

FINAL REPORT

FRESHWATER SPORT FISH COMMUNITY ASSESSMENTS IN
PUERTO RICO RESERVOIRS AND LAGOONS

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Fish community assessment in selected reservoirs

To derive indices of sport fish populations and community well being in selected Puerto Rico reservoirs (Loiza, Dos Bocas, Caonillas, Carite, Cidra and Toa Vaca).

Six reservoirs were monitored during July 1, 2012 to June 30, 2013. For the first semester (S1 2012) (July – December, 2012), only Loiza (388 ha) and Dos Bocas (254 ha) reservoirs were monitored. For the second semester (S2 2013) (January – June, 2013), six reservoirs were monitored including Loiza (388 ha), Dos Bocas (254 ha), Caonillas (280 ha), Cidra (170.8 ha), and Toa Vaca (321 ha). Although it was not among the reservoirs scheduled to be sampled during this segment, Guayo reservoir (118 ha) was monitored during S2 instead of Carite. These reservoirs are of high priority for sport fish management, according to the Puerto Rico Reservoir Fisheries Management Manual, and are not currently covered by Department of Natural and Environmental Resources (DNER) refuge management officials. In these reservoirs, the water level fluctuates because they are primarily used to supply water to the nearby communities. This situation can affect fish spawning and hence recruitment. The fish community assessments provide us with the data required to determine if these reservoirs are in need of active management of the fishery as a result of the water level fluctuations, fishing intensity or other causes.

During this segment, project personnel collaborated in electrofishing with personnel from Project F-34 - Development of Sport Fishing Activities at Guajataca Reservoir, Project F-60 - Development of Sport Fishing Activities at Cerrillos Reservoir and Project F-47 - Development of Sport Fishing Activities at La Plata Reservoirs because they had problems with their electrofishing boats or did not have one. Also, project personnel collaborated with personnel

from Project F-53R - Freshwater Sport Fish Management and Enhancement in a study performed at Cerrillos reservoir. In addition, a broodstock capture was performed as requested by Maricao Fish Hatchery personnel (Project F-35 – Maricao Fish Hatchery Operation and Maintenance).

Methodology

Reservoirs were sampled by standardized daytime electrofishing, during each six months period (semesters). The six sampled reservoirs were selected based on the greatest priority ranking for DNER but are not currently covered by DNER management officials (as described in the Puerto Rico Reservoir Fisheries Management Manual). Electrofishing procedures followed the Puerto Rico Reservoir Management Manual. A crew of three individuals sampled a total of six sites per reservoir. Each site was sampled for 10 minutes. All fish collected were identified to species, weighed (g) and measured (mm). Assemblage structure and relative abundance were established for all fish species. Size structure, relative abundance, and condition were analyzed for members of the fish assemblage as appropriate. Environmental data, including dissolved oxygen, temperature, depth and secchi disk transparency, were collected at each station. Fish were photographed for documentation purposes and reports.

Project personnel contacted tournament officials by telephone to obtain the following information: reservoir selected for tournaments, date, number of participants, fishing hours, and catch in terms of number and weight of specimens that qualify for the event. In addition, they were asked for the number of fish released alive, winning weight and number of anglers with at least one fish.

Data analysis and report preparation

To analyze data for annual and final reports.

Loiza and Dos Bocas reservoirs were monitored two times (July to December 2012 = **S1 2012**, and January to June 2013 = **S2 2013**). Caonillas, Cidra, Toa Vaca and Guayo reservoirs were monitored only during **S2 2013**. Mechanical problems with the boat, bad weather conditions and low water level at Carite reservoir, impeded us to fulfill the Annual work Plan as proposed.

LOIZA

The 2012-2013 electrofishing sample at Loiza reservoir was represented by ten species (Table 1). Threadfin shad (*Dorosoma petenense*) were observed during the sampling but were not used as part of the species composition analysis. The dominant species was the peacock bass (*Cichla ocellaris*) with a relative abundance of 27.0%. This is one of the preferred sport fish on the island. The red devil (*Amphilophus spp.*) showed a relative abundance of 23% and the guapote tigre (*Parachromis managuensis*) showed a relative abundance of 14.5%. In this reservoir, it is common to find several tropical aquarium species.

Table 1. Target species present in electrofishing samples at Loiza reservoir during July 2012 to June 2013. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2012	S2 2013	Composition
armored catfish	15 (29)	12 (12)	13.5
blue tilapia	4 (7)	12 (12)	8.0
channel catfish	1 (2)	2 (2)	1.5
firemouth cichlid	0	1 (1)	0.5
guapote tigre	1 (3)	28 (28)	14.5
largemouth bass	2 (4)	1 (1)	1.5
mozambique tilapia	2 (3)	13 (13)	7.5
peacock bass	44 (85)	10 (10)	27.0
redbreast tilapia	2 (4)	4 (4)	3.0
red devil	29 (55)	17 (17)	23.0
Total	100 (192)	100 (100)	100

Loiza Reservoir has 3 top-level predators; largemouth bass (*Micropterus salmoides*), peacock bass and guapote tigre. The guapote tigre, native to Costa Rica, is considered highly piscivorous and aggressive. It was introduced by university aquaculture researchers before 2003 to control the tilapia populations in an experimental aquaculture farm in Lajas, Puerto Rico. It was caught for the first time in Loiza reservoir during electrofishing sampling in 2008 and is now established. Fishing tournaments at Loiza reservoir include the guapote tigre among the target species.

Largemouth bass Length Frequency for Loiza reservoir in S1 2012 is shown in Figure 1. For S2 2013 sampling only one largemouth bass was caught (320 mm).

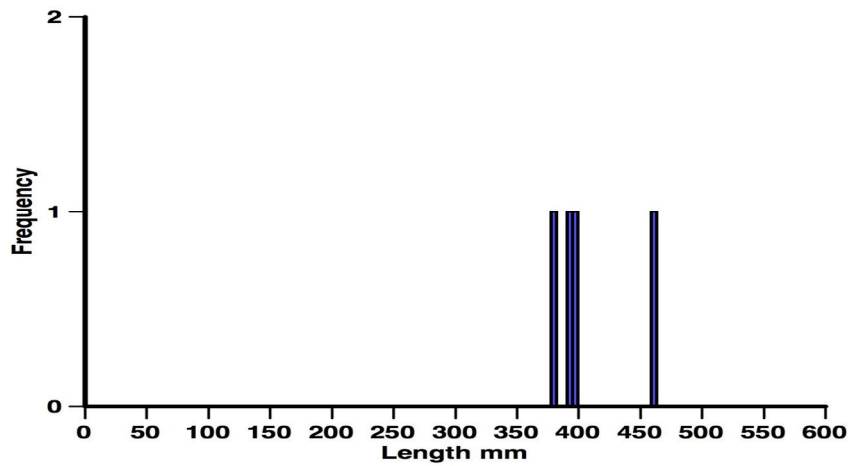


Figure 1. Length frequency distribution of largemouth bass at Loiza reservoir during S1 2012 electrofishing.

Total Catch per Unit of Effort (CPUE fish/hour), LMB CPUE and LMB Relative Weights in Loiza reservoir for July 2012 to June 2013 are presented in Table 2. The condition factor for largemouth bass was very good during both samplings.

Table 2. Total CPUE, LMB CPUE and LMB Relative Weight for Loiza reservoir for July 2012 to June 2013.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
S1 2012	192	4	103
S2 2013	100	1	105

DOS BOCAS

A total of 14 fish species were captured in Dos Bocas reservoir such that this reservoir has the greatest species diversity among the six monitored. Abundant threadfin shad were observed during the sampling and also the mosquito fish (*Gambusia sp.*) and the rosy barb (*Pethia conchonius*) were present. However none of these three species has been included in the species composition analysis (Table 3), since boat electroshocking is not the appropriate sampling technique for them and they are not target species.

The dominant species were the armored catfish (*Pterygoplichthys pardalis*) (28% for S1 2012 and 36% for S2 2013) and red devil (33% for S1 2012 and 18% for S2 2013). The firemouth cichlid (*Thorichthys meeki*) was present at a relative abundance of 4% and 9% for S2 2011 and S1 2012 respectively. Also the convict cichlid (*Archocentrus nigrafasciatus*) was present at a low average relative abundance (0.5%). All of these are invasive species, presumably from the aquarium industry. Largemouth bass showed a relative abundance of 4% (7 individuals) during S1 2012 and 2% (3.6 individuals) during S2 2013.

Table 3. Target species present in electrofishing samples at Dos Bocas reservoir during July 2012 to June 2013. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2012	S2 2013	Composition
armored catfish	28 (46)	36 (43)	32.0
blue tilapia	8 (13)	10 (12)	9.0
convict cichlid	1 (2)	0	0.5
channel catfish	4 (7)	6 (7)	5.0
firemouth cichlid	10 (17)	6 (7)	8.0
largemouth bass	4 (7)	2 (3)	3.0

mozambique tilapia	8 (13)	9 (11)	8.5
peacock bass	3 (4)	6 (7)	4.5
redbreast sunfish	0	3 (3)	1.5
redbreast tilapia	1 (1)	3 (3)	2.0
red devil	33 (53)	18 (22)	25.5
redeer sunfish	0	1 (1)	0.5
Total	100 (163)	100 (119)	100

Total Catch per Unit of Effort (CPUE fish/hour), LMB CPUE and LMB Relative Weight (W_r) at Dos Bocas reservoir during July 2012 to June 2013 is presented in Table 4.

Table 4. Total CPUE, LMB CPUE and LMB relative weight for Dos Bocas reservoir for July 2012 to June 2013.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB W_r
S1 2012	163	7	118
S2 2013	119	3.6*	109

*Five out of the standard six electrofishing samples were performed due to intensive rain.

During S1 2012, LMB CPUE was 7 fish/hour and largemouth bass condition factor was 118, which was excellent. For S2 2013, LMB CPUE was 3.6 fish/hour (only 5 electrofishing samples) and largemouth bass condition factor was 109, which was also very good.

LMB relative abundance is presented in Figure 2 and Figure 3. No largemouth bass at fingerling size (~ 76 mm TL – 203 mm TL) were captured in either of the electrofishing periods.

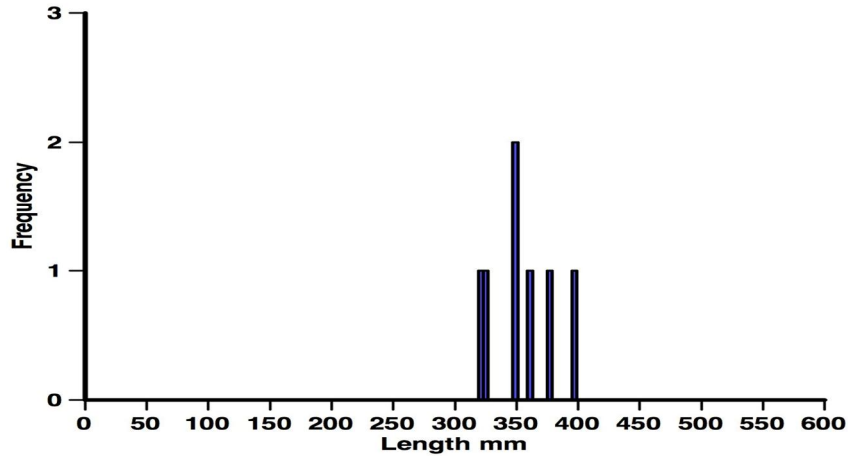


Figure 2. Length frequency distribution of largemouth bass at Dos Bocas reservoir during S1 2012 electrofishing.

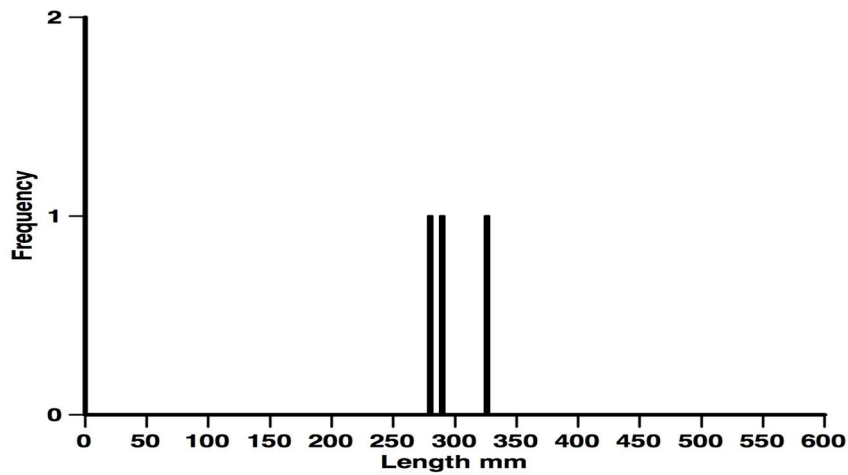


Figure 3. Length frequency distribution of largemouth bass at Dos Bocas reservoir during S2 2013 electrofishing.

CAONILLAS

In Caonillas reservoir, a total of eight fish species were captured. Threadfin shad were observed during the sampling but were not counted as part of the species composition analysis. The

dominant species were the invasive red devil (45.0%), and the armored catfish (20.0%) Table 5. The firemouth cichlid is also present at a relative abundance of 6.0%. The largemouth bass show an enhanced relative abundance of 15% with 22 individuals.

Table 5. Target species present in electrofishing samples at Caonillas reservoir during July 2012 to June 2013. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2012	S2 2013	Composition
armored catfish	---	20 (29)	---
blue tilapia	---	1 (1)	---
firemouth cichlid	---	6 (8)	---
largemouth bass	---	15 (22)	---
mozambique tilapia	---	1 (2)	---
redbreast tilapia	---	12 (18)	---
red devil	---	45 (66)	---
Total	---	100 (146)	---

As it was mentioned before, no sampling was performed during S1 2012 at Caonillas, Cidra, Toa Vaca and Guayo reservoirs due to problems with the boat generator or bad weather conditions.

Largemouth bass of fingerling size (approximately 76 mm TL – 203 mm TL) were found in the S2 2013 electrofishing sampling at Caonillas reservoir (Figure 4).

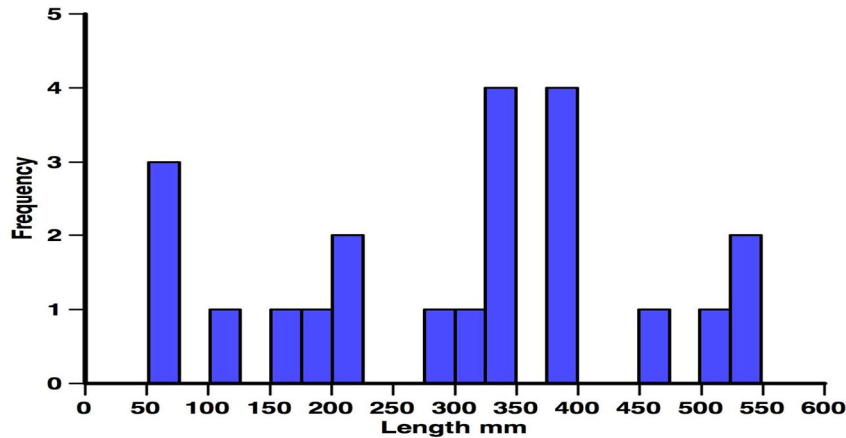


Figure 4. Length frequency distribution of largemouth bass at Caonillas reservoir during S2 2013 electrofishing.

Total CPUE, LMB CPUE and LMB relative weight is presented in Table 6. LMB CPUE S2 2013 electrofishing was 22 fish/hour. The condition factor for largemouth bass was good ($Wr = 101$).

Table 6. Total CPUE, LMB CPUE and LMB Relative Weight for Caonillas reservoir for July 2012 to June 2013.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
S1 2012	---	---	---
S2 2013	146	22	101

CIDRA

The 2012-2013 electrofishing capture at Cidra reservoir was represented by ten species (Table 7). For the first time since 2007, threadfin shad were not observed during the sampling. On the other hand, the Australian redclaw *Cherax quadricarinatus* was caught and observed during the sampling.

Table 7. Target species present in electrofishing samples at Cidra reservoir during July 2012 to June 2013. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2012	S2 2013	Composition
armored catfish	---	6 (10)	---
blue tilapia	---	1 (2)	---
channel catfish	---	5 (8)	---
largemouth bass	---	1 (1)	---
mozambique tilapia	---	2 (4)	---
peacock bass	---	17 (29)	---
redbreast sunfish	---	1 (2)	---
redbreast tilapia	---	59 (98)	---
redecor sunfish	---	6 (10)	---
red devil	---	2 (3)	---
Total	---	100 (167)	---

Largemouth bass, one of our target fish, showed a relative abundance of 1% (1 individual 349 mm). The dominant species was redbreast tilapia (*Tilapia rendalli*) (59%). The second dominant species was the peacock bass with 17%. The red devil that was detected for the first time during electrofishing in 2010, continue present at this reservoir at 2% relative abundance.

LMB CPUE was 1 fish/hour and the LMB condition factor (W_r) was 98, which is acceptable (Table 8).

Table 8. Total CPUE, LMB CPUE and LMB relative weight for Cidra reservoir for July 2012 to June 2013.

Sample	TOTAL CATCH	LMB CPUE	MEAN
	CPUE (fish/hour)	(fish/hour)	LMB W_r
S1 2012	---	---	---
S2 2013	167	1	98

TOA VACA

The electrofishing capture for July 2012 to Jun 2013 was represented by six species (Table 9). Threadfin shad were observed during the sampling but have not been used in the species composition analysis. Among the reservoirs sampled, Toa Vaca has the lowest fish diversity.

The dominant species was largemouth bass, one of our target fish. It showed a relative abundance of 49% (59 individuals). The redear sunfish (*Lepomis microlophus*) showed a relative abundance of 24% (29 individuals). The peacock bass, and the red devil, were not captured in this reservoir. However, one specimen of the convict cichlid (1%) was caught.

Table 9. Target species present in electrofishing samples at Toa Vaca reservoir during July 2012 to June 2013. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2012	S2 2013	Composition
armored catfish	---	20 (24)	---
convict cichlid	---	1 (1)	---
largemouth bass	---	49 (59)	---
redbreast tilapia	---	6 (8)	---
redear sunfish	---	24 (29)	---
Total	---	100 (121)	---

3

Total CPUE (fish/hour), LMB CPUE and LMB Relative Weight (W_r) at Toa Vaca reservoir for July 2012 to June 2013 is presented in Table 10. LMB CPUE was excellent and largemouth bass relative weight was satisfactory.

Table 10. Total CPUE, LMB CPUE and LMB Condition Factor for Toa Vaca reservoir for July 2012 to June 2013.

Sample	TOTAL CATCH	LMB CPUE	MEAN
	CPUE (fish/hour)	(fish/hour)	LMB W_r
S1 2012	---	---	---
S2 2013	121	59	97

The LMB length frequency at Toa Vaca reservoir is shown in Figure 5. A healthy largemouth bass population is present with representation of fingerling, juvenile and adult fishes.

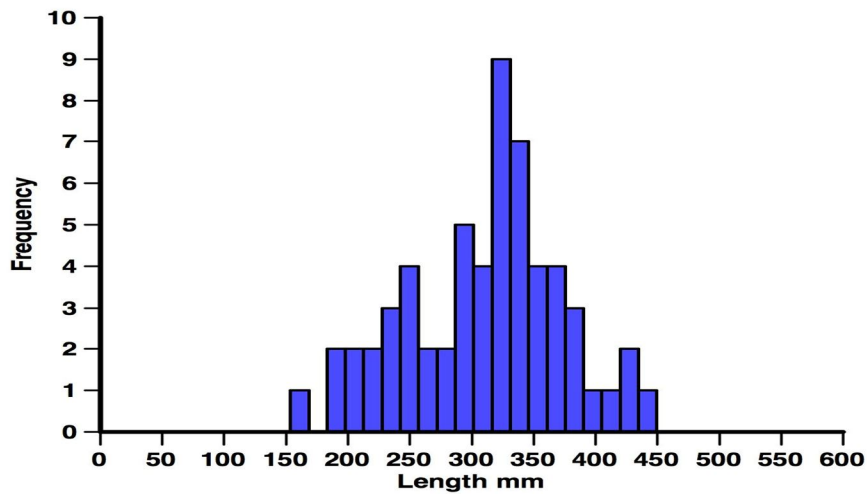


Figure 5. Length frequency distribution of largemouth bass at Toa Vaca reservoir during S2 2013 electrofishing.

GUAYO

Similar to Toa Vaca, and contrary to the majority of the reservoirs in Puerto Rico, the most abundant species in this reservoir was the largemouth bass with a relative abundance of 62% (134 individuals). The electrofishing capture at Guayo reservoir was represented by ten species (Table 11). The redear sunfish showed a relative abundance of 16% (35 individuals). Threadfin shad were present during sampling but were not included in the species composition analysis.

The peacock bass was not present in this reservoir.

Table 11. Target species present in electrofishing samples at Guayo reservoir during July 2012 to June 2013. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2012	S2 2013	Composition
armored catfish	---	10 (22)	---
bluegill sunfish	---	2 (4)	---
blue tilapia	---	1 (3)	---
channel catfish	---	1 (2)	---

largemouth bass	---	62 (134)	---
mozambique tilapia	---	1 (1)	---
redbreast sunfish	---	3 (7)	---
redbreast tilapia	---	4 (9)	---
redear sunfish	---	16 (35)	---
Total	---	100 (217)	---

Total Catch per Unit of Effort (CPUE fish/hour), LMB CPUE and LMB Relative Weight (W_r) at Guayo reservoir for S2 2013 is presented in Table 12. The CPUE was very high but the largemouth bass relative weight was quite low.

Table 12. Total CPUE, LMB CPUE and LMB Condition Factor for Guayo reservoir for July 2012 to June 2013.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB W_r
S1 2012	---	---	---
S2 2013	217	134	93

Fingerling LMB were observed in Guayo electrofishing sampling. Figure 6 presents the LMB Length Frequency for S2 2013.

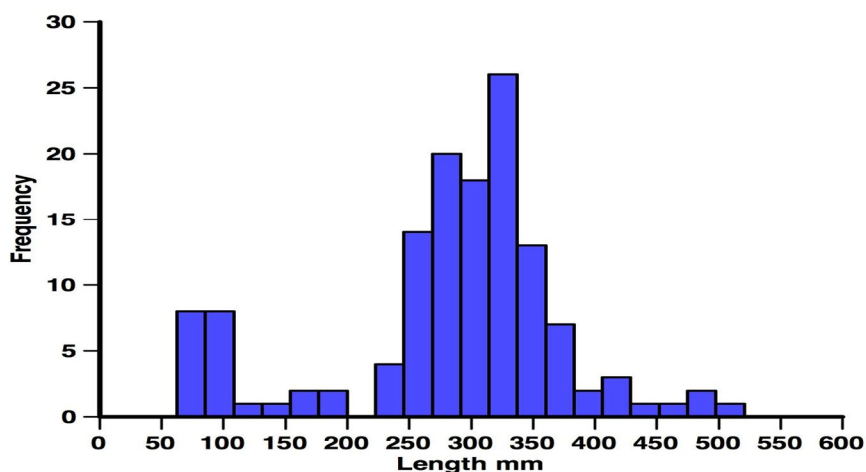


Figure 6. Length frequency distribution of largemouth bass at Guayo reservoir during S2 2013 electrofishing.

Water Quality

Table 13 shows the water quality data for all reservoirs during S1 2012 and S2 2013 electrofishing samplings. Water quality parameters were monitored at each reservoir. The parameters measured were temperature, secchi disk transparency, dissolved oxygen and specific conductivity. Also, the reservoir depth was taken at the point where the other parameters were measured, usually in the area of the dam.

Table 13. Water quality data for the six reservoirs sampled during July 2012 to June 2013.

	Temperature (°C)	Secchi (cm)	O. D. (mg/l)	Depth (feet)	Conductivity (μ)
Loiza	S1 / S2 30.0 / 27.4	S1 / S2 116.0 / 171.0	S1 / S2 6.45 / 4.02	S1 / S2 42.3 / 27.7	S1 / S2 316.1 / 424.8
Dos Bocas	S1 / S2 28.6 / 26.4	S1 / S2 117.0 / 165.0	S1 / S2 6.76 / 6.75	S1 / S2 59.9 / 66.6	S1 / S2 220.8 / 220.3
Caonilla	S1 / S2 --- / 26.4	S1 / S2 --- / 171.0	S1 / S2 --- / 6.25	S1 / S2 --- / 105.5	S1 / S2 --- / 209.1
Cidra	S1 / S2 --- / 24.6	S1 / S2 --- / 121.0	S1 / S2 --- / 6.20	S1 / S2 --- / 47.1	S1 / S2 --- / 198.1
Toa Vaca	S1 / S2 --- / 27.3	S1 / S2 --- / 116.0	S1 / S2 --- / 8.10	S1 / S2 --- / 123.9	S1 / S2 --- / 277.8
Guayo	S1 / S2 --- / 27.4	S1 / S2 --- / 74.0	S1 / S2 --- / 9.37	S1 / S2 --- / 113.8	S1 / S2 --- / 195.1

Bass tournaments

To describe the competitive fishery in selected reservoirs (Caonillas, Carite, Cidra, Dos Bocas, Loiza and Toa Vaca).

Tournament officials from the reservoirs monitored were contacted via telephone and/or e-mail by project personnel to obtain the information necessary to calculate the Effort, CPUE, # of tournaments, # of anglers, largemouth bass maximum weight, and successful anglers (%). In Carite Reservoir, no fishing tournaments were celebrated.

Dos Bocas, Cidra, and Toa Vaca did not reported tournament data as of the date of this report (Table 14). Loiza and Caonillas celebrated 4 tournaments, Guayo celebrated 9 and Garza

celebrated 1. An average of only 4 largemouth bass were captured in the Loiza tournaments (CPUE = 0.01). In Caonillas, an average of 17 largemouth bass were captured with CPUE = 0.04 fish/hour. For Garza, an average of 34 largemouth bass were captured with CPUE = 0.15 fish/hour. In Guayo reservoir an average of 125 largemouth bass were captured in the tournaments (CPUE = 0.25).

Table 14. Tournament data reported in reservoirs monitored from July 2012 to June 2013.

Reservoir	No. events reported	Effort (a/h)	Average anglers per event	Successful Anglers (%)	CPUE LMB	CPUE PKB	Average LMB per event	LMB Max. weight (kg)
Loiza	4	1015	22.5	63	0.01	0.14	4	†
Dos Bocas	†	†	†	†	†	†	†	†
Caonillas	4	1940	48.5	41	0.04	0.07	17	†
Cidra	†	†	†	†	†	†	†	†
Toa Vaca	†	†	†	†	†	†	†	†
Guayo	9	4586	54.22	73	0.25	N/A	125	2.61
Garza	1	231	21	71	0.15	0.0	34	1.79

† Data was not provided.

Discussion

Loiza reservoir

The electrofishing sampling at Loiza reservoir presented a species diversity of 10 fish species. Despite the implementation of some management measures including largemouth bass fingerling stocking and adult largemouth bass relocation at Loiza reservoir, its abundance has remained much the same over the past few years. The largemouth bass relative abundance remains low (1.5%) while peacock bass relative abundance remains high (27%). The presence of aquarium species (red devil) is at high relative abundance (23%). In contrast, the sunfish species (*Lepomis spp.*) that were part of the fish species composition in the past are absent since the 2011 sampling. The sunfish are important to the reservoir ecosystem as a prey species for the top level predator sportfish. Also, shore fishermen frequently target them. The guapote tigre that was detected for the first time during electrofishing sampling (2009) is now well established in this

reservoir. Loiza has 3 top-level predators in its species composition; largemouth bass, peacock bass and guapote tigre.

Another peculiarity of Loiza reservoir is the presence of water hyacinth (*Eichhornia crassipes*) and water lettuce. During S2 2013 sampling, some electrofishing sampling areas were restricted due a heavy infestation of water hyacinth and water lettuce, which cover a significant part of the lake's surface area, that made it impossible to perform the electrofishing sampling in those areas.

Dos Bocas reservoir

In August 2012, a drastic drop occurred in Dos Bocas reservoir water level provoking a substantial fish kill.



Interestingly, Dos Bocas presented the highest species richness among the six reservoirs sampled (12 fish species for S1 2012 /September 2012 and 14 fish species for S2 2013/April 2013). The dominant species were the armored catfish (32.0% average relative abundance) and the red devil (25.5%). These are two undesirable invasive species. The firemouth cichlid was present at an average relative abundance of 8.0%. Largemouth bass showed an average relative abundance of 3.0% and an excellent condition (Wr averaging 113.5%) probably due to the presence of forage species (threadfin shad, *tilapia spp.*, mosquito fish and rosy barb) and the low largemouth bass population density. Also the peacock bass, one of the favorite sport fish on the island, showed an average relative abundance of 4.5%.

Caonillas reservoir

In Caonillas, the dominant species were the red devil (average relative abundance 45.0%) and the invasive armored catfish (20.0%). However, it is worth mentioning that 2012-2013 largemouth bass average relative abundance (15%) has improved considerably in comparison with the last year electrofishing sampling, which was very low (3.0%). Although this reservoir had been stocked with largemouth bass fingerlings several times during 2006 – 2011, it had maintained a poor largemouth bass population. For year 2012, an intensive largemouth bass stocking was performed at Caonillas reservoir. Approximately 62% of the largemouth bass produced at the Maricao Fish Hatchery ($\approx 87,243$) were stocked in this reservoir. Largemouth bass of fingerling size were observed, which could be evidence of natural reproduction in this reservoir since the final fish stocking was done in January 2013 and the electrofishing sampling was performed in April 2013.

On the other hand, the redear sunfish was not collected during S2 2013, nor was the channel catfish (*Ictalurus punctatus*) observed in this year's monitoring. In the case of redear sunfish, there may be an inverse correlation between high abundance of red devil cichlids and low abundance of sunfish. This deserves further observation. The same apparent inverse correlation was observed in Loiza reservoir.

Cidra reservoir

In Cidra, ten fish species in total were represented in the electrofishing samples. The dominant species was redbreast tilapia with 59.0% average relative abundance, followed by the peacock bass 17%. Largemouth bass relative abundance was 1.0% and LMB condition factor (W_r) was 98.

In Cidra reservoir the relative abundance of redear sunfish (6.0%) is higher than the red devil's (2.0%). The red devil was first detected during 2010 and appears to be established.

Toa Vaca reservoir

Toa Vaca reservoir had the lowest species diversity among the reservoirs sampled (6 fish species). On the other hand, it had high largemouth bass abundance (LMB CPUE 59 fish/hour)

among reservoirs sampled during July 2012 to June 2013 exceeded only by Guayo reservoir. Toa Vaca reservoir has not been stocked with largemouth bass since 2003. However, it had a great largemouth bass population (% Average Composition of 49) and satisfactory condition (Wr averaging = 97). Also the redear sunfish is very abundant (24% Average Composition) and the red devil is not present.

Guayo reservoir

This reservoir was monitored instead of Carite reservoir, since access to Carite with our electrofishing boat was not available due to low water levels.

Of all the reservoirs sampled during July 2012- June 2013, Guayo had the most abundant largemouth bass population (LMB CPUE 134 fish/hour). This reservoir has not been stocked with largemouth bass since 2002. However it had a healthy largemouth bass population with representation of all sizes and also it was the most abundant fish. The LMB condition factor was 93 which is fairly low, though not surprising given the CPUE.

Similar to Toa Vaca and Cerrillos reservoirs, Guayo has a solid largemouth bass population that makes it a very special reservoir for recreational anglers.

In Guayo reservoir there are no peacock bass, nor red devil. Nevertheless, it has in its fish community the three sunfish species present in Puerto Rico reservoirs (redear sunfish *Lepomis microlophus*, bluegill sunfish *Lepomis macrochirus* and redbreast sunfish *Lepomis auritus*). These three species have disappeared from Loiza and Caonillas reservoirs where they were present in the past, and abundance have decreased in reservoirs like Dos Bocas and Cidra coinciding with increasing abundance of red devil cichlids.

The inverse correlation between sunfish and red devil is shown in Figure 7. The red devil CPUE for Loiza, Dos Bocas and Caonillas reservoirs is very high in contrast with sunfish CPUE. The opposite occurs with Cidra, Toa Vaca and Guayo reservoirs where red devil are scarce or absent.

Despite the fish diversity, the sunfish are important to the island's reservoir ecosystem because predator species like largemouth bass and peacock bass feed on them. Also, shore fishermen target them. In the case of redear sunfish, they help to control snail population in the reservoirs.

Red devil cichlids do not control snails, and through predation they appear to reduce the species diversity in our reservoirs. These and impacts of invasive red devil cichlids deserve evaluation.

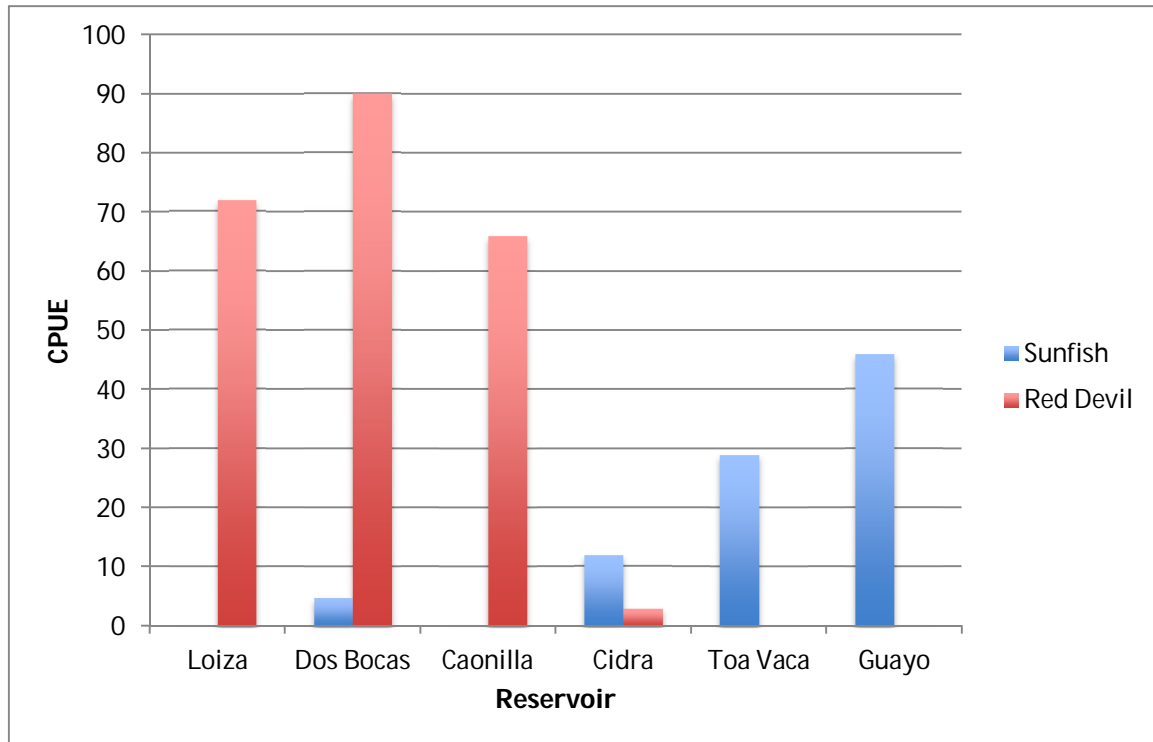


Figure 7. Inverse correlation between Sunfish and Red Devil in Loiza, Dos Bocas, Caonillas, Cidra, Toa Vaca and Guayo reservoirs for S12012 and S2 2013 electrofishing.

Water Quality

Loiza reservoir has the highest temperature (30.0 °C for S1 2012) whereas Cidra has the lowest for S2 2013 (24.6 °C). At Loiza, dissolved oxygen was low compared with the other reservoirs (4.02 mg/l for S2 2013). Dissolved oxygen levels below 4 mg/l are considered stressful for warmwater fish.

Bass Tournaments

Only four Fishing Clubs reported their data despite the request and follow-ups from project personnel.

Bass tournaments are very important to obtain users' information related to their CPUE. They usually provide valuable feedback to our stocking regimes. Nevertheless, sometimes there is a mismatch between the CPUE from the electrofishing sampling and the fishermen's reported experience. This may reflect the need for better outreach with our stakeholders, since the lack of success in the tournaments is sometimes interpreted by anglers as a need to stock additional bass.

Recommendations

- In Guayo and Toa Vaca, where a healthy largemouth bass population exists, no largemouth bass stocking should be performed for the moment.
- Toa Vaca reservoir was considered for construction of a public boat ramp sponsored by Department of Natural and Environmental Resources in order to promote sport fishing. This reservoir maintains a tremendous largemouth bass population that should be available to all the sport fishermen. Toa Vaca is administered by the Puerto Rico Aqueduct and Sewer Authority (PRASA) and an agreement to develop fishing facilities is in place. PRASA installed a water column destratification system and for almost a year kept the reservoir closed to the fishing activities. The DNER is negotiating with the PRASA executives to reopen the reservoir to sport fishing again.
- Although Dos Bocas has been stocked with largemouth bass fingerlings during 2000-2010) it is recommended to continue supplementing the largemouth bass population because of last year's fish kill (hundreds of largemouth bass among them) and it is known that this reservoir has natural recruitment problems. Besides, it has adequate facilities for sport fishermen.
- In Cidra where there is a fishing Club and adequate facilities for the users, supplemental largemouth bass stocking should continue with high priority to maintain a quality sport fishery.
- Although Carite lacks an adequate boat ramp, it shows an attractive sport fish population (largemouth bass, peacock bass and bigmouth sleeper (*Gobiomorus dormitor*). According to Bacheler et al. 2004, in Carite reservoir, recreational fishermen frequently target, catch, and consume bigmouth sleepers. We recommend the construction of an adequate boat access. During 2012-2013, project personnel attempted 3 times to sample this reservoir but it was not possible because the water level was too low and no adequate ramp was available.
- The presence of invasive fish species in the island's reservoirs has worsened. Some of these species that were present in Loiza, Dos Bocas, Caonillas, La Plata, Lucchetti, Patillas, Guayabal and Guajataca reservoirs are now present at Cidra, Toa Vaca, Guayo and Cerrillos. It is recommended to investigate the impact of invasive species on fresh water habitat and sportfish populations. Aquatic Resources Educational Program (Project F-9) should continue educating the public intensively about the problem of aquatic invasives.

- The armored catfish was present in the six reservoirs sampled in 2012-2013 and in many more including Cerrillos. We know about the negative impact this species causes to the reservoir shoreline hence it is recommended to promote the capture and consumption of this species and to prohibit the release of this species back into the reservoir when it is caught. Also the importation of this species by aquarium organism importers should be prohibited. It is suspected that multiple introductions were performed by aquarium hobbyists discarding their pets without understanding the consequences of their actions (Williams et al., 1994). An intense educational campaign should be performed to the general public in order to educate about this important matter.
- Illegal fishing in Puerto Rico's reservoirs is still a serious problem that should be addressed seriously. A rigorous plan to enforce the regulations should be implemented in order to protect the sport fisheries in the island.
- For many years, our sportfish management efforts have been focused on the restoration and supplementation of the largemouth bass population. Analyzing the data obtained for the past decades, it may be time to try different strategies or in some cases to focus on other targets in some reservoirs. We have reservoirs where the largemouth bass is not favored by the reservoir dynamics, for example; water fluctuations, lack of food or space, exotic species, etc. On the other hand, we have reservoirs where largemouth bass natural reproduction and recruitment is successful (Toa Vaca, Guayo, Cerrillos, Lucchetti). Taking this into consideration it is recommended to focus the largemouth bass stocking only to reservoirs where we can control and be effective in the management of this species instead of try to stock in all reservoirs of the island. It may be necessary to stock largemouth bass of sizes larger than the standard size that the Maricao hatchery has historically produced in some cases, and methods for this alternative management strategy should be investigated.
- There are reservoirs where the cichlids and other fish species are favored (Loiza, Dos Bocas, Caonillas). Also, there are fishermen interested in other fish species different from the largemouth bass (ex., bigmouth sleeper in Carite). Therefore, there is an opportunity and a need to manage different reservoirs for different fish species.
- The Maricao Fish Hatchery should continue to enhance and supplement largemouth bass populations in reservoirs where the data demonstrates the need, by continuing largemouth bass and forage species stocking.

Financial Remarks

During this project segment, two trips were made by project personnel to the American Fisheries Society meetings; Minnesota (September 2012) and Tennessee (February 2013).

A pick-up vehicle was purchased and we are waiting for the automobile dealer to deliver it soon. Also, some other equipment and materials were purchased including: marine batteries, trailer and vehicle tires, some electrofishing boat materials, computer software, uniforms, etc.

The boat generator was repaired on two occasions and the boat motor once. In addition, the boat trailer was modified to facilitate the electrofishing boat transport.

Significant Deviations

- Only two reservoirs were monitored during July to December 2012 (S1 2012) due to problems with the boat generator and the boat motor. Because there are not many specialists in Kohler generators in Puerto Rico, we had to wait for the availability of the specialist after completing the agency procedures to obtain the service order. The same occurred with the boat motor (Johnson). On the other hand, bad weather conditions forced us to change the work plan.
- At Loiza reservoir (S2 2013) the electrofishing sampling was modified due to a huge infestation of water hyacinth. It was impossible to reach five designated sampling stations and therefore the electrofishing samplings were done at different sites. This hyacinth infestation is a problem present in some of the island's reservoirs.



- At Dos Bocas reservoir only five out of the standard six electrofishing samples were performed during S2 2013 sampling due to intensive rain.
- For S2 2013 (January to June 2013) Guayo reservoir was monitored instead of Carite. On three occasions we tried to sample the reservoir at three different boat accesses but the water level was too low that was not possible. Instead we sampled Guayo reservoir.
- While the boat generator was damaged, project personnel dedicated their time to equipment and materials requisition activities, equipment maintenance, and communication with tournaments officials and data entry.
- Tournament data sometimes is incomplete due to the lack of cooperation from fishing clubs. Improving this is an on-going effort of this grant.

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