



Assortative mating of brook trout... What the heck does that mean?!?

Assortative Mating (defined): *A nonrandom mating pattern where individuals with certain physical characteristics mate with one another more frequently than what would be expected under a random mating pattern.*



Former Great Smoky Mountains National Park (GRSM) employee Casey Weathers is currently working on his masters degree in Fisheries Science through Penn State University. His project involves the investigation of assortative mating of brook trout within two restored streams in the park: Leconte Creek and Mannis Branch. This presentation will attempt to detail the ongoing project and what it means to the future of fisheries management in the park.

Great Smoky Mountains National Park Fisheries Management Goals



1. Monitor existing stream fish communities to ensure they are being protected and preserved for future generations.
2. Continue to monitor water quality across the park to:
3. **Restore southern Appalachian brook trout in streams that meet the three restoration criteria (*currently 6 streams totaling 12.8 miles remain to be restored*).***
4. Preserve the genetic integrity of southern Appalachian brook trout.
5. Continue to provide recreational angling opportunities.
6. Evaluate opportunities to provide handicap access for anglers.
7. Provide educational outreach to foster fisheries and aquatic resource support.

HOW DO WE ADDRESS AND MEET GOAL #3?

The GRSM Fisheries Department has identified 40 miles of the park's 2,000 miles of waterways that could be restored back to their natural state. To date, 27.2 miles of 11 streams have been restored by removing non-native trout (rainbow & brown) from streams above barriers and repopulating them with native brook trout from other streams within the park (source streams).

Little Greenbrier Creek



103

Cosby Creek



111

Indian Camp Creek



106

Leconte Creek:

In 1999, 320 brook trout from 3 source streams (Indian Camp, Little Greenbrier, Cosby) were used to repopulate Leconte Creek.

LeConte Creek

After rainbow trout are removed....
brook trout are transplanted back in!



OUT!

Mannis Branch

Mannis Branch:

In 1996, 105 brook trout from 2 source streams (Indian Camp, Little Greenbrier) were used to repopulate Mannis Branch.



50



55

Indian Camp Creek

Little Greenbrier Creek

Mannis Branch



10 years later...

Genetic testing determined that 75-83% of spawning was occurring **ONLY** between trout from the same source stream. In basic terms, trout from one source stream were not successfully breeding with fish from other source streams. It is speculated that this percentage is actually closer to 100%, as research has yet to find any trout that contains genes from a combination of source streams.

It is not clear what is causing this phenomena. The objective(s) of the joint NPS and PSU study are to determine the cause(s).

What could be causing this...???

LeConte Creek



What Could be Causing This Phenomena?

PRE-REPRODUCTIVE ISOLATING MECHANISM

Assortative Mating (Pre-spawning): Adults will only mate with trout from the same source stream

1. The trout may be able to differentiate between one another from physical features or specific actions.
2. Trout from one source stream may spawn at a different time than the other two.
3. The temperature of the water at which each trout begins spawning maybe slightly different within the source streams.
4. The construction of redds or spawning nests could be different between the source stream trout.



POST-REPRODUCTIVE ISOLATING MECHANISM

Reproductive Restriction: Mixed stream pairs do not produce young that are physically fit to survive

1. There is a possibility that when trout from two different source streams spawn, their genetic mixing inhibits the hatching of their offspring.
2. There may be physiological factors limiting their mating success.



How Will We Figure It Out? - *Project Methods*

The following procedures are being used to sample the 1.75 miles of Leconte Creek and 0.5 miles of Mannis Branch



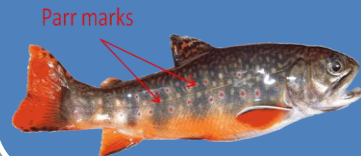
2010

- Identify pre-spawning behaviors on Leconte and 3 source streams
- Determine if there is a difference in pre-spawning activity within source stream trout
- Temperature monitoring devices were installed on Leconte and source streams to identify differences in spawning temperatures



2011

- Prior to spawn, 120 fin clips were taken from Leconte and each source stream to conduct DNA analysis
- Observations of spawning and red construction were documented
- Removed 40 trout from Leconte to measure physical characteristics (ex. number of spots, parr marks, head length, size of eye, lateral line scales, etc.)
- Recorded underwater video footage of spawning behavior over redds (ex. size of mating pairs, pairing behavior)
- Will use video to determine if pairs are same source or different



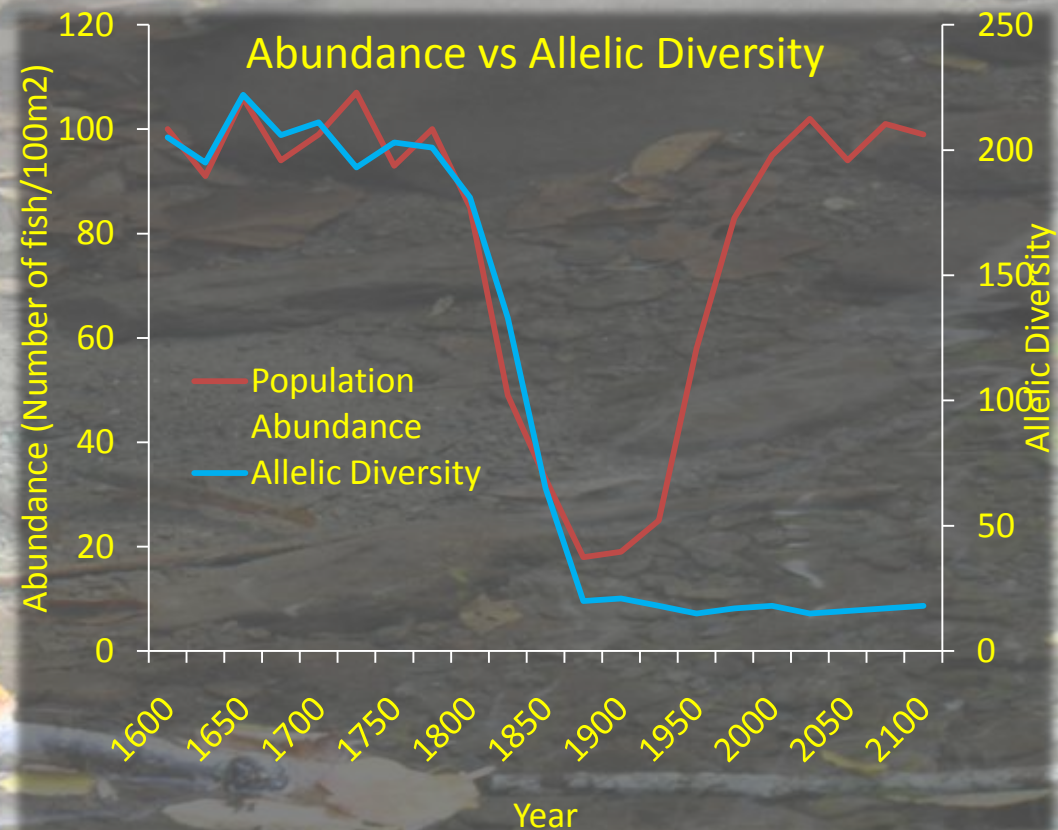
2012

- Will cross brook trout from different source streams in hatchery to see if they can produce viable offspring

Why is this important to brook trout management?

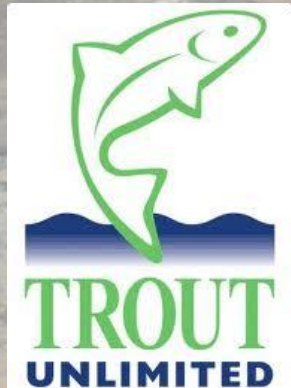
1. As brook trout from multiple source streams are transplanted to a stream, we want to establish one inter-breeding population, not multiple populations within the stream.
2. Improved genetic understanding helps guide future restoration projects by focusing effort on most genetically robust populations.
3. Offers ability to consider the genetic diversity within the species rather than just species abundance, to further enhance survivability of the species.
4. Determine potentially compatible streams within the park to improve fitness* of brook trout in restored streams.

***Genetic Fitness:** The extent to which an organism is adapted to or able to produce offspring in a particular environment.



This graph shows what can happen when genetic diversity is not taken into account during management. The population abundance recovered, but the genetic diversity did not. This leaves the population less prepared for disease outbreaks, invaders, environmental change, etc. Improving genetic diversity provides greater assurance the population will survive for future generations.

Special Thanks to the Project's Supporters



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For Further Information

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