

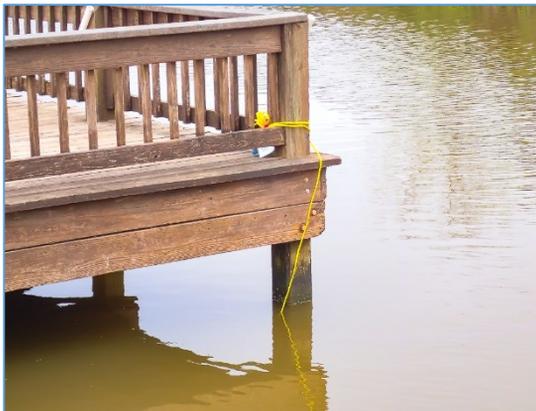
American Eel Project TPWD/USFWS Cedar Lake Creek at Cocklebur Slough

March 2018-May 2019
Observations, Photos and Report by
Peggy and Pete Romfh



Background and Goal

- **Background:** The American Eel life history includes stages spent at sea (eggs, larva, and glass eels) and stages spent in fresh water (elver, yellow eel, and silver eel (adults). While the population of eels along the Northern Atlantic coast is such that there is a significant commercial harvest, there have been insufficient studies and documentation of eel presence, habitat, and movement along the Gulf Coast. Historical records statewide show that there is some eel presence along major drainages into the Gulf of Mexico.
- **The goal** of the project is to determine the distribution and abundance of the American Eel in Texas Coastal waters from Nov. 2017 – summer of 2019. The project coordinator is Stephen Curtis, TPWD.
 - Texas Parks and Wildlife Department (TPWD) will conduct adult and juvenile eel sampling below dams in target drainages with supplemental sampling in coastal drainages using electrofishing, trot lines, minnow traps, dip nets, modified fyke nets, etc.
 - Texas Master Naturalists will conduct glass and elver eel sampling from fishing piers, bulkheads, and boat ramps along coastal drainages from Corpus Christi Bay to Sabine Lake using eel mops and minnow traps. Site characteristics will be within 25 miles from the Gulf of Mexico, be tidally influenced, and have freshwater inflow.
- **Our specific goal was to conduct sampling using an eel mop from the boat dock at Cedar Lake Creek/Cocklebur Slough in San Bernard National Wildlife Refuge. This site is tidally influenced, and depending on the flow of Gulf or upstream water, will show no to significant saline content. A permit was obtained from USFWS to conduct the sampling.**



Location of mop placement on Cedar Lake Creek dock



USFWS permit attached to rope of eel mop

Project Design

Materials – Eel Mop

- **Eel Mop** is used to catch glass/elver eels; it is designed to provide shelter during upstream movement. The mop was made from 25 inch sections of rope that were unwound to their finest strands. The strand bundles were attached to a plate that was weighted with a concrete disk. An eye bolt at the center of the plate was used to affix a rope. The rope was attached securely to the dock during the sampling periods.
- **Tote**: a 20 gallon plastic bin was used to hold the mop and rinses of site water during the mop check procedure.
- **Collection Screens/Sieves**: From March 2018 – Sept. 2018, a small aquarium net was used to filter the water from the tote. From Sept. 2018 – end of project, a set of screens were placed over a 5 gallon pail and the tote water was poured through the screens during the mop check procedure. The filter (screen) size of the screens used were 1/12 inch and 1/50 inch.
- **Macrophotography**: Cameras with either an 85 mm macro lens or a microscope setting were used to photograph macroinvertebrates that were trapped by the fine sieve.



Pete and Peggy Romfh deploying eel mop at Cedar Lake Creek dock

Project Design

Materials – Environmental Measures:

Since the Cedar Lake Creek site is also a location where we do environmental measures for Texas Stream Team, the following environmental measures were done at least once a month during the eel mop sampling study.

Temperature – air and water; calibrated thermometer

Conductivity – calibrated conductivity meter; measured in microSiemens.

Oxygen – chemical measurement of oxygen using Winkler titration method

Salinity – Refractometer and/or hydrometer

pH – chemical pH and pH meter

Turbidity – Secchi disk and/or Secchi tube

Wind - Anemometer

Collection Method:

The eel mop was attached to a rope and lowered into the water at the end of the dock at Cedar Lake Creek until it was touching bottom or just above the bottom. The rope was tied off to the end post so that the mop could drift only minimally.

On observation dates, the mop was pulled quickly and evenly from the water and inverted into a large plastic bin half-filled with creek water. The mop was shaken and agitated in the water several times to dislodge hiding species, and the water was then poured through a sieve to capture and count specimens. The bin was refilled 3-4 times more and the mop was shaken again until the water was substantively clear and no additional species could be retrieved.

Data Collection Period:

- Start Date: 3/17/2018
- End Date: 5/21/2019
- Mop retrieval was done approximately every two weeks. Flooding at the site on two occasions resulted in slight delays in sampling.



Pete pours creek water into bin so that eel mop can be rinsed.

Project Design

Specimen Capture, and Counting:

- 3/17/18 – 9/16/18: Bin water was poured through a small aquarium net. All fish, crab, crawfish, shrimp and large macroinvertebrates trapped in the net were counted and released. Few small macroinvertebrates were captured with this sieving process.
- 9/28/18 – 5/21/19: Bin water was poured through a double set of screens with large and fine sieve size. All fish, crab, crawfish, shrimp and large macroinvertebrates were found in the larger sieve, counted and released. Macroinvertebrates were trapped in the finer sieve and a representative sample was counted, both by using eyes and by use of macrophotography. In most cases, the fine silt and trapped macroinvertebrates were suspended in fresh creek water so that counting could be more accurately done.

Data Observation Categories:

- American Eel
- Other Eel-like Fish
- Other Fish
- Crabs
- Shrimp
- Crawfish
- Insect/Worms (insect larva)
- Other – includes Annelida, Cnidaria, Crustacea, and Mollusca

Results for Target species of American Eel or Eel-Like Fish:

No American Eels or other Eel-like Fish were observed using the eel mop at this site.

The remainder of this report summarizes the bycatch that was harvested and counted in the eel mop over the period of the study.



Left – Peggy pours bin water over screens so that species can be isolated and counted.

Right – Pete tabulates species counts on log sheet.



Results

Summary of Results by Categories

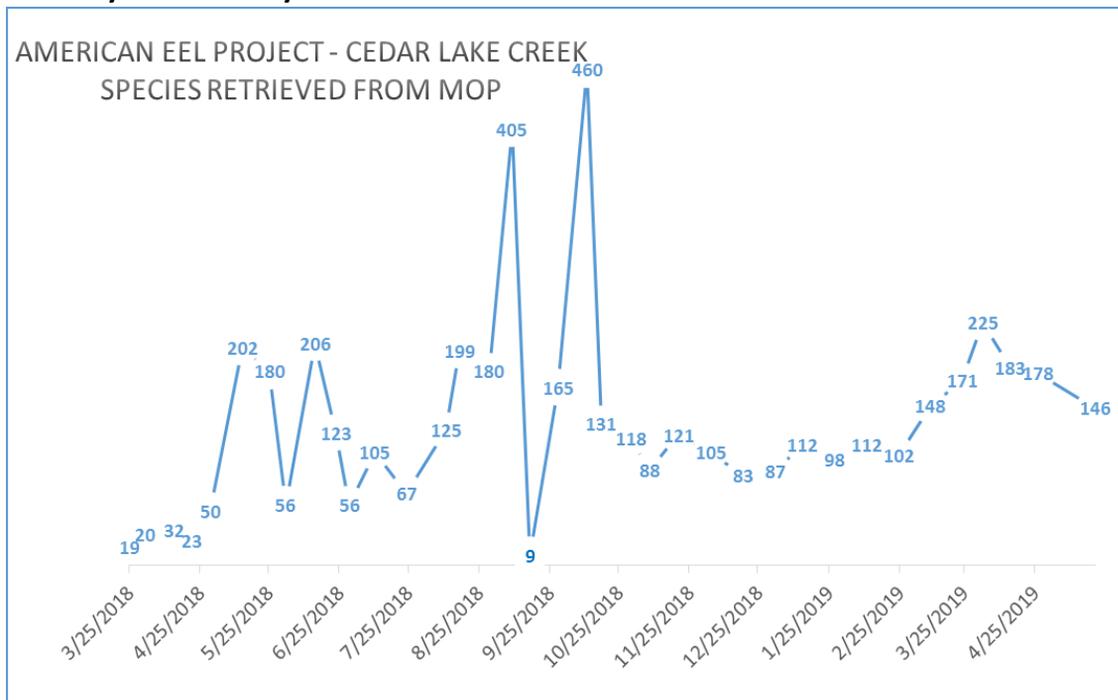
Dates of Collection: 3/25/2018 - 5/21/2019

Number of samplings done = 37

	American Eel	Eel-Like Animal	Other Fish	Crab	Shrimp	Crayfish	Insects/Larva	Other	Total
Totals Counted in Study	0	0	82	2581	111	150	539	1427	4890
Average/Sampling	0	0	2	70	3	4	15	39	132

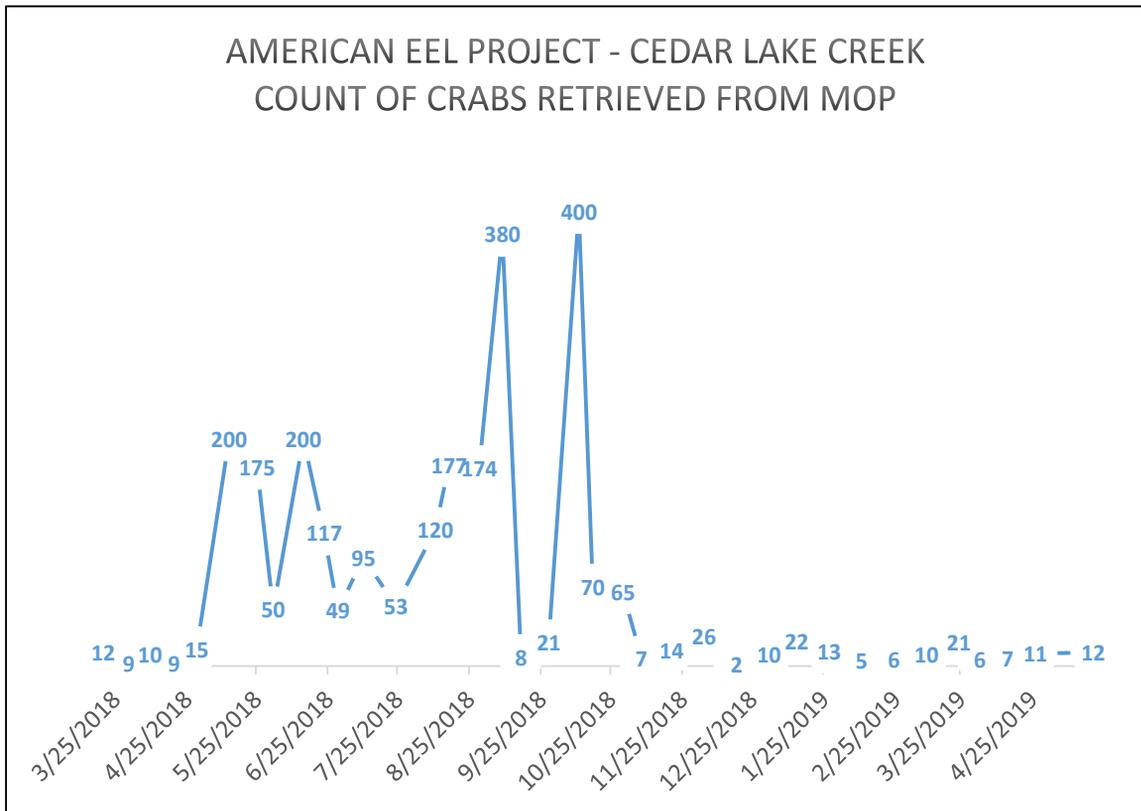
The table shows the counts of all species tallied over the period of collection. Insects, larva, and other (macroinvertebrates) may be under-represented for two reasons. During the first six months, an aquarium type net was used; this type of net was not fine enough to capture small macroinvertebrates. Starting in 9/28/2019, a set of sieves was used. There were so many macroinvertebrates in the fine sieve that not all could be counted. A maximum of 50 of each type was counted and a note made on the data sheet if more were present. Note that the saline content in the creek was low the last half of the study period and more pond species were also observed.

Summary of Results by Date



The chart shows the number of species counted with each eel mop retrieval. The value of 9 observed on 9/16/18 was during a period of intense flooding in the creek. Water levels were about 4 inches above the dock deck when the sampling was done. The peaks parallel the peaks in crabs observed (see crab chart).

Crabs - Statistics



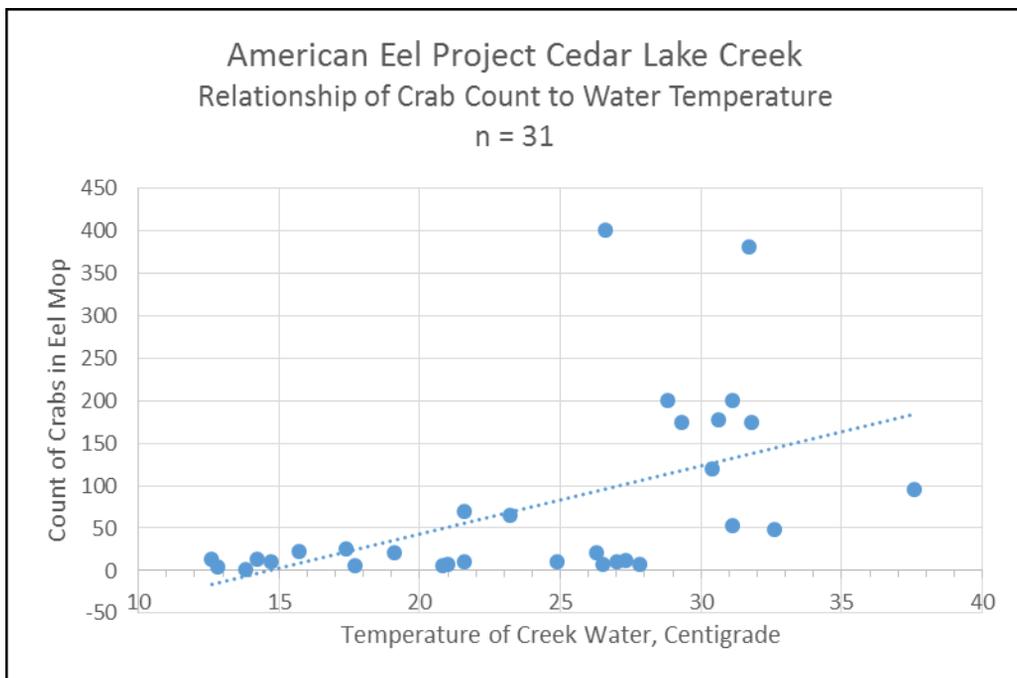
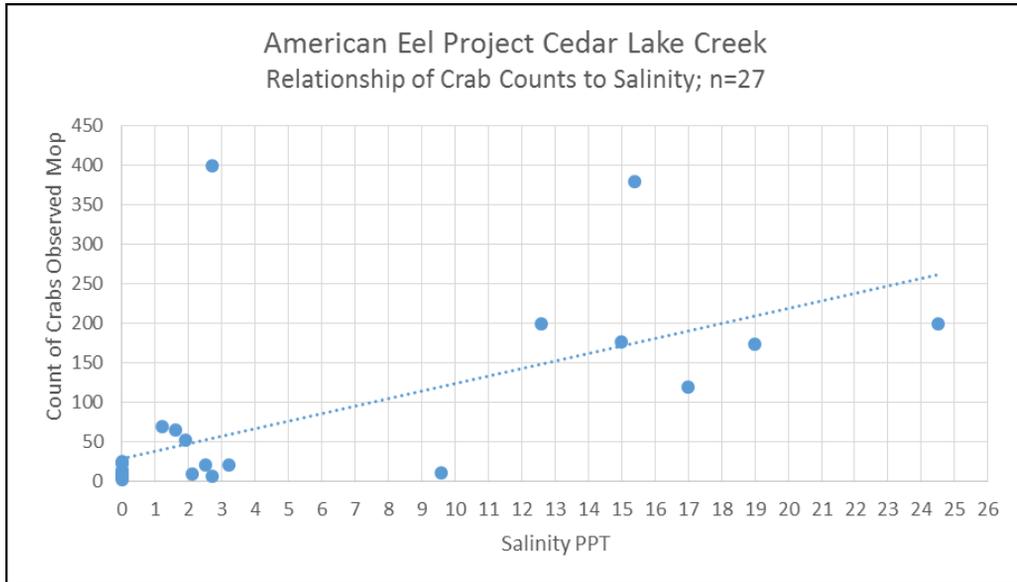
Crab Type	Count	%
Estuarine Mud	33	1%
Swimming	2548	99%
Total	2581	100%

2581 crabs were counted over the period of study. 99% of the crabs were swimming crabs, ranging in size from Megalops to adults about 50 mm carapace width. All adults were identified as Blue Crabs and it is assumed that the juveniles were also.

33 crabs were Estuarine Mud Crabs, distinguished by their white claws and absence of paddles on their fifth pair of legs. One female crab had an egg mass on her abdomen.

Charts on the next page show a direct relationship between higher salinity and higher water temperature and numbers of crabs observed. On two mop retrieval dates, 380 and 400 crabs were counted. On 9/16/2018, almost no species were collected, likely due to fast stream flow and significant flooding.

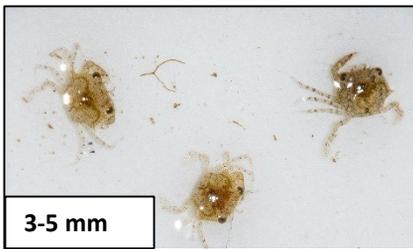
Crab - Statistics



The top chart shows the relationship between number of crabs observed and salinity for all dates in which salinity was measured.

The bottom chart shows the relationship between creek water temperature and number of crabs observed for all dates in which water temperature was measured. Since correlation is not causation, there is no direct proof that either salinity or water temperature caused the increase in crab population.

Crabs – Examples of Crabs Observed in Eel Mop



Megalops

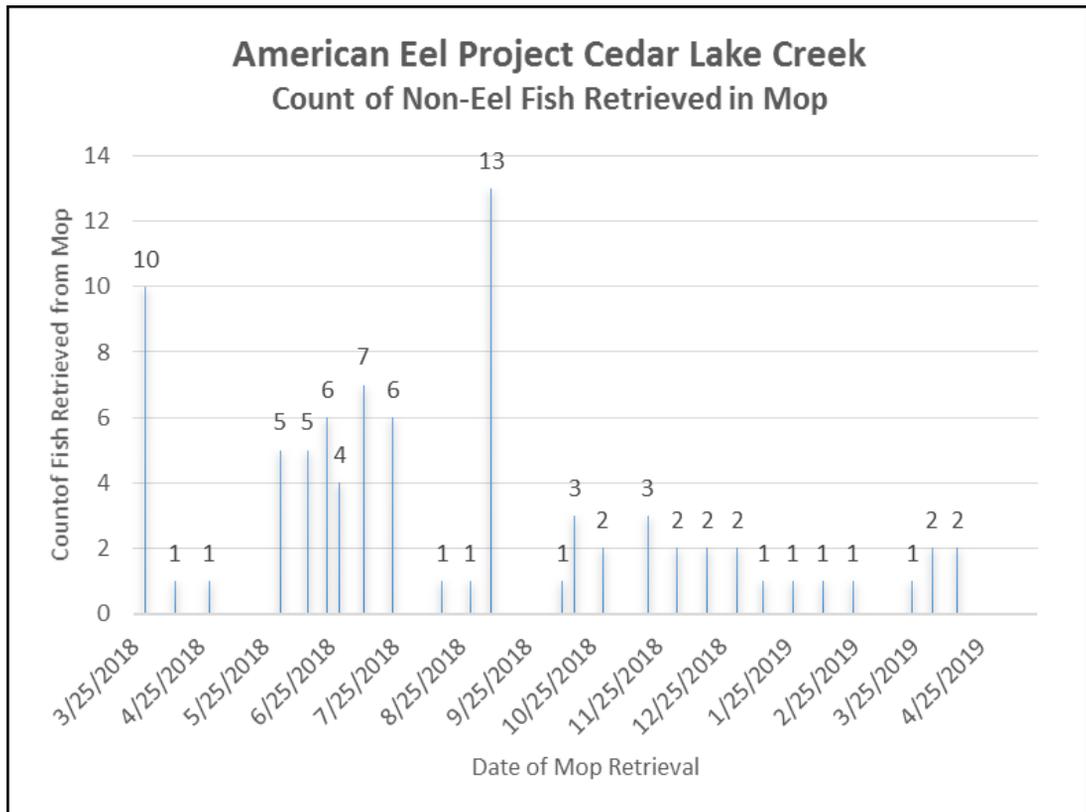
The life cycle of the Blue Crab is shown by the presence of Megalops, juvenile and adult crabs in the eel mop retrievals. When crab numbers were high, most of them were juveniles. Both male and female adults were seen.

The Estuarine Mud Crab was observed on several dates, especially when salinity levels were low. The photo on the right shows a female with an egg mass on her abdomen.



Fish - Statistics

Naked Goby	Goby species not ID	Eleotridae not ID	Fat Sleeper	Gray Snapper	Gulf Killifish	Sciaenidae not ID	Not ID	Total
53	12	2	2	1	1	1	12	84



The data table shows the distribution of species observed in the eel mop. Eighty four fish were found in the eel mop. About $\frac{3}{4}$ of the fish were Goby species. Most fish captured were 25-50 mm in size. The exception was the Eleotridae (Eleotris sp.), which was 10 cm in length.

Fish were observed throughout the study period, although more were seen during the first half, which corresponded in general to higher salinity levels in the creek. It is not known if the lower salinity levels affected the number of fish seen.

Fish – Examples of Fish Observed in Eel Mop



The most frequent fish caught in eel mop was the Naked Goby (see photos above). Most of the Gobies were 25-35 mm in length. Other Goby species were also seen but not specifically identified.

Photos of fish captured in the eel mop that were not identified. The two on the right are likely Goby species.



Fish – Examples of Fish Observed in Eel Mop



**3/30/2018
Not ID**



4/14/2019 Sciaenidae



12/18/2018 Gulf Killifish



11/16/2018 Gray Snapper



**10/11/2018 Fat Sleeper
Also seen 12/18/2018**



03/24/2019 Eleotridae



**6/29/18 Eleotrinae – Eleotris sp.
10 cm – largest fish caught in mop**

Shrimp – Examples of Shrimp and Crawfish Observed in Eel Mop



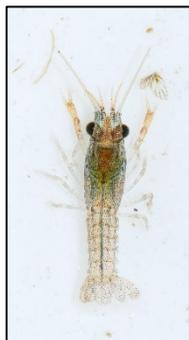
Bristled River Shrimp

111 Shrimp were found in the eel mop over the study period (Average = 3 shrimp/sampling.) Except for the Bristled River Shrimp, species ID was not done. Sizes were typically 10 – 50 mm in length, excluding antenna.

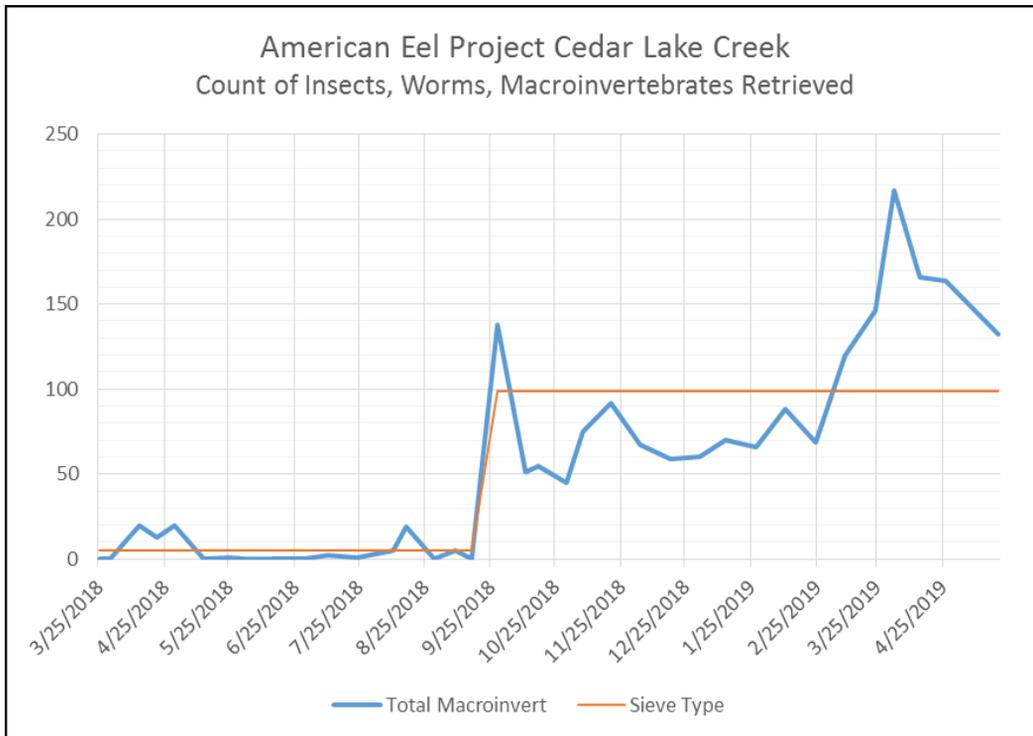


150 Crawfish were found in the eel mop over the study period.

Numbers of crawfish increased when there was no measured saline in the creek water. Sizes varied from 5 – 50 mm.



Insects/Larva and Other (Macroinvertebrates)



Before the finer-screen sieves were used to filter the mop water, low numbers of macroinvertebrates were seen. With the finer screen sieves (from late Sept. 2018 to the end of the study), large numbers of insects and other macroinvertebrates were harvested from the mop. The numbers counted are shown in the chart, but this may underestimate the totals actually present, as not all silt material in the fine sieve could be suspended and thus not all macroinvertebrates were counted. Consistent representative sampling was done in the fine silt layer containing macroinvertebrates each time, so the relative numbers give a reliable picture of the extent of macroinvertebrates in the water. No extrapolation of the data was done to increase the numbers based on estimates of the percent of fine sieve material examined. Only species counted are shown in the chart.

The 539 Insects and insect larva and pupa counted included diving beetles, bloodworms, miscellaneous other Diptera larva, Diptera pupa, mayfly nymphs, water boatman, damselfly and dragonfly nymphs, caddisfly larva, and other insect larva not ID. **The two predominant insect species seen were bloodworms and mayflies.**

The 1,427 other macroinvertebrates counted in the mop included Annelida (Polychaete worms and Serpulid worms, brown hydra, water mites, barnacles, mud shrimp (*Corophium*), scuds, Cladocera, Copepoda, Isopoda, Ostracoda, and a wide variety of bivalves and gastropods. **In terms of numbers, the predominant species seen were Ostracods and Copepods.**

Insects – Examples of Insects, Insect Larva and Nymphs Observed in Eel Mop



From L-R: Coleoptera (water beetle), Water Boatman, Caddisfly Larva



From L-R: Bloodworm, cluster of Bloodworms, and Diptera pupa



From L-R: Damselfly nymphs



From L-R: Two types of Dragonfly nymphs seen

Insects – Examples of Insects and Hydra Observed in Eel Mop



All photos above are mayfly larvae, a predominant macroinvertebrate in Cedar Lake Creek. The two mayflies on the right are Small Square-gilled Mayflies. The large number of mayflies present in Cedar Lake Creek provides a reliable indication of good water quality.

The photo at left is of an unidentified winged insect.



Brown Hydra were observed on two occasions. In the photo at the left, the asexual reproductive method of the Hydra is shown with the presence of budding from the parent column.

Other – Examples of Annelida Observed in Eel Mop

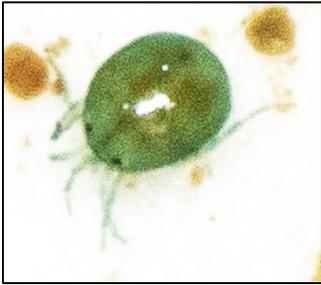


Polychaete worms were observed both in the mop and on the under-surface of the mop. A small Polychaete worm was observed in one bivalve.

The lower four photos show **Serpulid tube worms**, which continually used the concrete plate of the mop as a substrate to attach their tubes. Sometimes 15 or more were seen on the base. The fan-shaped feeding appendages can be seen in two of the photos.



Other – Examples of Water Mites and Crustacean Species Observed in Eel Mop



Small numbers of **water mites** were observed in the eel mop.

Crustaceans



Barnacles were frequently found adhering to the bottom plate of the eel mop. In some cases the barnacles were live and other times merely the shells remained.



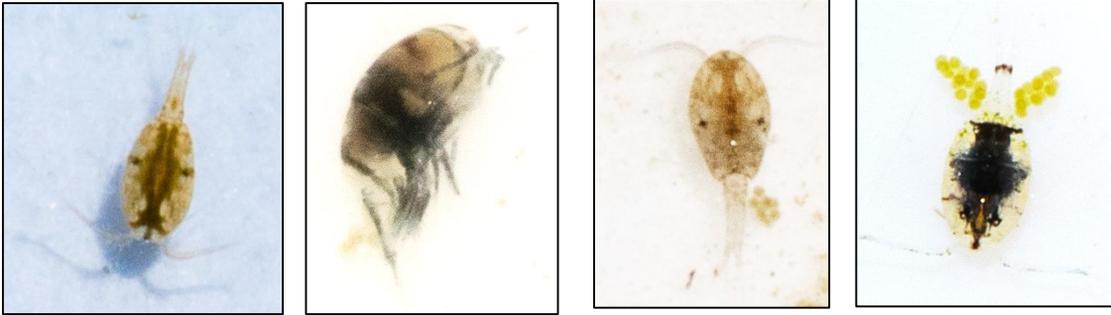
Amphipoda:
Scud



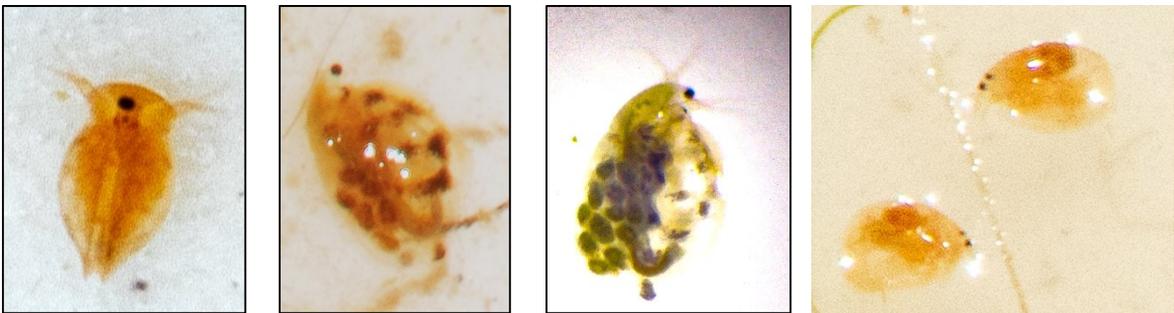
Amphipoda:
Mud Shrimp
(*Corophium*
***sp.*)**

Two species of Amphipods were commonly found in the eel mop: Scuds and *Corophium*.

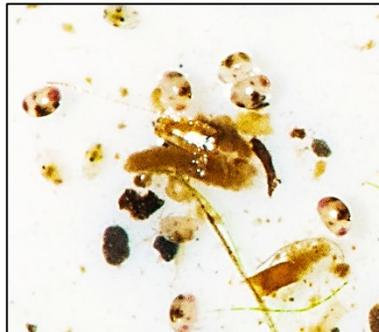
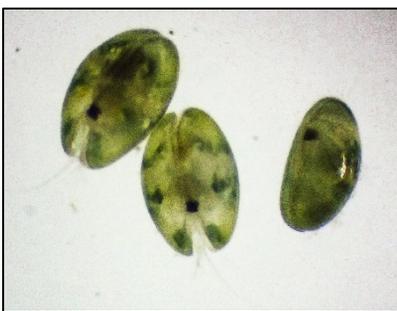
Other – Examples of Crustaceans Observed in Eel Mop



Copepoda – Several types of Copepods were observed. On several dates, over 50 Copepods were counted. Many had egg sacs.



Cladocera – Water fleas were frequently seen but in smaller numbers than the Copepods and Ostracods. Many had egg sacs.



Ostracoda (Seed Shrimp)

Most of the Ostracods seen were green but some were pink. On several dates, over 50 Ostracods were counted in the eel mop.



Isopoda



Isopoda – Aquatic sow bugs were seen in small numbers in the eel mop. It is not known if any of the Isopoda were parasitic species.

Other – Examples of Mollusca Observed in Eel Mop

Bivalves:



Small bivalves, typically, 5-10 mm in size, were found frequently in the eel mop. No speciation was done.

Gastropods seen in the eel mop include fresh water snails such as Physid snails, land snails such as the Globular Drop Snail, and other species not ID.

Gastropods:



Physid Snail



Globular Drop Snail



Minute Sea Snail
2 mm



Land Snail



Physid Snail



Conclusion:

Even though none of the target species, the American Eel, was seen during the study period, Cedar Lake Creek proved to be a species-rich environment for fish and a wide variety of macroinvertebrate species.

The absence of the American Eel may have been due to one of several factors:

- The eel mop may not be conducive as an intermediate resting area/hideout for American Eels migrating from the Gulf into Texas streams.
- Cedar Lake Creek may not be a Texas estuarine creek used by the American Eel as it traverses up Texas rivers and streams.
- The constantly changing hydrologic conditions of the creek due to periodic drought and flooding over the period of study may make this stream uninviting to eel populations.
- The lack of significant saline content in the creek for at least six months of the study may mean that the salt-water access is not always available to eel or other estuarine species attempting to move upstream.
- And lastly, during the study period, there may have been no American Eels migrating in Texas waters.

Which, if any of these or other reasons caused the absence of eels at Cedar Lake Creek is not known at this point. When this data is folded into the larger project data set that shows whether eel mops, fyke nets or other trapping methods were successful at other Texas river and stream sites., it is possible that a pattern of eel migration will emerge.

Acknowledgements:

We gratefully acknowledge the mentoring and project coordination of Stephen Curtis, Texas Parks and Wildlife and for TPWD for creating such a project in which Texas Master Naturalists can participate.

We also are thankful for the ongoing support of Jennifer Sanchez, USFWS, Texas Mid-Coast, for authorizing the placement of an eel mop on Cedar Lake Creek, a USFWS site for the length of the study period.

We also acknowledge the support of the Texas Master Naturalist, Cradle of Texas Chapter, and John Boettiger, Chapter Project Coordinator, for providing coordination and ongoing communication of the project.