Evaluation of Baffin Bay Arroyos as Critical Habitat for Fisheries Species

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Evaluation of Baffin Bay Arroyos as Critical Habitat for Fisheries Species

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Executive Summary

Baffin Bay arroyos were evaluated as critical habitat for fisheries species during drought conditions. Cast net and seine net samples were collected from three creeks (Los Olmos Creek (3 sites), Petronila Creek (3 sites), and San Fernando Creek (2 sites)) in January, May, June, and October 2008. A total of 977 fishes comprising 26 species/taxa were caught with the cast net and seine during the study. In Los Olmos Creek, the most abundant species/taxa were sheepshead minnows (52 % rank in abundance), silversides (11 %), bay anchovies (10 %), and skipjacks (8 %). In Petronila Creek, the most abundant species was Amazon mollies (62 %), Mexican tetras (23 %) and Western mosquitofish (8 %). In San Fernando Creek, the most abundant species was sheepshead minnows (51 %), sailfin mollies (9 %), striped mullets (9 %), Amazon mollies (8 %), and Gulf killifish (6 %). Of the three creeks sampled, San Fernando Creeks receives the most municipal wastewater effluent and the fishes collected from this creek were more characteristic of those found in freshwater and brackish water. Los Olmos Creek is the most pristine, and the fishes collected there were more characteristic of those found in typical estuaries. The results from this study suggest that the three creeks that drain into Baffin Bay are critical habitat for many fish species during drought conditions.

Introduction

Ephemeral streams are characteristic components of South Texas estuaries, especially in the Laguna Madre (Tunnell and Judd 2002). These ephemeral streams, or arroyos, typically have low flow rates and high salinity but occasionally are flooded by rain events. Black drum and other fisheries species make extensive use of these arroyos during these flood events (Purviance 2006). This project will investigate the roll that these streams play in the life history of these locally important finfishes. The project will also compare the use of arroyos by black drum (as a model species) of previously ephemeral arroyos in the region that are now "flowing" streams due to the regular input of municipal wastewater.

Objectives of this project include comparing selected finfish species utilization of pristine arroyos with urbanized arroyos, particularly those receiving municipal effluent outflows; and to compare seasonal reproductive status of black drum found in the open region of upper Baffin Bay, in "created" streams (i.e. those receiving municipal effluent), and ephemeral streams.

Study Area

The study area (Fig. 1) is located west and northwest of the Laguna Madre/Baffin Bay Complex. Figure 2 is a map of Texas and the arrow indicates the general sampling area. Three major ephemeral arroyos drain into three sub-bays connected to Baffin Bay (Fig. 1). Los Olmos Creek drains into Laguna Salada, San Fernando Creek drains into Cayo de Grullo, and Petronila Creek drains into Alazan Bay. Of the three creeks, Los Olmos Creek is probably the most pristine. San Fernando Creek is the most urbanized and runs just north of Kingsville, Texas. In addition, the cities of Kingsville, Texas and Alice, Texas drain their sewage effluent into creeks that will eventually drain into San Fernando Creek. Petronila Creek runs through the most agricultural land.

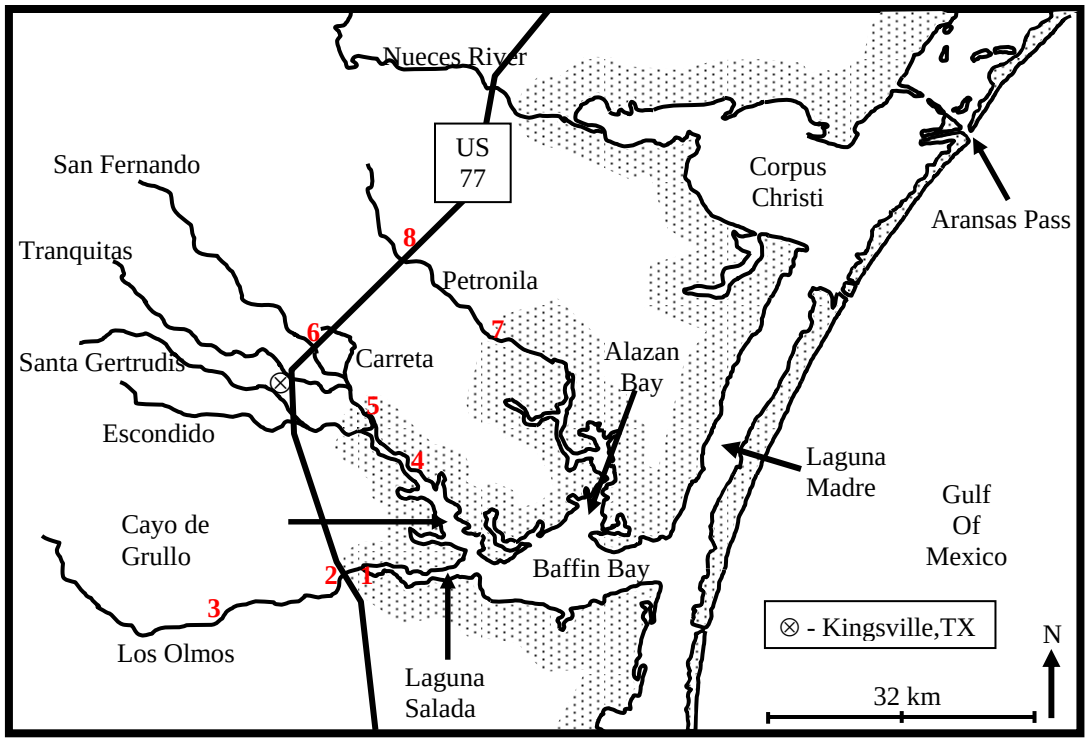

Figure 1. This is a map of the Laguna Madre/Baffin Bay complex. The three creeks samples were Los Olmos Creek (sites 1,2,3), San Fernando Creek (Sites 4,5,6), and Petronila Creek (Sites 7,8).

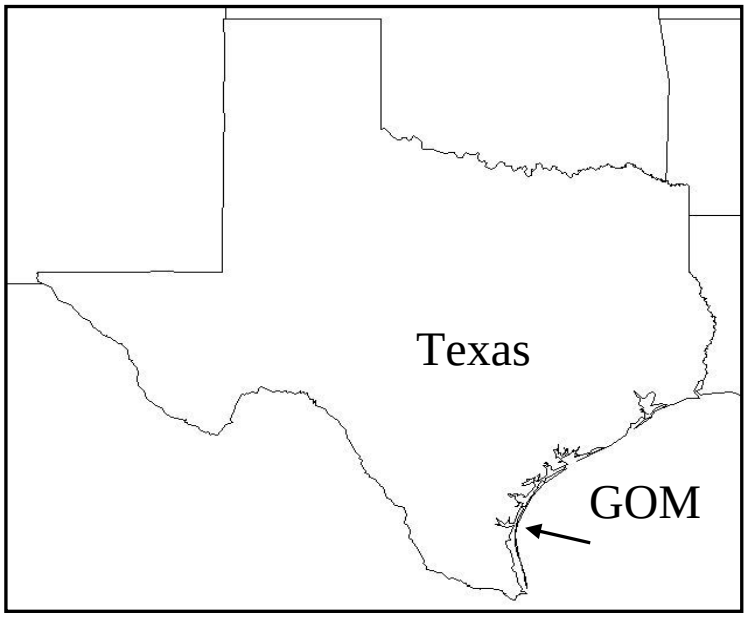

Figure 2. This is a map of Texas including the coastline. The arrow indicates where the study was conducted. GOM is the Gulf of Mexico.

Materials and Methods

Samples were taken on four dates, 20 January, 11 May, 22 June, and 17 October of 2008. Samples were taken using a cast net (1.8 diameter) and a seine (6.1 m length x 1.5 m height). Three sites were sampled at Los Olmos Creek, three at San Fernando Creek, and two at Petronila Creek (Fig. 1). At each site a cast net was thrown 10 times, and those fishes were pooled into one jar (Fig. 2). In addition, at each site three seines were pulled and those fishes were placed into individual jars. On 17 October 2008, only the San Fernando Creek sites were sampled. All fishes were placed into 60 % isopropyl, and then later sorted to species or to the lowest taxonomic level possible. Once sorted, each taxon was enumerated.

Environmental conditions were measured and recorded using a YSI 556 MDS data-logger and 5564 Datasonde. Parameters measured were temperature, salinity, dissolved oxygen, pH and depth, except on the last trip when we only recorded salinity because of instrument failure.

The percent rank in abundance was calculated for each fish. The percent rank in abundance for each fish is the total number of each fish caught divided by the total number of fish caught multiplied by 100. The standard length (SL) was measured and recorded for each fish collected.

Figure 3. This is an image from one of the sampling events where a cast net is being used during sample collection.

Results

A total of 977 fishes comprising 26 species were caught with the cast net and seine during the study (Table 1). Two hundred and forty-four fishes were caught with the cast net, and 744 fishes were caught with the seine. The data for the cast samples and the seine samples were pooled for all further analysis. The two dominant species caught were sheepshead minnows (31 % rank in abundance) and Amazon mollies (29 %) (Table 1). Mexican tetras had a percent rank in abundance of 10. All other species had a percent rank in abundance of less than 5. Eighteen Sciaenid fishes were caught comprising four species [spot (10), spotted seatrout (4), black drum (3), and red drum (1)]. None had a percent rank in abundance of more than one.

Two hundred fishes comprising 16 species were caught in Los Olmos Creek (Table 2). The most abundant species was sheepshead minnows (52 % rank in abundance). Silversides (11 %), bay anchovies (11 %), and skipjacks (8 %) were the next three most abundant species. All other species had a percent rank in abundance of less than five.

Table 1. Species and taxa collected with the cast net and seine net from creeks in 2008. SL is the standard length.

Species/Taxa	Total catch	Mean (SL)	Var.	% rank in abundance
Sheepshead minnow *Cyprinodon variegatus*	298	2.2	0.4	30.5
Amazon molly *Poecilia formosa*	280	4.3	2.2	28.7
Mexican tetra *Astyanax mexicanus*	95	5.6	0.5	9.7
Gulf killifish *Fundulus grandis*	40	3.6	5.1	4.1
Sailfin molly *Poecilia latipinna*	40	4.3	0.7	4.1
Striped mullet *Mugil cephalus*	38	11.3	32.0	3.9
Bay Anchovy *Anchoa mitchilli*	35	2.8	0.3	3.6
Western mosquitofish *Gambusia affinis*	32	3.0	0.4	3.3
Silverside *Menidia* sp.	24	3.5	0.5	2.5
Skipjack *Elops saurus*	15	6.0	1.9	1.5
Longnose killifish *Fundulus similis*	13	3.2	0.4	1.3
Blue tilapia *Oreochromis aureus*	11	7.2	5.9	1.1
Spot *Leiostomas xanthurus*	10	5.7	2.1	1.0
Blue gill *Lepomis macrochirus*	9	7.1	1.4	0.9
Gizzard Shad *Dorosoma cepidianum*	8	11.0	4.4	0.8
Channel catfish *Ictalurus punctatus*	7	10.8	44.4	0.7
Rio Grande cichlid *Herichthys cyanoguttatus*	5	7.4	2.0	0.5
Pinfish *Lagodon rhomboides*	4	5.1	1.3	0.4
Spotted seatrout *Cynoscion nebulosus*	4	6.4	37.7	0.4
Black drum *Pogonias cromis*	3	7.9	32.1	0.3
Atlantic needlefish *Strongylura marina*	1	7.1		0.1
Darter goby *Ctenogobius boleosoma*	1	2.8		0.1
Gulf menhaden *Brevortia patronus*	1	3.0		0.1
Gulf pipefish *Syngnathus scovelli*	1	7.5		0.1
Naked goby *Gobiosoma bosc*	1	3.4		0.1
Red drum *Sciaenops ocellatus*	1	2.1		0.1
TOTAL	977			

Table 2. Species and taxa collected with the cast net and seine net from each creek in 2008. SL is the standard length. Scientific names are as in Table 1.

Creek	Species/Taxa	Total catch	Mean (SL)	Var.	% rank in abundance
Los Olmos Creek	Sheepshead minnow	104	2.4	0.6	52.0
	Silverside	22	3.5	0.5	11.0
	Bay Anchovy	21	2.9	0.2	10.5
	Skipjack	15	6.0	1.9	7.5
	Gulf killifish	9	3.1	2.8	4.5
	Spot	8	5.1	1.0	4.0
	Striped mullet	6	10.0	27.8	3.0
	Pinfish	4	5.1	1.3	2.0
	Spotted seatrout	4	6.4	37.7	2.0
	Atlantic needlefish	1	7.1		0.5
	Black drum	1	8.4		0.5
	Darter goby	1	2.8		0.5
	Gulf pipefish	1	7.5		0.5
	Naked goby	1	7.1		0.5
	Gulf menhaden	1	3.0		0.5
	Red drum	1	2.1		0.5
	TOTAL	200			
Petronila Creek	Amazon molly	250	4.4	2.4	62.2
	Mexican tetra	91	5.6	0.5	22.6
	Western mosquitofish	32	3.0	0.4	8.0
	Gulf killifish	7	7.1	6.1	1.7
	Sailfin molly	6	3.4	1.7	1.5
	Rio Grande cichlid	5	7.4	2.0	1.2
	Sheepshead minnow	4	3.2	0.7	1.0
	Bluegill	3	5.8	0.9	0.7
	Channel catfish	3	9.1	4.6	0.7
	Silverside	1	3.3		0.2
	TOTAL	402			
San Fernando Creek	Sheepshead minnow	190	2.0	0.2	50.7
	Sailfin molly	34	4.4	0.4	9.1
	Striped mullet	32	11.6	33.2	8.5
	Amazon molly	30	4.0	1.2	8.0
	Gulf killifish	24	2.7	1.4	6.4
	Bay Anchovy	14	2.8	0.5	3.7

Longnose killifish	13	3.2	0.4	3.5
Blue tilapia	11	7.2	5.9	2.9
Gizzard Shad	8	11.0	4.4	2.1
Blue gill	6	7.7	0.4	1.6
Channel catfish	4	12.0	81.0	1.1
Mexican tetra	4	5.7	0.2	1.1
Black drum	2	7.7	63.8	0.5
Spot	2	7.9	0.1	0.5
Silverside	1	4.5		0.3
TOTAL	375			

Four hundred and two fishes comprising 10 species were caught with the cast net and seine in Petronila Creek (Table 2). The most abundant species was Amazon mollies (62 % rank in abundance). Mexican tetras (23 %) and Western mosquitofish (8 %) were the next most abundant fishes. All others had a percent rank in abundance of less than 2.

Three hundred and seventy-five fishes comprising 15 species were caught in San Fernando Creek (Table 2). Sheepshead minnows were the most abundant fish (51 % rank in abundance). Sailfin mollies (9 %), striped mullets (9 %), Amazon mollies (8 %), and Gulf killifish (6 %) were the next most abundant species. All others had a percent rank in abundance of less than five. The fishes that had a percent rank in abundance of at least 5 % by creek are on Figure 4.

In January, 140 fishes were caught, and the dominant species was sheepshead minnows (61 %)(Table 3). In May, 388 fishes were caught, and the dominant species was Amazon mollies (49 %). In June, 132 fishes were caught, and the dominant species was also Amazon mollies (47 %). In October, 317 fishes were caught, and the dominant species was sheepshead minnows (60 %). The fishes that had a percent rank in abundance of at least 5 % by date are on Figure 5.

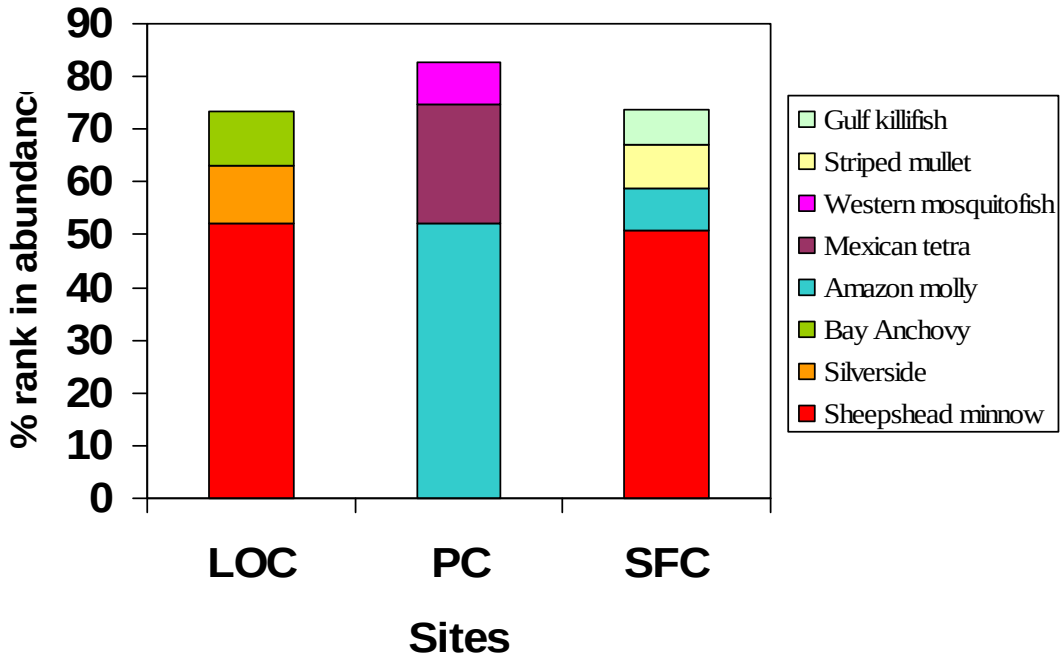

Figure 4. This is a graph of the fishes that had a percent rank in abundance of at least 5 % by creek. LOC is Los Olmos Creek, PC is Petronila Creek, and SFC is San Fernando Creek.

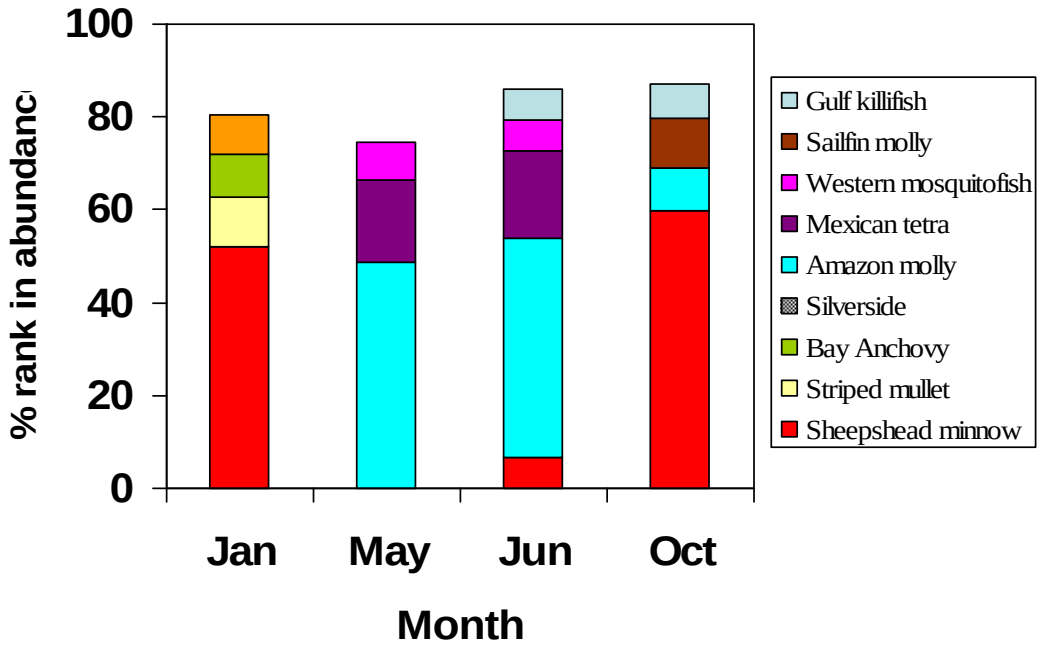

Figure 5. This is a graph of the fishes that had a percent rank in abundance of at least 5 % by date.

Table 3. Species and taxa collected with the cast net and seine net by date of collection in 2008. SL is the standard length. Scientific names are as in Table 1.

Date	Species/Taxa	Total catch	Mean (SL)	Var.	% rank in abundance
Jan	Sheepshead minnow	85	2.2	0.3	60.7
	Striped mullet	15	12.5	9.9	10.7
	Bay anchovy	13	3.0	0.1	9.3
	Silverside	12	3.4	0.7	8.6
	Gulf killifish	6	3.3	3.3	4.3
	Gizzard shad	5	12.1	0.8	3.6
	Naked Goby	1	3.4		0.7
	Red drum	1	2.1		0.7
	Blue tilapia	1	8.7		0.7
	Channel catfish	1	25.5		0.7
	TOTAL	140			
May	Amazon molly	189	3.9	1.9	48.7
	Mexican tetra	69	5.4	0.4	17.8
	Western mosquitofish	32	3.0	0.4	8.2
	Striped mullet	18	10.0	52.3	4.6
	Sheepshead minnow	14	2.9	0.7	3.6
	Bay anchovy	13	2.6	0.5	3.4
	Skipjack	10	5.7	2.4	2.6
	Spot	10	5.7	2.1	2.6
	Silverside	7	3.3	0.1	1.8
	Gulf Killifish	5	6.0	6.9	1.3
	Sailfin molly	5	2.9	0.1	1.3
	Pinfish	3	4.6	0.5	0.8
	Spotted seatrout	3	7.2	52.9	0.8
	Channel catfish	2	10.1	4.2	0.5
	Darter goby	1	2.8		0.3
	Gulf menhaden	1	3.0		0.3

	Atlantic needlefish	1	7.0		0.3
	Gulf pipefish	1	7.5		0.3
	Bluegill	1	4.7		0.3
	Rio Grande cichlid	1	5.6		0.3
	Black drum	1	2.0		0.3
	Gizzard shad	1	7.1		0.3
	TOTAL	388			
Jun	Amazon molly	62	5.9	0.7	47.0
	Mexican tetra	25	5.9	0.5	18.9
	Bay anchovy	9	3.0	0.2	6.8
	Sheepshead minnow	9	3.8	0.9	6.8
	Gulf killifish	6	5.4	11.3	4.5
	Skipjack	5	6.6	0.4	3.8
	Silverside	4	4.0	0.4	3.0
	Rio Grande cichlid	4	7.8	0.5	3.0
	Bluegill	2	6.3	0.1	1.5
	Black drum	1	8.4		0.8
	Pinfish	1	6.6		0.8
	Spotted seatrout	1	4.1		0.8
	Striped mullet	1	4.4		0.8
	Channel catfish	1	7.3		0.8
	Sailfin molly	1	6.0		0.8
	TOTAL	132			
Oct	Sheepshead minnow	190	2.0	0.2	59.9
	Sailfin molly	34	4.4	0.4	10.7
	Amazon molly	29	4.0	1.2	9.1
	Gulf killifish	23	2.6	1.3	7.3
	Longnose killifish	13	3.2	0.4	4.1
	Blue tilapia	10	7.1	6.3	3.2
	Bluegill	6	7.7	0.4	1.9
	Striped mullet	4	14.4	6.7	1.3
	Channel catfish	3	7.5	0.1	0.9
	Gizzard shad	2	10.0	4.8	0.6
	Black drum	1	13.3		0.3

Mexican tetra	1	5.4	0.3
Silverside	1	4.5	0.3
TOTAL	317		

Discussion and Conclusions

A total of 26 species were caught during the study despite drought conditions throughout the study period (Table 1). Since no major rain events occurred during the study, black drum and other commercially important sciaenid species were not observed migrating up these creeks. Consequently very few of these fishes were caught. However, some small juvenile spot, black drum and spotted seatrout and a single red drum were caught.

Sheepshead minnows were the most abundant species caught. This species was caught in all creeks sampled and during each sampling date. Sheepshead minnows are known to be one of the most euryhaline species in the world, and so these results were not unexpected.

The Amazon molly was the second most abundant species, and far more abundant than the congener sailfin molly. Our results are consistent with those of McNeely and Wade (2003) who also found Amazon mollies more abundant than sailfin mollies near Brownsville, Texas. The Amazon molly is an all female species (Hubbs and Hubbs 1932). Females of this species mate with males of another species. In this area, they mate with male sailfin mollies, however, the sperm of these males only initiates embryogenesis and does not get incorporated into the egg. Therefore, females give rise to genetically identical offspring. It would be more expected that the sailfin molly with the more typical mating strategy be more abundant since their offspring are genetically variable. This variation should be more advantageous in the highly variable environmental conditions in these arroyos.

Los Olmos Creek is the most pristine of the three creeks sampled. It receives the least amount of municipal effluent which comes from Riviera, Texas. The fishes caught at this creek are more typical of fishes caught in estuaries. San Fernando Creek receives more municipal effluent. The fishes caught at this creek are more representative of fishes caught in freshwater and brackish conditions.

Black drum are known to migrate up these creeks after heavy rain events. Some evidence exists that these fishes are migrating up creeks to spawn (Purviance 2006). These creeks may be even more important to fishes particularly black drum larvae and early juveniles during these times. Moreover, the effects of the more pristine arroyo to that of the urbanized arroyos on larval and juvenile black drum and other fish species should be determined.

After these rain events, there have been several reports that black drum and other fishes get stranded in pools particularly near human-made dams after the water level subsides (Soto pers. com.). After a heavy rain event, a quantitative estimate of the number of stranded fishes should be obtained. This estimate should be used as a baseline to determine the feasibility of developing fish ladders at these dams to allow uninterrupted migration routes for these fishes.

This study determined that Baffin Bay arroyos are critical habitat for fisheries species during drought conditions. Further sampling should be conducted to determine the effects of major rain events on the fish composition in these creeks, particularly the effects of these rain events on commercially and recreationally important Sciaenid species.

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