CREW
Center for Restoration of Ecosystems and Watersheds
University of Oklahoma

Measuring the Recovery of Fish Communities in a First Order Stream to Tar Creek After Implementation of Two Passive Treatment Systems

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Introduction

Methods

Results

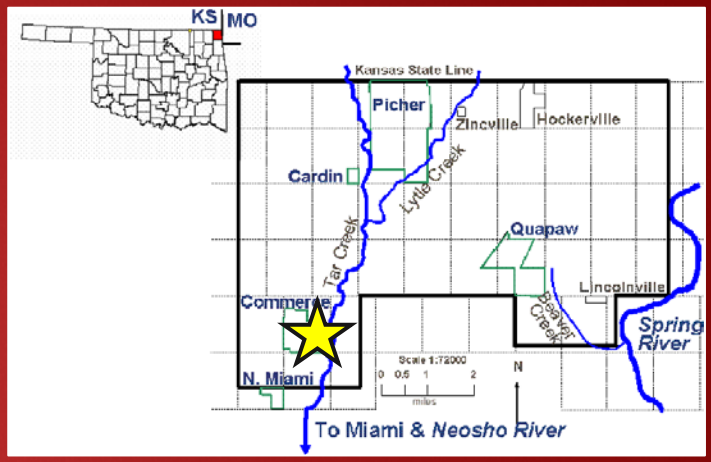
Conclusions

Introduction

Tar Creek Superfund Site

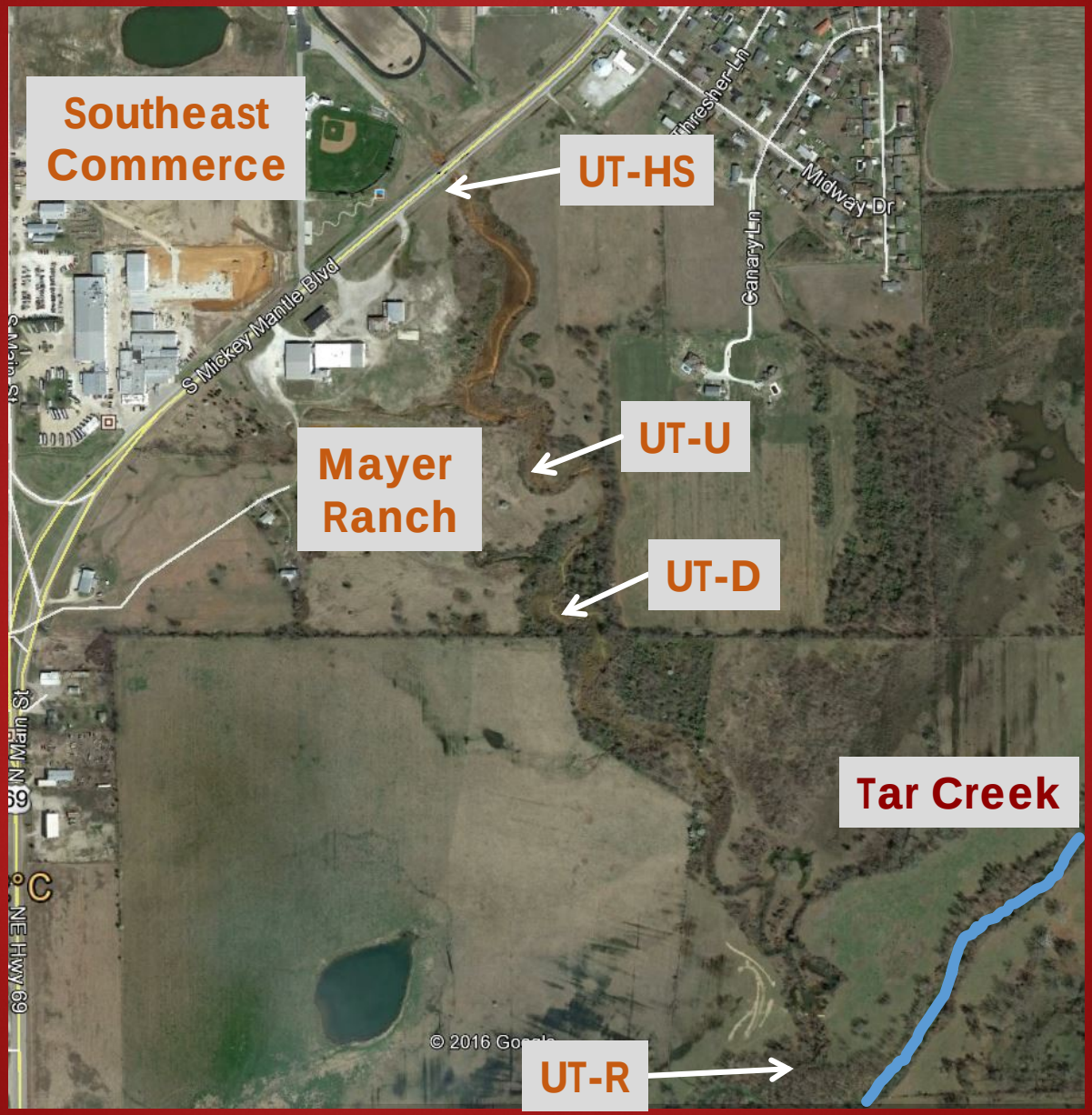
- Oklahoma portion of the abandoned Tri-State Lead-Zinc Mining District
  - Approximately 40 square mile site
  - Trace metal contamination (Fe, Zn, Cd, Pb)
  - Negatively impacts aquatic and terrestrial biota

Unnamed Tributary (UT)



- Located in Commerce, OK
  - Tar Creek Superfund Site
- Impacted by mine drainage
  - SEC: Start of study reach, untreated mine drainage
    - Treatment began Feb. 2017
  - MRPTS: Second source 1/3 mile downstream
    - Treatment began Nov. 2008
- Tributary one mile long and flows into Tar Creek

Unnamed Tributary (UT)



Methods

Fish Collections

- Periodic sampling since 2005
  - Before and after PTS implementation
- 10 seine hauls at each location per sampling event
- Identify fish in the field or laboratory

Timeline: 2005-2007

2005
2006
2007
2008
2009
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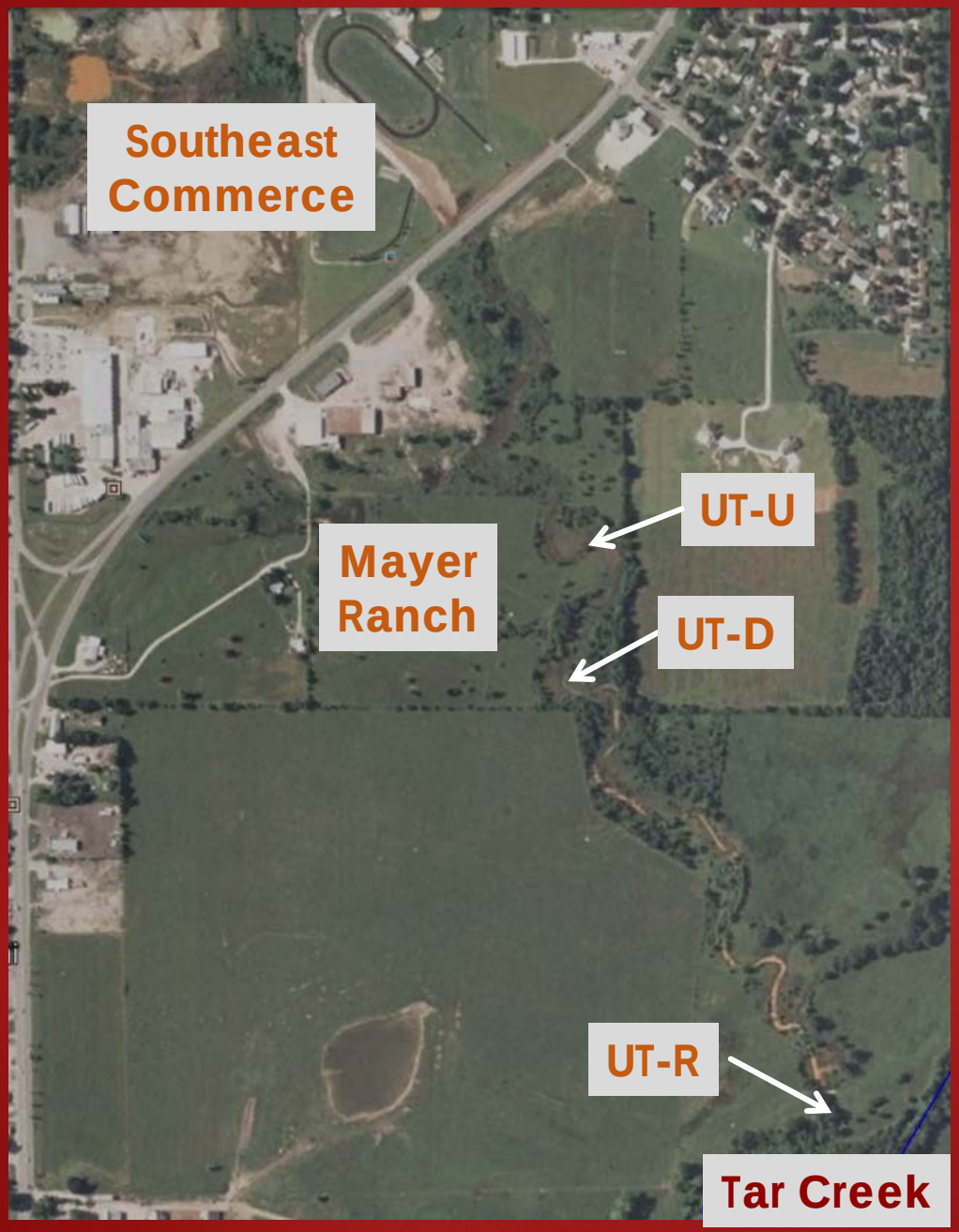
2011
2012
2013
2014
2015
2016
2017
2018



MD Discharge Metals Concentrations (mg/L)

	SEC	MR
[Fe]	133	175
[Zn]	9.71	8.42
[Pb]	0.063	0.069
[Cd]	0.031	0.016

Timeline: 2009-2016

2005
2006
2007
2008
2009
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2011
2012
2013
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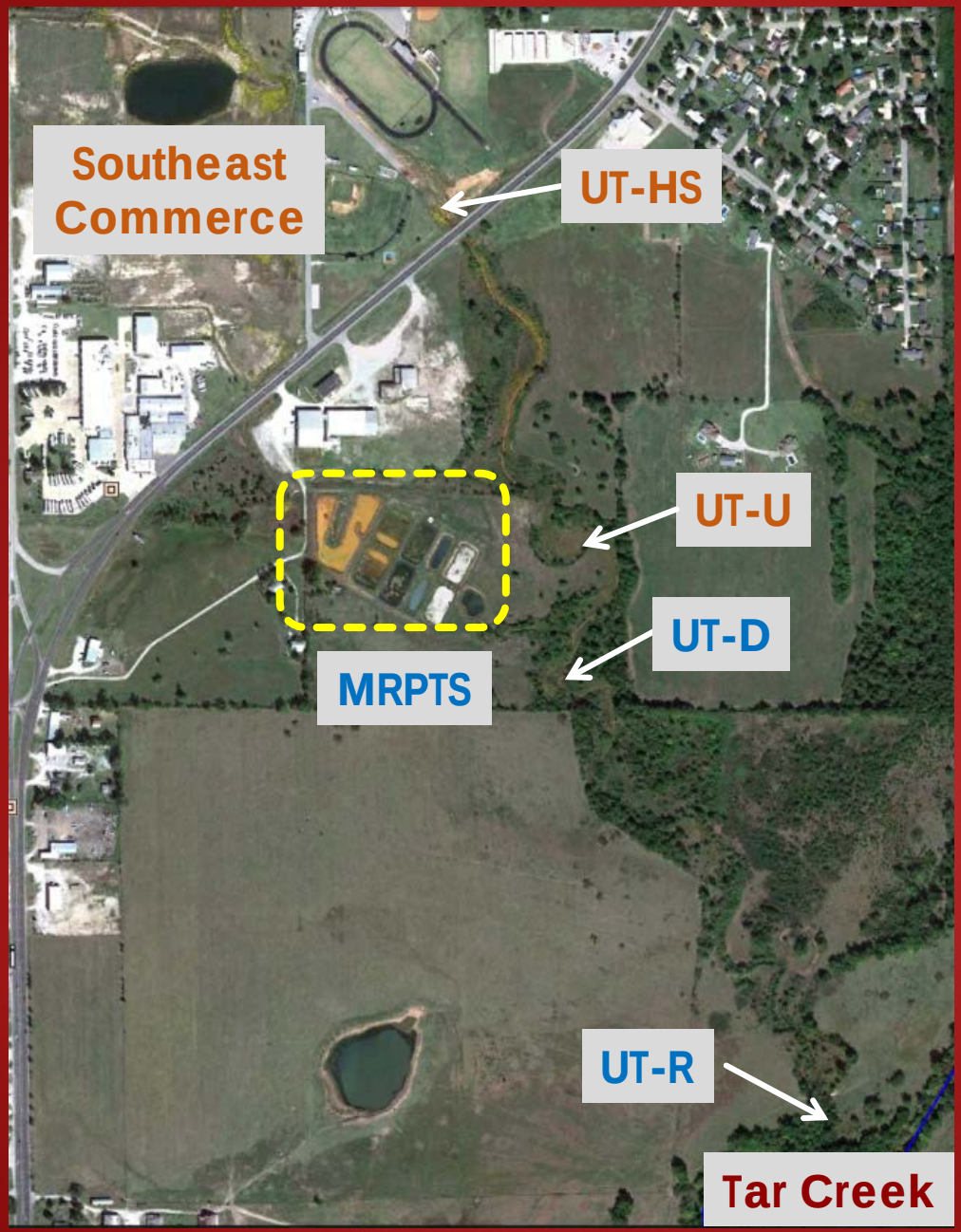
2015
2016
2017
2018



MD Discharge Metals Concentrations (mg/L)

	SEC	MRPTS
[Fe]	133	0.65
[Zn]	9.71	0.46
[Pb]	0.063	<PQL
[Cd]	0.031	<PQL

Timeline: 2017-2018

2005
2006
2007
2008
2009
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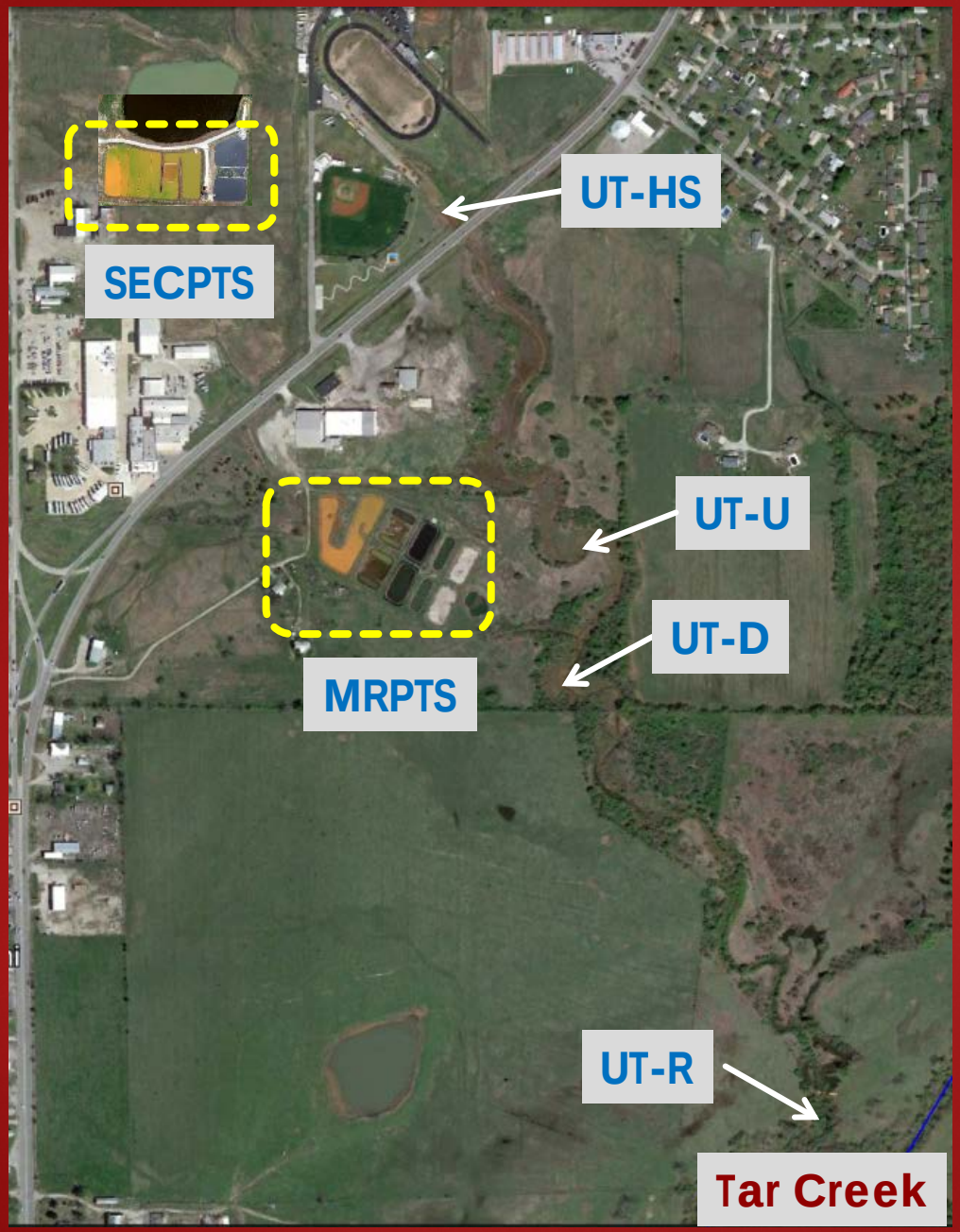
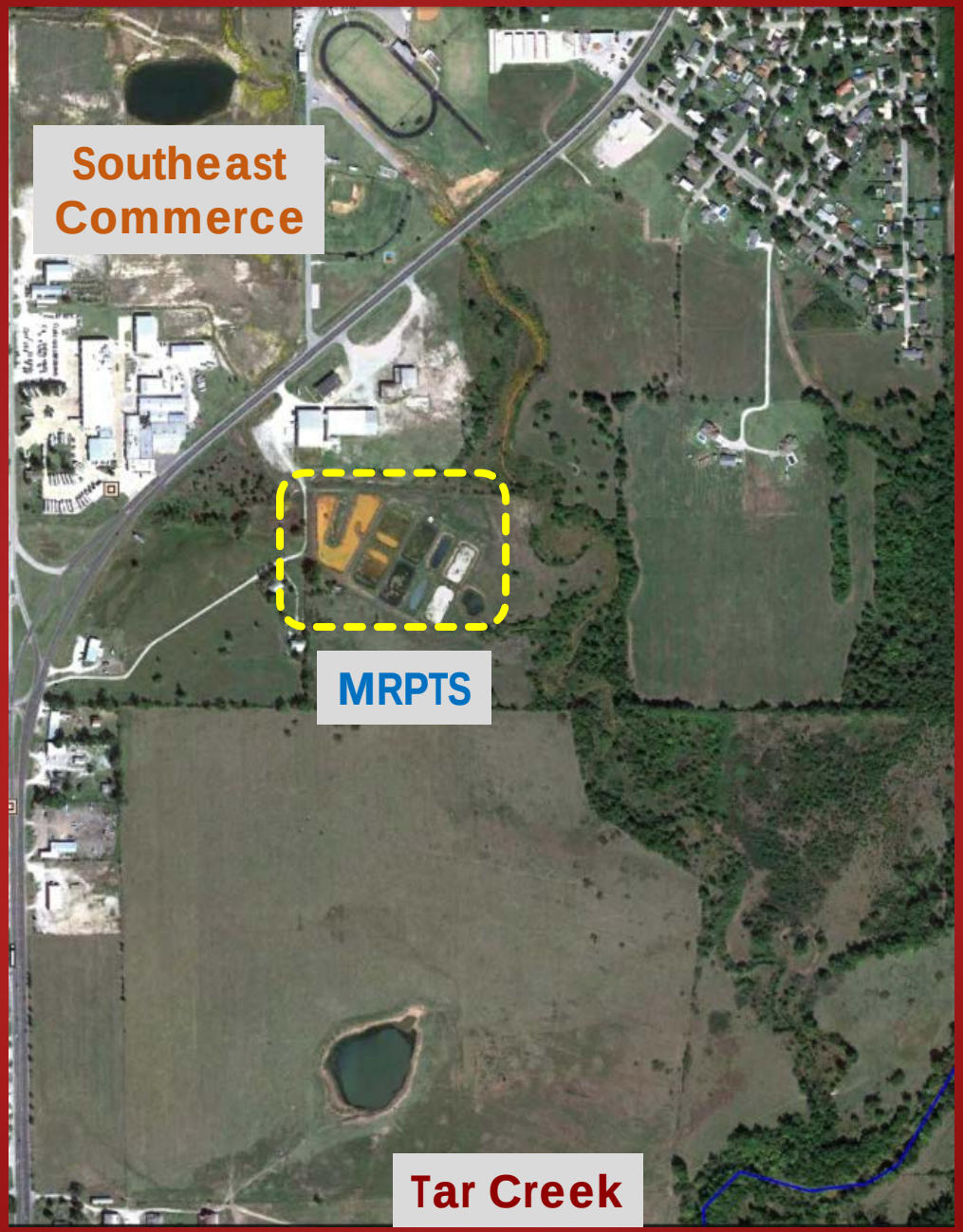
2011
2012
2013
2014
2015
2016
2017
2018



MD Discharge Metals Concentrations (mg/L)

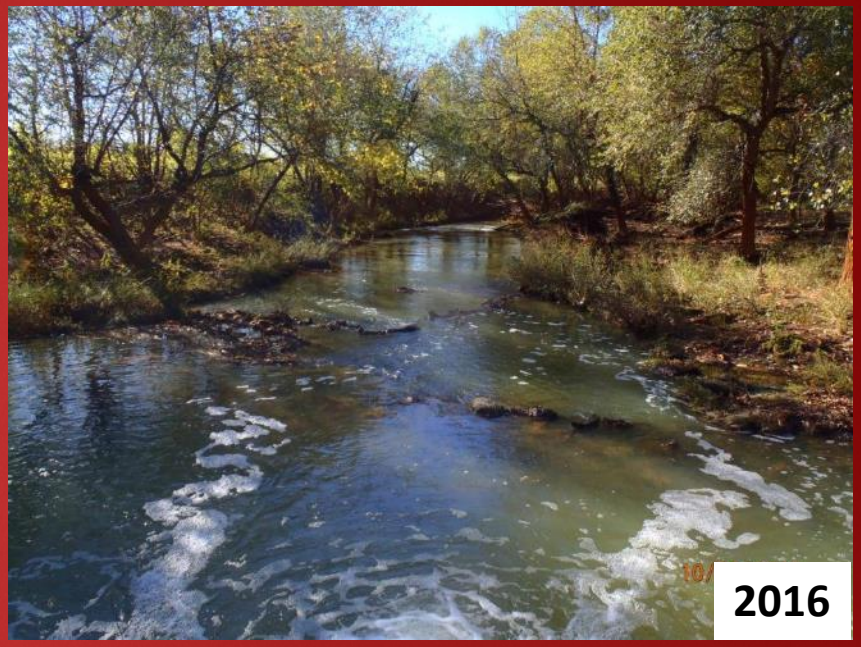
	SEC	MRPTS
[Fe]	0.86	0.65
[Zn]	0.13	0.46
[Pb]	0.028	<PQL
[Cd]	<PQL	<PQL

Results

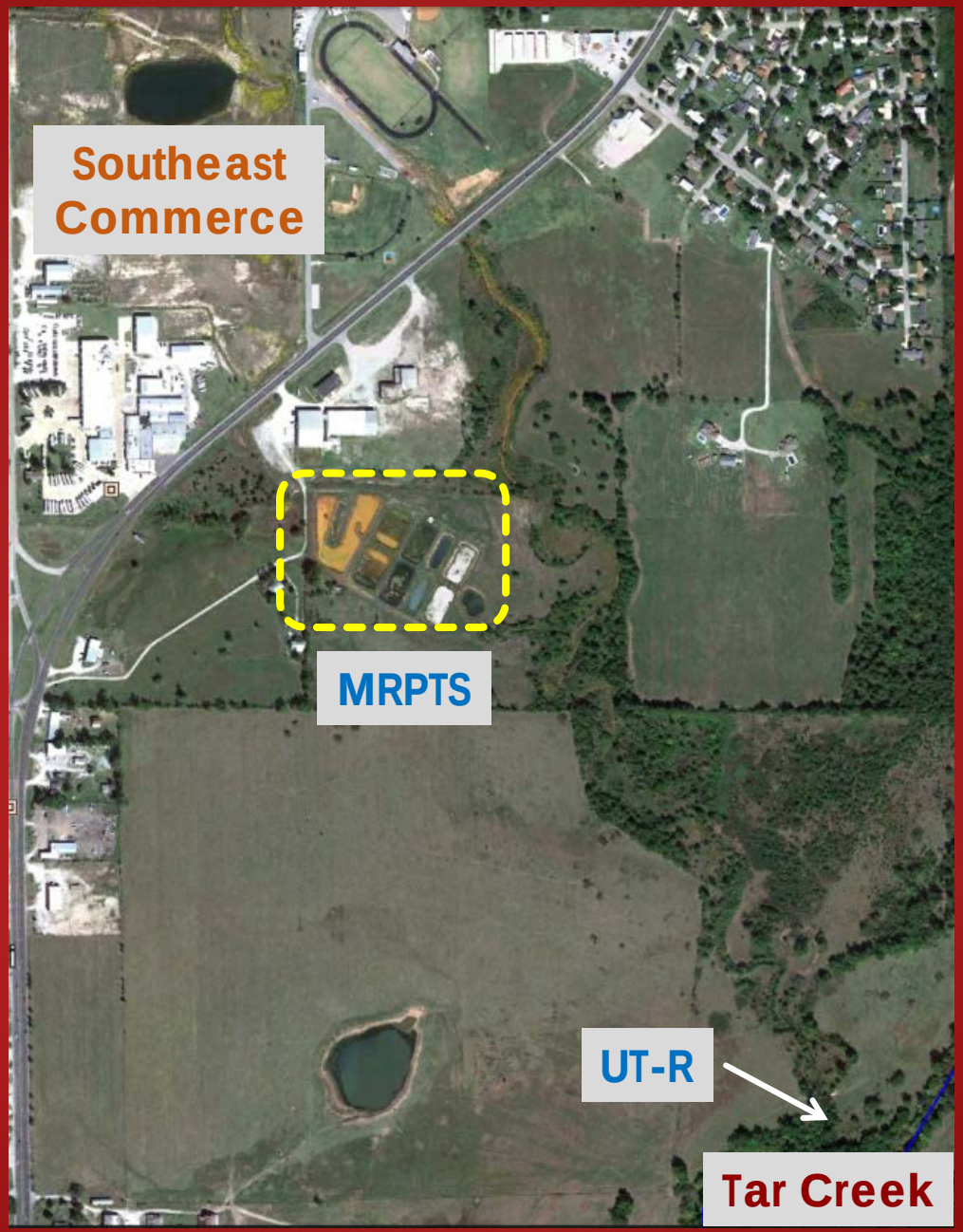

Southeast Commerce
MRPTS
Tar Creek

Tar Creek-Robinson

Fishes available to colonize UT from Tar Creek	
Black Bullhead Catfish	Bluegill Sunfish
Central Stoneroller	Longear Sunfish
River Carpsucker	Redear Sunfish
Bluntface Shiner	Cardinal Shiner
Red Shiner	Redfin Shiner
Bluntnose Darter	Largemouth Bass
Blackstripe Topminnow	Emerald Shiner
Western Mosquitofish	Golden Shiner
Smallmouth Buffalo	Carmine Shiner
Channel Catfish	Logperch
Brook Silversides	Bluntnose Minnow
Green Sunfish	Bullhead Minnow
Warmouth Sunfish	White Crappie
Orangespotted Sunfish	Black Crappie
Hybrid Sunfish	



At Least 29 Species Available to Colonize UT


Southeast Commerce
MRPTS
UT-R
Tar Creek

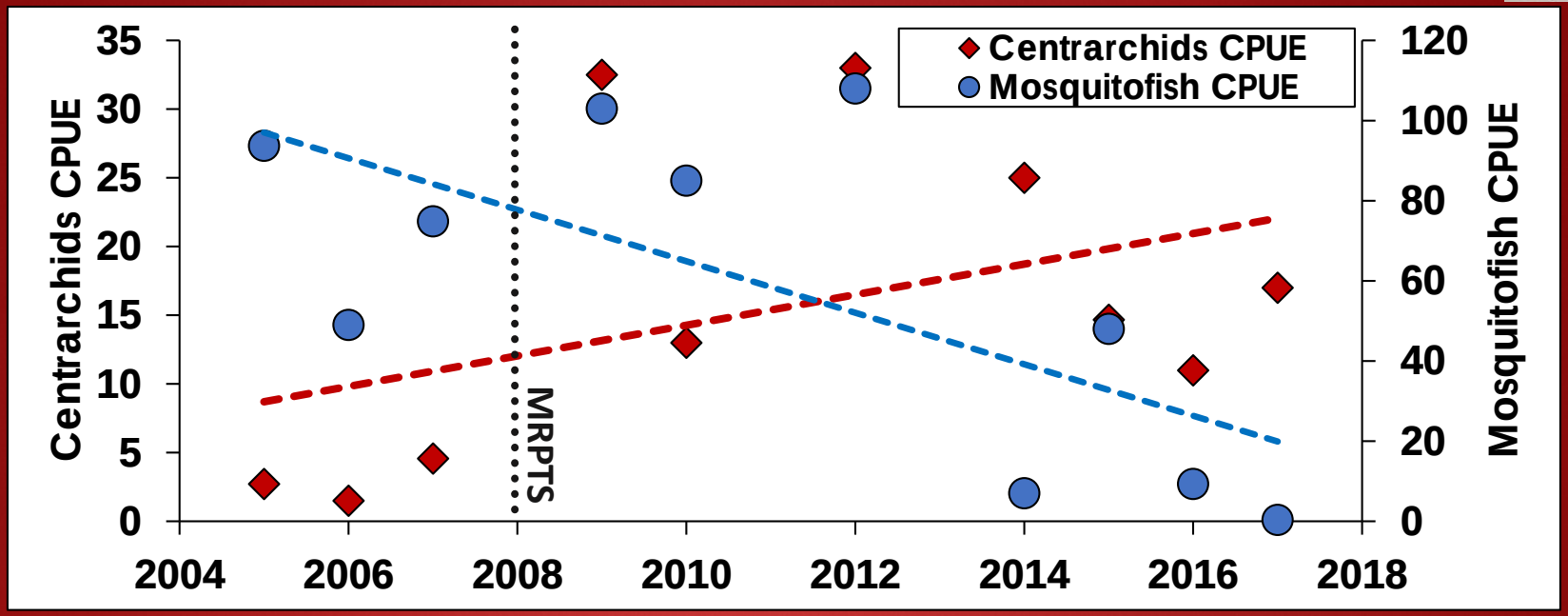
UT-Robinson

UT-R annual average CPUE before and after MRPTS construction

Species	2005-2007	2008	2009-2018
Western Mosquitofish	72.52		46.90 ↓
Green Sunfish	2.64		9.27 ↑
Bluegill Sunfish	0.29		3.15 ↑
Blackstripe Topminnow	0.14		15.83 ↑
Slough Darter	0.19		0.27 ↑
Black Bullhead Catfish	0.05		
River Carpsucker	0.04		
Golden Shiner	0.10		
Bluntnose Darter			0.04
Brook Silversides			6.63
Warmouth Sunfish			0.19
Orangespotted Sunfish			0.79
Longear Sunfish			0.77
Redear Sunfish			3.23
Largemouth Bass			0.56
White Crappie			0.04
Hybrid Sunfish			0.38
Total Species	8		13

MRPTS Construction

UT-Robinson


Centrarchids CPUE
Mosquitofish CPUE
Centrarchids CPUE
Mosquitofish CPUE
MRPTS
0
5
10
15
20
25
30
35
0
20
40
60
80
100
120
2004
2006
2008
2010
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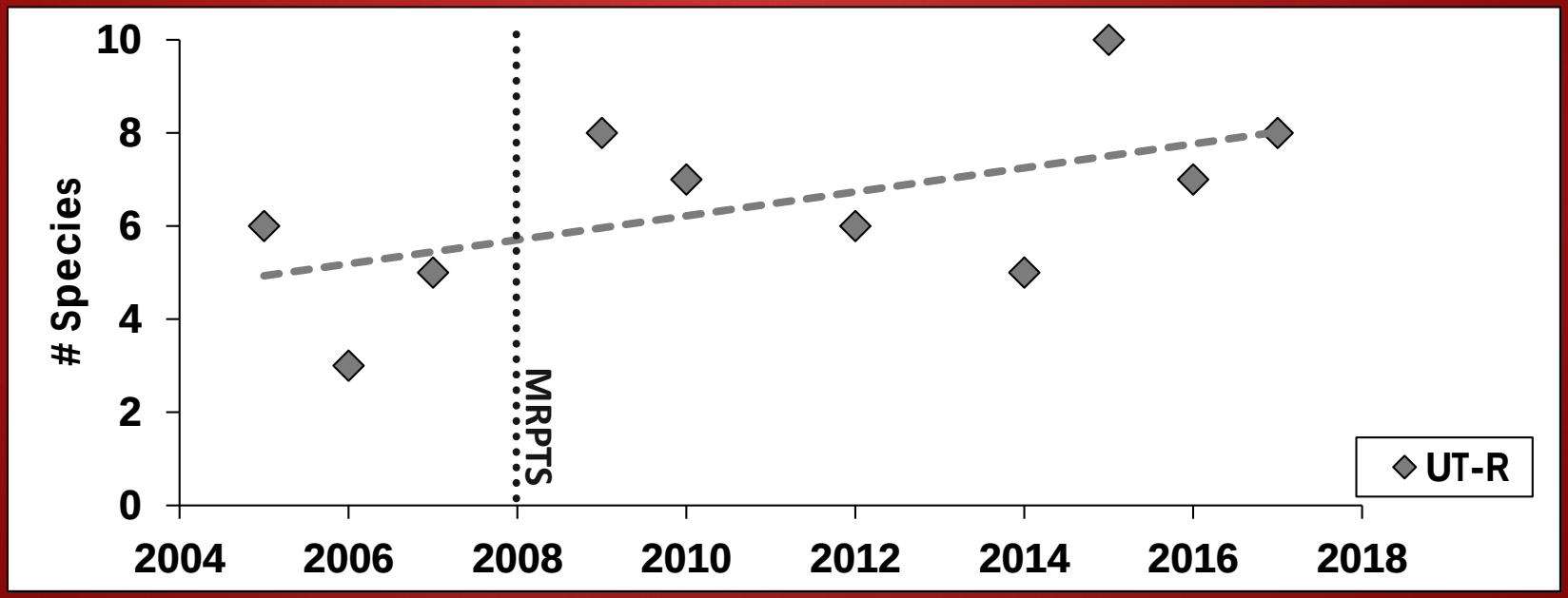
Species
MRPTS
UT-R
0
2
4
6
8
10
2004
2006
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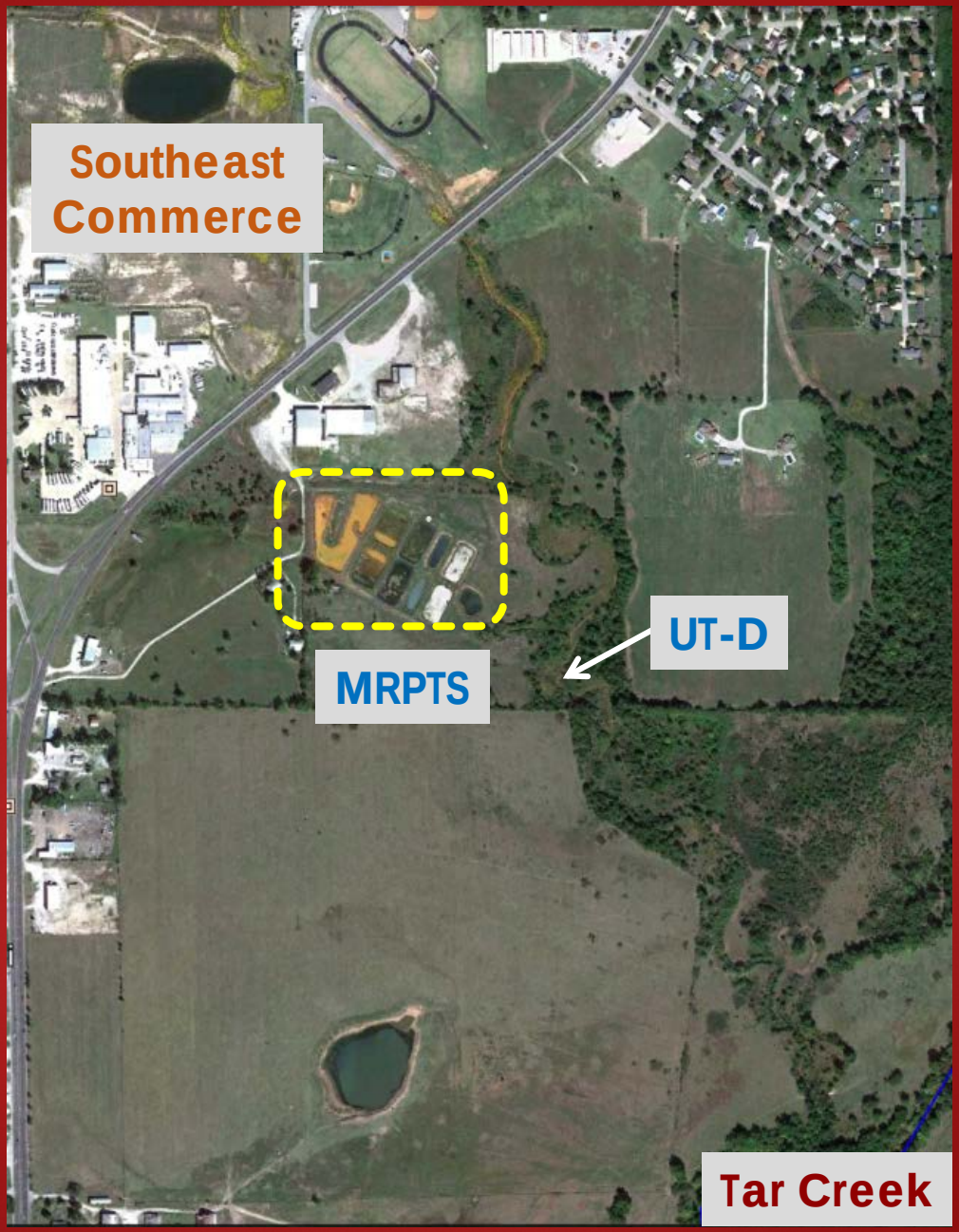
2018

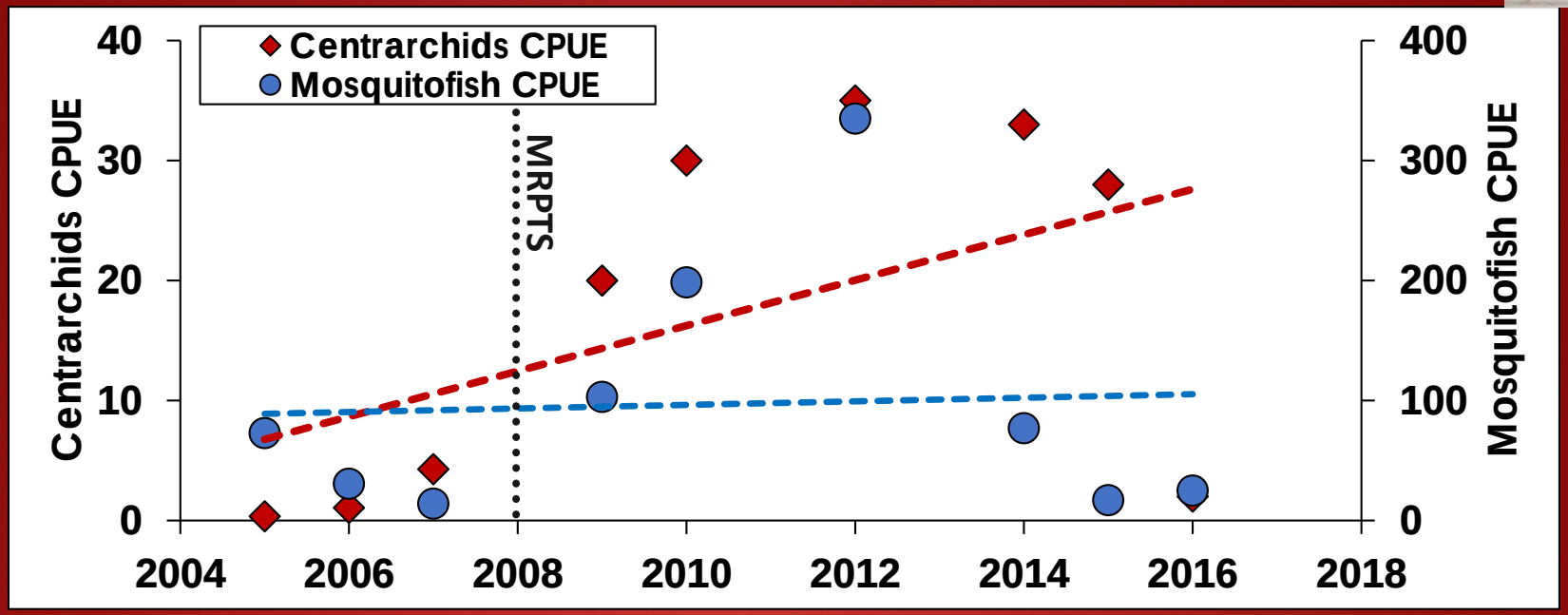

Southeast Commerce
MRPTS
UT-D
Tar Creek

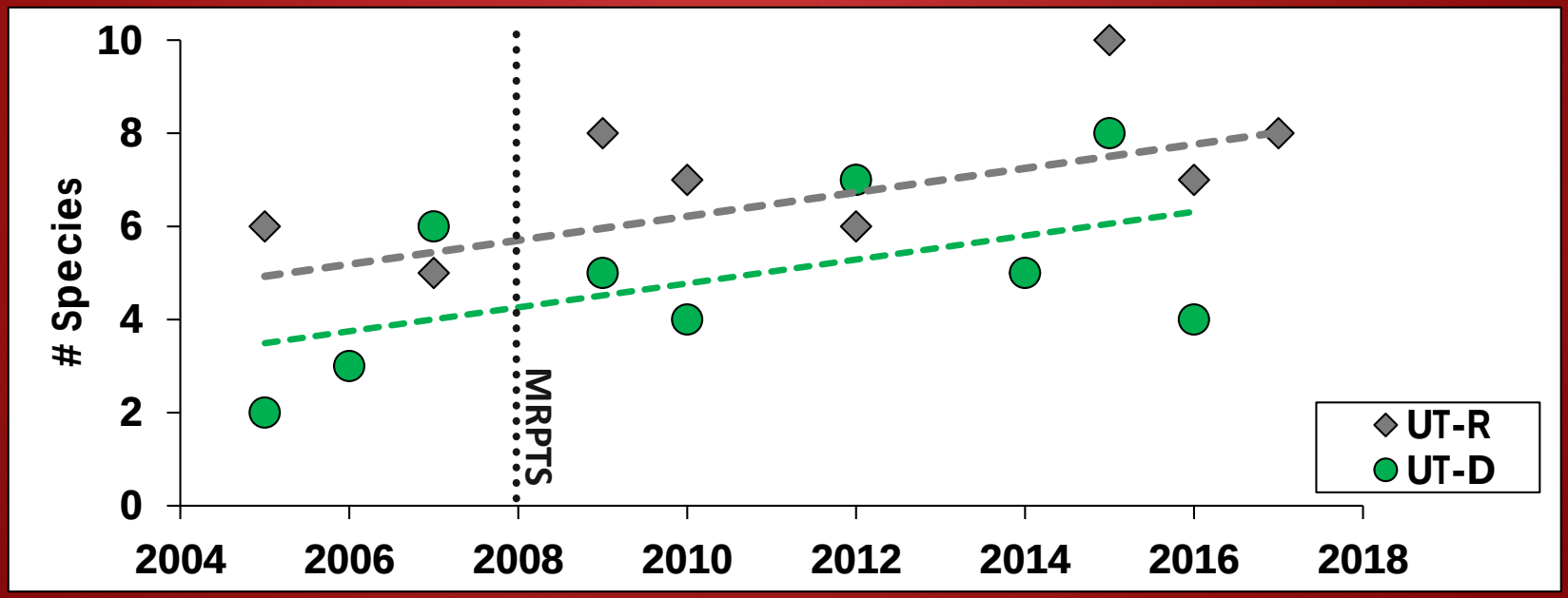
UT- Downstream of MRPTS

UT-D annual average CPUE before and after MRPTS construction

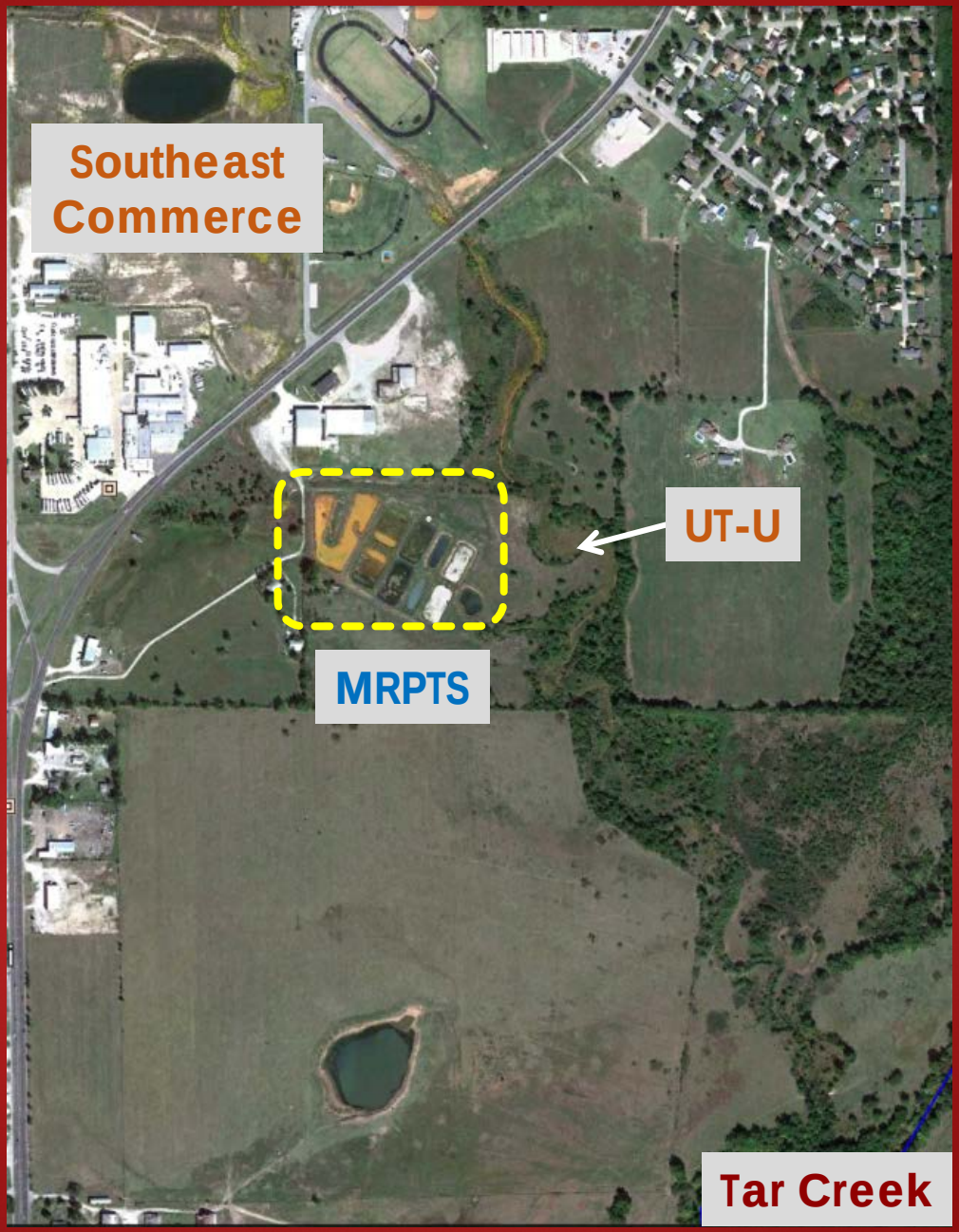
Species	2005-2007	2008	2009-2016
Western Mosquitofish	39.24		125.92 ↑
Green Sunfish	0.81		14.08 ↑
Bluegill Sunfish	1.00		5.50 ↑
Warmouth Sunfish	0.07		0.42 ↑
Longear Sunfish	0.02		3.00 ↑
Golden Shiner	0.17		0.50 ↑
Black Bullhead Catfish		MRPTS Construction	0.22
Largemouth Bass			0.56
Slough Darter			0.67
Blackstripe Topminnow			1.06
Redear Sunfish			1.00
Hybrid Sunfish			0.11
Total Species	6		11

UT-Downstream of MRPTS





UT- Downstream of MRPTS

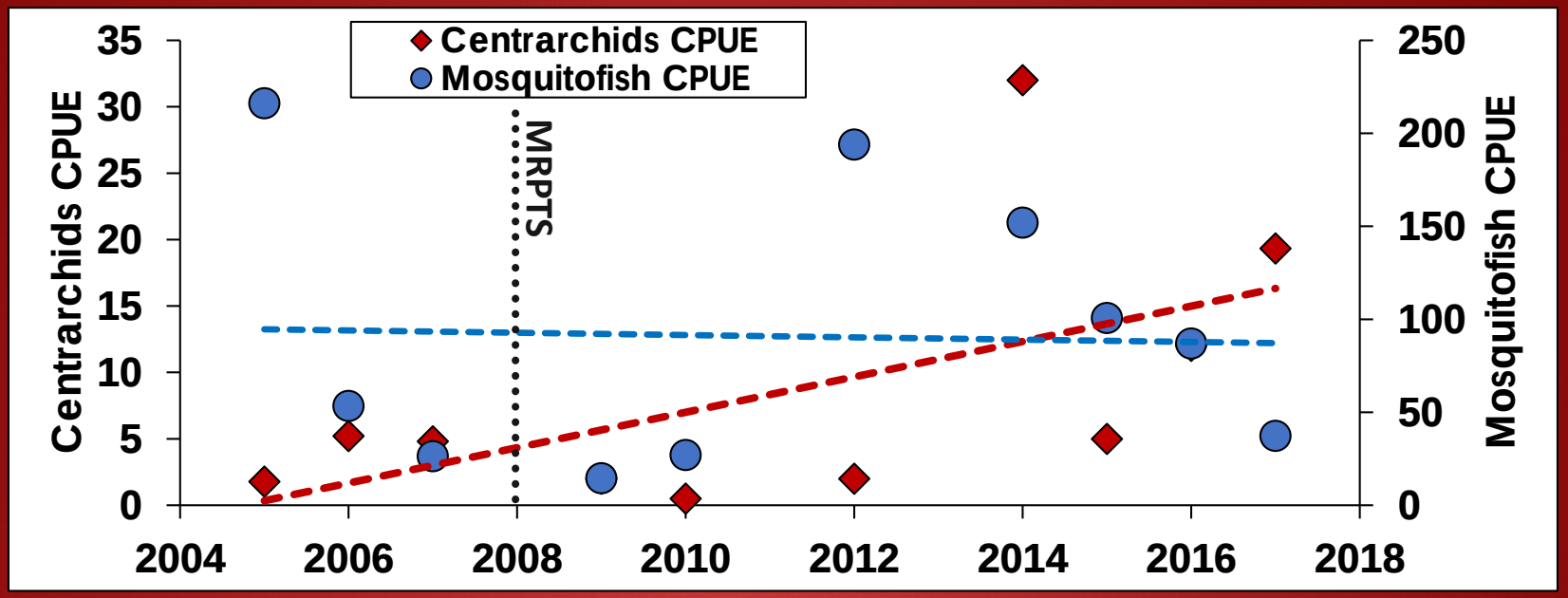

Southeast Commerce
UT-U
MRPTS
Tar Creek

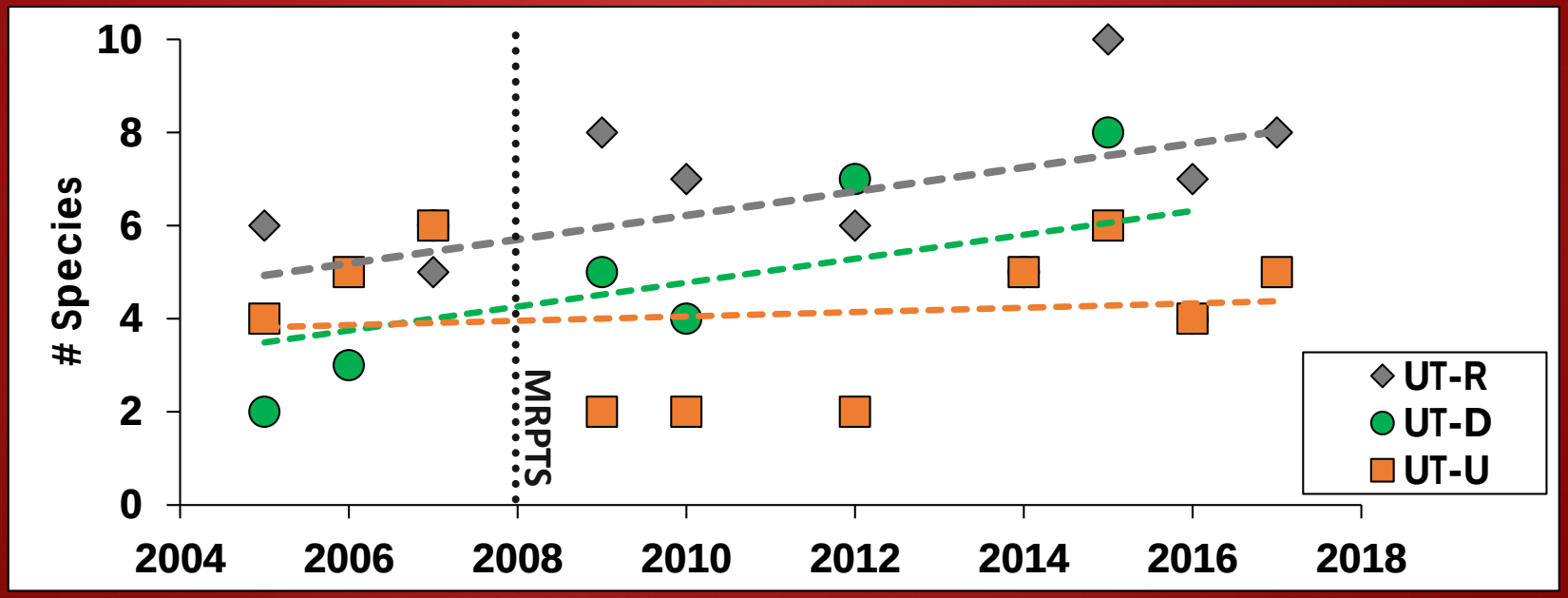
UT- Upstream of MRPTS

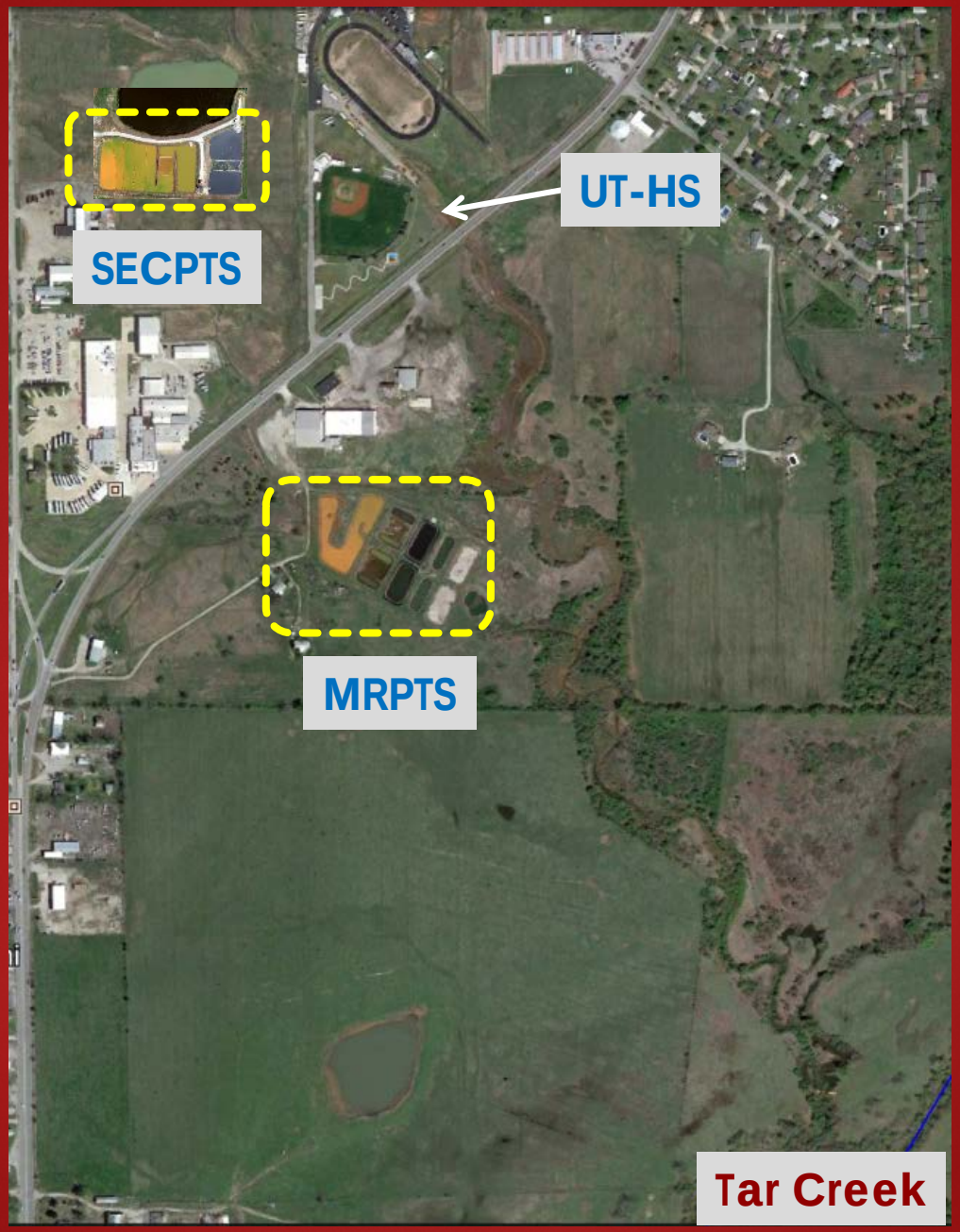
UT-U annual average CPUE before and after MRPTS construction

Species	2005-2007	2008	2009-2018
Western Mosquitofish	98.67		79.50 ↓
Green Sunfish	3.24		5.44 ↑
Bluegill Sunfish	0.19		1.25 ↑
Warmouth Sunfish	0.05		0.19 ↑
Largemouth Bass	0.06		2.50 ↑
Black Bullhead Catfish	0.05		0.13 ↑
Redear Sunfish	0.02		
Golden Shiner	0.19		
Slough Darter		MRPTS Construction	0.13
Blackstripe Topminnow			1.96
Total Species	8		8

UT-Upstream of MRPTS





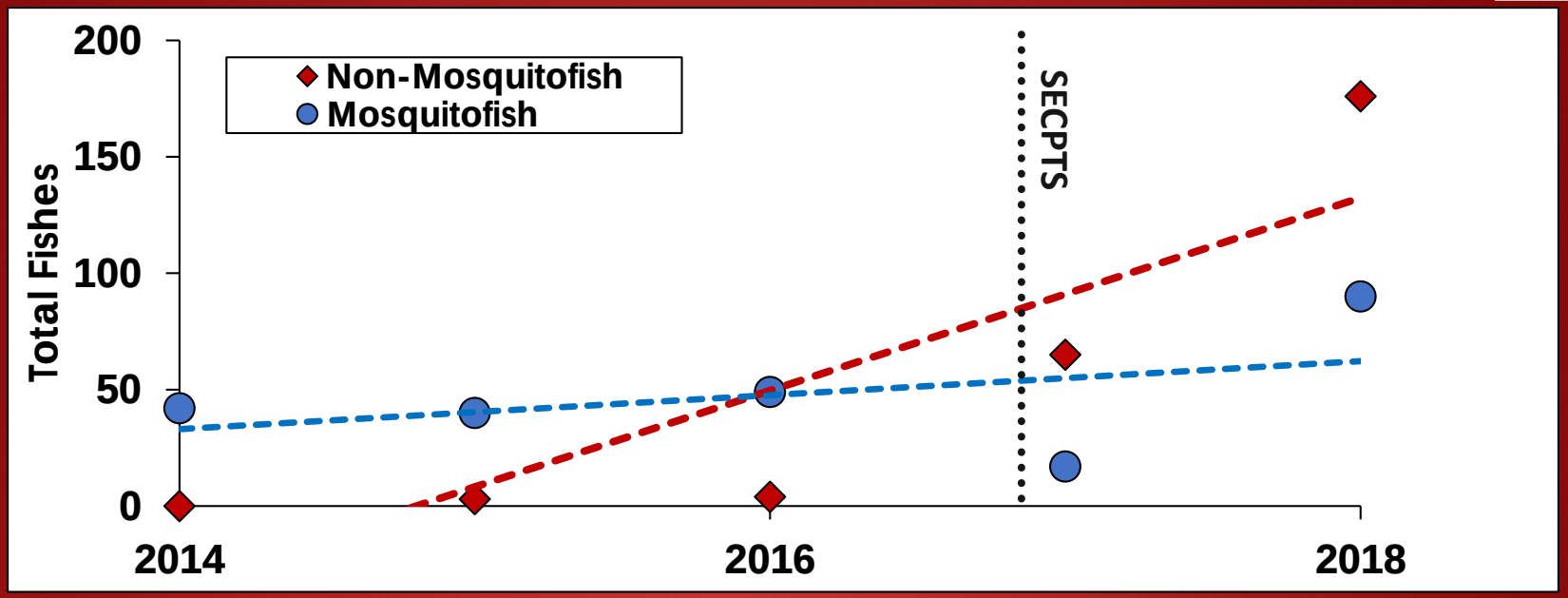

SECPTS
UT-HS
MRPTS
Tar Creek

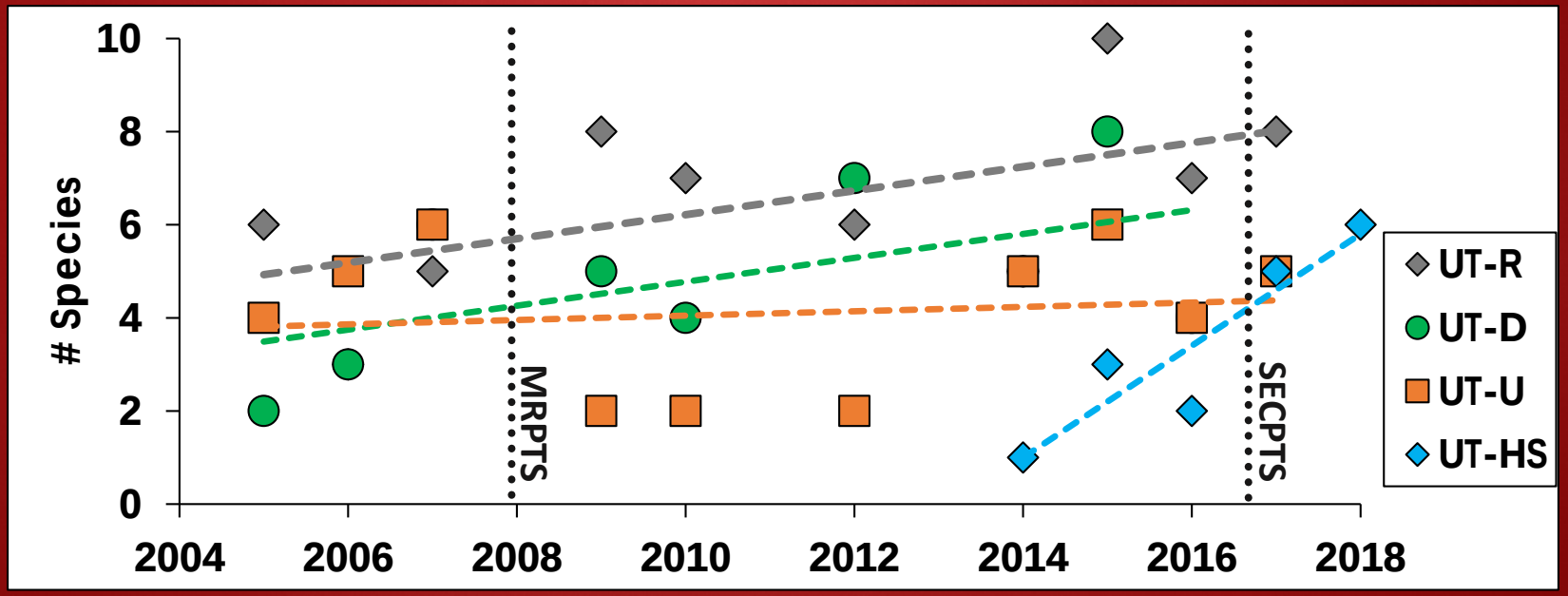
UT- Highschool

UT-HS Total fish caught before and after SECPTS construction

Species	2014-2016	2017	2017-2018	
Sample Size	7		5	
Western Mosquitofish	131	SECPTS Completed	107	↓
Bluegill Sunfish	4		188	↑
Green Sunfish	2		42	↑
Largemouth Bass	1		2	↑
Blackstripe Topminnow			6	
Warmouth Sunfish			3	
Total Fish	138		339	
Total Non-Mosquitofish	7		232	
Total Species	4		6	

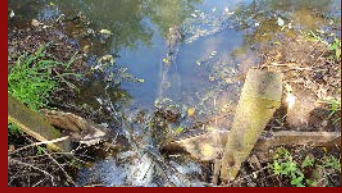
UT- Highschool





Conclusions

Conclusions



- Diversity and quantity of fish has increased after implementation of passive treatment systems
  - UT-R 8 increased to 12 species
  - UT-D 6 increased to 11 species
  - UT-HS 4 increased to 6 species
    - with 97% increase in non-mosquito fish per sample

- Passive treatment has significantly decreased metals concentrations and increased fish species diversity in UT

- Continued monitoring is warranted to determine the impact of SECPTS over the next few years

Acknowledgements

- Property owners: Mayer, Robinson, Martin Families
- University of Oklahoma Zoology/Biology Department
  - Dr. Matthews and students
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Questions?