Recovery of Fish Populations in an Unnamed Tributary to Tar Creek After The Implementation of Two Passive Treatment Systems

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Introduction

Methods

Results

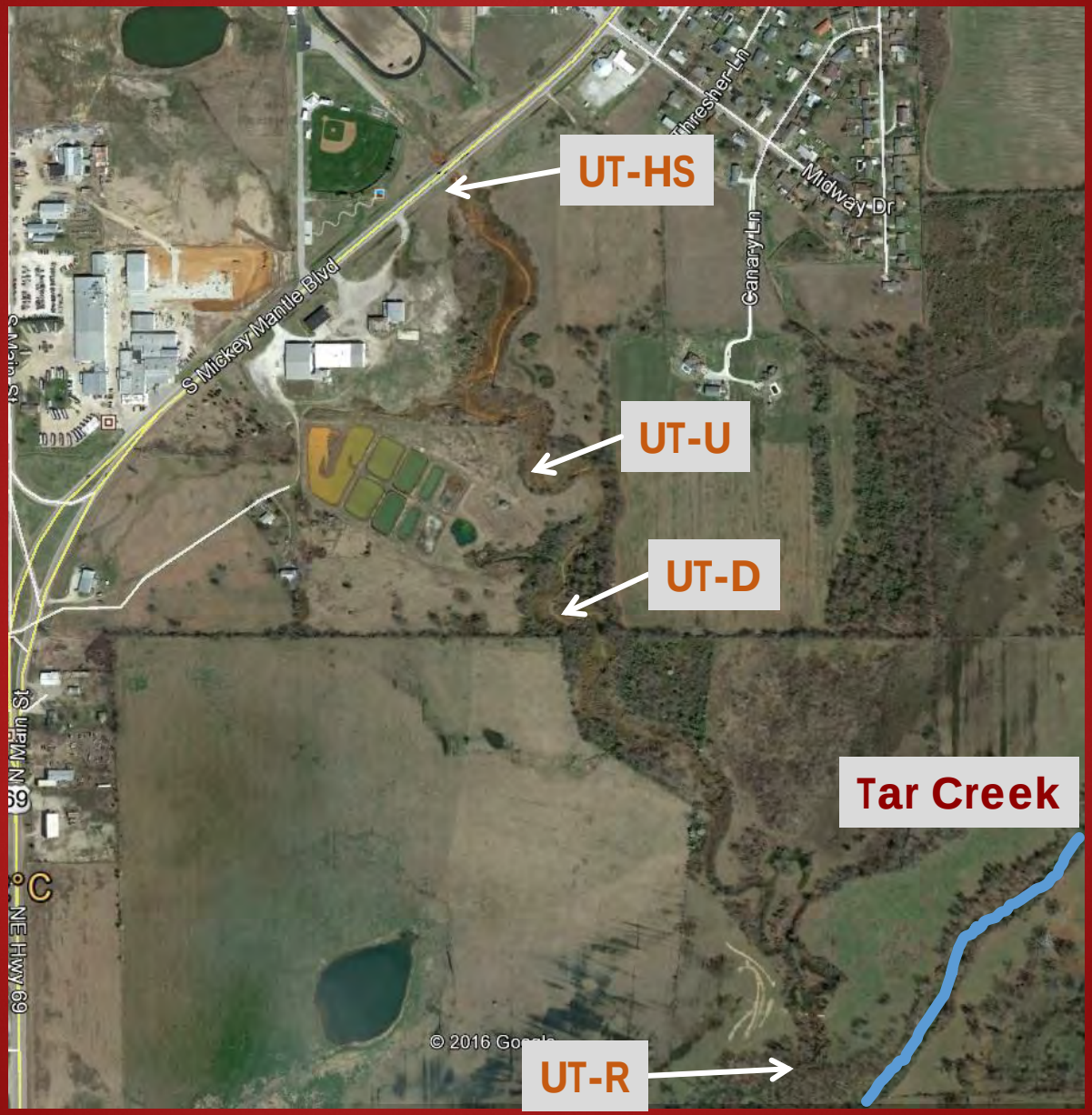
Conclusions

Introduction

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

Introduction: Unnamed Tributary (UT)



Introduction: Passive Treatment

- Naturally-occurring biogeochemical, microbiological and ecological processes
- Driven by renewable energies
- Low O&M costs but larger land areas

Ecological Engineering!

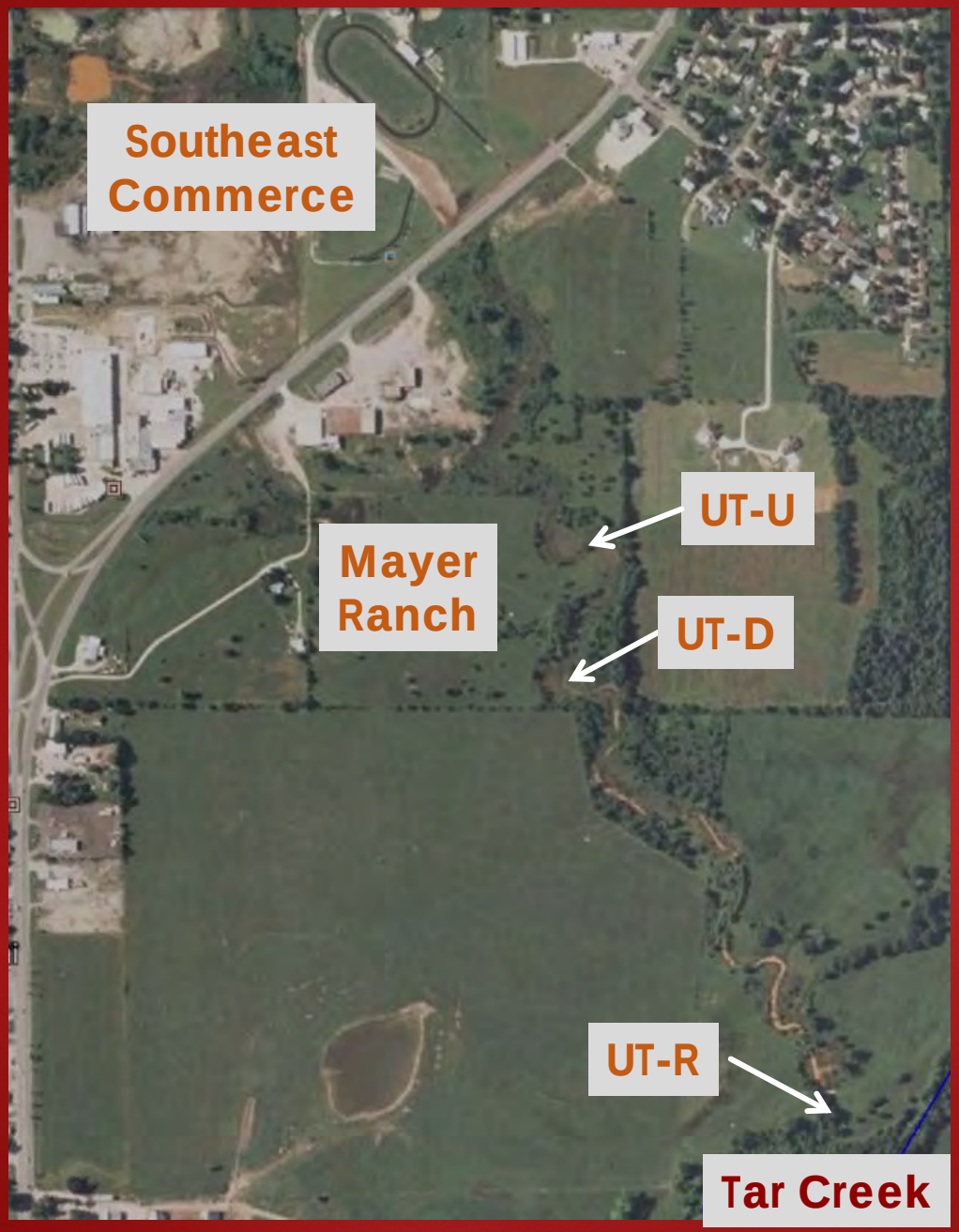
Methods

Methods: Fish Collection

- 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

Methods: Timeline

2005
2006
2007
2008
2009
2010
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

Methods: Timeline

2005
2006
2007
2008
2009
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2011
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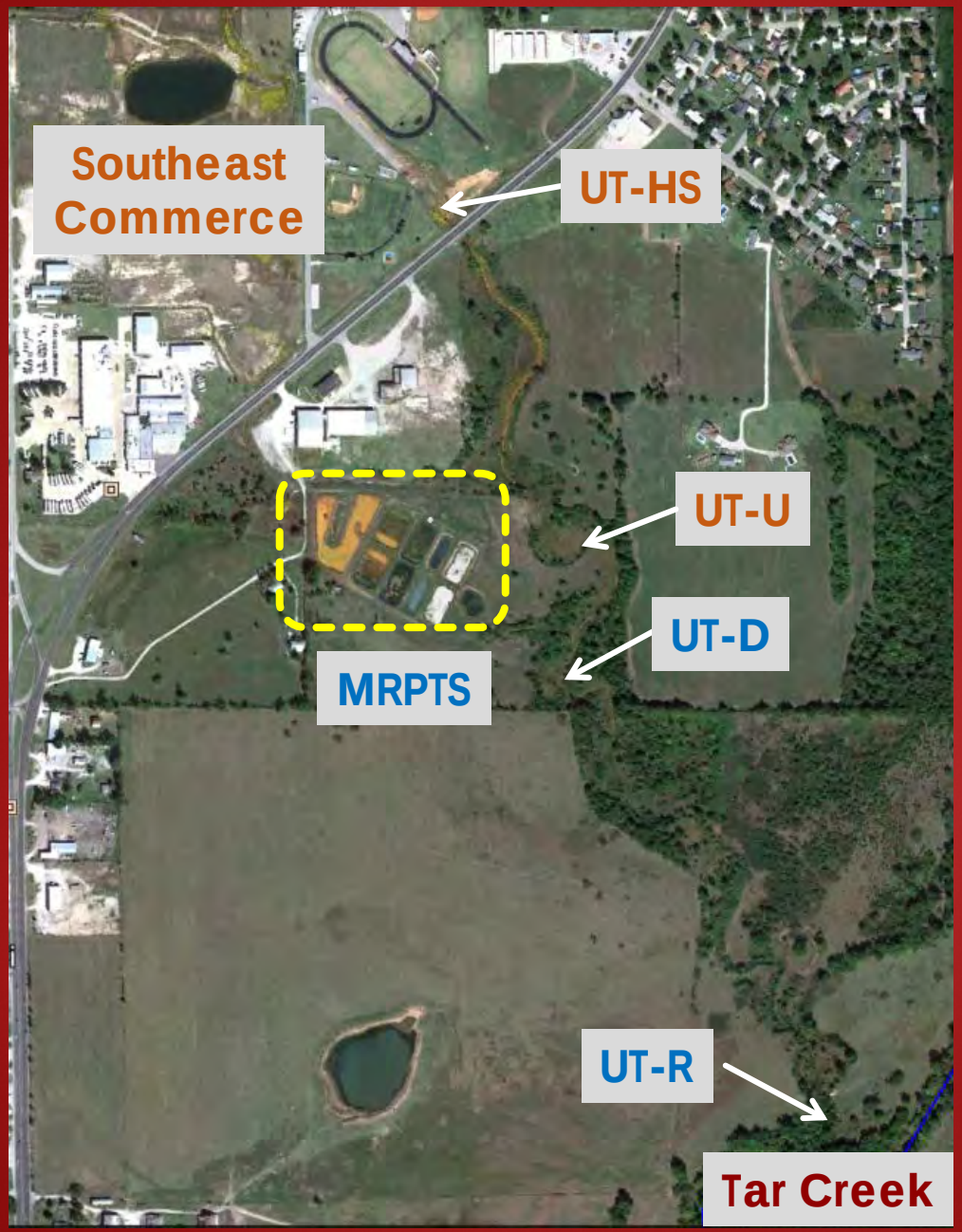
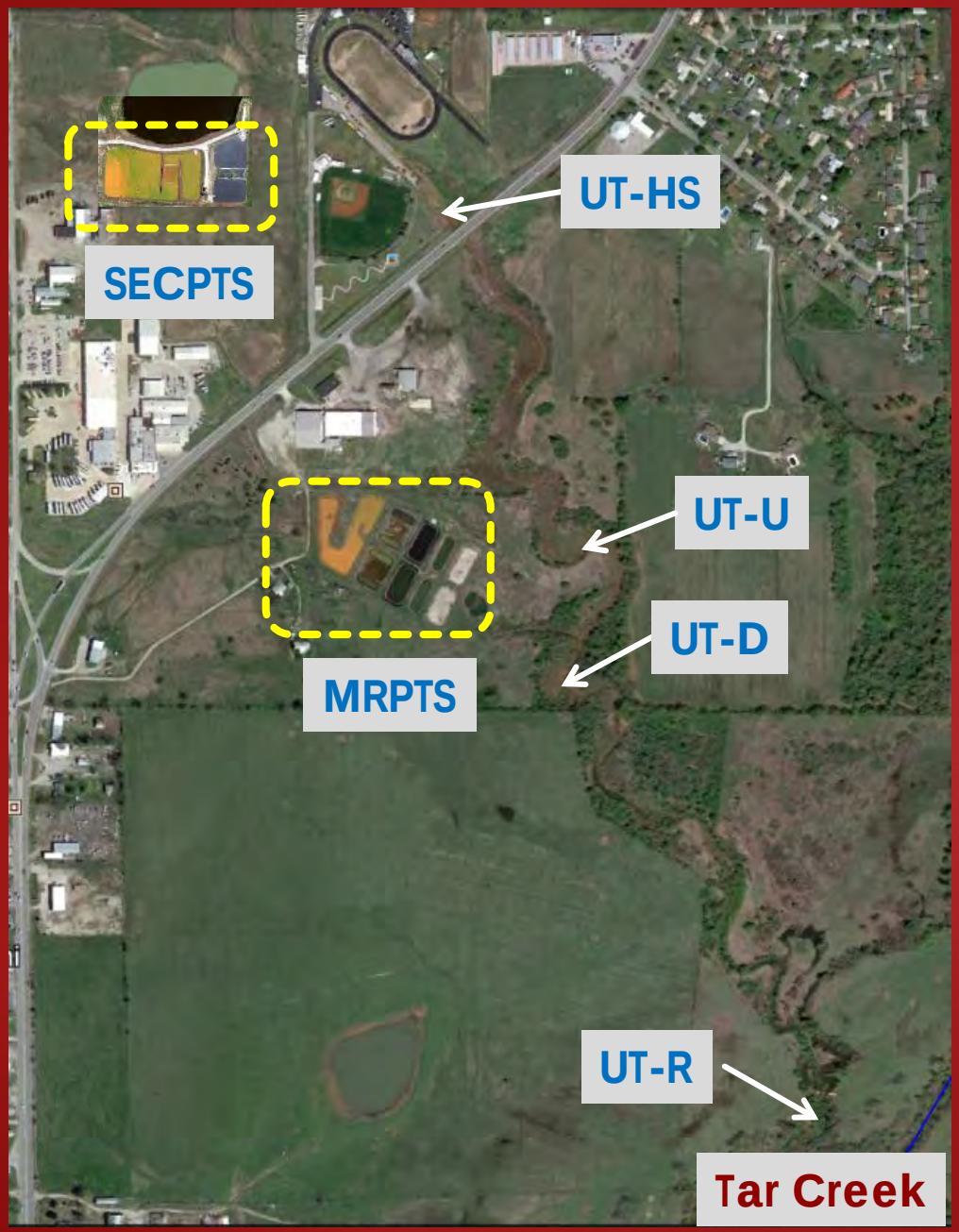


MD Discharge Metals Concentrations (mg/L)

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

Methods: Timeline

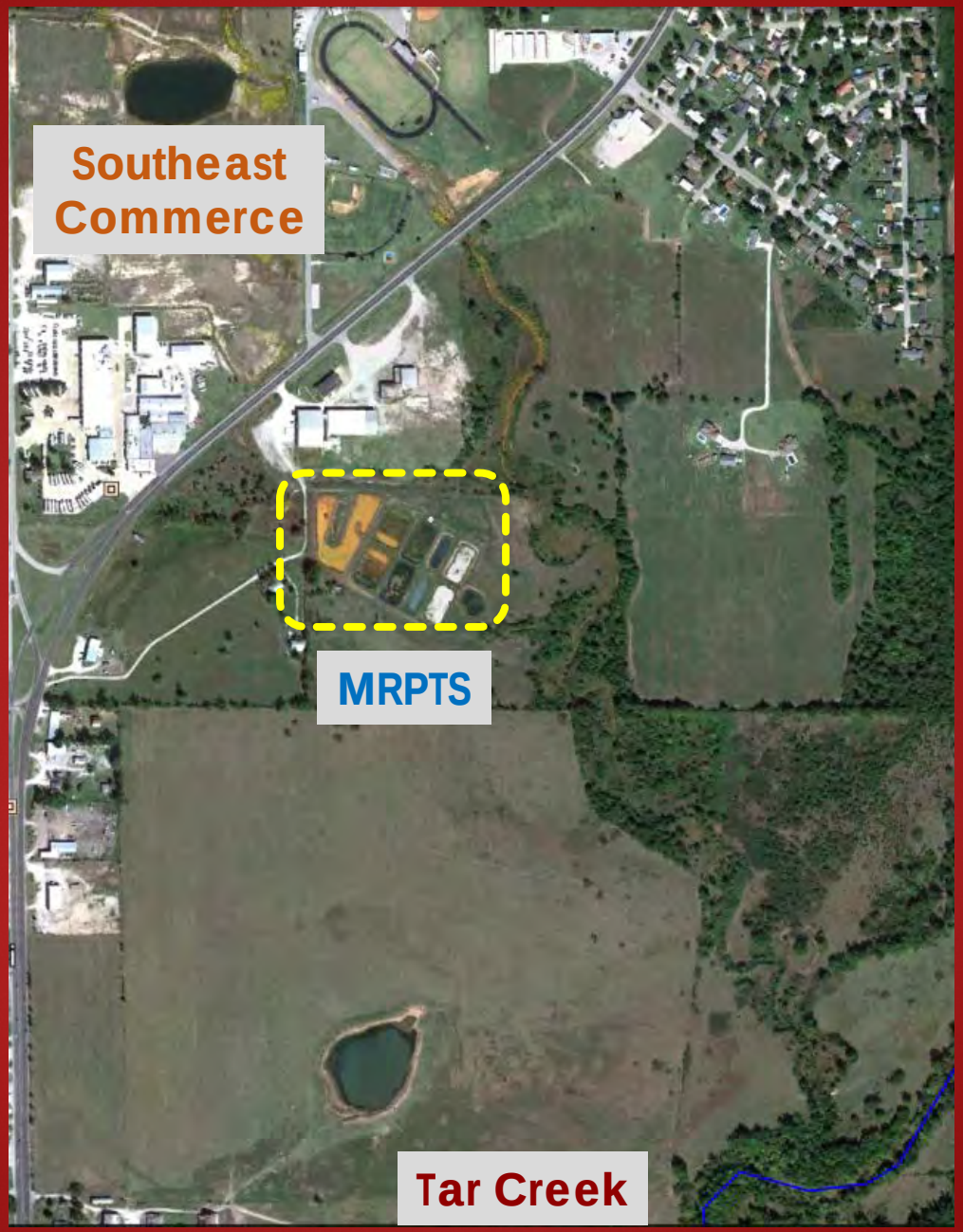
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018



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

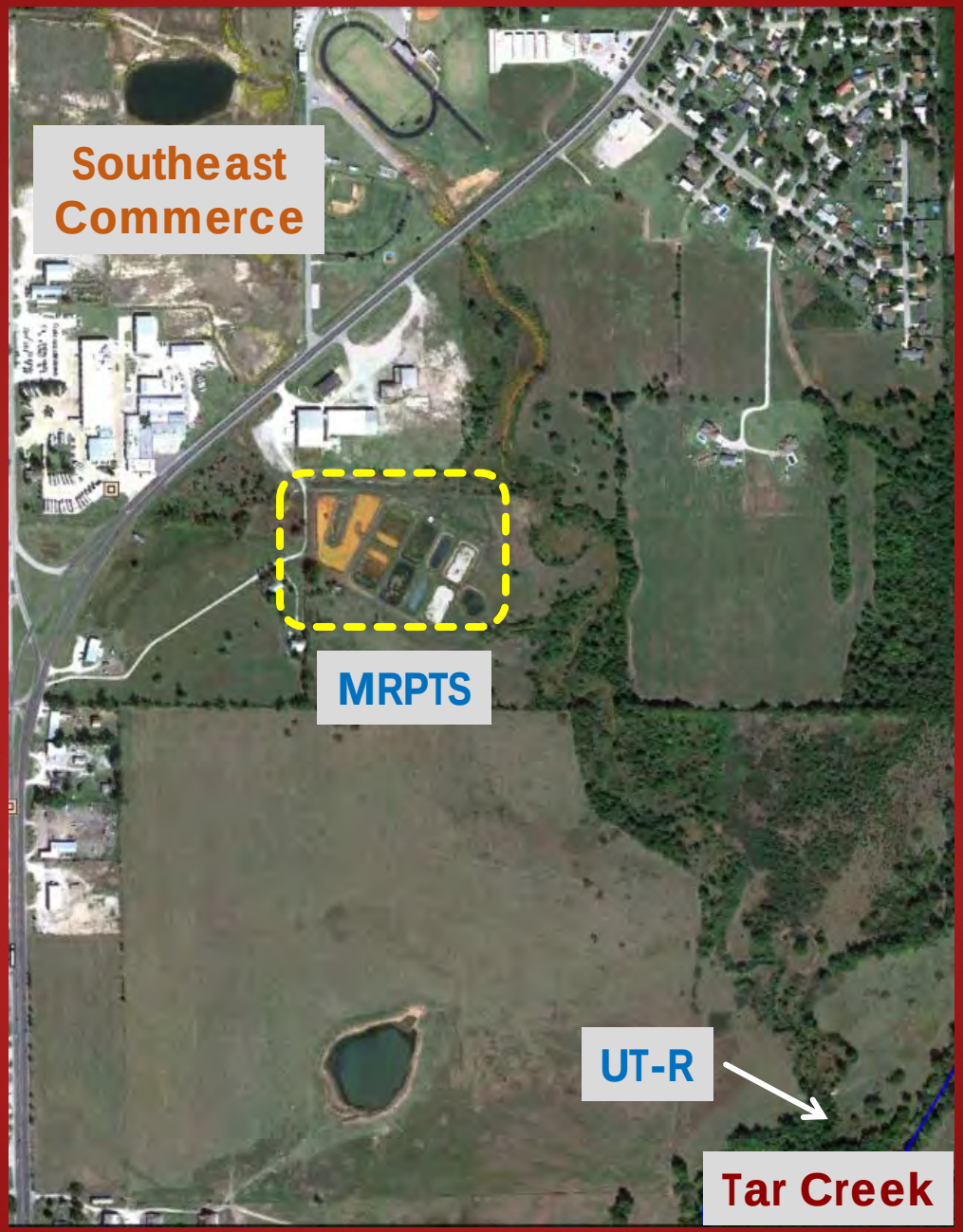
Results


Southeast Commerce
MRPTS
Tar Creek

Results: Tar Creek-Robinson

Fishes available to colonize UT from Tar Creek

Possible New Species for Unnamed Tributary	Total caught 2005-2010 in Tar Creek
Red shiner	93
Redfin shiner	65
Central Stoneroller	63
Largemouth bass	53
Bluntnose minnow	6
Smallmouth buffalo	5
Redear sunfish	3
Emerald shiner	3
Brook silversides	2
Logperch	2
Channel catfish	2
Orangespotted sunfish	1
White crappie	1
Bullhead minnow	1
Bluntface shiner	1
Total Species	15

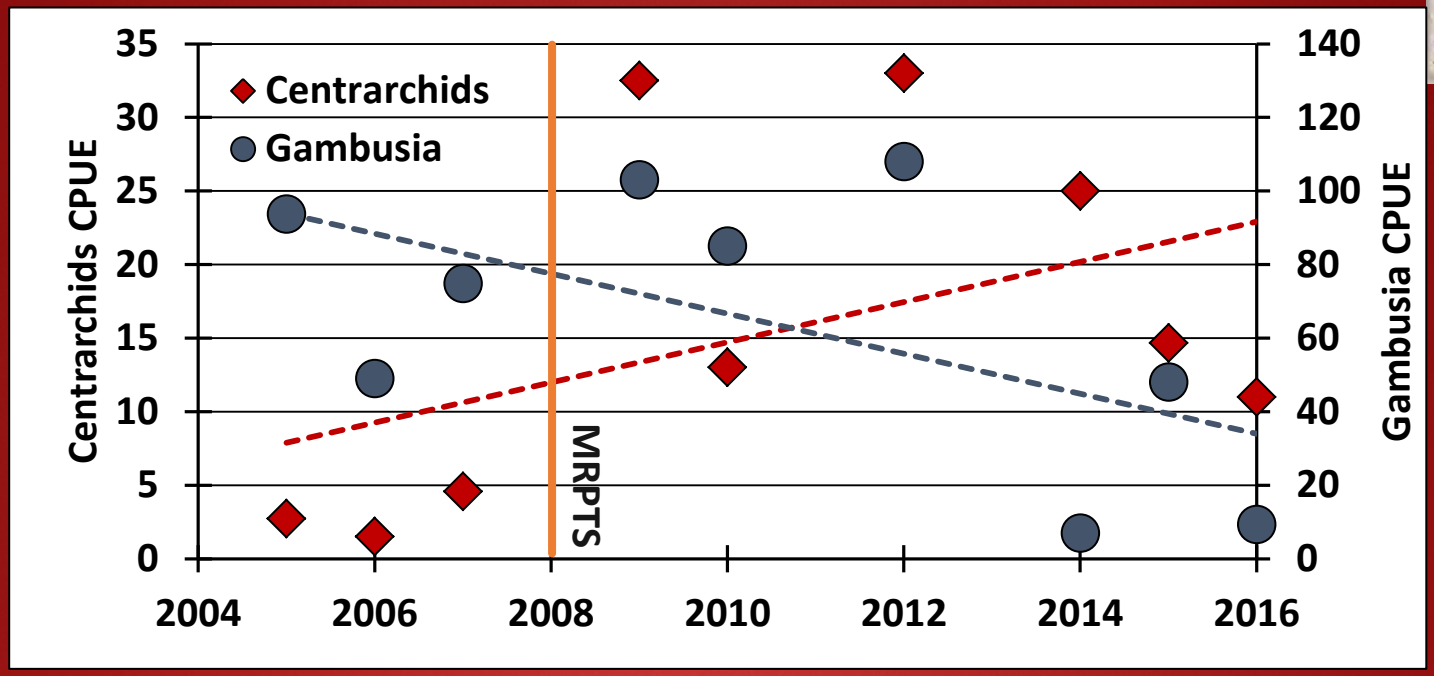

Southeast Commerce
MRPTS
UT-R
Tar Creek

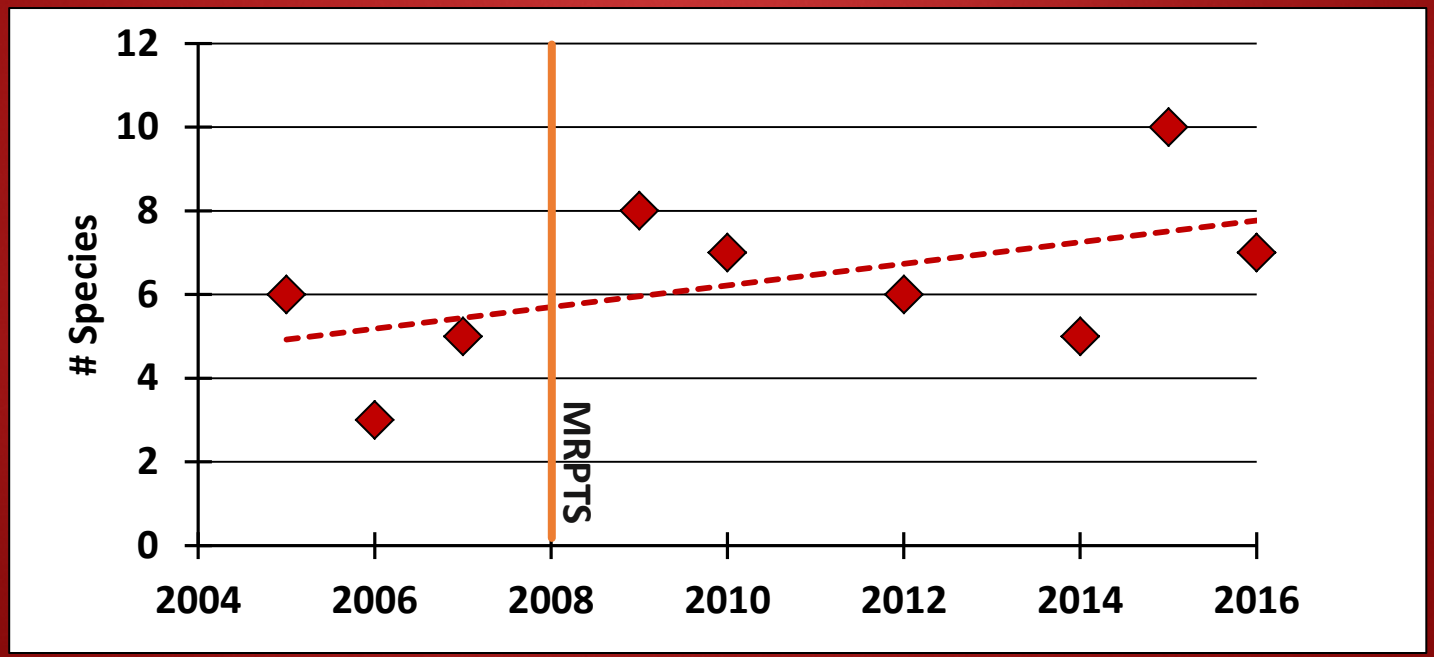
Results: UT-Robinson

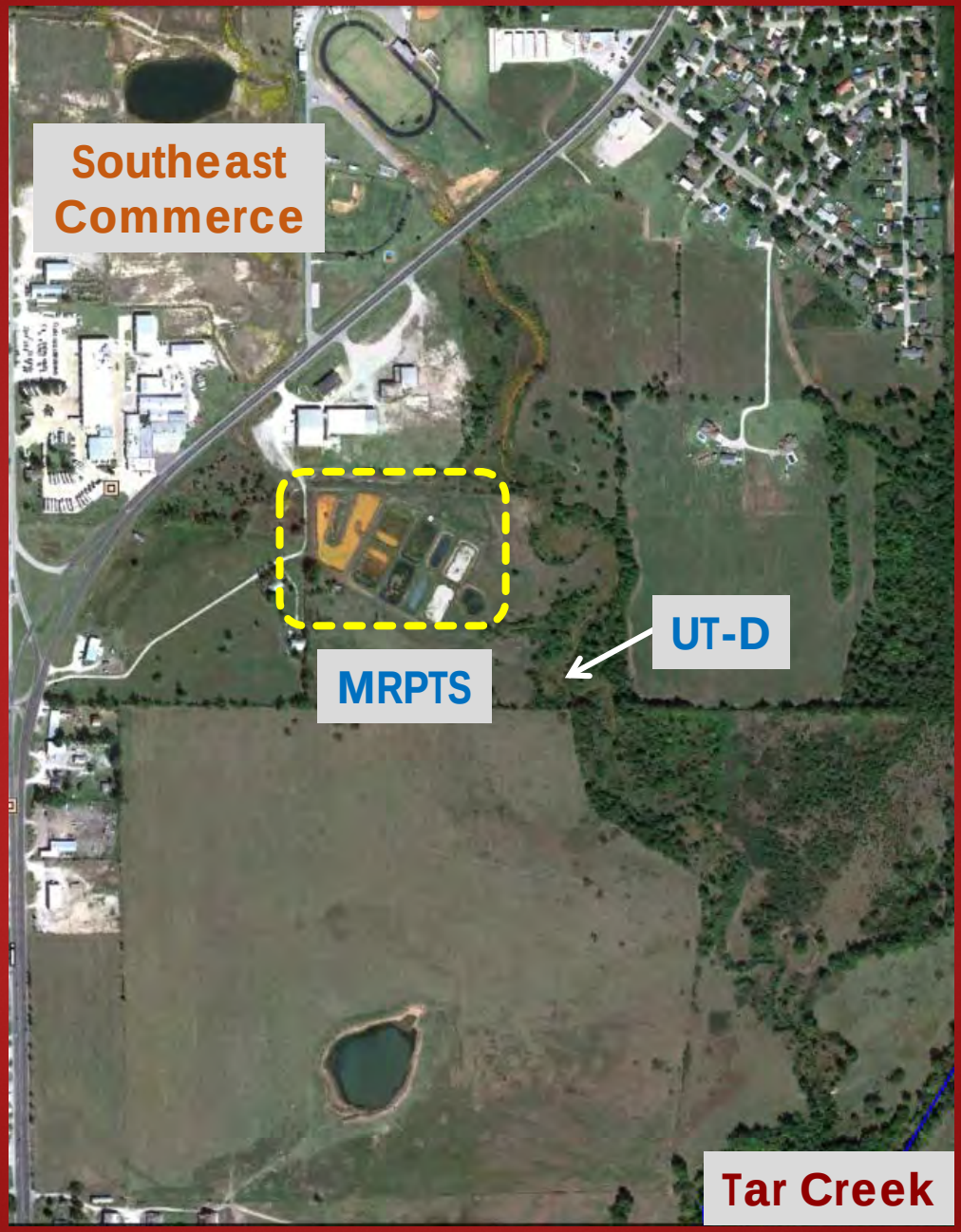
UT-R annual average CPUE before and after MRPTS construction

Specie	2005-2007	2008	2009-2017	
Western Mosquitofish	72.5		56.1	Decrease
Green Sunfish	2.6		10.4	Increase
Slough Darter	0.3		0.3	Same
Bluegill	0.3		4.7	Increase
Blackstripe Topminnow	0.1		18.4	Increase
Black Bullhead	0.0			
River Carpsucker	0.0			
Golden Shiner	0.1			
Redear Sunfish		MRPTS Construction	2.8	New
Longear Sunfish			1.7	New
Largemouth Bass			1.2	New
Sunfish Hybrid			0.4	New
Brook Silverside			0.3	New
Warmouth			0.5	New
White Crappie			0.1	New
Total Species:	8		12	

Results: UT-Robinson






Southeast Commerce
MRPTS
UT-D
Tar Creek

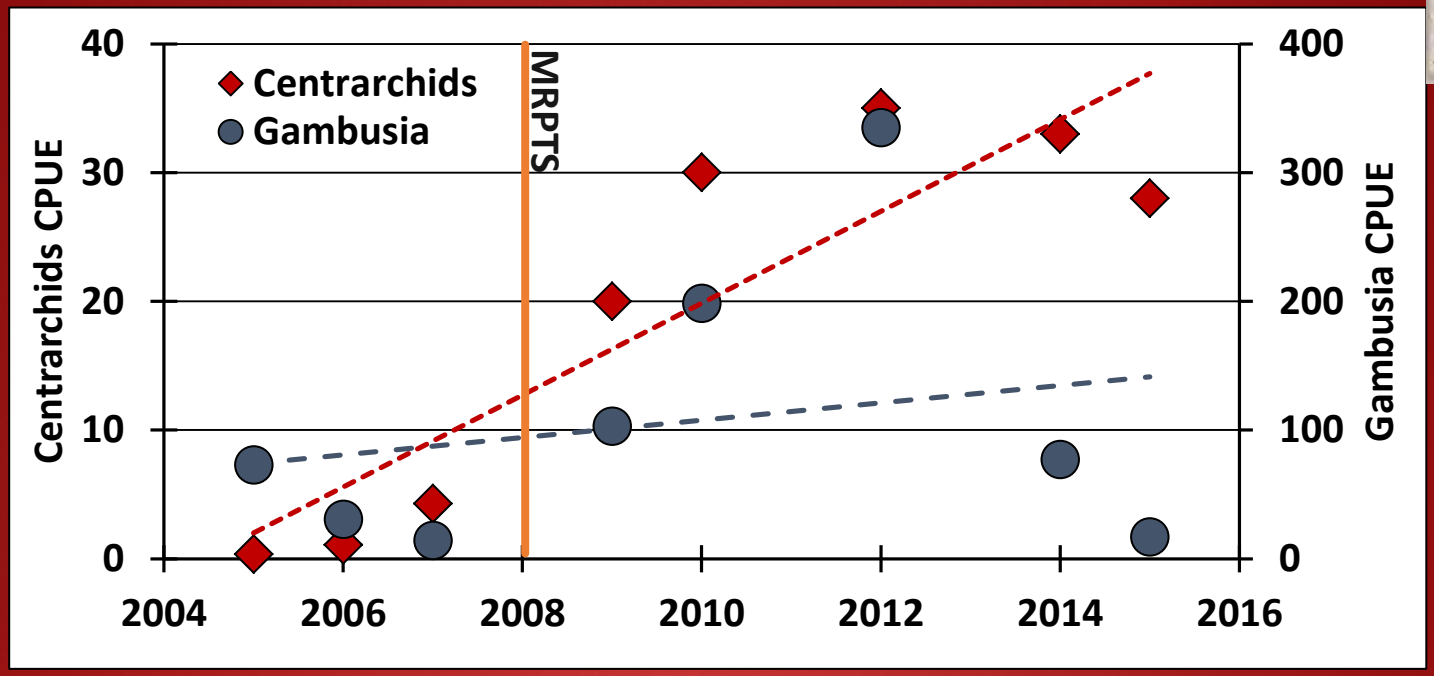
Results: UT- Downstream of MRPTS

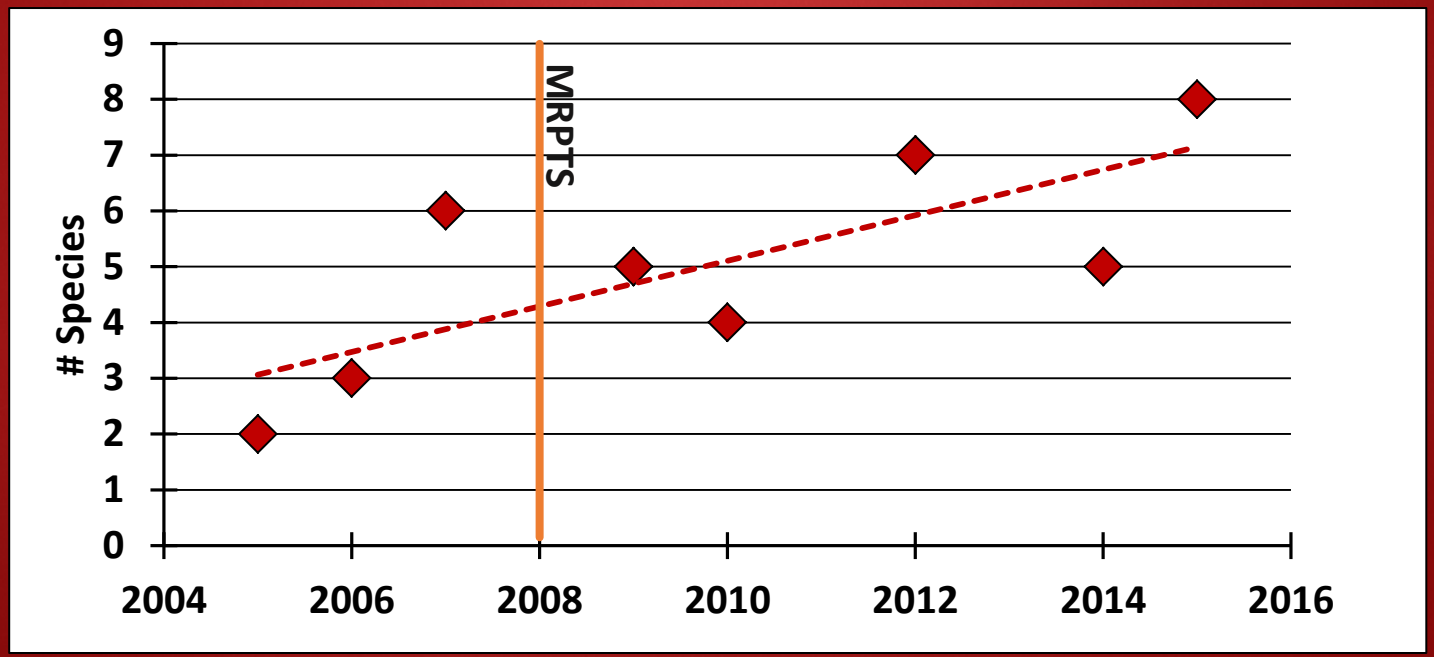
UT-D annual average CPUE before and after MRPTS construction

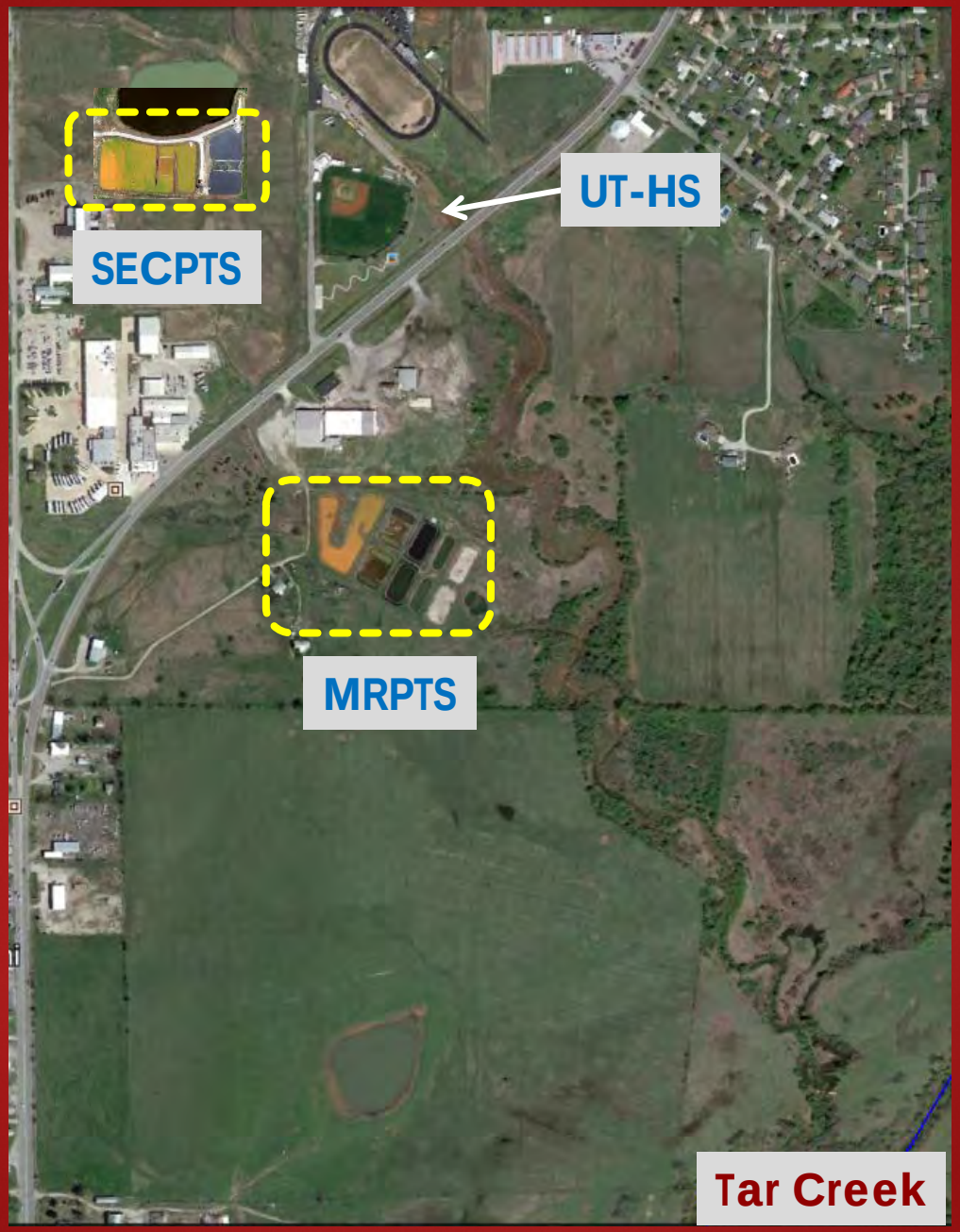
Specie	2005-2007	2008	2009-2015	
Western Mosquitofish	39.23		146.10	Increase
Green Sunfish	0.80		16.90	Increase
Bluegill	1.00		6.60	Increase
Longear Sunfish	0.03		3.40	Increase
Golden Shiner	0.17		0.60	Increase
Warmouth	0.07		0.50	Increase
Redear Sunfish		MRPTS Construction	1.20	New
Blackstripe Topminnow			1.06	New
Slough Darter			0.80	New
Largemouth Bass			0.46	New
Black Bullhead			0.26	New
Hybrid Sunfish			0.14	New
Total Species:	6		11	

Results: UT- Downstream of MRPTS

Results: UT-Downstream of MRPTS





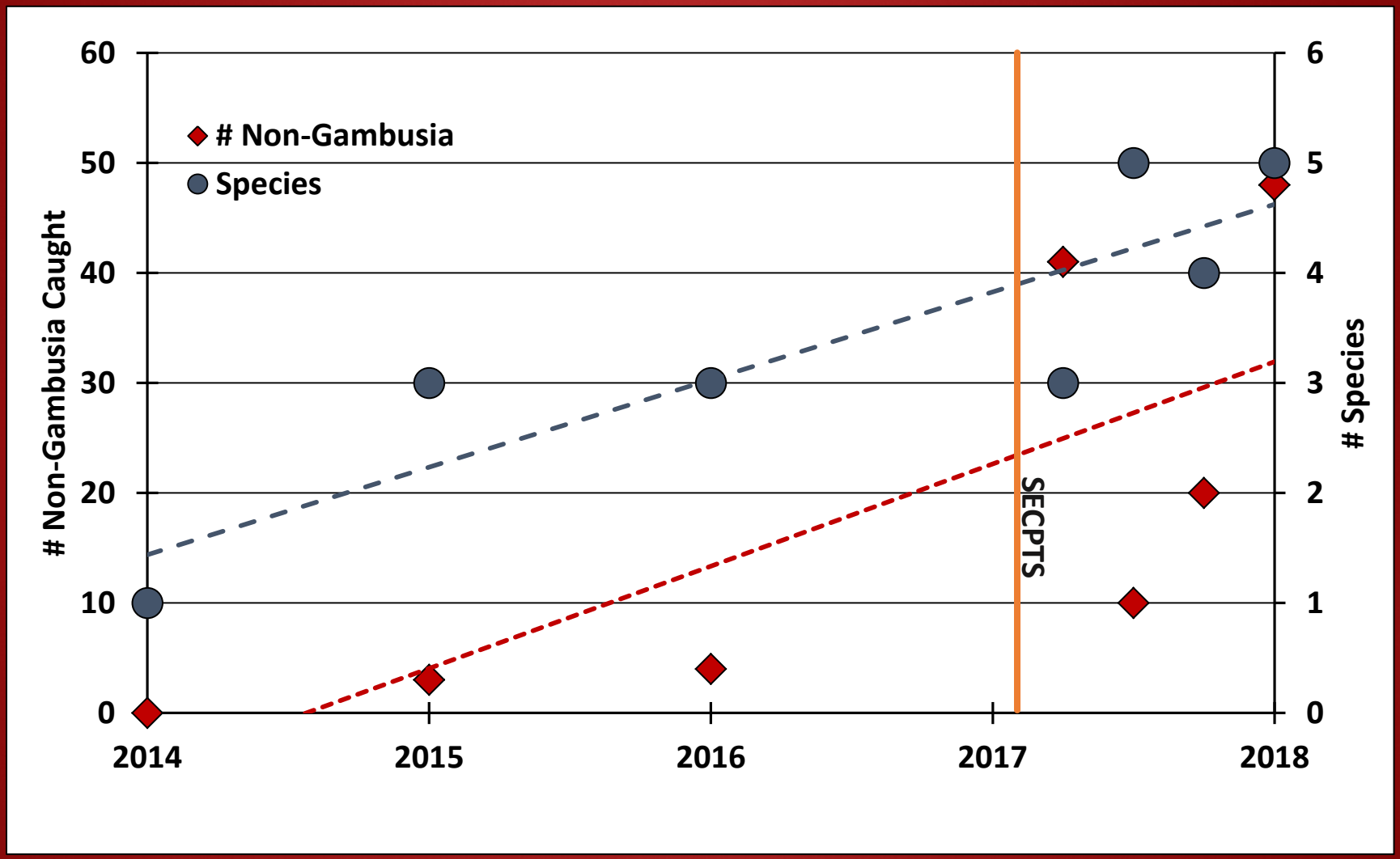

UT-HS
SECPTS
MRPTS
Tar Creek

Results: UT- Highschool

UT-HS Total fish caught before and after SECPTS construction

Species	2014-2016		2017-2018
Sample Size	3	SECPTS Completed (Feb)	4
Western Mosquitofish	131		67
Green Sunfish	2		33
Bluegill	4		78
Largemouth Bass	1		1
Blackstripe Topminnow	0		5
Warmouth	0		2
Total Fish (per Event)	146 (46.0)		226 (56.5)
Total Non-Mosquitofish (per Event)	7 (2.3)		119 (29.8)

Results: UT- Highschool



Conclusions

Conclusions

- Diversity and quantity of fish has increased after implementation of passive treatment
  - UT-R 8 increased to 12 species
  - UT-D 6 increased to 11 species
  - UT-HS 4 increased to 6 species
    - With 92% 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

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Questions?