

Natural history, threats, and current research related to Candy Darter in Virginia



Katie E. McBaine

Virginia Tech

&

Paul L. Angermeier

USGS, Virginia Cooperative Fish and Wildlife Unit

Description

- Member of the true Perch family, Percidae
- Described by Hubbs and Trautman, 1932
 - Finescale Saddled Darter
 - 1991 – renamed Candy Darter

- Closely related species
 - Variegate Darter *Etheostoma variatum*
 - Kanawha Darter *Etheostoma kanawhae*

Candy Darter



Variegate Darter

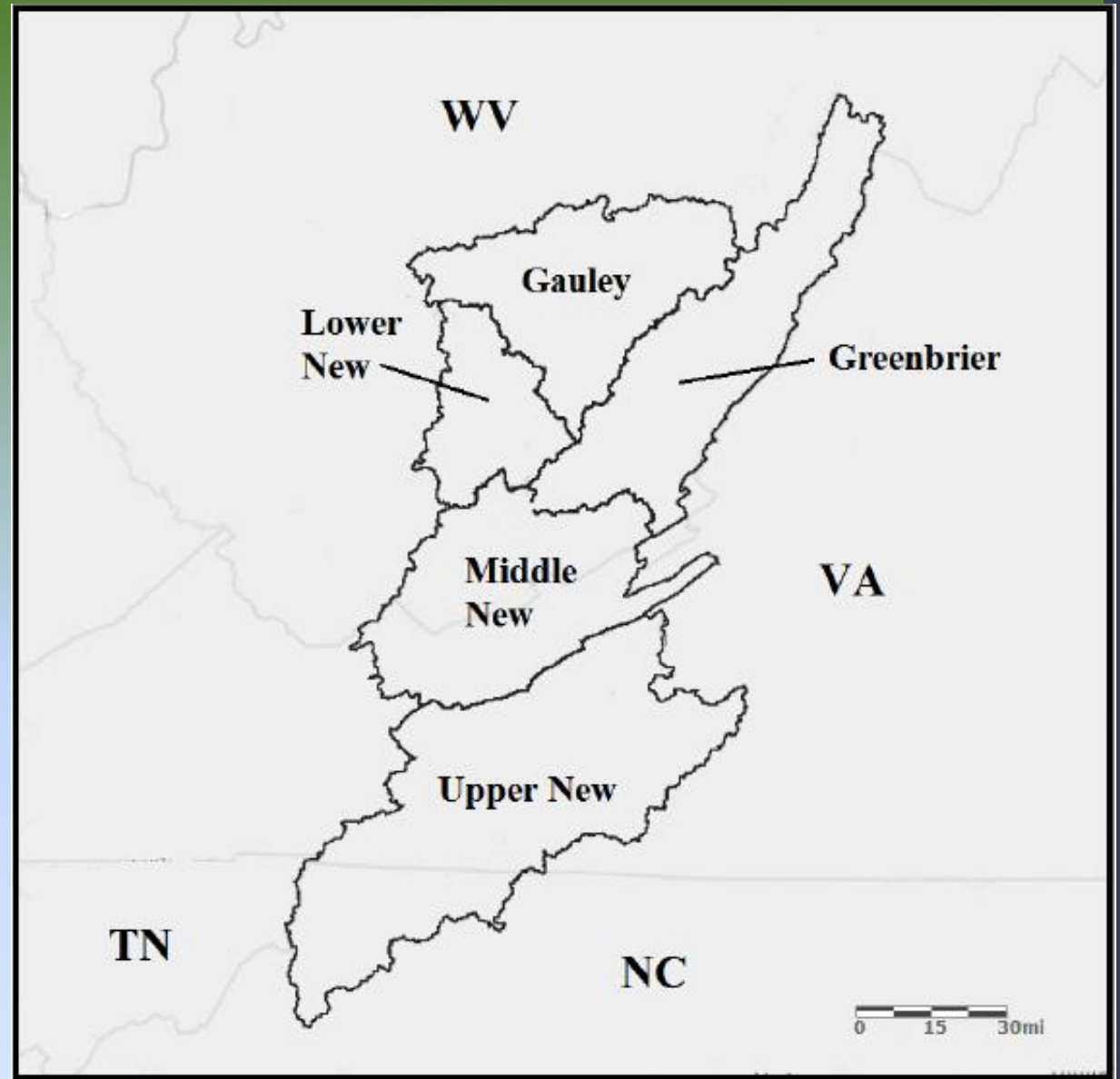


Kanawha Darter



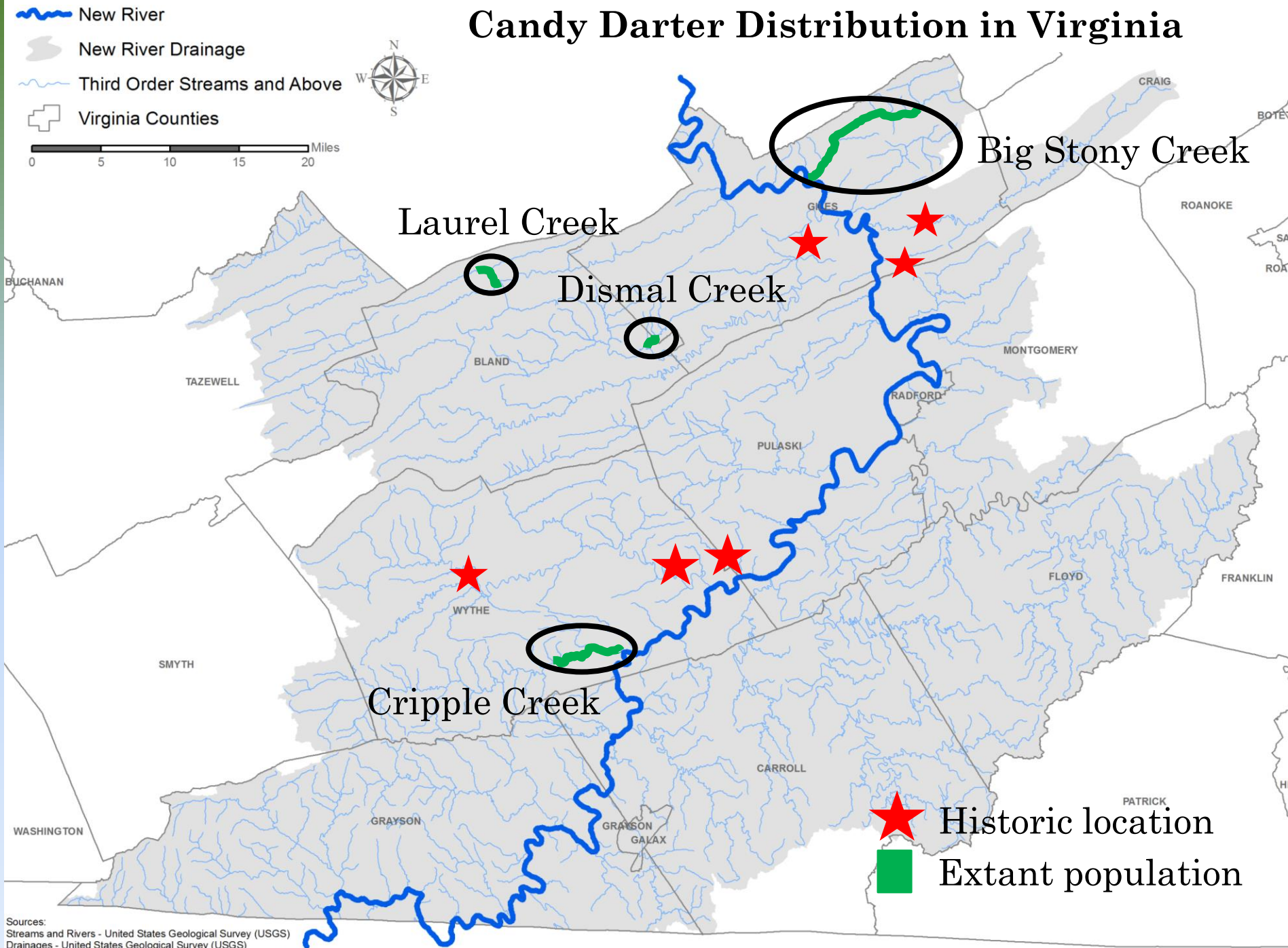
Distribution

- Kanawha River Basin
- West Virginia
 - 80% of distribution
 - Gauley River
 - Greenbrier River
 - Bluestone River
- Virginia
 - New River



Watersheds of Kanawha River basin

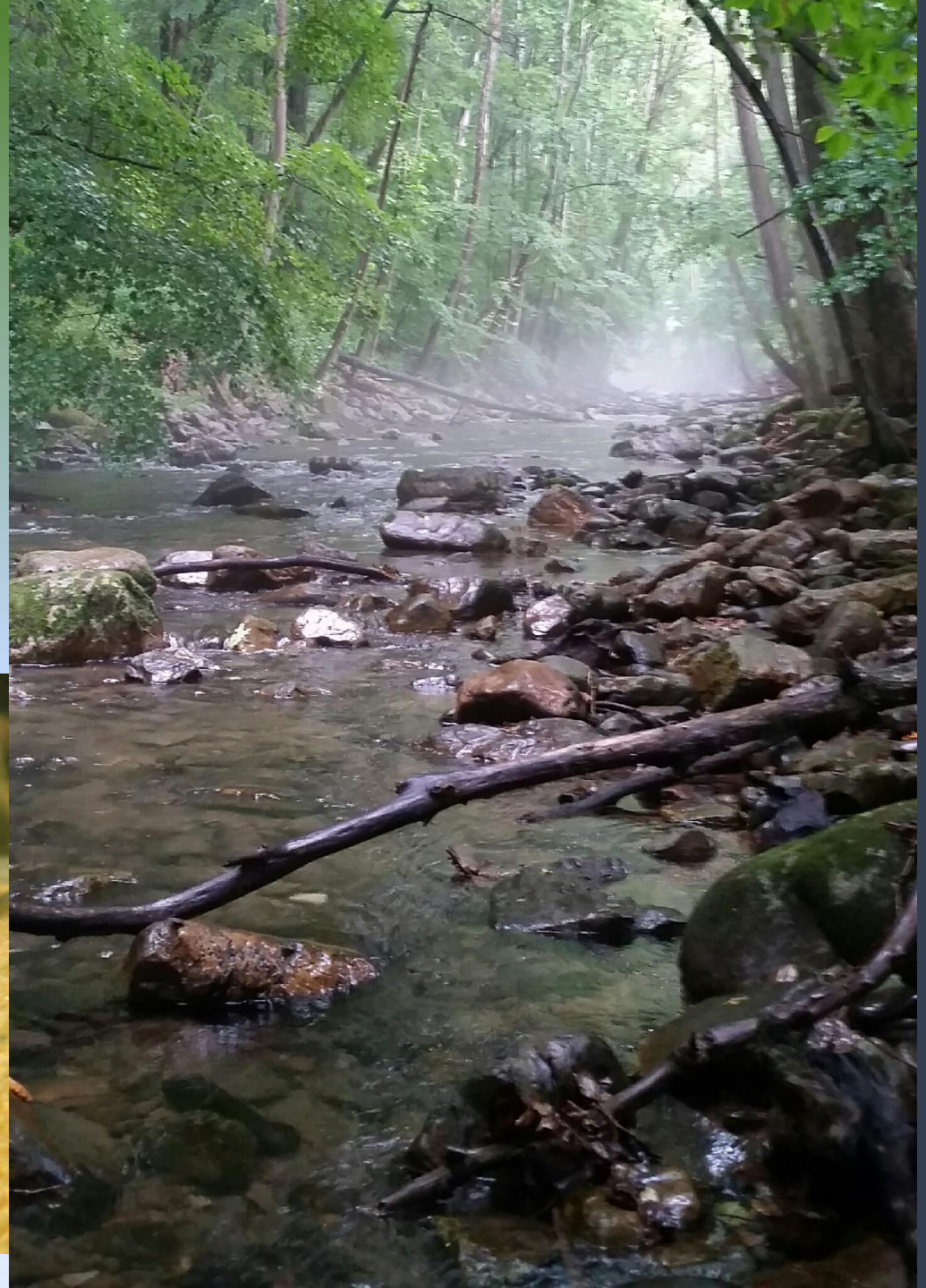
Candy Darter Distribution in Virginia



Sources:
Streams and Rivers - United States Geological Survey (USGS)
Drainages - United States Geological Survey (USGS)
Virginia Counties - Virginia Department of Conservation and Recreation (DCR)

Habitat

- Stream widths 2 – 23 m
- Riffle-dwelling species
- Cold-cool temperatures
 - Co-occur with trout
- Silt-free substrates
 - Large cobble and gravel



Life History

- Sexually mature at 2 years
- Spawning season
 - April – June
 - Deposit eggs in gravel/pebble among large cobble and boulder
- Maximum age of 3 years
- Sexually dimorphic species
 - Coloration
 - Length
- Small 60 – 115 mm in total length
 - 55 – 99 mm standard length



Life History

- Diet
 - Benthic macroinvertebrates (mayflies, caddisflies, stoneflies)



Threats

Hybridization

- Bait bucket release above Kanawha Falls
- Variegate Darters outcompete Candy Darters for mates

F1 – hybrid Candy Darter x Variegate Darter



Photo credit: Dr. Stewart Welsh

Threats

Fine sediment deposition

- Land-use practices



Warming waters

- Loss of canopy cover
- Climate change



<https://iowalearningfarms.wordpress.com/tag/erosion/>



WolfeNotes.com

Threats

Introduction of non-native species

- Predators
- Competitors

Brown Trout *Salmo trutta*



Rainbow Darter *Etheostoma caeruleum*



Snubnose Darter *Etheostoma simoterum*



Conservation

- State-level
 - Virginia
 - Species of Greatest Conservation Need
 - Tier I - Critical conservation need
 - West Virginia
 - Species of Greatest Conservation Need
 - Priority 1 status based on conservation urgency
- Federal-level
 - Currently being reviewed for ESA listing



Knowledge gaps

- Are Virginia populations increasing, decreasing, or stable?
- Do Candy Darters move among riffles throughout a stream?
- How genetically diverse are the populations of Candy Darter in Virginia?

Importance to conservation

- Population persistence
- Resiliency to environmental change
- Genetic diversity can be an index of population health

Detectability, movement, and management options for candy darter in Virginia

- **Chapter I. Spatiotemporal variation in detectability of Candy Darter and other riffle-dwelling species.**
- **Chapter II. Small-scale patterns of movement in isolated Candy Darter populations in relation to population persistence.**
- **Chapter III. Large-scale population patterns for Candy Darter in isolated streams of Virginia.**

Chapter I. Spatiotemporal variation in detectability of Candy Darter and other riffle-dwelling species.

Objectives

- Examine and compare detectability across a variety of habitat characteristics, seasons, and species among streams
- Examine the relationship between single- and multiple-pass electrofishing on detectability

Chapter I. Background

Occupancy is the proportion of sites or area occupied by a species.

- Presence – absence

Detectability is the probability of capturing an individual given its presence.

- Influenced by
 - Physical habitat
 - Behavior
 - Density
 - Fish size
 - Sampling method
 - Level of sampling effort



Chapter I. Background

Accounting for variation in detection

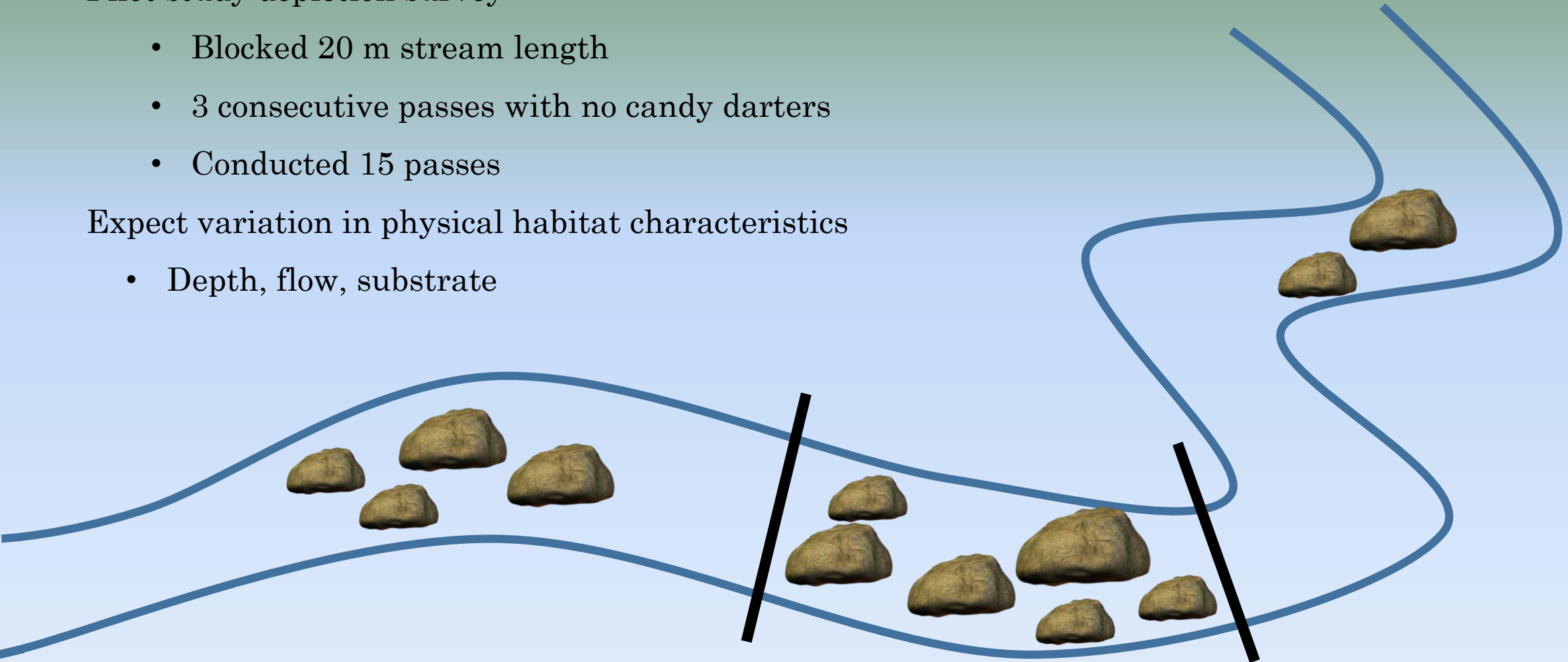
- Increase reliability and precision of estimates

Pilot study depletion survey

- Blocked 20 m stream length
- 3 consecutive passes with no candy darters
- Conducted 15 passes

Expect variation in physical habitat characteristics

- Depth, flow, substrate



Chapter I. Questions

- What physical habitat characteristics influence detectability of Candy Darters?
- Does detectability differ with density of Candy Darter?
- What level of sampling effort is necessary to detect species occupancy?
 - Does detectability differ for single- and multiple-pass electrofishing?



Chapter I. Products and outcomes

Account for variation associated with

- Physical habitat characteristics
- Density
- Fish size
- Sampling effort

Importance

- Enhance ability to map distributions
- Detect movement patterns



Chapter II. Small-scale patterns of movement in isolated Candy Darter populations in relation to population persistence.

Objectives

- Examine how the distribution of riffles influence individual movement
- Examine and compare the relationship between movement and survival among streams

Chapter II. Field Methods

Targeted sampling for mark-recapture

Initial mark site

- Stony Creek (2 sites, 150-200 m) and Laurel Creek (1 site, 500 m)

Recapture sites 500 m upstream and downstream

Marking

Visual implant elastomer tag (VIE)

Fin-clip from every individual upon every encounter

Each clip given an individual alphanumeric code

Standard length, total length, and sex (if determinable)



Chapter II. Preliminary results

VIE tagging

Stony Creek

- 1 recapture within initial mark site
- 1 recapture above mark site

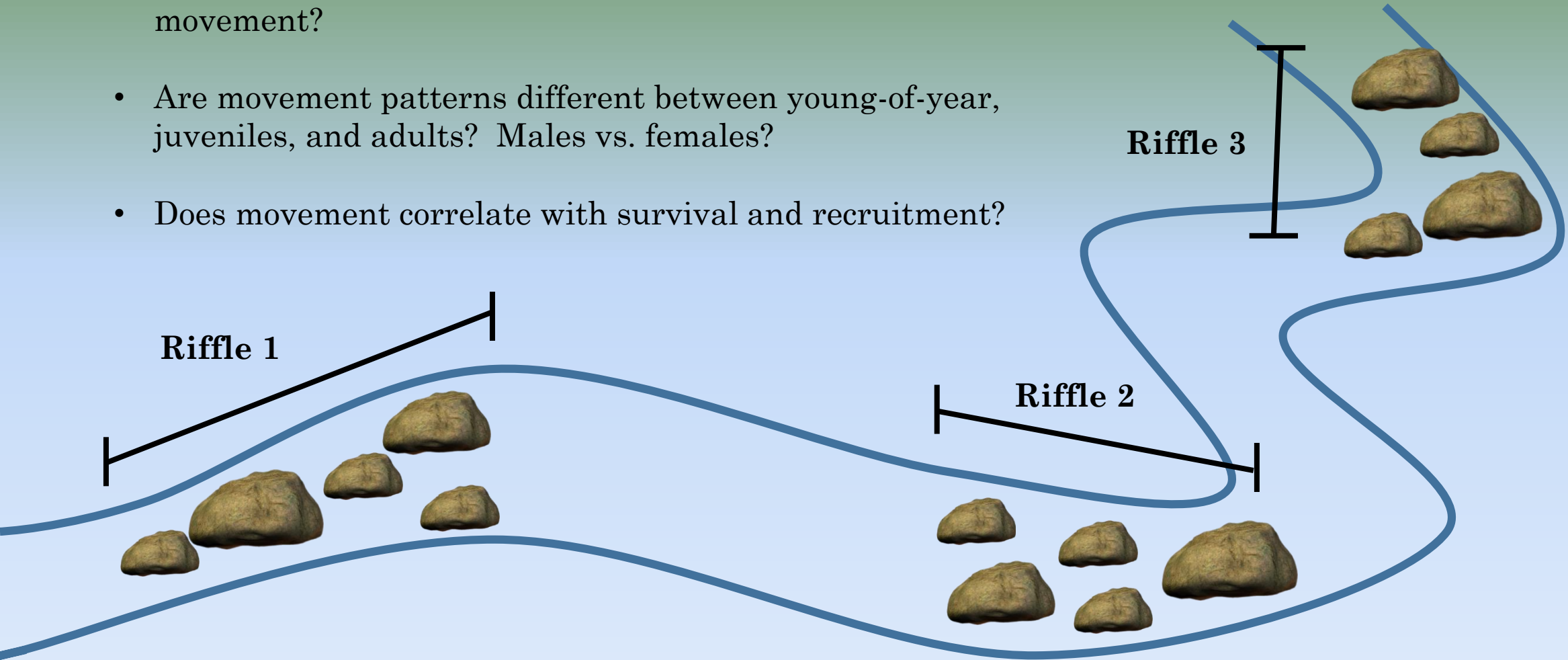
Laurel Creek

- 3 recaptures within initial mark site



Chapter II. Questions

- Does the length of a riffle influence movement?
- Does the length of non-riffle (pool-run) habitats influence movement?
- Are movement patterns different between young-of-year, juveniles, and adults? Males vs. females?
- Does movement correlate with survival and recruitment?



Chapter II. Products and outcomes

- Provide first estimates of movement for Candy Darter
- Current knowledge of population dynamics
 - Survival and recruitment estimates
- Identify habitat characteristics that limit Candy Darter movement



Chapter III. Large-scale population patterns for Candy Darter in isolated streams of Virginia.

Objectives

- Describe genetic diversity and differences between isolated streams
- Provide a context for evaluating source populations for possible translocation or addition of individuals to increase genetic diversity

Chapter III. Questions

- Is there migration between streams? If so, how many individuals migrate between streams?
- What is the level of genetic diversity within each stream?
- How many reproductive adults are in each isolated stream (population)?
- Which population(s) will be able to persist if individuals are removed?



Chapter III. Products and outcomes

- Provide managers with baseline knowledge of genetic diversity
- Identify if populations could be managed collectively or as separate populations
- Identify the population(s) that could serve as source populations for
 - Direct translocation
 - Hatchery production
 - Reintroduction



Photo credit: Mike Pinder

Acknowledgments

Committee members

- Dr. Paul Angermeier
- Dr. Eric Hallerman
- Dr. Emmanuel Frimpong



Labmate

- Zach Martin

Field work

- Mike Pinder
- Derek Wheaton
- Ryan Mowery
- 2016 CATT crew
- Andy Dolloff
- Craig Roghair
- Colin Krause
- Matt Winn
- Erica Reed
- Aaron Adkins
- Rebecca Bourquin
- Billy Moore
- Morgan Reed
- Connor Parsons
- Danielle Goldberg
- Chelsey Faller
- Courtland Caldwell
- Jireh Clarington
- Hannah Glass
- Courtney Dalimonte
- Anna Dellapenta
- Melissa Vaughn
- Cole Reeves
- Nick Poss
- Dylan Casciano
- 2016 CMI crew



VirginiaTech
College of Natural Resources
and Environment

Genetic Work

- Miluska Hyde

Questions?

