Habitat Utilization and Impact of Flooding on James spinymussel (*Parvaspina collina*) Populations in Virginia Streams

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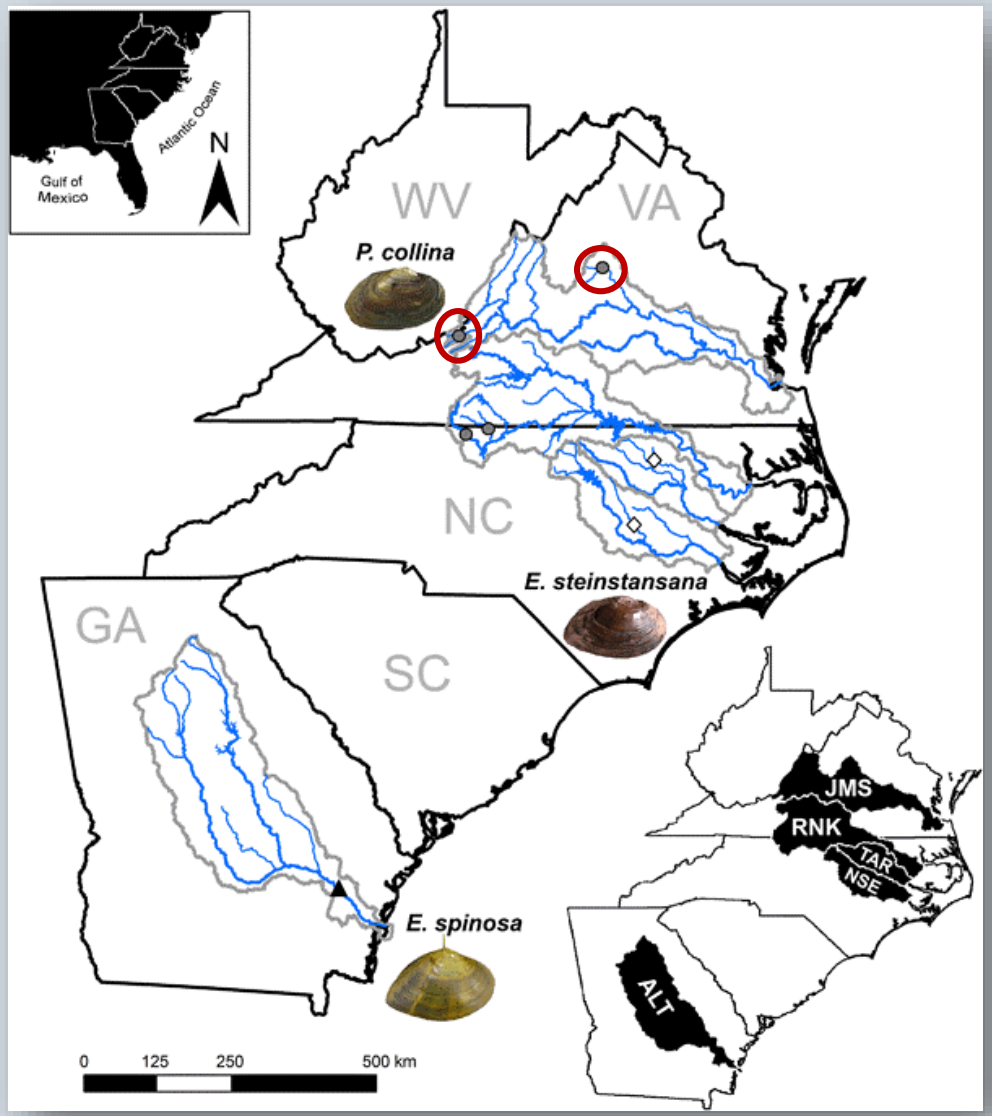
James spinymussel (*Parvaspina collina*)

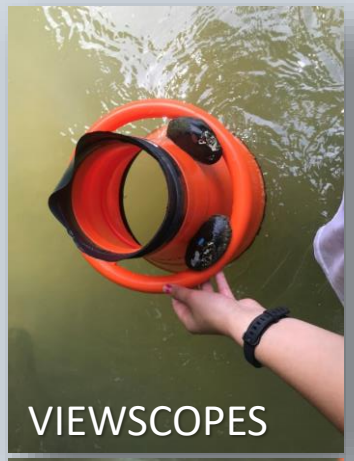
- One of three spinymussels found in the Atlantic Slope Region
- Critically endangered
  - Loss of over 90% of the species since the 1990s
- Recovery plan developed in 1990 by USFWS

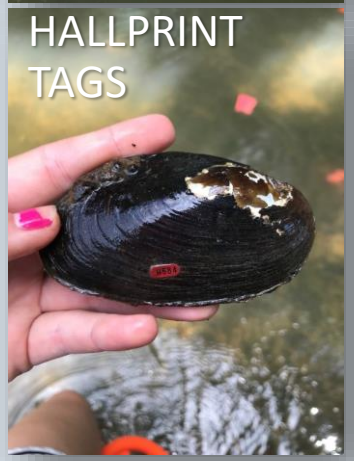


Perkins et al. 2017

How do we study the James spinymussel?

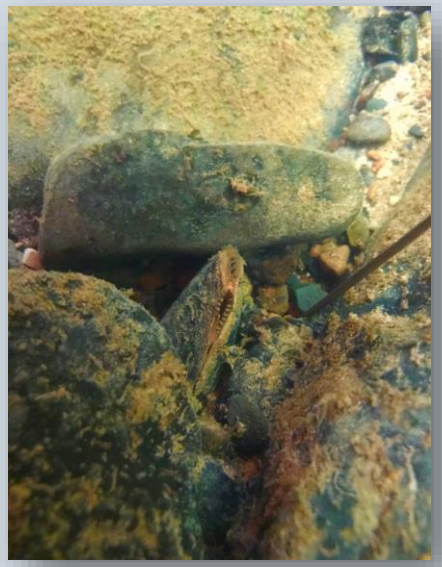
VISUAL DETECTION





BARRIERS TO VISUAL DETECTION

- Cryptic species
- Critically endangered
- Often burrowed



- Visual detection rates vary
- *P. collina* surface detection rate = 7% at low flow rates (Esposito 2015)

PIT TAGS

- Detection rate = 76%
- 15-37cm detection range (Esposito 2015)

Site Locations

- LOCATION 1 – SWIFT RUN
  - Tributary upstream of the main stem of the Rivanna River.
  - Part of a JMU 6-year long-term mark-recapture study.
  - 245m
  - *P. collina* & *V. constricta*

- LOCATION 2 – LITTLE OREGON CREEK
  - Part of a VDGIF long-term mark-recapture study.
  - 100m
  - ~400m downstream of Johns Creek Dam #2.

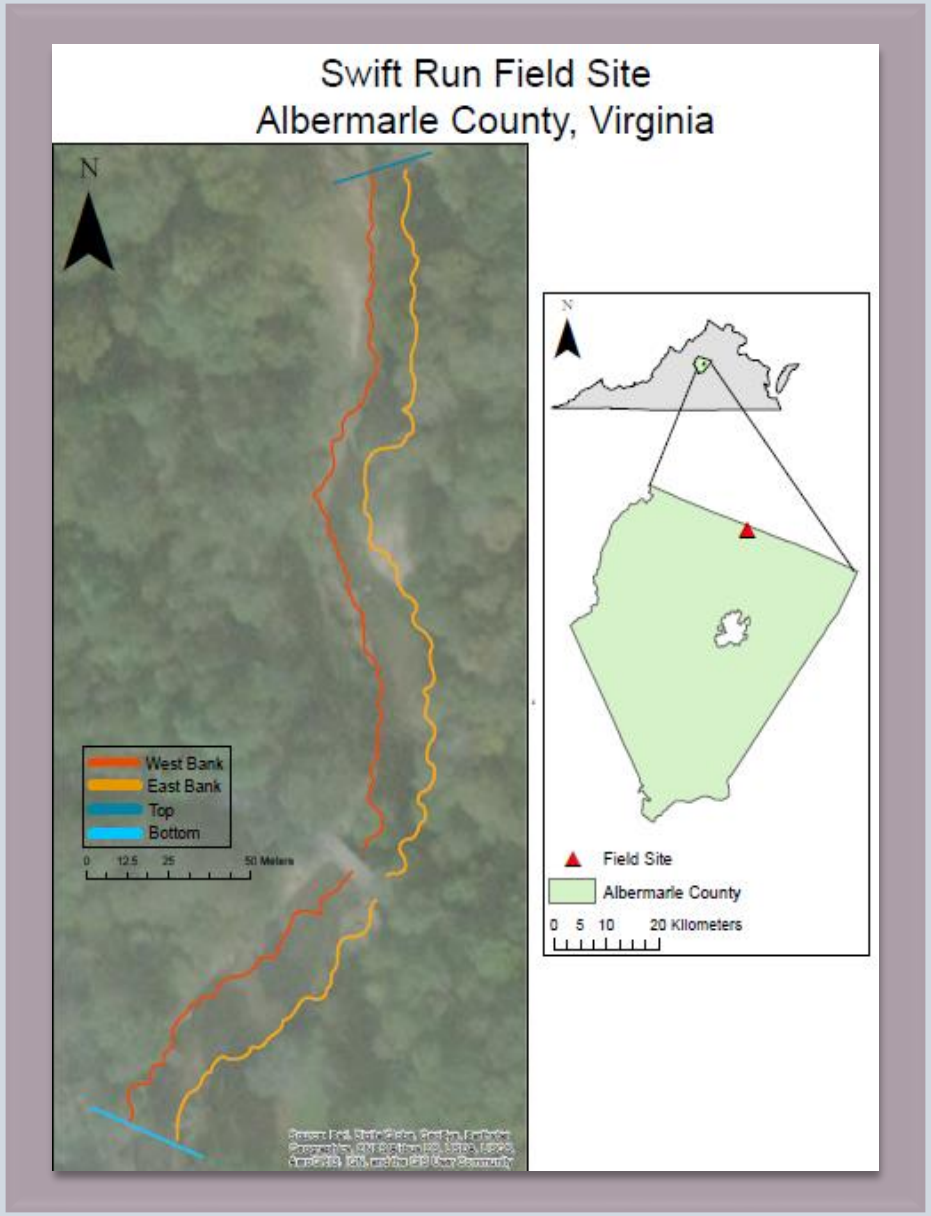


Figure 1. Swift Run Field Site located in Albermarle County, VA.

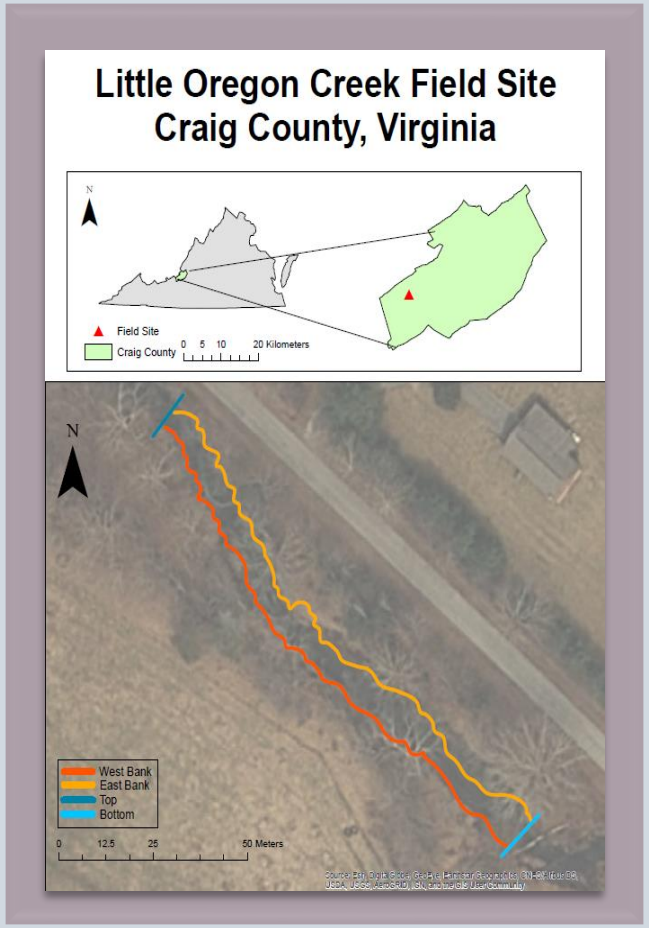


Figure 2. Little Oregon Creek Field Site located in Craig County, VA.

Swift Run Community Detection Trends

- MUSSEL SPECIES INCLUDE:
  - *Parvaspina collina*
  - *Villosa constricta*
- OVERALL:
  - 305 tagged *V. constricta*
  - 76 tagged *P. collina*
    - in 2019 only detected 13
  - No longer detect any *P. collina* from the first three years of the study

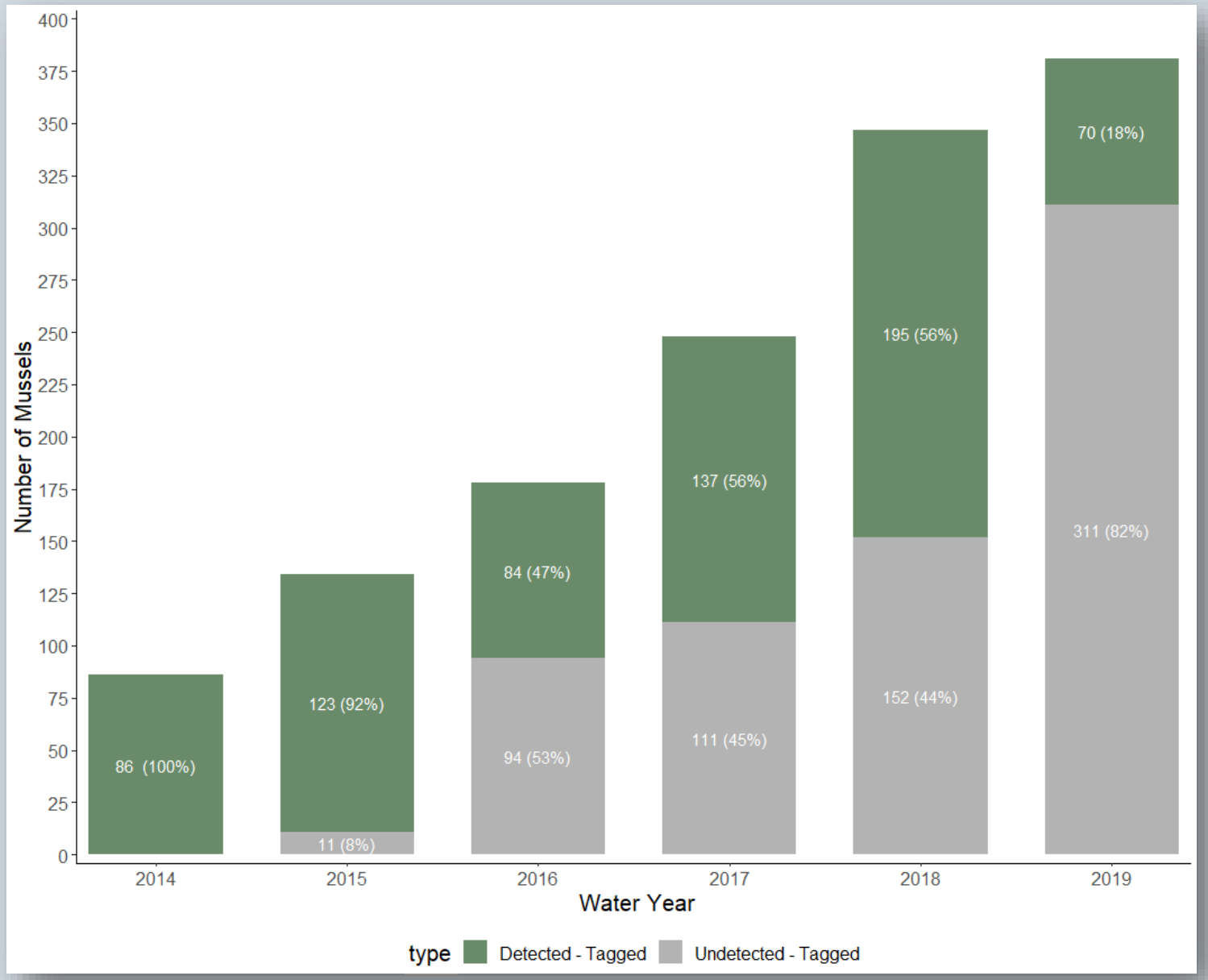


Figure 3. Detection trends for all years on record at Swift Run.

What is going on at Swift Run?

- Detection above and below JMU Study Site is low.
  - Never detected in the Rivanna River
- Substrate at the study site is predominately sand.
- Transiency of individual mussels at the study site is high.
- Flooding has been observed during the study.

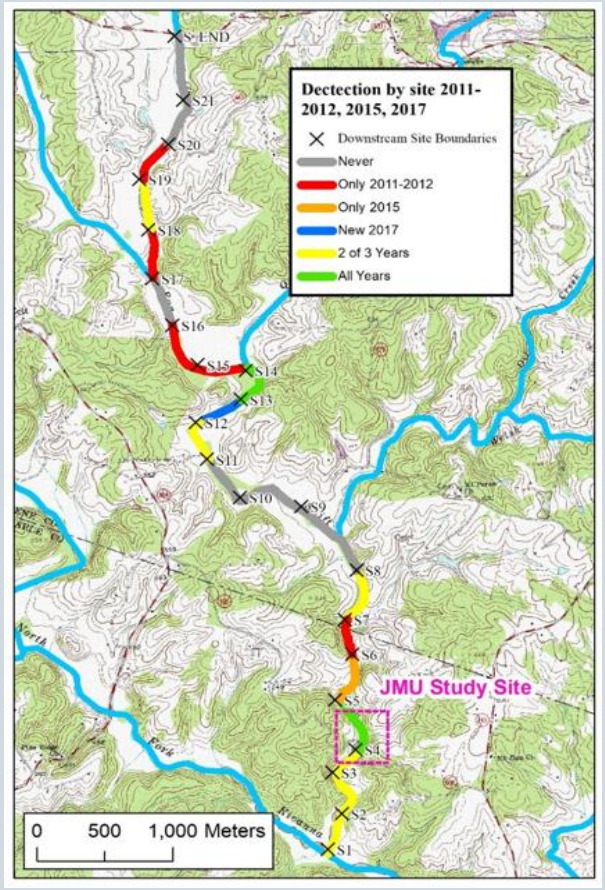


Figure 4. Compiled surveys for *P. collina* above and below the JMU Study Site at Swift Run from 2011 – 2017 (Otsby 2017).

Objectives

1. Determine if there is correlation between flood disturbance and mussel population dynamics through time.
2. Identify habitat preferences for *Parvaspina collina.*

Objective 1 – Flood Disturbance and Population Dynamics at Swift Run

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- FLOOD CLASSIFICATION
  - Discharge > 3,500 (ft^3/s)
- MAY 2014 – MAY 2019
  - 7 floods at Swift Run > 3,500 (ft^3/s)
  - At least one every year, except 2014

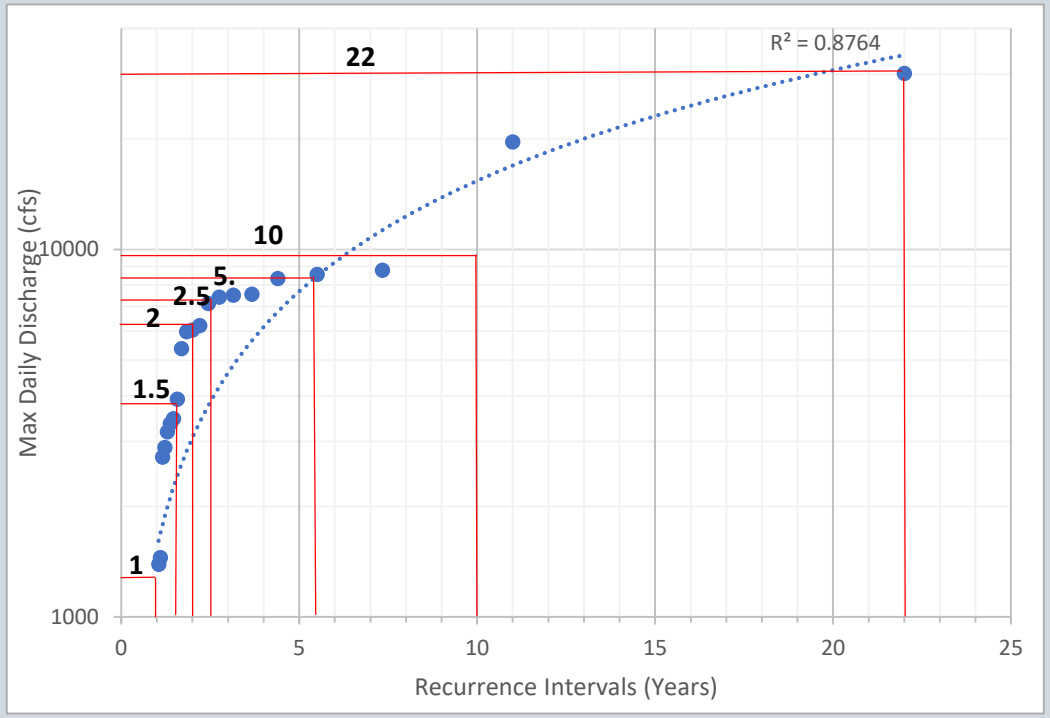


Figure 5. Swift Run flood recurrence intervals. Data from USGS gage 02032640.

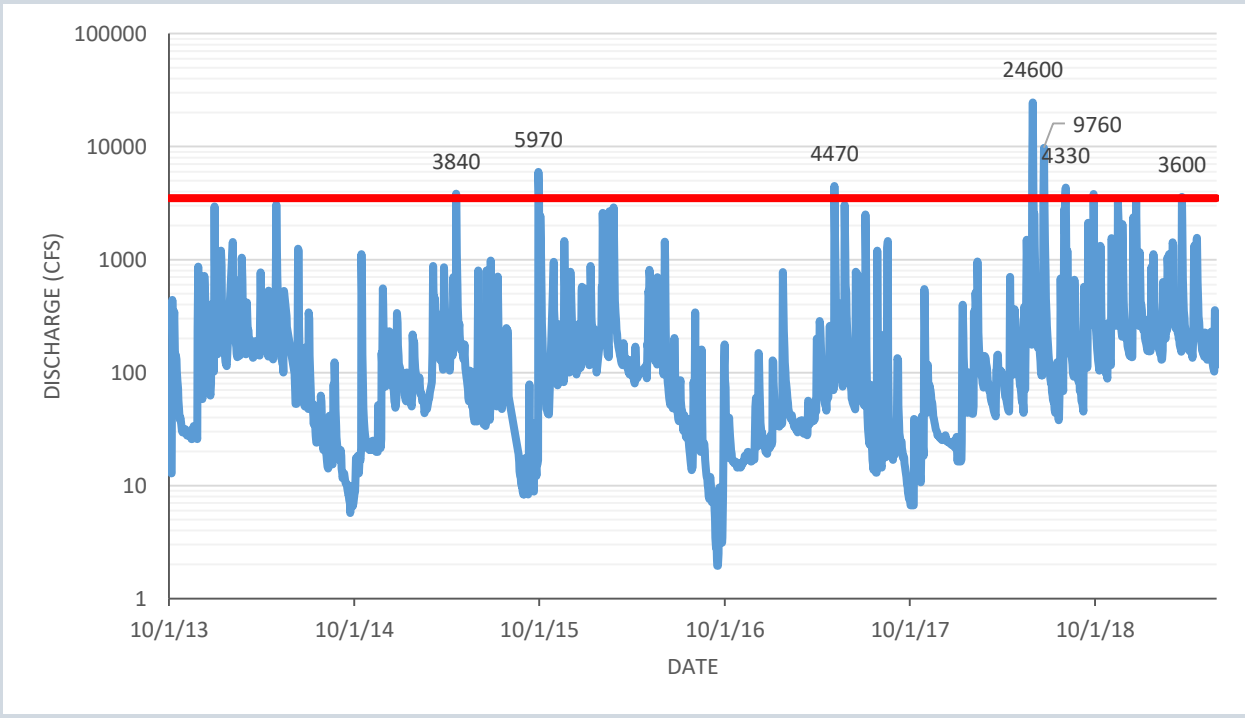


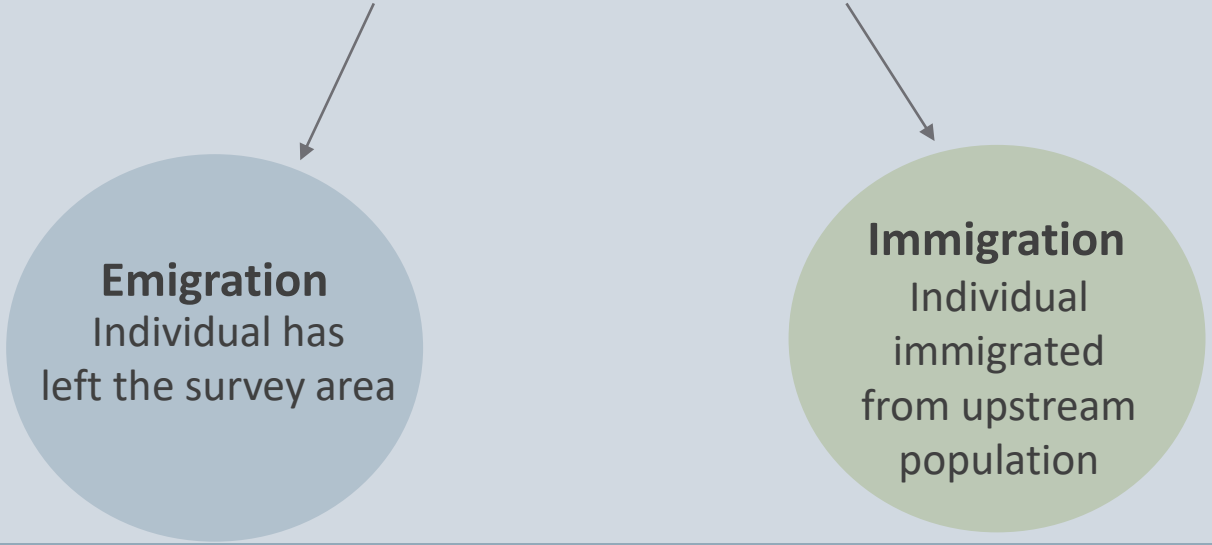
Figure 6. Swift Run hydrographs for all years on record. Data from USGS gage 02032640.

Objective 1 – Flood Disturbance and Population Dynamics at Swift Run

SWIFT RUN COMMUNITY ASSUMPTIONS

1. *P. collina* is acting similarly to *V. constricta*, the common species found at Swift Run. Analysis includes both mussel species.

POPULATION DYNAMICS ASSUMPTIONS



Objective 1 – Flood Disturbance and Population Dynamics at Swift Run

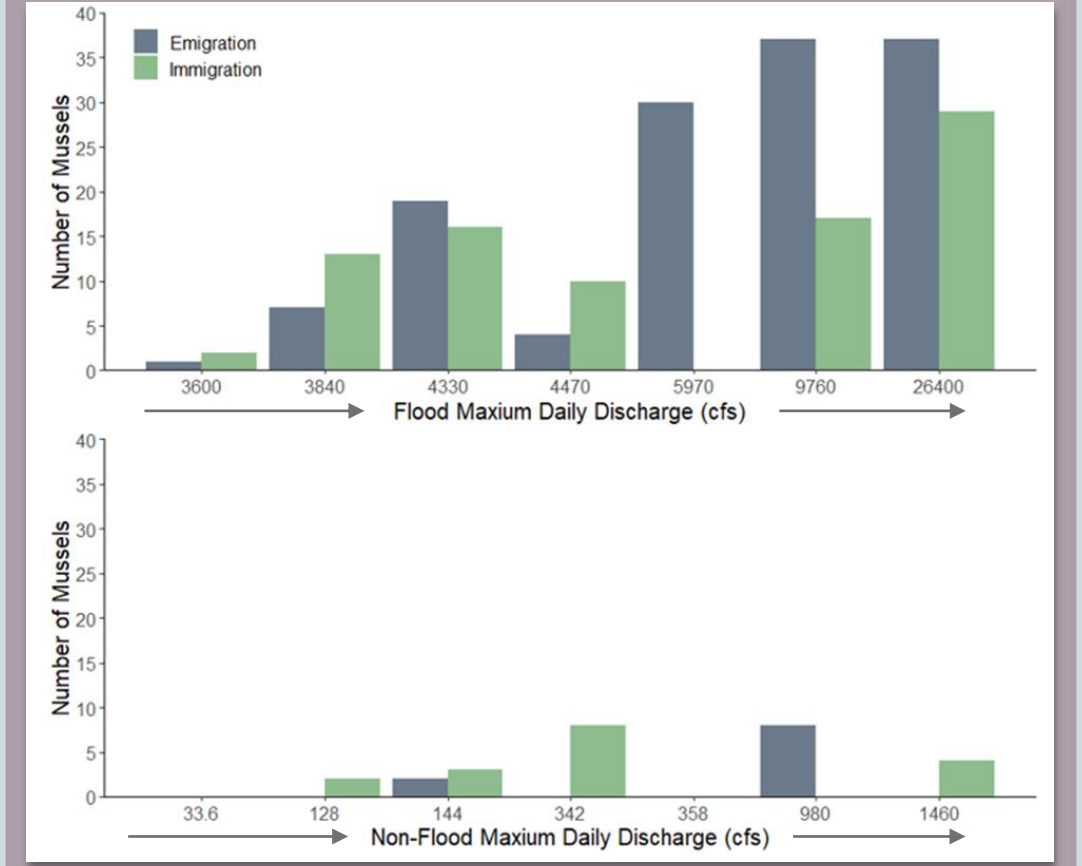


Figure 7. Emigration and Immigration before and after flooding and non-flooding events at Swift Run.

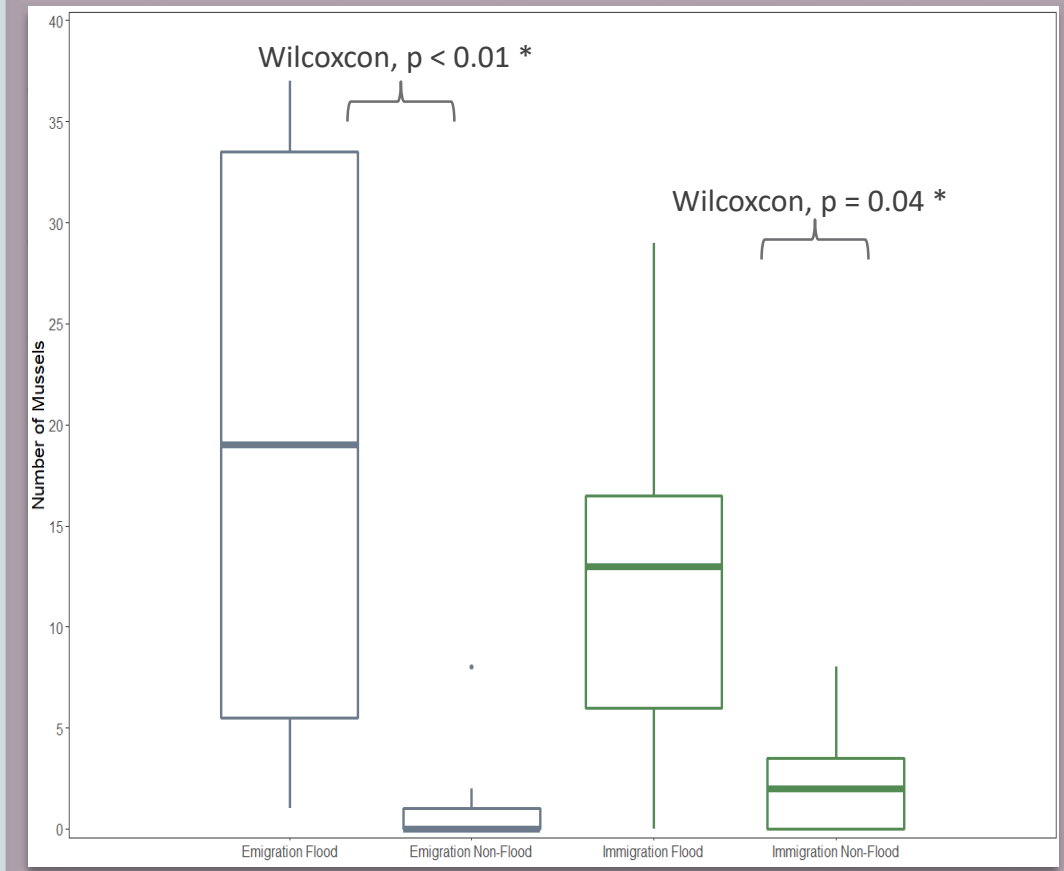


Figure 8. Comparison of population dynamic variables between flooding and non-flooding events at Swift Run.

Objective 1 – Flood Disturbance and Population Dynamics at Swift Run

EMIGRATION

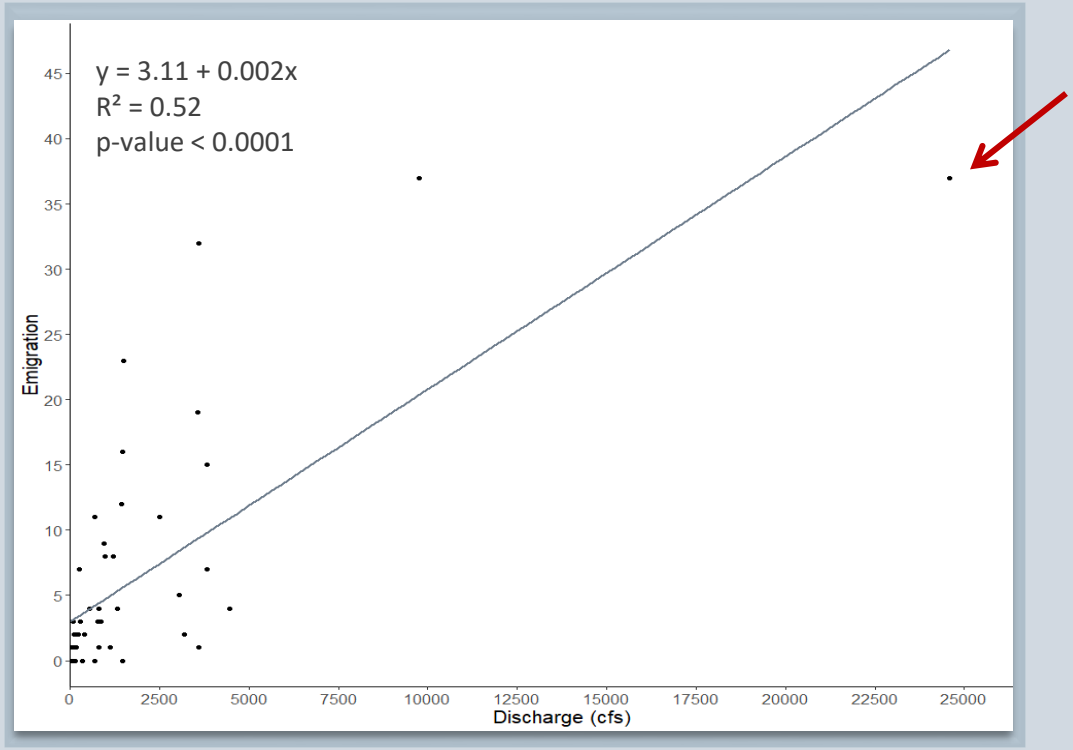


Figure 9. Linear Regression results for emigration at Swift Run, including all sampling events.

IMMIGRATION

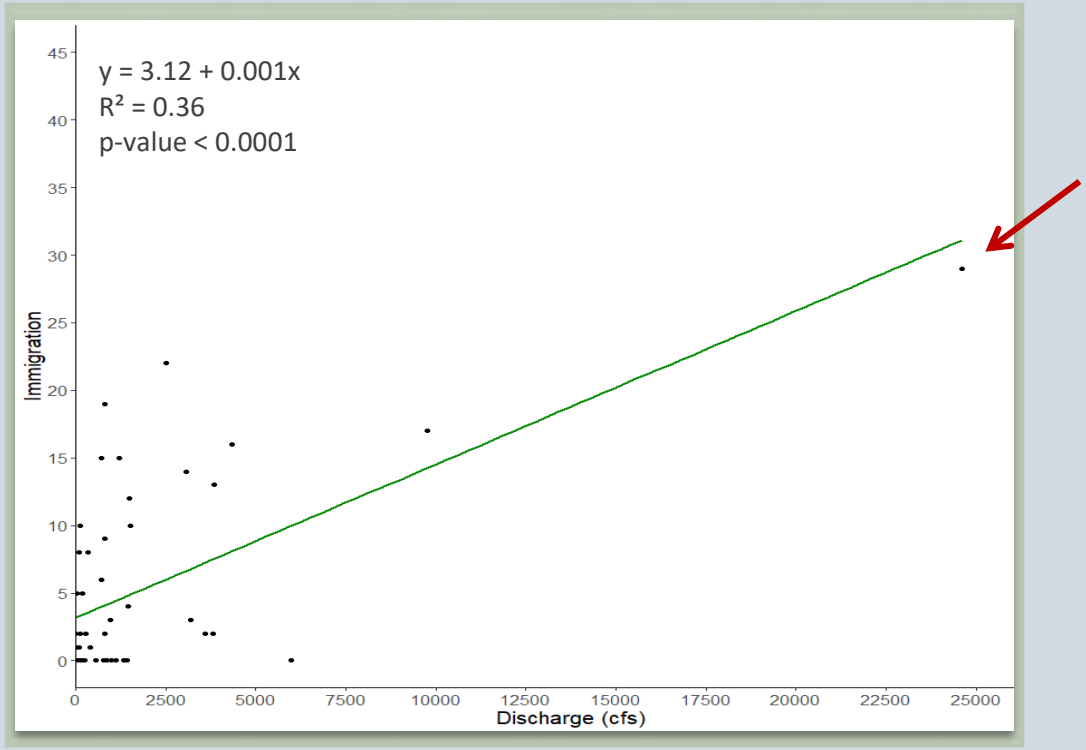


Figure 10. Linear Regression results for immigration at Swift Run, including all sampling events.

Objective 1 - Flood Disturbance and Population Dynamics Summary

- Emigration > Immigration
- Population at Swift Run is decreasing
- Transiency for individual mussels is high
  - Predominantly sand bedded channel

- Objective 2: Identify Habitat Preferences for *P. collina*

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SWIFT RUN

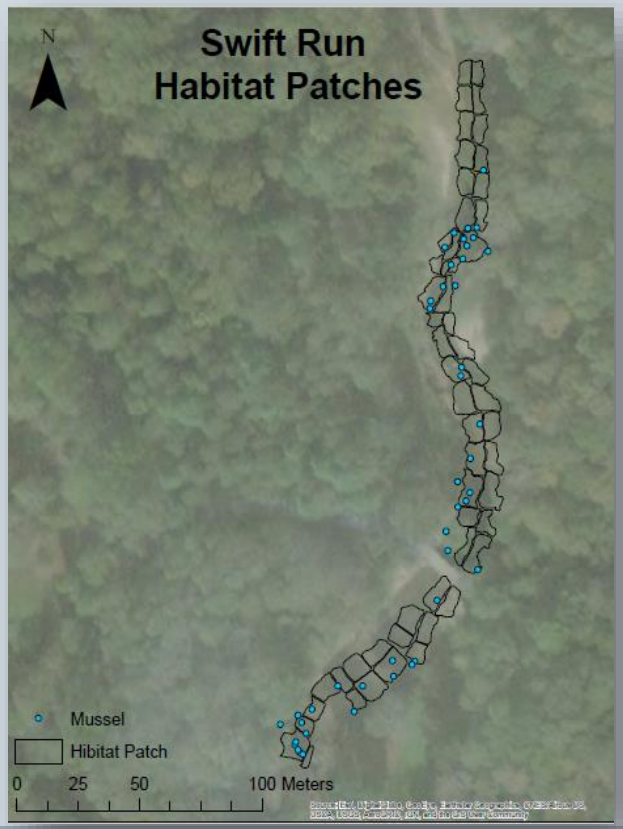


Figure 11. Habitat Patches at Swift Run.

- Mapped streambed at both sites to divide the reach into habitat patches.
- Overlaid with GPS points of mussels from summer 2019
  - Determined occupancy
- Measured variables:
  - Depth (cm)
  - Velocity (m/s)
  - Substrate Size (mm)

LITTLE OREGON CREEK

Figure 12. Habitat Patches at Little Oregon Creek.

Objective 2 – Identifying Habitat Preferences for *P. collina*

SWIFT RUN

Unoccupied (0) vs. Occupied (1)

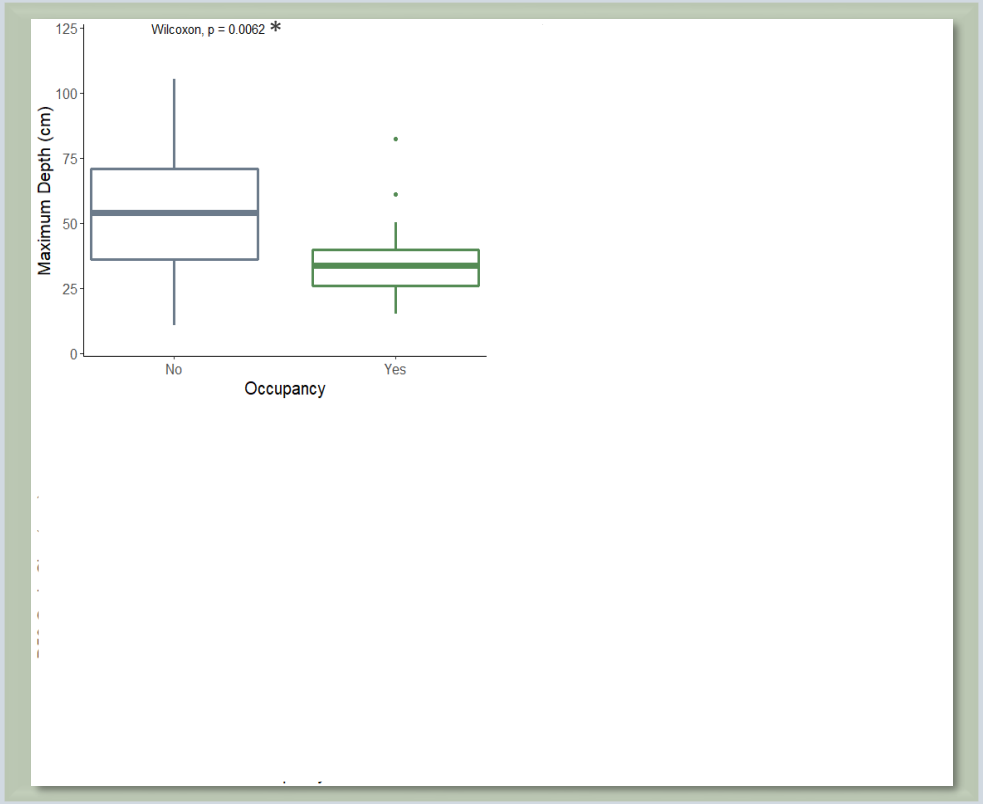


Figure 13. Comparison of habitat variables measured at Swift Run by occupancy of habitat patch.

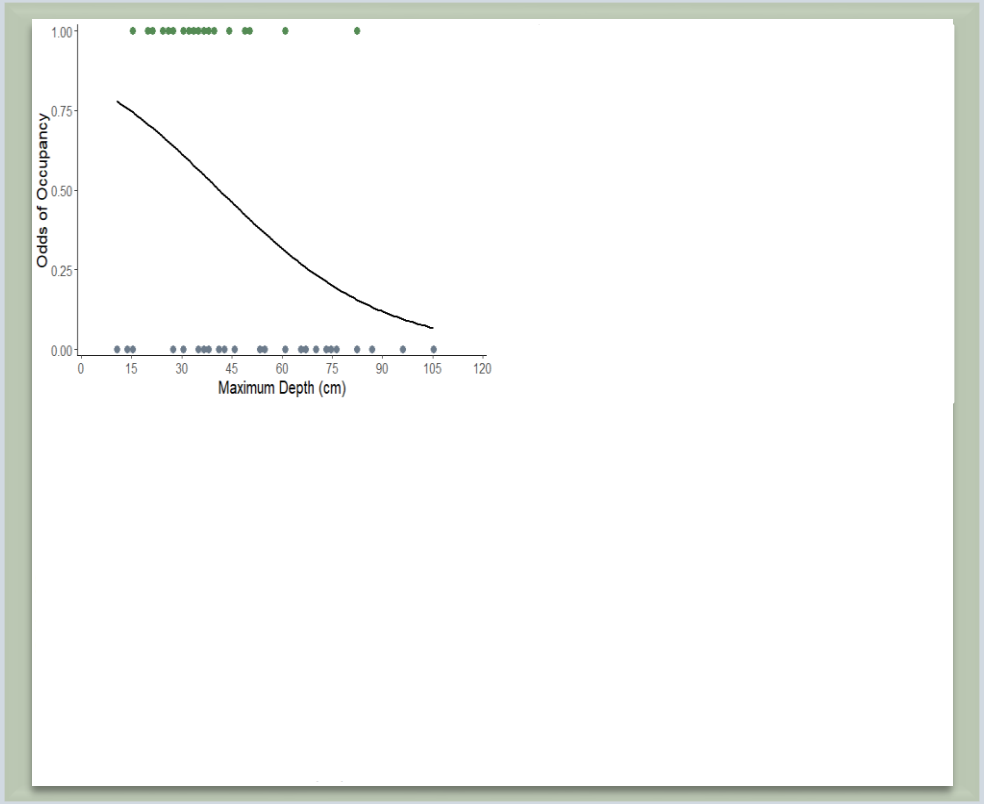


Figure 14. Logistic regression results: Odds of habitat patch occupancy for all variables measured at Swift Run.

Objective 2 – Identifying Habitat Preferences for *P. collina*

OCCUPIED HABITAT – STABLE VS. TRANSIENT

- Stable patches are those that we have consistently detected mussel in throughout the study.

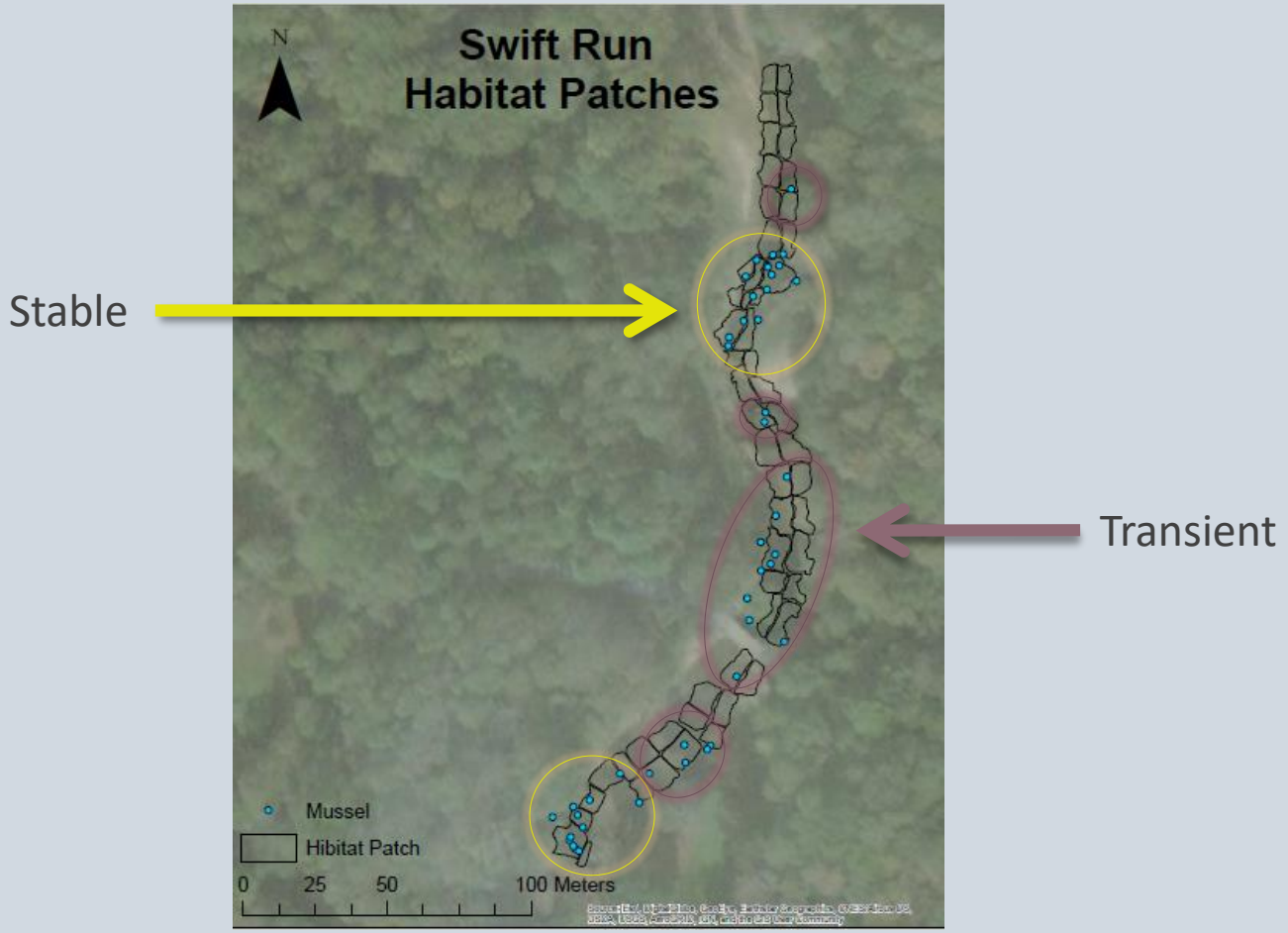


Figure 15. Location of stable and transient occupied habitat patches at Swift Run.

Objective 2 – Identifying Habitat Preferences for *P. collina*

SWIFT RUN

Occupied Habitat – Stable (1) vs. Transient (0)

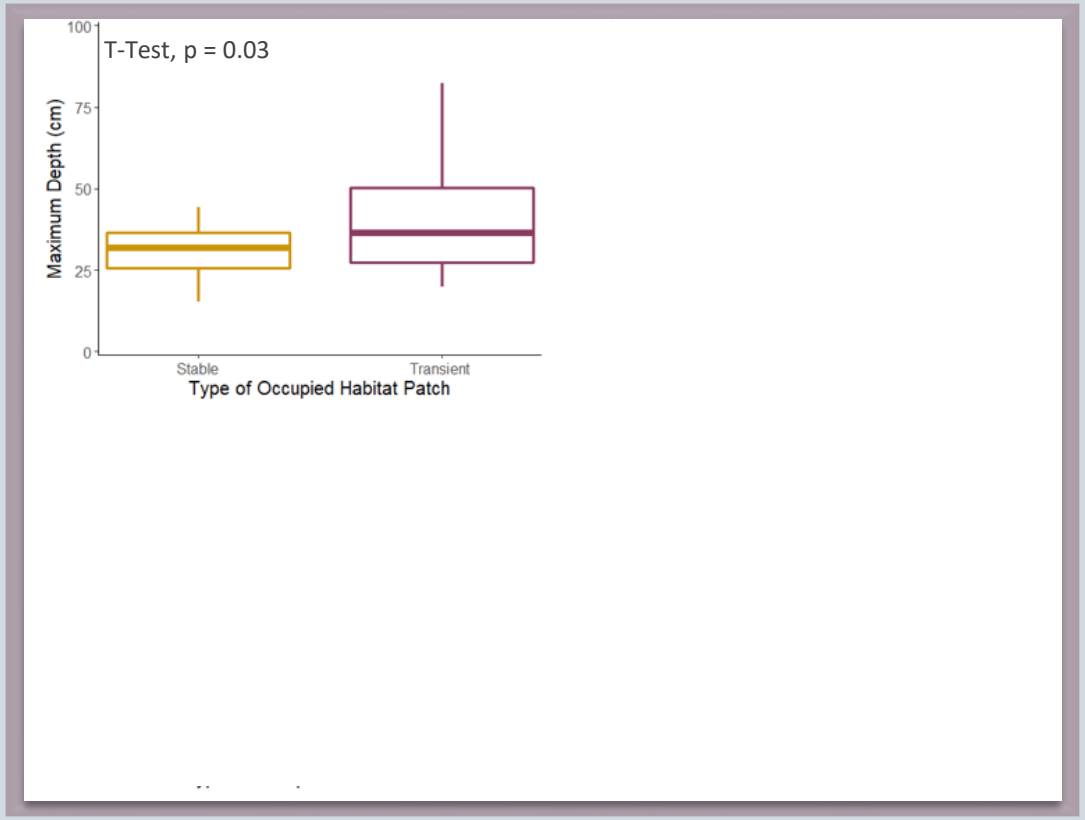


Figure 16. Comparison of habitat variables between stable and transient occupied habitat patches at Swift Run.

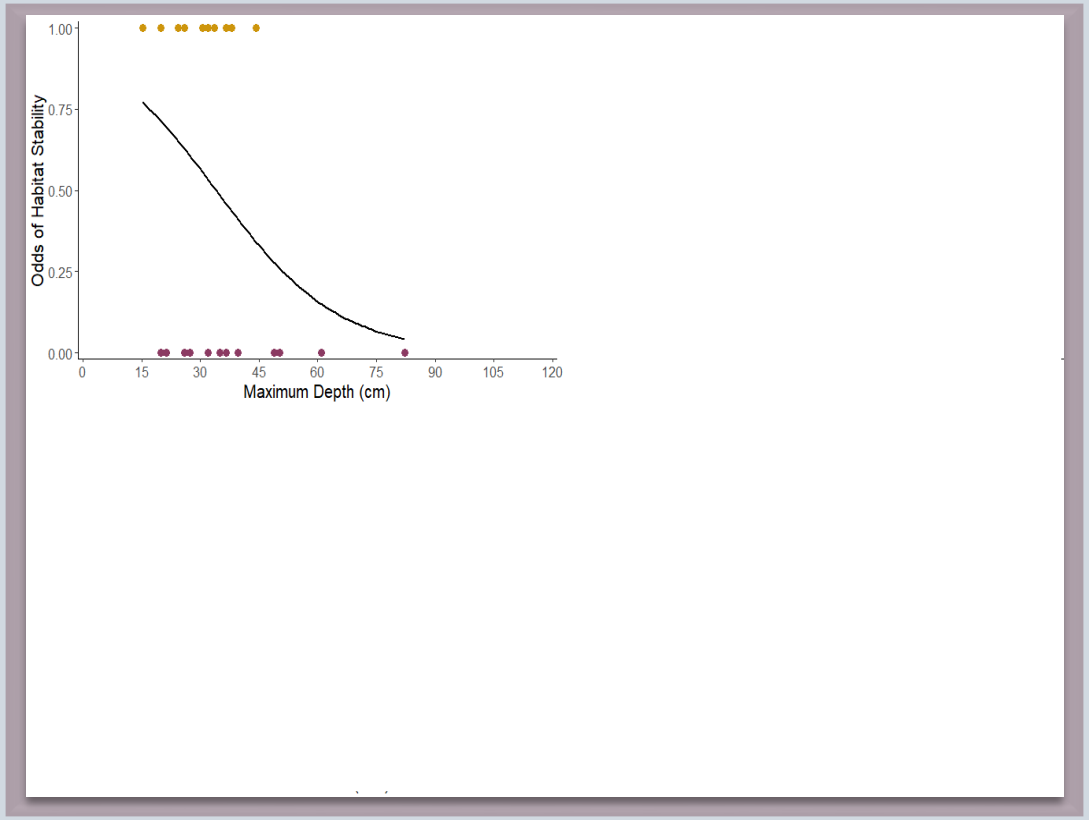
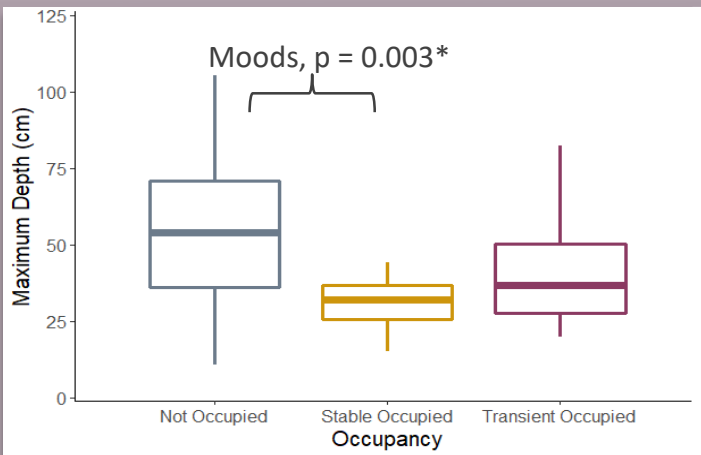


Figure 17. Logistic regression results: Odds of stable (1) vs. transient (0) habitat patch occupancy for all variables measured at Swift Run.

Objective 2 – Identifying Habitat Preferences for *P. collina*



- 60% of all patches are sand (≥16mm)

Figure 18. Comparison of habitat variables in stable occupied, transient occupied and not occupied habitat patches at Swift Run.

Objective 2 - Habitat Preference Summary

OCCUPIED VS. **UNOCCUPIED**

- >50% of habitat patches at Swift Run are occupied
- Depth is a significant predictor
  - Unoccupied depth > occupied
- Velocity
  - Unoccupied < occupied
- Substrate
  - Unoccupied > occupied

STABLE VS. **TRANSIENT**

- 48% of occupied habitat patches at Swift Run are stable
- Depth is a significant predictor
- Depth
  - Stable patches have the lowest depth
- Substrate
  - Stable contains coarser substrate compared to the sand sized in transient patches

Future Directions

- Predict occupancy at Little Oregon Creek with Swift Run habitat model.
- Compare variation in size of mussels between Swift Run and Little Oregon Creek.
- Use Program MARK to compare survival and recapture rates after flooding and low flow events.

Figure 12. Habitat Patches at Little Oregon Creek.

Acknowledgments

- Dr. Christine May
- Brian Watson – VDGIF
- Brett Ostby
- JMU Department of Biology
- Field assistants
  - Haley Grove
  - Kevin Reifenburg
  - Hannah Eismen
  - Jack Doss
  - Chris Will

Questions?