

INTERIM REPORT
FRESHWATER SPORT FISH COMMUNITY ASSESSMENTS

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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 Caonillas, Carite, Cidra, Dos Bocas, Loiza and Toa Vaca).

Six reservoirs were monitored during calendar year 2011. For the first semester (January - June), only Loiza reservoir (388 ha) was monitored. For the second semester (July-December), the six reservoirs were monitored including Caonillas (280 ha), Carite (133 ha), Cidra (170.8 ha), Dos Bocas (254 ha) and Toa Vaca (321 ha). 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 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 the past year, project personnel collaborated in electrofishing with personnel from Cerrillos and La Plata reservoirs because they had problems with their electrofishing boats. Also, project personnel performed broodstock capture as requested by Maricao Fish Hatchery personnel (Project F-35).

A fish identification guide was prepared to inform the fresh water sport fishermen about the sport fish and the invasive fish species. It has been distributed to the reservoir managers, other personnel related to the Sport fish Program and fishermen. The guide is included as part of this report.

Data analysis and report preparation

To analyze data for annual and final reports.

Loiza reservoir was monitored twice (January to June 2011-Semester 1 = S1 and July to December 2011 - Semester 2 = S2). The rest of the reservoirs (Caonillas, Carite, Cidra, Dos Bocas and Toa Vaca) were monitored only in S2.

LOIZA

A total of eleven fish species were captured in Loiza reservoir (Table 1). In this reservoir, it is common to find several tropical aquarium species. Threadfin shad (*Dorosoma petenense*) were observed during the sampling but were not used as part of the species composition analysis; likewise the native shrimp *Xiphocaris elongata*. The dominant species was the red devil *Amphilophus spp.* with a relative abundance of 34.5%. The peacock bass (*Cichla ocellaris*), one of the favorite sport fish on the island, showed a relative abundance of 17% (8 individuals) during S1 electrofishing sampling and 5% (9 individuals) during S2.

Table 1. Target species present in electrofishing samples at Loiza reservoir during 2011. The number of fish of each species appears in parentheses.

Species	% Composition		% Average Composition
	S1 2011	S2 2011	
armored catfish	13 (6)	17 (28)	15.0
blue tilapia	31 (14)	4 (6)	17.5
channel catfish	4 (2)	2 (4)	3.0
firemouth cichlid	0	2 (4)	1.0
guapote tigre	9 (4)	7 (11)	8.0
largemouth bass	0	3 (5)	1.5
mozambique tilapia	2 (1)	7 (12)	4.5
peacock bass	17 (8)	5 (9)	11.0
redbreast tilapia	2 (1)	6 (10)	4.0
red devil	22 (10)	47 (80)	34.5
Total	100 (46)*	100 (169)	100

* Only three electrofishing samples were performed due to mechanical problems with the electrofishing boat generator.

Loiza Reservoir joins Carite Reservoir in having 3 top-level predators; largemouth bass (*Micropterus salmoides*), peacock bass and guapote tigre *Parachromis managuensis*. This cichlid, 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.

Largemouth bass Length Frequency for Loiza reservoir in S2 is shown in Figure 1.

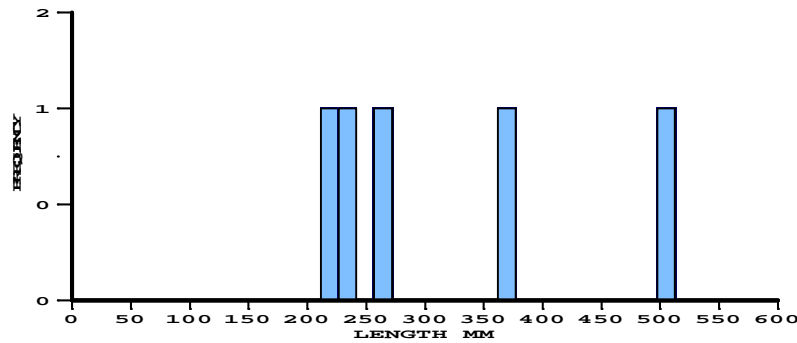


Figure 1. Length frequency distribution of largemouth bass at Loiza reservoir during S2 electrofishing (2011).

Total Catch per Unit of Effort (CPUE fish/hour), LMB CPUE and LMB Relative Weights in Loiza reservoir for S1 and S2 2011 are presented in Table 2.

Table 2. Total CPUE, LMB CPUE and LMB Relative Weight for Loiza reservoir for 2011.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
S1 2011	46*	0*	----
S2 2011	169	5	105

* Three out of the standard six electrofishing samples were performed.

CAONILLAS

In this reservoir, ten fish species were represented in 2011 electrofishing. Threadfin shad were observed during the sampling but were not counted as part of the species composition analysis. As in 2010, the dominant species were the invasive armored catfish (*Pterygoplichthys pardalis*) (42.0%) and the red devil (26.0%), Table 3. Redbreast tilapia is present at a relative abundance of 13.0%. The firemouth cichlid (*Thorichthys meeki*) is also present at a relative abundance of 2.0%.

The redear sunfish (*Lepomis microlophus*) that was present in last year's monitoring, was not collected during this sampling at Caonillas reservoir. On the contrary, the channel catfish (*Ictalurus punctatus*) was present in this year's monitoring (2 individuals) but was not during 2010. The low abundance of channel catfish could result in their capture or non-capture due to chance. In the case of redear sunfish, there may be a correlation between high abundance of red devil cichlids and low abundance of sunfish. This deserves further observation.

Table 3. Target species present in electrofishing samples at Caonillas reservoir during 2011. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2011	S2 2011	Composition
armored catfish	---	42 (37)	---
blue tilapia	---	1 (1)	---
channel catfish	---	2 (2)	---
firemouth cichlid	---	2 (2)	---
largemouth bass	---	2 (2)	---
mozambique tilapia	---	5 (4)	---
peacock bass	---	7 (6)	---
redbreast tilapia	---	13 (1)	---
red devil	---	26 (23)	---
Total	---	100 (78)	---

No fingerling sized (approximately 76 mm TL – 203 mm TL) largemouth bass were found in the S2 electrofishing sampling (Figure 2).

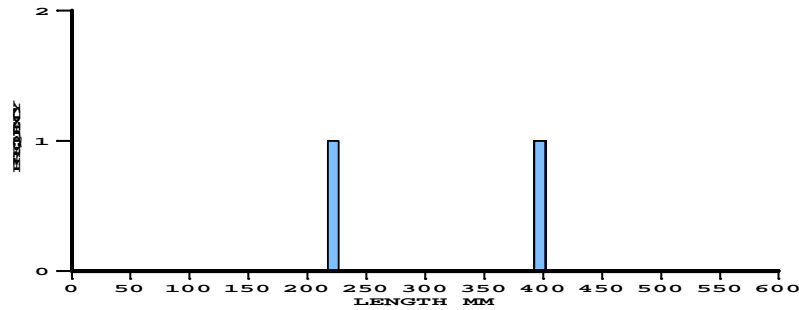


Figure 2. Length frequency distribution of largemouth bass at Caonillas reservoir during S2 electrofishing (2011).

Total CPUE, LMB CPUE and LMB relative weight is presented in Table 4. LMB CPUE S2 electrofishing was 2 fish/hour, which is very low. As expected, the condition factor for largemouth bass was excellent.

Table 4. Total CPUE, LMB CPUE and LMB Condition Factor for Caonillas reservoir for 2011.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
S1 2011	---	---	---
S2 2011	78	2	106

CARITE

In Carite reservoir, a total of eleven fish species were captured. As well as in Patillas and Loiza reservoirs, Carite is distinguished by having 3 top-level predators (in this case, largemouth bass, peacock bass and bigmouth sleepers). Similar to last year, the native bigmouth sleeper (*Gobiomorus dormitor*) was the most abundant species (32%), followed by largemouth bass (17%). The redear sunfish and the peacock bass showed a relative abundance of 15% (6 individuals) and 7% (3 individuals) respectively.

Table 5. Target species present in electrofishing samples at Carite reservoir during 2011. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2011	S2 2011	Composition
armored catfish	---	3 (1)	---
bluegill	---	3 (1)	---
blue tilapia	---	2 (1)	---
bigmouth sleeper	---	32 (13)	---
brown bullhead	---	5 (2)	---
channel catfish	---	7 (3)	---
largemouth bass	---	17 (7)	---
peacock bass	---	7 (3)	---
redbreast sunfish	---	2 (1)	---
redbreast tilapia	---	7 (3)	---
redeer sunfish	---	15 (6)	---
Total	---	100 (41)	---

LMB CPUE was 7 fish/hour. The LMB condition factor (Wr) was an excellent 97 (Table 6).

Table 6. Total CPUE, LMB CPUE and LMB relative weight for Carite reservoir for 2011.

Sample	TOTAL CATCH	LMB CPUE	MEAN
	CPUE (fish/hour)	(fish/hour)	LMB Wr
S1 2011	---	---	---
S2 2011	41	7	97

Only two largemouth bass were captured of fingerling size (approximately 76 mm TL – 203 mm TL) during the electrofishing sampling.

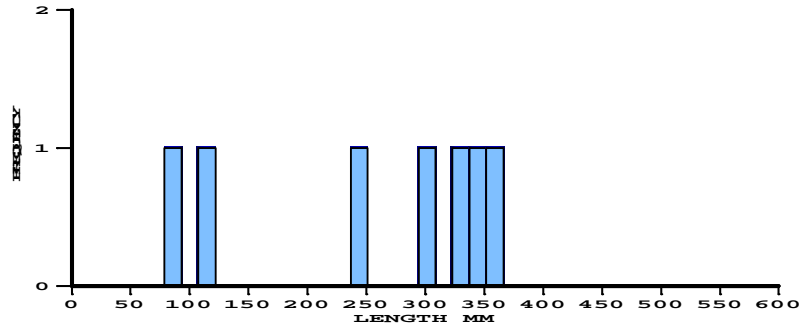


Figure 3. Length frequency distribution of largemouth bass at Carite reservoir during S2 electrofishing (2011).

CIDRA

The 2011 electrofishing capture at Cidra reservoir was represented by nine species (Table 7). Largemouth bass, one of our target fish, showed a relative abundance of 12% (13 individuals). The dominant species was redbreast tilapia (*Tilapia rendalli*) (30%). The red devil that was detected for the first time during electrofishing 2010, was not present this year in the S2 electrofishing sampling.

Table 7. Target species present in electrofishing samples at Cidra reservoir during 2011. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2011	S2 2011	Composition
armored catfish	---	16 (18)	---
blue tilapia	---	1 (1)	---
channel catfish	---	3 (3)	---
largemouth bass	---	12 (13)	---
mozambique tilapia	---	11 (12)	---
peacock bass	---	15 (16)	---
redbreast sunfish	---	3 (3)	---
redbreast tilapia	---	30 (33)	---
redeer sunfish	---	9 (10)	---
Total	---	100 (109)*	---

*Only five electrofishing stations were performed due to problems with the boat fiberglass poles that support the anodes.

LMB CPUE was 13 fish/hour. The LMB condition factor (Wr) was 100 showing a very good condition for largemouth bass (Table 8).

Table 8. Total CPUE, LMB CPUE and LMB relative weight for Cidra reservoir for 2011.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
S1 2011	---	---	---
S2 2011	109*	13*	100*

*Five out of the standard six electrofishing samples were performed.

Figure 4 presents the LMB Length Frequency for S2. No LMB at fingerling size (approximately 76 mm TL – 203 mm TL) were captured at Cidra reservoir for this electrofishing period.

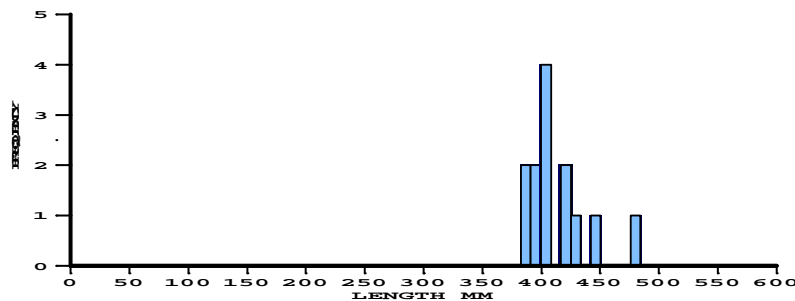


Figure 4. Length frequency distribution of largemouth bass at Cidra reservoir during S2 electrofishing (2011).

DOS BOCAS

A total of 12 fish species were captured in Dos Bocas reservoir (Table 9), 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.*) was present. However neither of these two species has been included in the species composition analysis, since boat electroshocking is not the appropriate sampling technique for them and they are not target species.

The dominant species were the armored catfish (37%) and red devil (26%). The firemouth cichlid was present at a relative abundance of 4%. Largemouth bass showed a relative abundance of 5% (7 individuals).

Table 9. Target species present in electrofishing samples at Dos Bocas reservoir during 2011. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2011	S2 2011	Composition
armored catfish	---	37 (52)	---
blue tilapia	---	2 (2)	---
channel catfish	---	4 (6)	---
firemouth cichlid	---	4 (5)	---
largemouth bass	---	5 (7)	---
mozambique tilapia	---	15 (21)	---
peacock bass	---	1 (1)	---
redbreast sunfish	---	1 (2)	---
redbreast tilapia	---	5 (7)	---
red devil	---	26 (37)	---
Total	---	100 (140)	---

Total Catch per Unit of Effort (CPUE fish/hour), LMB CPUE and LMB Relative Weight (Wr) at Dos Bocas reservoir S2 2011 is presented in Table 10.

Table 10. Total CPUE, LMB CPUE and LMB relative weight for Dos Bocas reservoir for 2011.

Sample	TOTAL CATCH	LMB CPUE	MEAN
	CPUE (fish/hour)	(fish/hour)	LMB Wr
S1 2011	---	---	---
S2 2011	140	7	109

LMB CPUE was 7 fish/hour and largemouth bass condition factor was 109, which was very good. This is to be expected as this reservoir has abundant forage species (threadfin shad, *tilapia*

spp. and mosquito fish) and many other ornamental fish while the largemouth bass population density is low.

LMB relative abundance is presented in Figure 5.

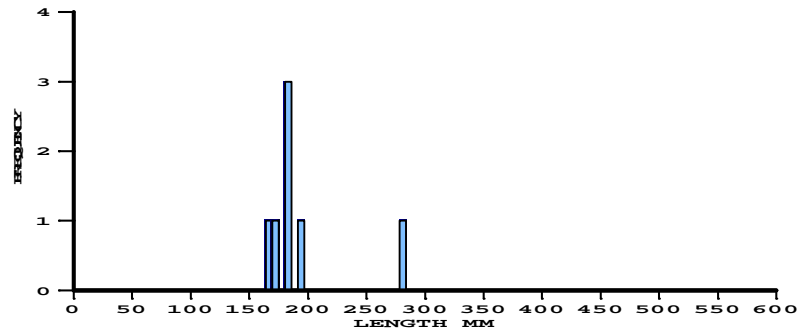


Figure 5. Length frequency distribution of largemouth bass at Dos Bocas reservoir during S2 electrofishing (2011).

TOA VACA

Among the reservoirs sampled, Toa Vaca has the lowest fish diversity. The electrofishing capture for 2011 was represented by six species (Table 11).

Table 11. Target species present in electrofishing samples at Toa Vaca reservoir during 2011. The number of fish of each species appears in parentheses.

Species	% Composition	% Composition	% Average
	S1 2011	S2 2011	Composition
armored catfish	---	4 (4)	---
blue tilapia	---	1 (1)	---
largemouth bass	---	39 (40)	---
mozambique tilapia	---	1 (1)	---
redbreast tilapia	---	21 (21)	---
reдеar sunfish	---	34 (34)	---
Total	---	100 (101)*	---

*Only four stations were performed due to boat mechanical problems.

The dominant species was largemouth bass, one of our target fish. It showed a relative abundance of 40 individuals (39%) (four electrofishing stations). The redear sunfish showed a relative abundance of 34 individuals (34%). The peacock bass was not captured in this reservoir.

Total CPUE (fish/hour), LMB CPUE and LMB Relative Weight (W_r) at Toa Vaca reservoir for 2011 is presented in Table 12.

Table 12. Total CPUE, LMB CPUE and LMB Condition Factor for Toa Vaca reservoir for 2011.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB W_r
S1 2011	---	---	---
S2 2011	101*	39*	103*

* Four out of the standard six electrofishing samples were performed.

The largemouth bass relative weight was very good, indicating that abundant forage is available to the bass in this reservoir.

A bimodal distribution is represented in the LMB length frequency (Figure 6). The first group is composed by LMB ranged from fingerling size to adult size. The other is a group of LMB adult sizes only.

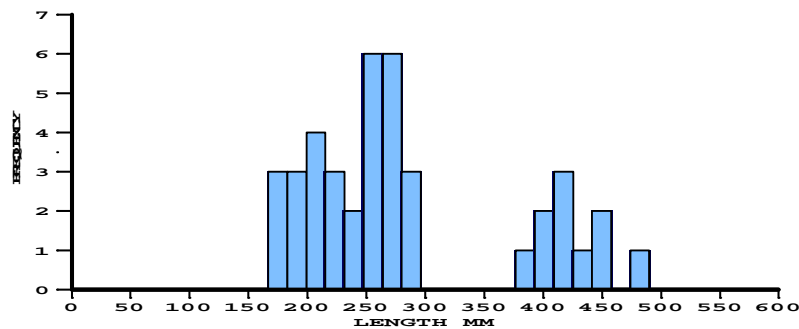


Figure 6. Length frequency distribution of largemouth bass at Toa Vaca reservoir during S2 electrofishing (2011).

Water Quality

Table 13 shows the water quality data for all reservoirs during S2 electrofishing samplings. Water quality parameters were monitored at each reservoir when it was possible. In some samplings, it was not possible due to bad weather conditions such as heavy rain or heavy wind. In others samplings, the water quality equipment was not available.

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 2011.

Reservoir	Temperature (°C)		Secchi (cm)		O. D. (mg/l)		Depth (feet)		Conductivity (μ)	
Loiza	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2
	†	/ 29.3	†	/ 43.0	†	/ 6.1	†	/ 38.4	†	/ 213.2
Caonillas	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2
	†	/ 28.3	†	/ 69.5	†	/ 8.20	†	/ 132.0	†	/ 151.5
Carite	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2
	†	/ 23.3	†	/ 160.0	†	/ 4.20	†	/ 53.7	†	/ 81.8
Cidra	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2
	†	/ 25.9	†	/ 100.0	†	/ 4.06	†	/ 43.9	†	/ 150.4
Dos Bocas	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2
	†	/ 28.1	†	/ 126.0	†	/ 8.73	†	/ 63.6	†	/ 208.7
Toa Vaca	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2	S1	/ S2
	†	/ 27.3	†	/ 28.9	†	/ 6.0	†	/ 82.0	†	/ 291.9

† Data not collected.

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.

Caonillas and Toa Vaca were the only reservoirs that reported tournament data as of the date of this report (Table 14). Caonillas celebrated 5 tournaments, and Toa Vaca 3. An average of only 2 largemouth bass were captured in the Caonillas tournaments (CPUE = 0.00), whereas CPUE for largemouth bass was 0.05 fish/hour in Toa Vaca tournaments. Peacock bass CPUE in Caonillas was 0.16 fish/hour.

Table 14. Tournament data reported in reservoirs monitored during 2011.

Reservoir	# events reported	Effort (a/h)	Average anglers per event	Successful Anglers (%)	CPUE LMB	CPUE PKB	Average # LMB per event	LMB Max. weight (kg)
Caonillas	5	2396	34	53	0.00	0.16	2	2.99
Cidra	†	†	†	†	†	†	†	†
Dos Bocas	†	†	†	†	†	†	†	†
Loiza	†	†	†	†	†	†	†	†
Toa Vaca	3	500	11	34	0.05	†	8	2.08

† Data was not provided.

Discussion

Loiza reservoir presented a species diversity of 11 fish species. The sunfish species (*Lepomis spp.*) that were part of the fish species composition in the past were absent during 2011 samplings. The peacock bass, one of the favorite sport fish on the island, showed a relative abundance of 11.0%. The guapote tigre that was caught for the first time during electrofishing sampling (2009), is still present in this reservoir. Similar to Carite reservoir, Loiza has 3 top-level predators in its species composition; in this case, largemouth bass (*Micropterus salmoides*), peacock bass (*Cichla ocellaris*) and guapote tigre (*Parachromis managuensis*).

In June 2009, a largemouth bass relocation event (of specimens ≥ 254 mm) from Cerrillos reservoir to Loiza was performed by project personnel. The intention was to improve the LMB population with adult individuals, to avoid predation of the normally stocked fingerlings (approximately 2 inches) by peacock bass or guapote tigre. Although this year's largemouth bass relative abundance was 3% for S2 and none were detected in S1 (only 3 electrofishing samplings), this species is now being reported by fishermen indicating that the transfer was a successful management action. In Loiza reservoir, 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.

In Caonillas, the dominant species were the invasive armored catfish (42.0%) and the red devil (26.0%). Largemouth bass relative abundance was very low (2.0%) although this reservoir was stocked with largemouth bass fingerlings several times during 2006 - 2010.

In Carite reservoir, a total of eleven fish species were found. Historically, this reservoir had distinguished itself from almost all other reservoirs in Puerto Rico (except Patillas and now Loiza) by having 3 top-level predators (largemouth bass, peacock bass and bigmouth sleepers).

The most abundant fish species is the native bigmouth sleeper (32%) followed by largemouth bass (17%). This reservoir has the particularity of maintaining a healthy population of bigmouth sleeper, so it is an alternative to those fishermen that prefer this fish. According to Bachelier et al. 2004, in Carite reservoir, recreational fishermen frequently target, catch, and consume bigmouth sleepers. Another particularity of this reservoir is that it is the only reservoir of the six monitored that has in its fish community the three sunfish species present in Puerto Rico reservoirs (reard sunfish *Lepomis microlophus*, bluegill sunfish *Lepomis macrochirus* and redbreast sunfish *Lepomis auritus*). These three species have disappeared from reservoirs like Loiza and Caonillas where they were present in the past, coinciding with increasing abundance of red devil cichlids.

In Cidra, nine fish species in total were represented in the electrofishing samples. The dominant species was redbreast tilapia 30% followed by the armored catfish (16%) and the peacock bass 15%. Largemouth bass was 12% and apparently the abundant populations of threadfin shad and redbreast tilapia contribute to a very good largemouth bass condition (W_r averaging 100%).

Dos Bocas presented the highest species richness among the six reservoirs sampled (12 fish species). The dominant species were the armored catfish (37%) and the red devil (26%). These are two undesirable invasive species. The firemouth cichlid was present at a relative abundance of 4%. Largemouth bass showed a relative abundance of 5% and an excellent condition (W_r averaging 109%) probably due to the presence of forage species (threadfin shad and mosquito fish).

Toa Vaca reservoir had the lowest species diversity among the reservoirs sampled (6 fish species). On the other hand, it had the greatest largemouth bass abundance (LMB CPUE 40 fish/hour) of all reservoirs sampled during 2011. This reservoir has not been stocked with largemouth bass since 2003. However, it had a healthy largemouth bass population with representation of all sizes (% Composition of 39) and excellent condition ($W_r = 103$). Also the redear sunfish is very abundant (34%).

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 Toa Vaca, where a healthy largemouth bass population exists, no largemouth bass or forage species stocking should be performed. Toa Vaca reservoir is being considered for construction of a public boat ramp sponsored by DNER in order to promote sport fishing. This reservoir keeps a tremendous largemouth bass population that should be available to all the sport fishermen. At the present, the Puerto Rico Aqueduct and Sewer Authority (PRASA) administers this reservoir, an agreement to develop this project is in place. PRASA is currently installing a water column destratification system that may open additional habitat for fish in this reservoir below the current oxycline.
- Dos Bocas has been stocked intensively (approximately 123,972 largemouth bass fingerlings during 2000-2010) and it is recommended to continue supplementing the large mouth bass population because it has adequate facilities for sport fishermen but natural recruitment problems.
- 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.
- Carite presents a complex scenario where additional research may be required in order to formulate a specific management strategy. The main problem appears to be very

poor primary productivity which is reflected in a paucity of forage species. All three top level predators, therefore, are limited in their abundance.

- The presence of invasive fish species in the island's reservoirs has worsened. Some of these species are present in Loiza, Dos Bocas, Caonillas, La Plata, Lucchetti, Patillas, Guayabal and Guajataca reservoirs and we expect their range to extend eventually to other reservoirs. 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 to educate the public intensively about the problem of aquatic invasives.
- The armored catfish was present in the six reservoirs sampled in 2011. Also we were informed that it was detected recently in Cerrillos reservoir. A small scale private fish culture station has been established upstream from this reservoir, and this may be the source. 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.
- The Maricao Fish Hatchery should continue to investigate techniques to produce larger fingerling largemouth bass for stocking, to increase survival in reservoirs with abundant predatory invasives.

Significant Deviations

The electrofishing boat was unavailable for about 3 months during the first semester of 2011 due to a mechanical failure. On two occasions, a mechanic accompanied us to the field to check the generator and determine the repair needed. Several trips to reservoirs were made believing the equipment had been repaired, only to find the generator was still non-functional. Repairs were delayed since the spare part was not in stock at the distributor. This situation had a negative impact on the fieldwork plan for S1.

While the boat generator was damaged, project personnel dedicated their time to equipment and materials requisition activities, equipment maintenance, communication with tournaments officials, data entry, and design, photo selection, text edition and fact-checking of the exotic freshwater fish species.

Tournament data sometimes is incomplete due to the lack of cooperation from fishing clubs. Improving this is an on-going effort of this grant.

Literature Cited

Aquatic Nuisance Species Research Program Bulletin, Vol-04-1 February 2004. US Army Corps of Engineers, Engineer Research and Development Center.

J. Wesley Neal, Richard L. Noble, Craig G. Lilyestrom, Timothy N. Churchill, Alexis R. Alicea, Daniel E. Ashe, F. Michael Holliman, and D. Scott Waters. Puerto Rico Department of Natural and Environmental Resources. Federal Aid in Sport Fish Restoration Project F-41.2. Freshwater sportfish community investigation and management Final Report 1999.

J. Wesley Neal, Richard L. Noble, Craig G. Lilyestrom, Nathan M. Bacheler, and J. Christopher Taylor. Puerto Rico Department of Natural and Environmental Resources. Federal Aid in Sport Fish Restoration Project F-41.2. Freshwater sportfish community investigation and management Final Report 2001.

María de L. Olmeda, Craig G. Lilyestrom, Ramón Del Moral. Puerto Rico Department of Natural and Environmental Resources. Federal Aid in Sport Fish Restoration Project F-52.4. Freshwater Sport Fish Community Assessments Final Report 2009.

María de L. Olmeda, Craig G. Lilyestrom, Ramón Del Moral. Puerto Rico Department of Natural and Environmental Resources. Federal Aid in Sport Fish Restoration Project F-52.5. Freshwater Sport Fish Community Assessments Final Report 2010.

Nathan M. Bacheler, J. Wesley Neal, and Richard L. Noble. 2004. Reproduction of a landlocked diadromous fish population: Bigmouth sleeper *Gobiomorus dormmitor* in a reservoir in Puerto Rico. Caribbean Journal of Science, Vol. 40, No. 2, 223-231.

Williams-Bunkley, L., E. H. Williams, C. G. Lilyestrom, I. Corujo Flores, A. J. Zerbi, C. Aliaume, T. N. Churchill. 1994. The South American Sailfin Armored Catfish, *Liposarcus multiradiatus* (Hanock), a New Exotic Established in Puerto Rican Fresh Waters. Caribbean Journal of Science, Vol. 30, No. 1-2, 90-94.

Prepared by:

María de Lourdes Olmeda, M.S. – Project Leader

Craig Lilyestrom, Ph. D. – Marine Resources Director