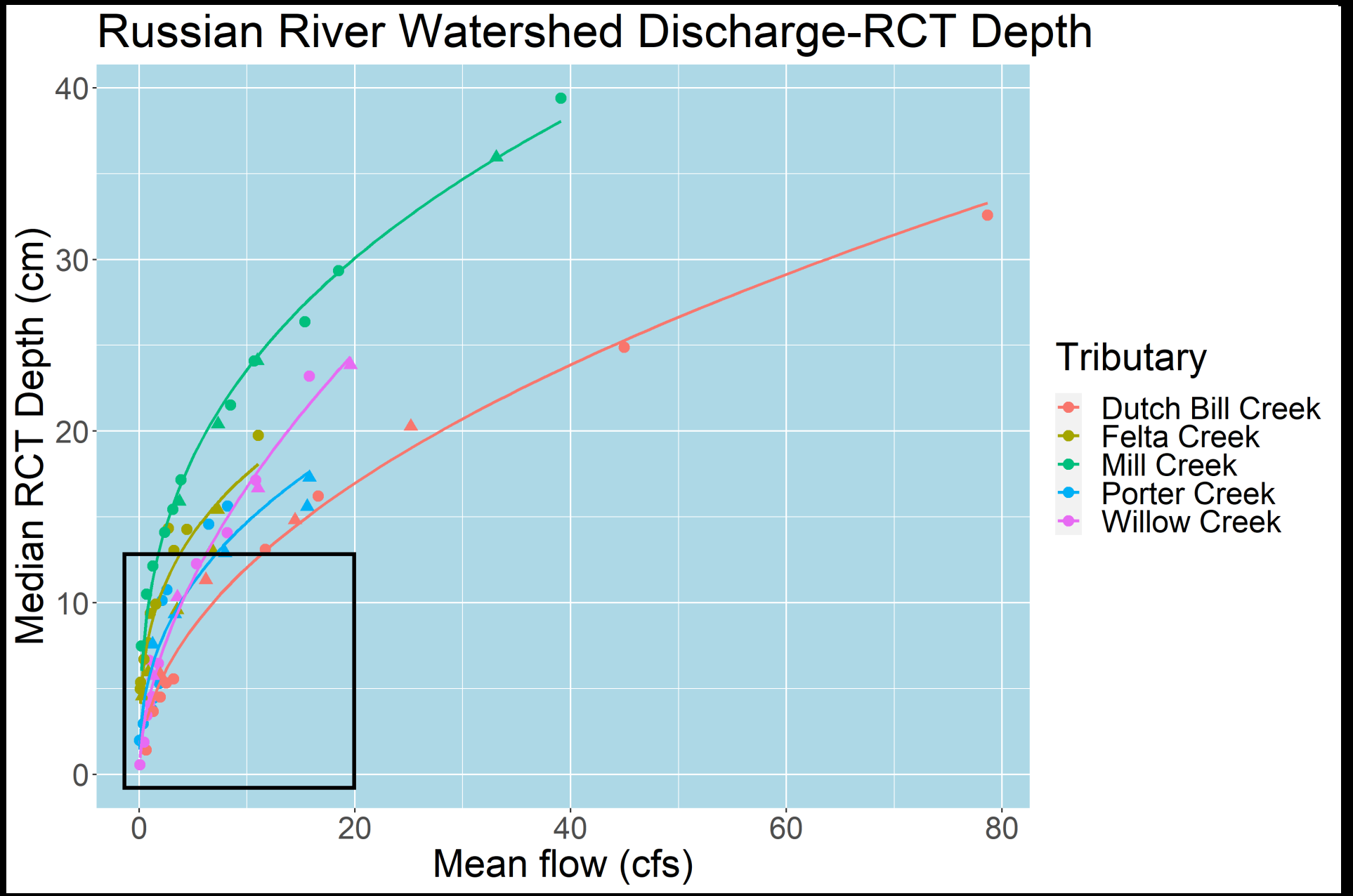


- Substrate size scales with RCTd during outmigration
- Does not account for seasonality

RCTd rating curves

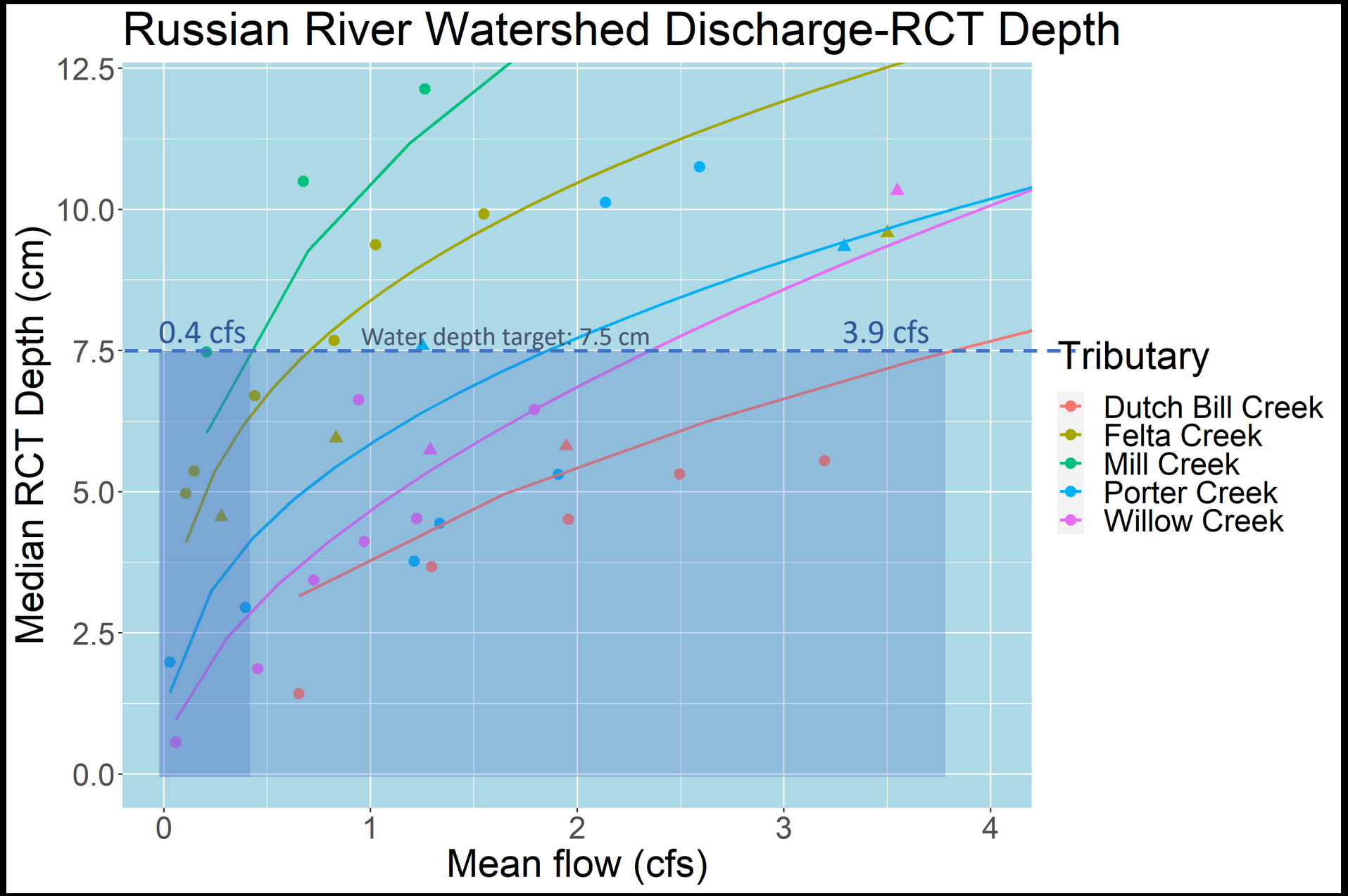
- Stream-specific flow requirements can be made
- Rating curves control the relationship between flow diversions and RCTd reductions[1]

[1] Mierau et al. 2017



RCTd rating curves

- Stream-specific flow requirements can be made
- Rating curves control the relationship between flow diversions and RCTd reductions[1]



[1] Mierau et al. 2017

Take-aways

- Shallow water depths at RCTs (riffle crest thalwegs) limit the duration and occurrence of outmigration
- RCT depths that support outmigration vary by geomorphology
- RCT rating curves estimate flows required to reach desired RCT depths (variable among tributaries by a factor of 9)
- Next steps: 1) drought impacts, and 2) seasonal controls

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