

Commonwealth of Puerto Rico  
Department of Natural and Environmental Resources

**FRESHWATER SPORT FISH COMMUNITY ASSESSMENTS**  
**F-52.1**  
**Annual Report**

**Hon. Javier Vélez Arocho**  
**Secretary**

**Mr. Ernesto L. Diaz Velazquez**  
**Administrador**

**Mr. José Berrios**  
**State Federal Aid Coordinator**

**Mrs. Lourdes Olmeda**  
**Project Leader**

**ANNUAL PERFORMANCE REPORT  
FRESHWATER SPORT FISH COMMUNITY ASSESSMENTS**

Project Title : Freshwater Sport Fish Community Assessments  
 Project Number : F-52.1  
 State : Puerto Rico  
 Period Covered : January 1, 2005 to December 31, 2006

**Fish population assessment in five reservoirs**

Objective 1: To derive indices of sport fish populations and community well-being in selected Puerto Rico reservoirs (Carite, Patillas, Loiza, Caonillas and Dos Bocas).

Remarks: Five reservoirs were monitored twice during Spring (March-April) and Fall (October-December), including Carite (133 ha), Caonillas (280 ha), Loiza (388 ha), Dos Bocas (254 ha) and Patillas (137 ha). According to the Manual for the Management of the Sport Fish in Puerto Rico’s Reservoirs, excepting Patillas, these reservoirs are of high priority for sport fish management. However, Patillas is also important for us due to the interest of the sport fishermen in the bigmouth sleeper population there. These reservoirs are primarily used to supply water to the nearby communities. For that reason the water level fluctuates, which can affect fish spawning and hence recruitment.

During the past year, we performed some broodstock capture as requested by Maricao Fish Hatchery biologists (Project F-35). Also, we collected specimens needed for the research project F-53R Freshwater Sport Fish Enhancement and Management. In addition, we collaborated in Fall electrofishing with Guajataca and Cerrillos personnel because they had problems with their respective electrofishing boats.

**Data analysis and report preparation**

Objective 2: To analyze data for annual and final reports

Remarks: After several years without electrofishing monitoring of fish communities in the majority of P.R. reservoirs (only Guajataca, Lucchetti, La Plata and Cerrillos are routinely monitored) five reservoirs were monitored between March – April and again from November – December 2006.

Loiza

Fourteen fish species in total were represented in the electrofishing samples from Loiza reservoir (Table 1), such that this reservoir is the one with the greatest species diversity among the five monitored.

Table 1. Species present in electrofishing samples at Loiza reservoir during 2006. The number of fish of each species appears in parentheses.

Species	% Composition Spring 2006	% Composition Fall 2006	% Average Composition
tilapia mozambique	50 (116)	18 (50)	34
threadfin shad	11 (27)	17 (46)	14
red devil	10 (23)	21 (57)	15.5
redbreast tilapia	9 (21)	14 (37)	11.5
redecor sunfish	8 (20)	3 (7)	5.5

redbreast sunfish	0	0 (1)	0
channel catfish	4 (10)	5 (13)	4.5
peacock bass	4 (9)	1 (2)	2.5
guppy	0	4 (11)	2
armored catfish	3 (8)	12 (33)	7.5
largemouth bass	1 (3)	3 (8)	2
rosy barb	0 (1)	0	0
green swordtail	0 (1)	0 (1)	0
mosquito fish	0	1 (2)	0.5
convict cichild*	0	1 (4)	0.5

\* Convict cichlid (*Archocentrus nigrafasciatus*), according as identified by Felix Grana from PRDNER.

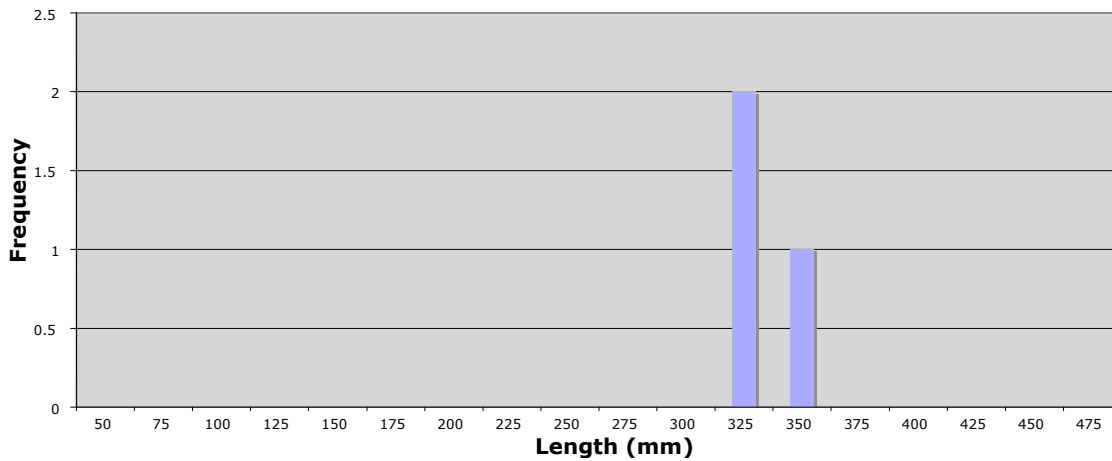
For Spring electrofishing we found eleven fish species. In Loiza, the largemouth bass, one of our target fish, showed a low relative abundance with only three individuals (1%). In the Fall electrofishing, fourteen fish species were represented. High species diversity in Loiza is principally because of the presence of several tropical aquarium species. We found one specimen of the Australian redclaw (*Cherax quadricarinatus*). This crayfish was accidentally introduced to this reservoir after escape from earthen aquaculture ponds on a farm in northeastern Puerto Rico as a result of Hurricane Georges in 1998 (Williams et al., 2001). However, it has not been included in the species composition analysis. In the Fall sampling, the largemouth bass relative abundance increased (3%) in relation to the Spring sampling (1%). The dominant species was mozambique tilapia (*Tilapia mosambica*). The red devil (*Amphilophus spp.*) relative abundance was quite high, taking in consideration that this cichlid has been recently introduced to Puerto Rico's reservoirs, probably from aquarium related sources. Total Catch per Unit of Effort (CPUE fish/hour), LMB CPUE and LMB Relative Weight ( $W_r$ ) at Loiza reservoir for April 2006 and November 2006 is presented in the following table.

Table 2. Total CPUE, LMB CPUE and LMB Condition Factor for Loiza reservoir for 2006.

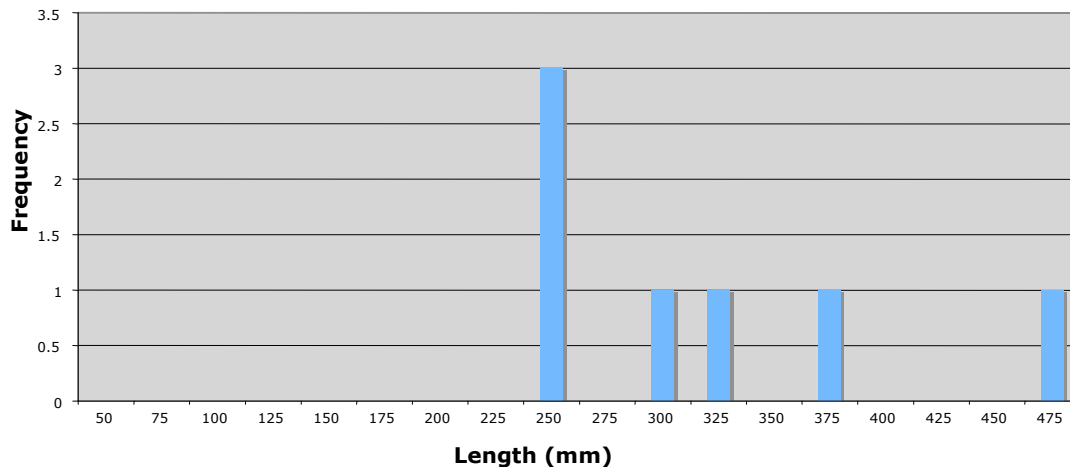
Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB $W_r$
Spring 2006	239	3	113.97
Fall 2006	272	8	114.61

The largemouth bass relative weight was within an acceptable range for both electrofishing periods, indicating that adequate forage is available to the bass in this reservoir.

Figure 1 and Figure 2 present the LMB Length Frequency for Spring and Fall respectively. Fingerling LMB, were not encountered in either sample. In the Fall, juveniles were sampled though the majority were adults. Juvenile LMB of 270 mm TL would have been born approximately 10 months earlier, shortly before the Spring sampling and thus would have been too small to be captured with the boat shocking equipment.



**Figure 1. Length frequency distribution of largemouth bass at Loiza reservoir during Spring electrofishing (2006).**



**Figure 2. Length frequency distribution of largemouth bass at Loiza reservoir during Fall electrofishing (2006).**

### Dos Bocas

A total of thirteen fish species were found in Dos Bocas (Table 3), such that this reservoir has the second greatest species diversity among the five monitored.

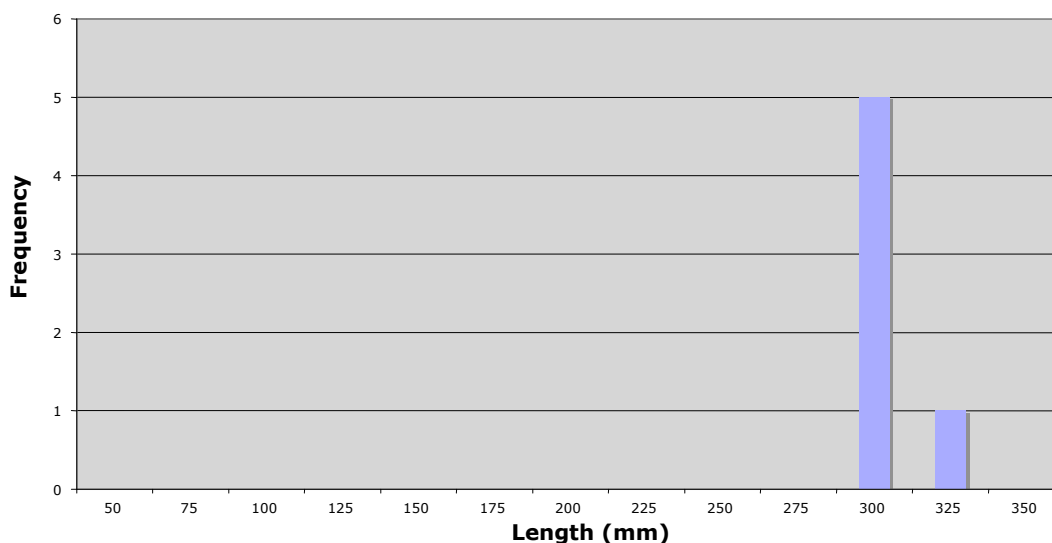
Table 3. Species present in electrofishing samples at Dos Bocas reservoir during 2006. The number of fish of each species appears in parentheses.

Species	% Composition Spring 2006	% Composition Fall 2006	% Average Composition
tilapia mozambique	22 (65)	26 (104)	24
threadfin shad	19 (56)	7 (28)	13
red devil	7 (22)	8 (35)	7.5
redbreast tilapia	4 (12)	5 (20)	4.5
redeer sunfish	26 (78)	10 (43)	18
redbreast sunfish	3 (10)	2 (10)	2.5
channel catfish	10 (31)	4 (18)	7
peacock bass	1 (3)	2 (7)	1.5

armored catfish	5 (14)	19 (78)	12
largemouth bass	2 (6)	17 (72)	9.5
rosy barb	0	0 (1)	0
mosquito fish	0	0 (2)	0
white catfish	0	0 (1)	0
marbled bullhead	1 (2)	0	0.5

As in Loiza, in Dos Boca reservoir there exists a high fish diversity, partly due to the presence of ornamental fishes. The red devil is an example of these unauthorized introductions probably made by people unaware of the environmental threat they present. The relative abundance of red devils, which were first detected in Guajataca reservoir several years ago, is now 7% in Dos Bocas reservoir.

LMB Length Frequency for Spring 2006 is shown in Figure 3. No fingerling sizes were present and few adults were captured. However, their condition factor, based on relative weights ( $W_r$ ), is excellent (105.67). The low population density of the largemouth bass and abundant prey contributes to fast growth and good condition.



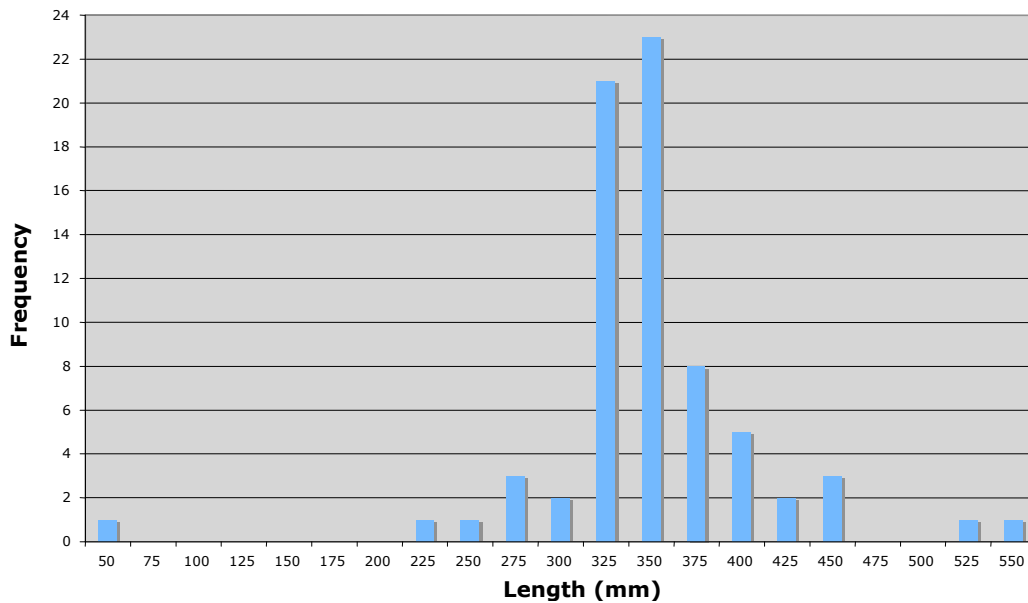
**Figure 3. Length frequency distribution of largemouth bass at Dos Bocas reservoir during Spring electrofishing (2006).**

Table 4 presents the CPUE information and LMB Relative Weights in Dos Bocas for Spring and Fall 2006.

**Table 4. Total CPUE, LMB CPUE and LMB Relative Weight for Dos Bocas reservoir for 2006.**

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB $W_r$
Spring 2006	299	6	105.67
Fall 2006	419	72	112.92

In Fall electrofishing the dominant species was tilapia mosambique (N=104) followed by armored catfish (N=78). Largemouth bass were found in the Fall sample in great abundance (N=72) compared with the Spring sampling. Also, fingerling sizes were represented (Figure 4), probably because a fingerling stocking was made at the beginning of November. Other LMB sampled which were less than 305 mm indicate natural spawning in Dos Bocas occurred in early 2006.



**Figure 4. Length frequency distribution of largemouth bass at Dos Bocas reservoir during Fall electrofishing (2006).**

### Caonillas

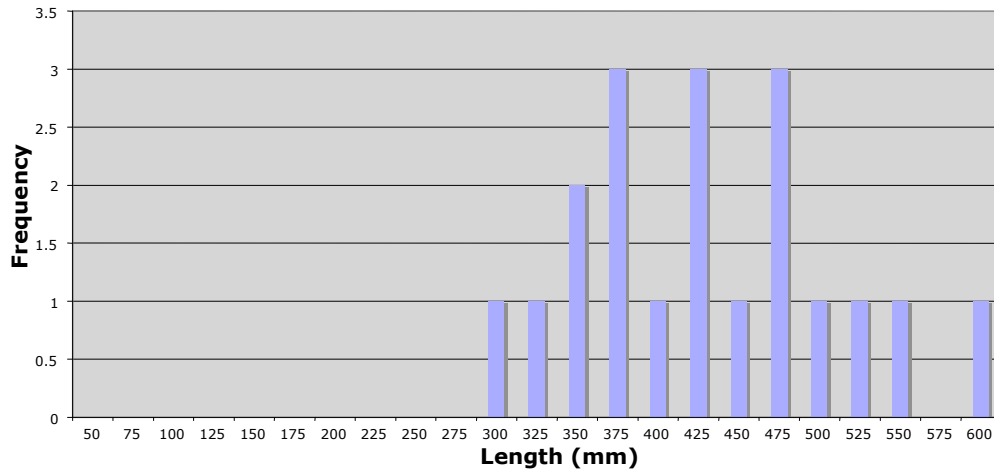
In this reservoir, ten fish species were represented in 2006 electrofishing. The dominant species were the invasive armored catfish (*Pterygoplichthys multiradiatus*) (33%) and the redbreast tilapia (*Tilapia rendalli*) (31%), Table 5. Among the 5 reservoirs sampled, in Caonillas was found the greatest abundance of armored catfish. Previous studies have shown an inverse relationship between LMB relative abundance and armored catfish relative abundance Neal et al. (\_\_\_\_). Relative abundance of both target species, largemouth bass and peacock bass, was quite low, averaging 4.5% and 2%, respectively.

Table 5. Species present in electrofishing samples at Caonillas reservoir during 2006. The number of fish of each species appears in parentheses.

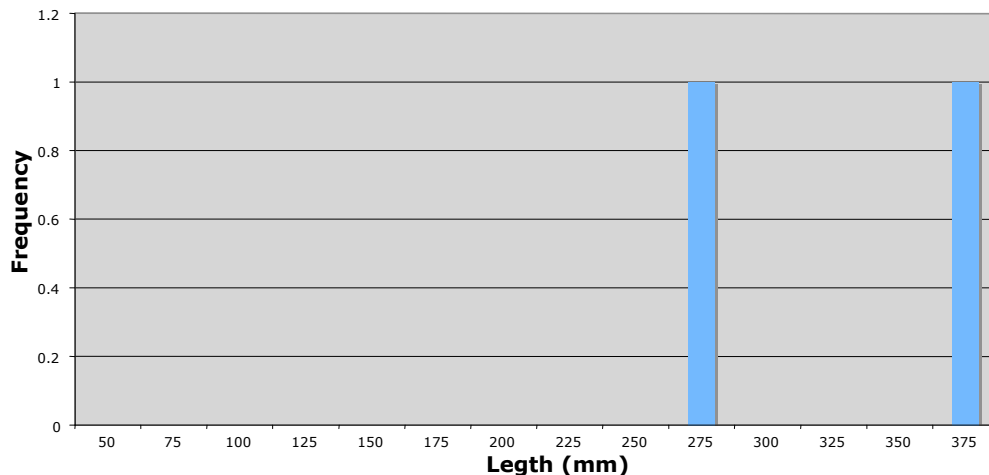
Species	% Composition Spring 2006	% Composition Fall 2006	% Average Composition
armored catfish	33 (72)	28 (118)	30.5
redbreast tilapia	22 (47)	31 (128)	26.5
redeer sunfish	8 (16)	23 (98)	15.5
threadfin shad	12 (25)	9 (39)	10.5
tilapia mosambique	6 (12)	2 (7)	4
redbreast sunfish	3 (6)	4 (16)	3.5

channel catfish	5 (10)	1 (4)	3
peacock bass	2 (5)	2 (9)	2
largemouth bass	9 (19)	0 (2)	4.5
bluegill	0	0 (1)	0

During the Fall electrofishing only two specimens of largemouth bass were collected, unlike the Spring in which nineteen specimens were collected. In neither sample were fingerling sizes found (Figure 5 and Figure 6).



**Figure 5. Length frequency distribution of largemouth bass at Caonillas reservoir during Spring electrofishing (2006).**



**Figure 6. Length frequency distribution of largemouth bass at Caonillas reservoir during Fall electrofishing (2006).**

Total CPUE, LMB CPUE and LMB relative weight is presented in Table 6. LMB CPUE for Fall electrofishing was very low (2 fish/hour). On the other hand, LMB CPUE for Spring

electrofishing was 19 fish/hour. The condition factor for largemouth bass was very similar in both samplings, and acceptably good.

Table 7. Total CPUE, LMB CPUE and LMB Condition Factor for Caonillas reservoir for 2006.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
Spring 2006	212	19	96.48
Fall 2006	422	2	97.48

### Carite

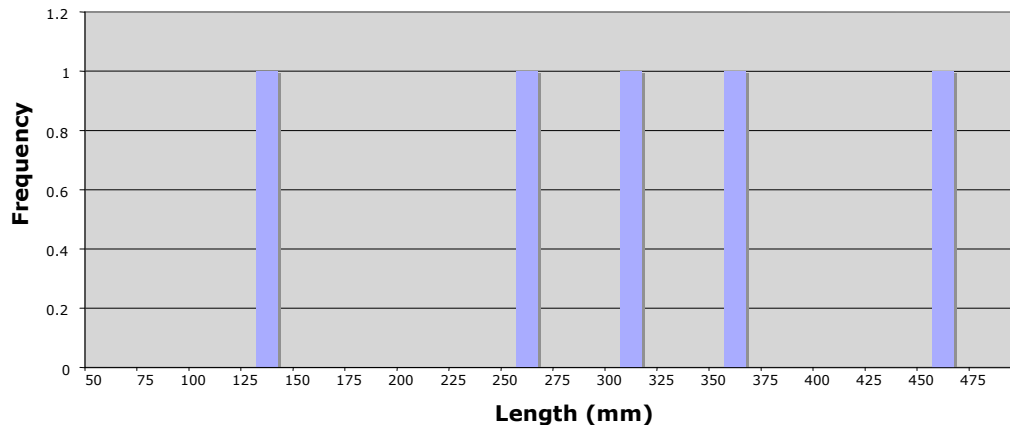
The 2006 electrofishing at Carite reservoir was represented by nine species (only five during Spring) (Table 8). Unlike the other three reservoirs discussed before, the dominant species was the native bigmouth sleeper (*Gobiomorus dormitor*) (43% in Spring and 37% in Fall), followed by largemouth bass (18% in Spring and 7% in Fall). Carite distinguishes itself from almost all other reservoirs (except Patillas) in Puerto Rico by having 3 top-level predators (largemouth bass, peacock bass and bigmouth sleepers).

Table 8. Species present in electrofishing samples at Carite reservoir during 2006. The number of fish of each species appears in parentheses.

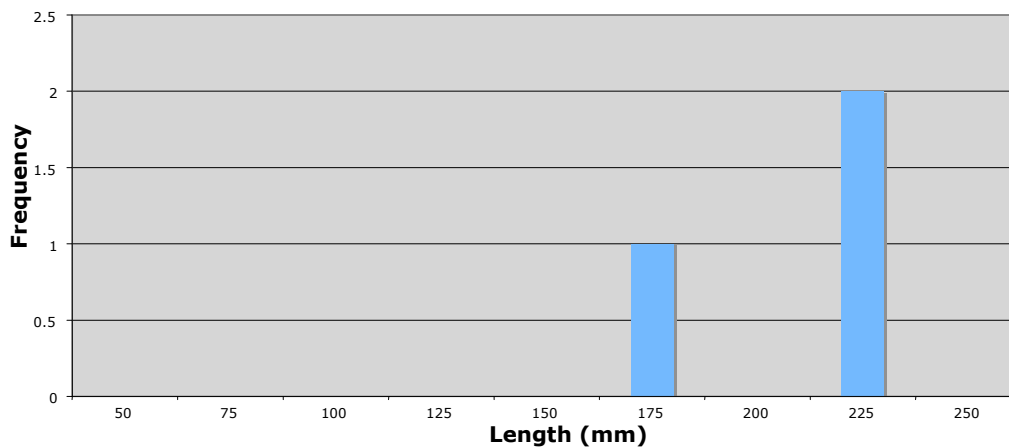
Species	% Composition Spring 2006	% Composition Fall 2006	% Average Composition
bigmouth sleeper	43 (12)	37 (15)	40
largemouth bass	18 (5)	7 (3)	12.5
channel catfish	21 (6)	7 (3)	14
redbreast tilapia	0	15 (6)	7.5
redecor sunfish	14 (4)	12 (5)	13
redbreast sunfish	0	5 (2)	2.5
peacock bass	4 (1)	7 (3)	5.5
bluegill	0	5 (2)	2.5
blue tilapia	0	5 (2)	2.5

In this reservoir no threadfin shad were detected, which is an important forage species. The sunfish population was relatively low with the % average composition of 13 and 2.5 for redear sunfish and bluegill respectively. Largemouth bass relative abundance was 18% for Spring (Figure 7) and 7% in Fall (Figure 8).





**Figure 7. Length frequency distribution of largemouth bass at Carite reservoir during Spring electrofishing (2006).**



**Figure 8. Length frequency distribution of largemouth bass at Carite reservoir during Fall electrofishing (2006).**

The Total CPUE was greater during the Fall (41 fish/hour) while the LMB CPUE was greater during the Spring (5 fish/hour). However, largemouth bass condition factor was considerably low, especially during the Fall electrofishing (82.66) and in Spring was 90.63. This suggests the need for more forage, for example threadfin shad.

Table 9. Total CPUE, LMB CPUE and LMB relative weight for Carite reservoir for 2006.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB W <sub>r</sub>
Spring 2006	28	5	90.63
Fall 2006	41	3	82.66

#### Patillas

In this reservoir, a total of ten fish species were found. The most abundant species was redbreast tilapia (*Tilapia rendalli*) followed by blue tilapia, redear sunfish and armored catfish.

Table 10. Species present in electrofishing samples at Patillas reservoir during 2006. The number of fish of each species appears in parentheses.

Species	% Composition Spring 2006	% Composition Fall 2006	% Average Composition
redbreast tilapia	21 (18)	30 (34)	25.5
blue tilapia	17 (14)	11 (12)	14
redecor sunfish	19 (16)	8 (9)	13.5
armored catfish	11 (9)	16 (18)	13.5
bigmouth sleeper	5 (4)	2 (2)	3.5
largemouth bass	5 (4)	5 (6)	5
channel catfish	11 (9)	9 (10)	10
peacock bass	4 (3)	10 (11)	7
bluegill	16 (13)	8 (9)	12
brown bullhead	0	1 (1)	0.5

In Patillas as well as Carite, bigmouth sleeper were present during 2006 electrofishing sampling. Another similarity with Carite reservoir was the absence of threadfin shad. LMB CPUE was quite low at 4 fish/hour for Spring and 6 fish/hour for Fall. The LMB condition factor was 92.31 and 96.90 for Spring and Fall 2006 respectively (Table 11). Like in Carite reservoir, the low condition factor of largemouth bass could be evidence of the necessity of threadfin shad.

Table 11. Total CPUE, LMB CPUE and LMB relative weight for Patillas reservoir for 2006.

Sample	TOTAL CATCH CPUE (fish/hour)	LMB CPUE (fish/hour)	MEAN LMB Wr
Spring 2006	*83	*4	92.61
Fall 2006	112	6	86.90

\*During Spring electrofishing only 3 sampling stations were done due to mechanical problems with the boat generator.

No largemouth bass at fingerling sizes were sampled during the Spring electrofishing, however we did find them during the Fall.

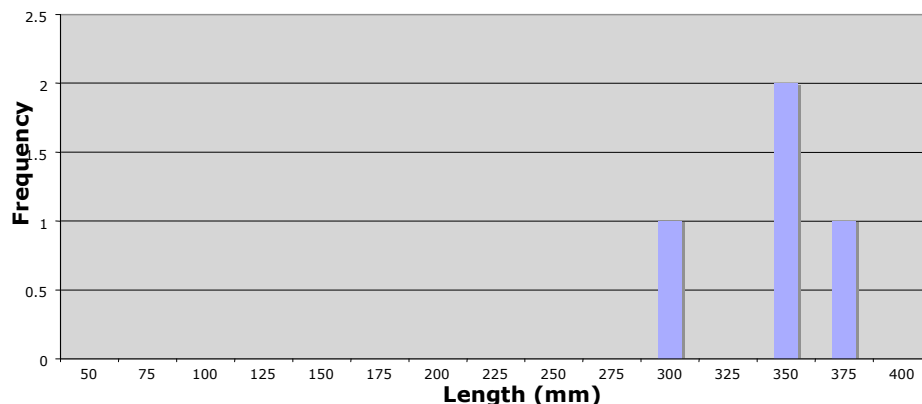
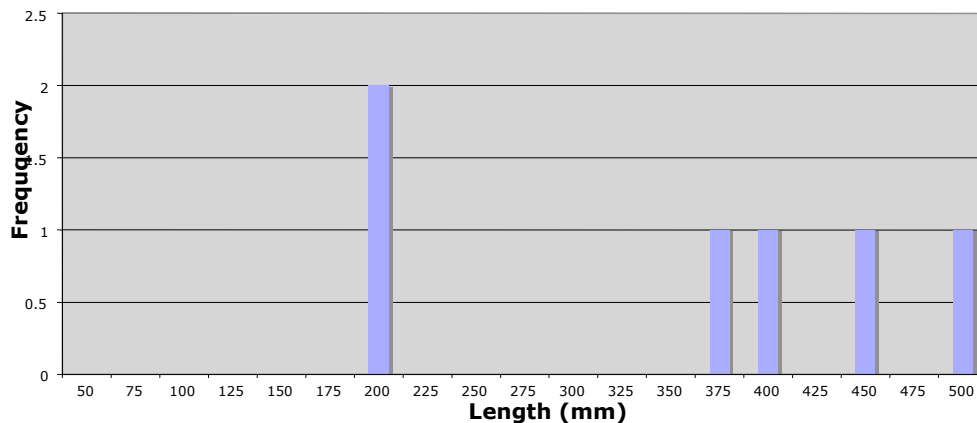


Figure 9. Length frequency distribution of largemouth bass at Patillas reservoir during

## Spring electrofishing (2006).



**Figure 10. Length frequency distribution of largemouth bass at Patillas reservoir during Fall electrofishing (2006).**

Water quality parameters were monitored at each reservoir. The parameters measured were temperature, secchi and dissolved oxygen. Also, the reservoir depth was taken at the point where the others parameters were measured. In Caonillas during the Fall electrofishing it was not possible to monitor water quality due to very high winds. At Loiza, dissolved oxygen was low compared with the other reservoirs (3.23 mg/l for Spring and 4.85 mg/l for Fall). Dissolved oxygen levels below 4 mg/l are considered stressful for warmwater fish. Table 13 shows the water quality data for all reservoirs during Spring and Fall.

Table 13. Water quality data for the five reservoirs sampled during 2006.

	<u>Loiza</u>		<u>Dos Bocas</u>		<u>Caonillas</u>		<u>Carite</u>		<u>Patillas</u>	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Temperature (°C)	27.7	26.6	25.9	26.9	26.3	*	24.6	25.4	28.2	26.6
Secchi (cm)	63	34	63	63	174	*	200	200	300	200
O. D. (mg/l)	3.23	4.85	5.76	7.13	7.94	*	7.45	6.50	7.25	5.71
Depth (feet)	12	†	68	†	12	*	†	†	41.5	22

\* - Water quality data was not taken due to strong winds

† - Water depth data not collected.

### Discussion:

Loiza and Dos Bocas reservoirs presented the highest species diversity among the five reservoirs sampled. During the last years, several ornamental fishes have been introduced (red devil *Amphilophus spp.* as well as *Pterygoplichthys* and african cichlids) and other aquatic species like the Australian redclaw crayfish *Cherax quadricarinatus* and Asian clams (*Corbicula fluminea*) to the reservoirs.

In Loiza we sampled at least three invasive species of cichlids and other fish species that are used as bait by the fishermen. Largemouth bass relative abundance was low, and the condition factor averaged 114.29, which is excellent. The reason for this low relative abundance could be that this reservoir has not been stocked since 2001, and natural recruitment is inadequate to maintain the populations over time, probably due to water level fluctuations, which interfere with

spawning. On the other hand, apparently the abundant populations of tilapia and shad contribute to excellent largemouth bass condition. As in the past, this reservoir has a heavy infestation of water hyacinth and water lettuce, which cover a significant part of the lake's surface area. This situation may affect the primary production of phytoplankton by inhibiting light penetration and also restrict the sampling (and angling) areas. It should be noted that Oscars (*Astronotus ocellatus*) and pacu (*Colossoma spp.*) have been reported from Loiza, but not confirmed by our sampling.

In Dos Bocas, there are present some tropical aquarium species contributing to the high fish diversity. The redear sunfish relative abundance was 18%. Together with mozambique tilapia (24%) and shad (13%) these comprised 55% of the species composition. Of all the reservoirs sampled during 2006, Dos Bocas had the greatest largemouth bass population (LMB CPUE 72 fish/hour). This reservoir has been stocked with largemouth bass and sunfish (bluegill and redear) since 2002. During 2006 Spring electrofishing, largemouth bass fingerling sizes were not found. Nevertheless, the presence of juvenile LMB in the Fall sampling confirms natural reproduction was successful. The boat mounted electrofishing equipment is more efficient at sampling fish greater than fingerling size.

Among the fish community at Caonillas reservoir, one of the most abundant fish was the invasive armored catfish. This fact is of concern because of its spawning habits, armored catfish construct nesting burrows and sometimes occur in very close proximity to each other, thus compromising shoreline stability, increasing erosion and suspended sediment loads (ANSRP Feb 2004). Reservoir bank erosion could affect the largemouth bass spawning sites. In Caonillas the high population density of this fish is evident by visual inspection of the lake basin. No largemouth bass fingerling sizes were found, possibly influenced by this factor as well as the water level fluctuations in the reservoir.

Carite reservoir evidenced the greatest bigmouth sleeper (*Gobiomorus dormitor*) relative abundance, such as has been reported in the past. This native fish had been reported in samplings from 4 of 13 major reservoirs in Puerto Rico (Neal et al., 1999). However, Neal et al. (2001), indicated that catch rates of this species were extremely low in all reservoirs except Carite reservoir, which supported a moderate population. Patillas was the other reservoir of this sampling where the bigmouth sleeper was present. As in the past, the Carite population is considerably higher than in Patillas. This reservoir is an alternative to those fishermen that prefer this fish. According to Bacheler et al. 2004, in Carite reservoir, recreational fishermen frequently target, catch, and consume bigmouth sleepers.

Carite and Patillas reservoirs are very similar in their species composition. Both have bigmouth sleeper and neither have threadfin shad. On the other hand, in Carite we sampled *Cherax quadricarinatus*, but not in Patillas. Nevertheless, armored catfish were present at Patillas but not in Carite.

Largemouth bass abundances in both reservoirs are relatively low. In Patillas fingerling size bass were not sampled during Spring. After a supplemental stocking in June, the minimum size of largemouth bass caught during Fall was 132 mm, which likely corresponds to a stocked fingerling. In Carite we sampled one fingerling LMB during Spring electrofishing.

It should be mentioned that peacock bass (*Cichla ocellaris*) that in the past was a very dominant fish population in some reservoirs, has been present in this year's sampling but in low abundances.

## Recommendations:

Due to the high fish diversity at Loiza reservoir it is recommended to investigate the impact of invasive species on the fresh water habitat and sportfish populations. Some of these species are present also in Dos Bocas and Guajataca reservoirs and we expect their range to extend eventually to other reservoirs.

The armored catfish high mean CPUE at Caonillas reservoir is a matter of concern (95 fish/hour). Also, it is present in Dos Bocas (CPUE = 46 fish/hour), Loiza (CPUE = 20.5 fish/hour) and Patillas (CPUE = 10 fish/hour). It is recommended to advocate the capture and consumption of this species and to prohibit the release of this species back into the reservoir when it is caught.

Supplemental largemouth bass stocking should continue at all reservoirs monitored, especially at Dos Bocas, and Caonillas where there are fishing Clubs and adequate facilities for the users. In addition, largemouth bass should be stocked in Loiza where no fish stockings have been done since 2001 and fishing pressure is high.

In Carite and Patillas reservoirs the island's three top level predators, bigmouth sleeper, peacock bass and largemouth bass co-exist. Threadfin shad should be stocked in order to expand the forage alternatives and prey biomass available to these species.

### Literature Cited

- Aquatic Nuisance Species Research Program Bulletin, Vol-04-1 February 2004. US Army Corps of Engineers, Engineer Research and Development Center.
- Nathan M. Bacheler, J. Wesley Neal, and Richard L. Noble. 2004. Reproduction of a landlocked diadromous fish population: Bigmouth sleeper *Gobiomorus dormitor* in a reservoir in Puerto Rico. *Caribbean Journal of Science*, Vol. 40, No. 2, 223-231.
- J. Wesley Neal, Richard L. Noble, Craig G. Lilyestrom, Timothy N. Churchill, Alexis R. Alicea, Daniel E. Ashse, 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.
- Williams, E. H., Jr., L. Bunkley-Williams, C. G. Lilyestrom and E. A. R. Ortiz-Corps. 2001. A review of recent introductions of aquatic invertebrates in Puerto Rico and implications for the management of nonindigenous species. *Caribbean Journal of Science*, Vol. 37, No. 3-4, 246-251.