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Eel Ramps and eDNA to Detect Recruitment of American Eel (*Anguilla rostrata*) in Texas

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INTRODUCTION

American Eel, *Anguilla rostrata*, has a unique and complex life history (Fig. 1). They are facultative catadromous fish with six distinct life stages. Data are lacking related to juvenile (glass eel and elver) recruitment along the continental shelf, and bays and estuaries of the Gulf of Mexico. American Eel are a Species of Greatest Conservation Need by the TPWD. The goal of the study is to document the ingress of glass and elver American Eel, and to better understand their recruitment timing, distribution, density, and habitat associations. This is a summary of preliminary work completed to date, and on-going efforts to detect recruiting American Eel in Texas.

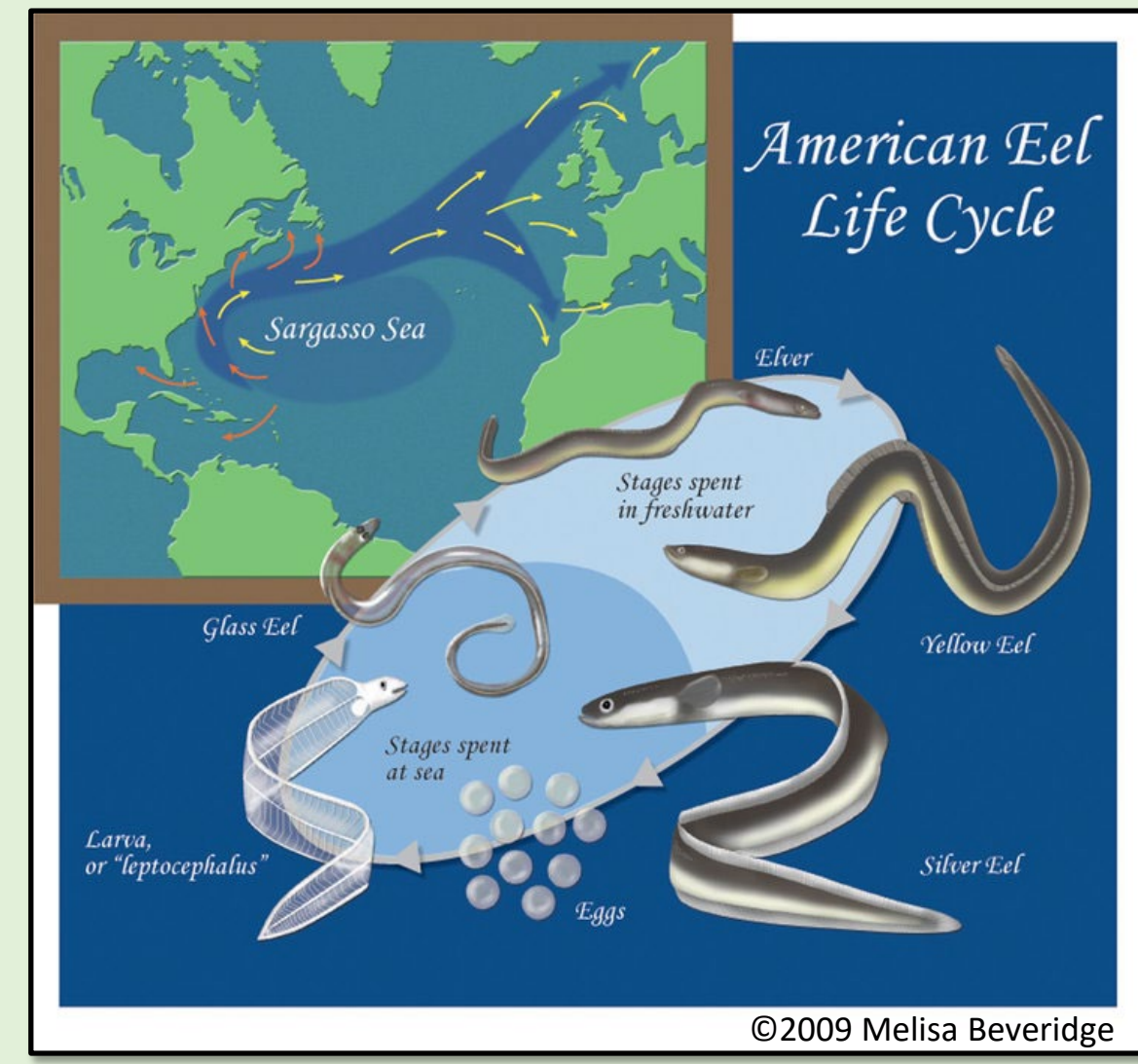


Figure 1. Life History of American Eel.

HISTORICAL DISTRIBUTION

>340 records of yellow eel, detected in all major river basins in Texas (except the Canadian).

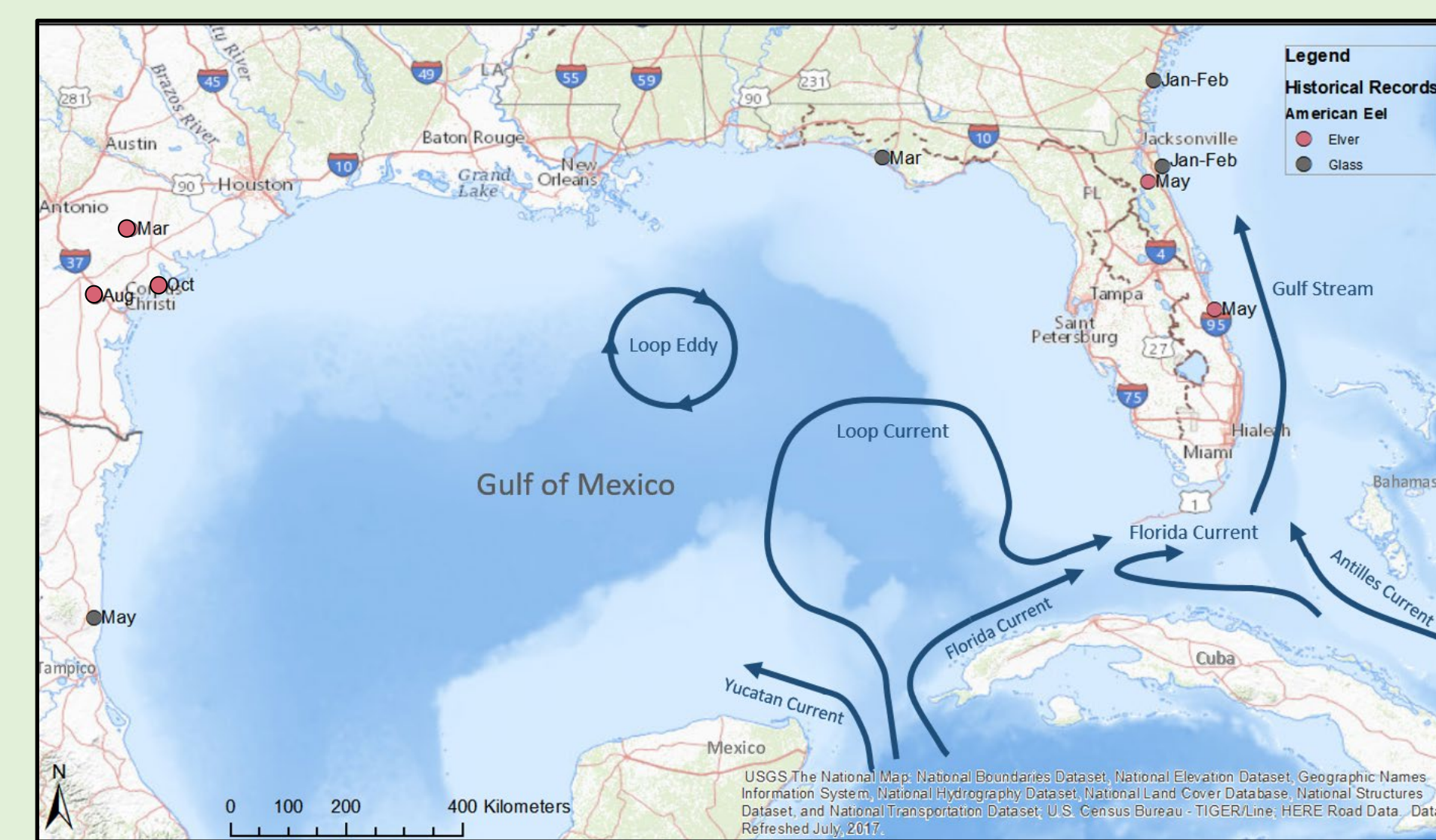


Figure 1. Historical records of glass and elver American Eel life stage.

- Elvers: 3 records in Texas (Fig. 1).
- Glass eel: 1 record in Florida and 1 in Mexico.
- Leptocephalus: movement into western Gulf of Mexico is poorly understood.

METHODS - SITES

- Study Area: coastal counties from Victoria to Orange, Texas.
- Site Selection: Desktop evaluation identified 121 potential sites, of which 92 were visited for reconnaissance. Twenty sites met criteria for the study. Twelve sites (Fig. 2) were chosen for inclusion in study based on criteria:
 - Direct connectivity to coastal/estuarine waters
 - Vertical relief to support gravity-fed ramp
 - Shallow receiving waters (typically less than 1 ft)
 - Landowner permission for access
 - Maximized spatial distribution throughout study area

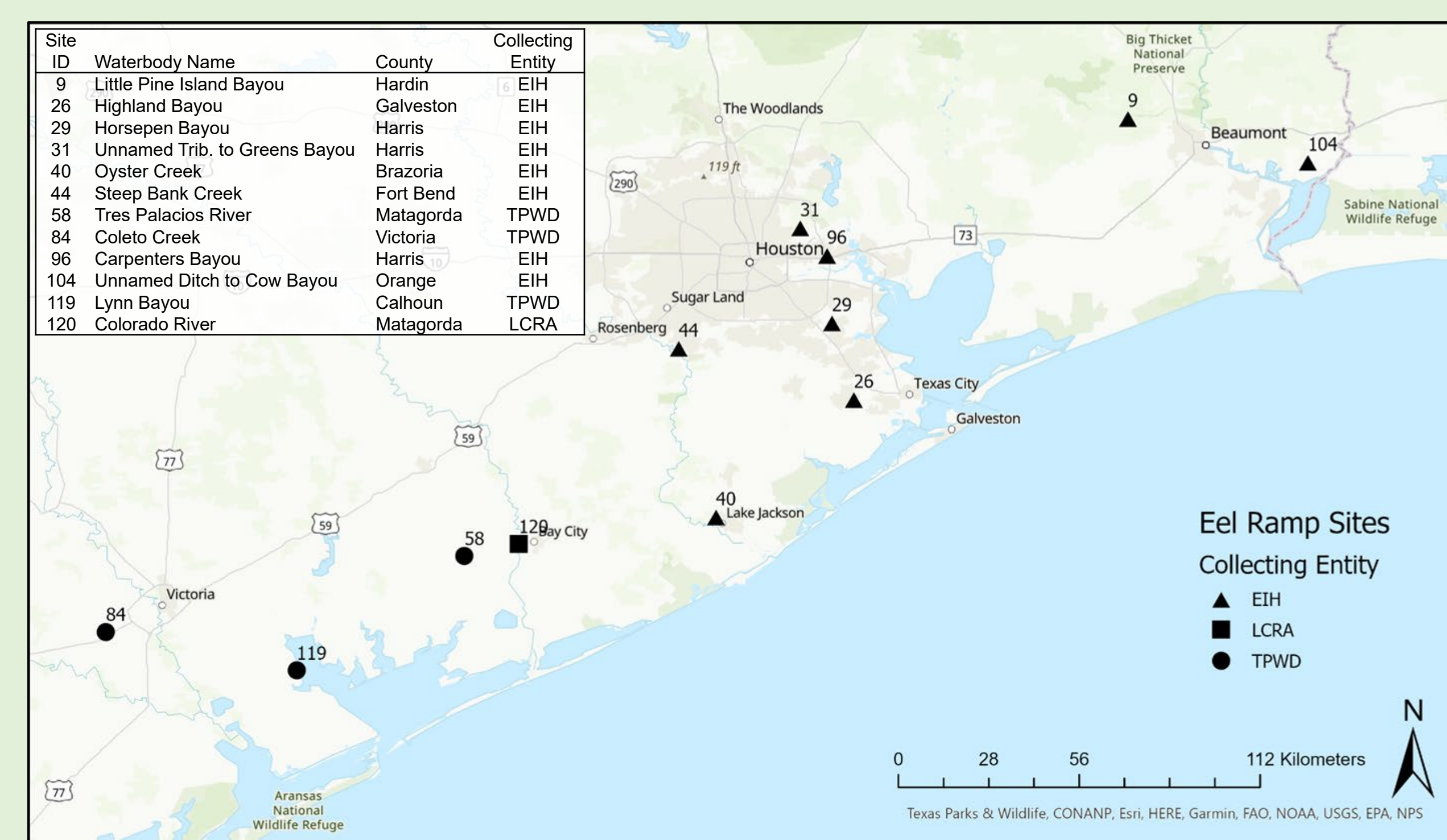


Figure 2. Map of study sites where eel ramps are deployed. Site 29 was discontinued on October 18, 2022 due to continued challenges keeping the ramp fishing.

METHODS - EEL RAMP

- Prototype eel ramps designed, constructed, and tested in Spring 2022. Tested three substrates: enkammat, ½” and 1” sheet drain.
- Constructed 16 eel ramps 42” x 12” x 6” (Fig. 3). Substrate used = ½” sheet drain. Deployed June - July 2022.
- Additional ramp (site 120) monitored by the LCRA. 96” x 16” (Fig. 4). Deployed April 2022.
- Ramps checked weekly for 1 year (July 2022-June 2023).



Figure 3. a: Gravity-fed eel ramp deployed at site 113. b: Example of target flow over ½” sheet drain and collection bucket at site 44.



Figure 4. LCRA eel ramp deployed at site 120. Designs have varied slightly during study period.

METHODS - ENVIRONMENTAL DNA (eDNA)

- Eight of the eel ramp sites are also monitored for eDNA during weekly checks.
- Two 1L eDNA grab water samples are collected from the bottom half of the water column. One sample is taken 10 m downstream from the ramp, the second samples is taken adjacent to the mouth of the ramp.
- Filtered same-day with self-contained Smith-Root 1.5uM filters.
- DNA extracted within 48 hours using DNeasy PowerSoil Pro Kit (Qiagen, Inc.) with OneStep Inhibitor Removal Kit (Zymo) (Fig. 5).
- Quantitative PCR using a dual marker assay (AME1 & AME2) (Moyer, et al. 2022). Signal detection on both markers = positive detection.

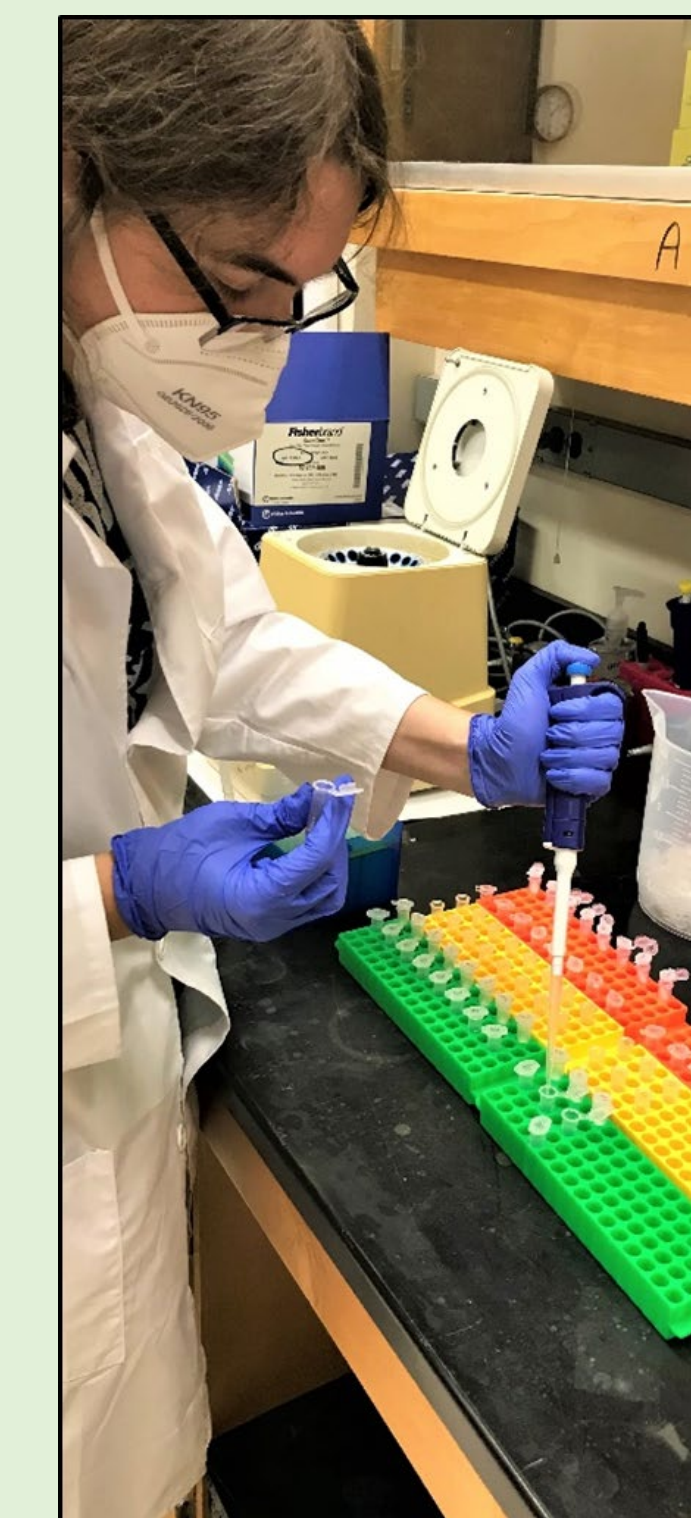


Figure 5. DNA extraction

RESULTS – EEL RAMP

- Site checks to date: 351 (~ 32 per site), ramps were found “not fishing” a total of 142 of those checks (40% of the time).
- To date, one Elver (captured in May, 2022) and 19 glass eels (captured in January, 2023) have been documented. (Table 1).

Table 1. Summary of average site conditions and eel catch to date.

Site	Ramp Angle	Depth at ramp mouth (m)	Spec. Cond. (µS/cm)	D.O. (mg/L)	pH	Secchi (m)	Elvers	Glass Eel
9	21.50	0.30	394.01	6.88	7.23	0.45	-	-
26	20.66	0.35	653.30	5.61	7.71	0.71	-	-
29	19.21	0.80	731.67	6.37	7.55	0.60	-	-
31	21.03	0.23	586.38	7.75	7.68	0.48	-	-
40	20.48	0.38	746.07	5.78	7.84	0.23	-	-
44	20.48	0.19	1013.09	7.45	7.75	0.21	-	-
58	18.08	0.17	741.33	7.07	7.97	0.24	-	-
84	19.10	0.21	367.46	8.65	8.04	0.57	-	-
96	17.90	0.32	664.10	9.00	7.81	0.57	-	-
104	19.03	0.17	1216.06	7.11	7.33	0.46	-	-
119	19.62	0.28	14934.83	8.46	7.77	0.56	-	19
120	22.00	0.49	836.43	8.98	8.28	0.33	1	-
Total	19.89	0.29	1871.82	7.43	7.75	0.44	1	19

- Glass eels collected had an average total length of 54.16 mm (min = 50 mm & max = 58 mm), and an average wet weight of 118.57 mg (min = 70 mg & max = 160 mg). Example glass eel (Fig. 6).

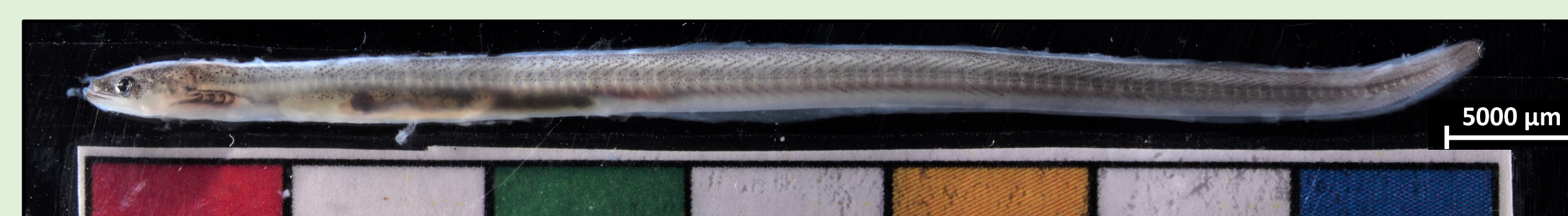


Figure 6. Glass American Eel captured in eel ramp at site 119, total length 57mm, wet weight 120 mg. Photo credit: Polly Hajovsky

RESULTS – Eel Ramps Bycatch

- To date a total of 111 non-target fishes representing 10 families and 18 species have been captured in the eel ramps.
- Additionally various invertebrates, including insects, decapods, mollusks, as well as tadpoles and one snake have been captured.
- In most cases it is presumed that these bycatch (particularly the fishes) were washed into the catch bucket from the upstream siphon or during high water events.

RESULTS - eDNA

- First 25 weeks of eDNA samples (375 samples) have been run.
- Positive detections (both markers: AME1 and AME2) at six of the eight sites (Table 2).
- Site 119 was not an eDNA site, since the first glass eel catch we have been collecting samples, but they have not been analyzed yet.
- Highest number of positive detections at site 120 where yellow eel are consistently collected (~24% of ramp checks).

Table 2. Environmental DNA results for the first 25 weeks of sampling by sample location (downstream/ramp), marker (AME1/AME2), and positive detections (both markers positive) by site.

Site	Downstream			Ramp		
	AME1	AME2	Both (Positive)	AME1	AME2	Both (Positive)
9	2	1	1	-	1	-
40	6	7	3	3	4	1
44	-	-	-	-	1	-
58	3	1	-	7	7	4
84	12	11	8	4	6	3
96	6	6	3	6	11	4
104	-	-	-	-	-	-
120	22	20	20	9	8	4
Total	51	46	35	29	38	16

DISCUSSION AND FUTURE WORK

- Sampling is on-going, 18 weeks of sampling remain (→ June 2023).
- First documented glass American Eel recruitment in Texas.
- Only other glass American Eel in northern GOM in FL in March.
- Site 119 is our most southern and coastal eel ramp site.
- Expect (hope) for detections to continue and move more inland.
- Plan to assess influence of environmental conditions (e.g., water chemistry, river miles to open water/nearest pass, moon phase, tide, weather and habitat) on eDNA detections, and juvenile eel presence and catch per unit effort.
- Morphometrics and other samples (DNA and otoliths) will be collected from American Eel.
- Vouchers will be provided to Biodiversity Collection at the University of Texas at Austin.

ACKNOWLEDGEMENTS

We would like to thank:

- EIH staff and students that assisted with the field sampling as well as field assistance from our Texas Parks and Wildlife Department partners and support staff.
- Texas State Wildlife Grants for funding the on-going eel ramp and eDNA studies. CFDA: 15.634

All sampling was conducted under Texas Parks and Wildlife Department Scientific Research Permit SPR-0504-383 and IACUC Protocol T0322.001.R0



For more information on the on-going study please visit:



For more information on EIH please visit:



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