TRACKING INVASIVES IN TEXAS: A COMPARISON OF SPATIAL DISTRIBUTION OF INVASIVE FISH OVER THE LAST DECADE

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Introduction

Non-native species that are introduced through anthropogenic influences, i.e. invasive species, cause harm to native systems in numerous ways and account for billions of dollars in damages each year. Generally, invasive species have such high success in ecosystems through their ability to outcompete native species, spread and multiply rapidly, and adapt to a variety of environments.

Efforts have been made to mitigate the impacts and spread of invasive species and this analysis seeks to track the spatial and temporal changes of invasive fish species in Texas over the last decade. This research can be used to determine whether suppression efforts have been successful or if more rigorous efforts need to be made.

Study Area

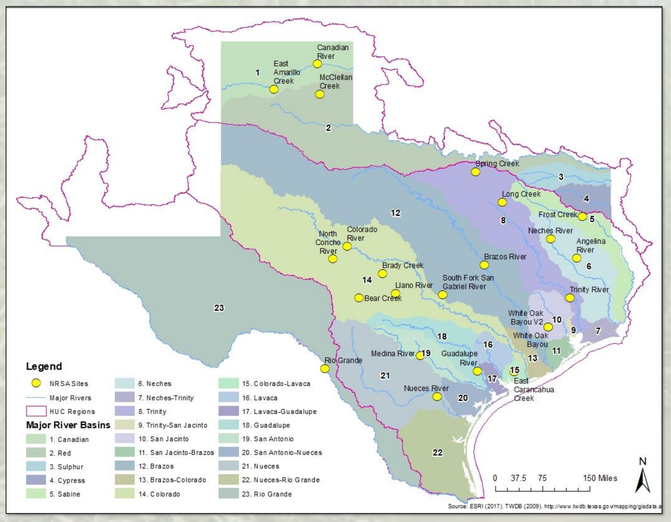

Figure 1: Study map of Texas showing the major rivers, major river basins, Hydrologic Unit Code (HUC) 02 regions, and the revisited sites.

Methods

- Every five years, rivers and streams across the nation are surveyed as part of the National Rivers and Streams Assessment (NRSA). Using EPA standard methods, researchers quantify ecosystem health and the biotic factors associated with those waterbodies.
- 14 sites in Texas sampled in 2008, 2013, and 2018 (Figure 1).
- 8 additional sites were sampled in 2013 and 2018 (Figure 1).
- Fish abundance and diversity were collected via electroshock fishing (boat, barge, or backpack) or seining (Figure 2) and all fish were identified to species by an experienced fish taxonomist. Collection method was determined based on water depth, conductivity levels, and permitting restrictions.
- From those revisited sites, fish abundance and diversity were analyzed and non-native species were identified using the texasinvasives.org database or the Texas Invasive Species Institute to confirm invasive status.
- Analysis:
  - % invasive fish (per site) = abundance of invasive fish/total abundance
  - If same site sampled twice per year, % invasive fish averaged

Figure 2: Fish collection methods a) Electroshock boat, b) barge shocking, c) backpack shocking, d) seining.

Results

Invasive Species Occurrence

- Invasive species present for at least one sampling event at 19 of 22 sites.
- Present in all HUC 02 regions & all major basins with revisit sites (Figure 1).

Invasive Species Abundance and Distribution

- In 2018, the Texas-Gulf Region had the highest concentration of invasive species while the Arkansas-White-Red region had the lowest.
- The Colorado River Basin contained 2 out of the 3 sites with the highest concentrations of invasive species.
  - Colorado River Basin: Llano River = 51%; Bear Creek = 29%
  - Brazos River Basin: South Fork San Gabriel River = 33%
- For all years sampled, no invasive fish were caught at 3 sites: Long Creek (Trinity river basin), North Concho River (Colorado river basin), East Amarillo Creek (Canadian river basin).
- Sites resampled over 10 years (2008-2018; n = 14): (Figure 3)
  - General decrease from 2008-2013 with increase from 2013-2018
- Sites resampled over 5 years (2013-2018; n = 22): (Figure 4)
  - Increase from 2013 to 2018
- Overall changes in total abundance (Figure 5a)
  - The trend observed for total abundance similar to percent invasive fish
  - 13 sites = increase in abundance from 1st sample period to most recent
  - 5 sites = decrease in abundance from 1st sample period to most recent
  - 4 sites show no change:
    - 3 sites no invasive fish captured during sampling events
    - Canadian River - not fished in '08 or '13 due to permit restrictions.

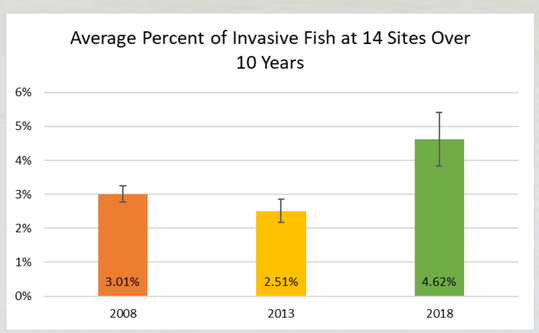

Figure 3: Comparing the average percent of invasive fish caught at 14 sites over 10 years. Error bars show variance based on entire population.

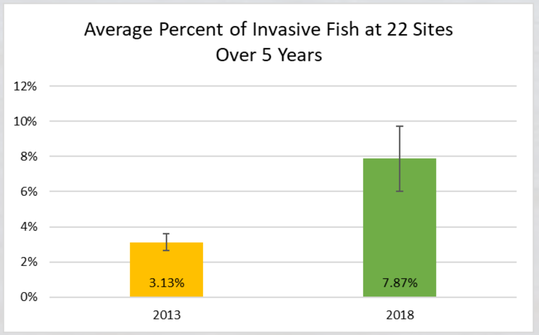

Figure 4: Comparing the average percent of invasive fish caught at 22 sites over 5 years. Error bars show variance based on entire population.

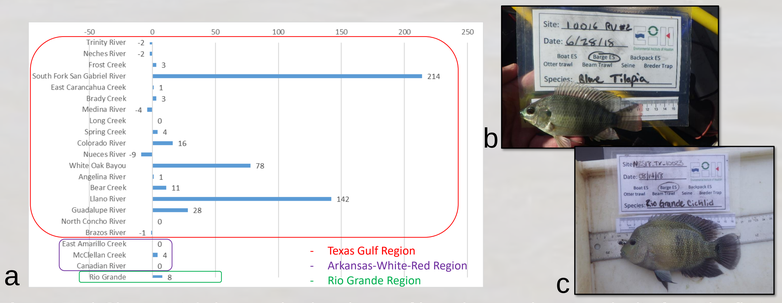

Figure 5: a) Shows total changes in abundance of invasive species at each site from the first sampling event to the most recent; sites are grouped according to HUC 02 Regions b) Photo voucher of a Blue Tilapia caught at White Oak Bayou c) Photo voucher of a Rio Grande Cichlid caught on the Guadalupe River.

	Waterbody Name	Site ID	Armored Catfish spp.	Blue Tilapia	Common Carp	Grass Carp	Redbreast Sunfish	Rio Grande Cichlid	Number of Non-native Species	Species Richness (S)
2018	Trinity River	NRS18_TX_10002	-	-	5	-	-	-	1	20
	Neches River	NRS18_TX_10003	-	-	-	-	3	-	1	23
	Frost Creek	NRS18_TX_10004	-	-	-	-	3	-	1	14
	South Fork San Gabriel Riv	NRS18_TX_10005	-	-	-	-	249	-	1	15
	East Carancahua Creek	NRS18_TX_10006	-	-	1	-	-	-	1	16
	Brady Creek	NRS18_TX_10007	-	-	3	-	-	-	1	14
	Medina River	NRS18_TX_10009	2	-	-	-	-	9	2	20
	Long Creek	NRS18_TX_10010	-	-	-	-	-	-	0	8
	Spring Creek	NRS18_TX_10011	-	-	10	-	-	-	1	26
	Canadian River	NRS18_TX_10012	-	-	1	-	-	-	1	
	Colorado River	NRS18_TX_10013	-	-	20	-	-	-	1	12
	Nueces River	NRS18_TX_10014	-	-	1	-	-	7	2	14
	Rio Grande	NRS18_TX_10015	N/A	-	-	-	-	-	N/A	Not sampled
	White Oak Bayou	NRS18_TX_10016 V	17	64	-	-	-	59	3	7
	Angelina River	NRS18_TX_10019	-	-	1	-	-	-	1	28
	Bear Creek	NRS18_TX_10021	-	-	-	-	-	149	1	19
	Llano River	NRS18_TX_10022	-	-	-	-	263	4	2	15
	Guadalupe River	NRS18_TX_10023	-	-	-	-	-	30	1	18
	North Concho River	NRS18_TX_10025	-	-	-	-	-	-	0	8
	Brazos River	NRS18_TX_10026	-	-	-	-	-	-	0	16
	East Amarillo Creek	NRS18_TX_10029	-	-	-	-	-	-	0	4
	McClellan Creek	NRS18_TX_10030	-	-	4	-	-	-	1	6
2013	Trinity River	TXR9-0907	-	-	2	1	-	-	2	20
	Neches River	TXR9-0914	-	-	-	-	-	-	0	16
	Frost Creek	TXS9-0929	-	-	-	-	-	-	0	11
	South Fork San Gabriel Riv	TXS9-0933	-	-	-	-	26	-	1	11
	East Carancahua Creek	TXS9-0934	-	-	-	-	-	-	0	11
	Brady Creek	TXS9-0931	-	-	3	-	-	-	1	13
	Medina River	TXR9-0910	3	-	2	-	-	5	3	17
	Long Creek	TXS9-0936	-	-	-	-	-	-	0	3
	Spring Creek	TXS9-0937	-	-	7	-	-	-	1	19
	Canadian River	TXR9-0905	-	-	-	-	-	-	N/A -	Permit Restricts
	Colorado River	TXR9-0915	-	-	3	-	-	-	1	17
	Nueces River	TXR9-0909	-	-	-	-	-	-	0	13
	Rio Grande	TXR9-0912	-	-	20	-	4	NA	2	20
	White Oak Bayou	TXS9-0926 V1	-	3	-	-	-	16	2	12
	Angelina River	TXRO-1080	-	-	-	-	-	-	0	17
	Bear Creek	TXLS-1133	-	-	-	-	-	37	1	16
	Llano River	TXRO-1085	-	-	1	-	120	4	3	22
	Guadalupe River	TXRM-1010	-	-	-	-	-	2	1	23
	North Concho River	TXLS-1117	-	-	-	-	-	-	0	8
	Brazos River	TXRM-1002	-	-	1	-	-	-	1	25
	East Amarillo Creek	TXSS-1205	-	-	-	-	-	-	0	1
	McClellan Creek	TXSS-1209	-	-	-	-	-	-	0	7
2008	Trinity River	FW08TX037	-	-	7	-	-	-	1	7
	Neches River	FW08TX053	-	-	5	-	-	-	1	5
	Frost Creek	FW08TX045	-	-	-	-	-	-	0	0
	South Fork San Gabriel Riv	FW08TX104	-	-	-	-	34	1	2	35
	East Carancahua Creek	FW08TX118	-	-	-	-	-	-	0	0
	Brady Creek	FW08TX067	-	-	-	-	-	-	0	0
	Medina River	FW08TX043	2	-	2	-	-	11	3	15
	Long Creek	FW08TX124	-	-	-	-	-	-	0	0
	Spring Creek	FW08TX156	-	-	6	-	-	-	1	6
	Canadian River	FW08TX033	-	-	-	-	-	-	N/A -	Permit Restricts
	Colorado River	FW08TX055	-	-	4	-	-	-	1	4
	Nueces River	FW08TX042	-	-	6	-	-	11	2	17
	Rio Grande	FW08TX050	-	-	13	-	3	NA	2	21
	White Oak Bayou	FW08TX025	2	-	-	-	-	60	2	62

Figure 6: Total counts of invasive individuals for all sites examined and overall species richness for each site.

Conclusions

- Overall, invasive fish species have increased across Texas since the first NRSA in 2008.
- Suppression efforts have not been sufficient enough to decrease the amount of invasive fish species in Texas' waterbodies.
- The Colorado and Brazos river basins contain the highest concentrations of invasive species.
- Limitations of this analysis include changes in fish collection methods from 2013 to 2018 due to permitting restrictions, resulting in a lack of data for some sites, and limitations of gear itself in special circumstances, i.e. swift waters, deep pools, etc.

Future Work

- The National Rivers and Streams Assessment will continue sampling every 5 years to determine the extent to which rivers and streams support a healthy biological condition and the extent of major stressors that affect them.
- The data collected from the NRSA can be used to continuously monitor invasive populations and their impacts on native communities.
- More in-depth statistical analyses can be made using these datasets
- More rigorous invasive species suppression efforts need to be made.

Acknowledgments

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