CONTRIBUTIONS TO THE ECOLOGY OF JUVENILE TARPON *MEGALOPS ATLANTICUS* IN AN IMPOUNDMENT IN SOUTHWESTERN PUERTO RICO

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ABSTRACT

Juvenile tarpon were found in both fresh water channels and brackish mangrove back waters of an impoundment in Boquerón, Puerto Rico. A pilot capture and recapture experiment along with in situ injection of Oxytetracycline hydrochloride (OTC) at 100 mg/kg provided estimates of growth, age and residency time in these areas. Juvenile tarpon were found to colonize the backwater areas from June to January, reside several months and grow 1.1 % of their standard lengths per day.

Oxytetracycline HCL injection both peritoneal and intra-muscular were successful in marking otoliths from juvenile tarpon (40 to 100 mm SL). Difficulties with daily ring readings of tarpon larger than 100 mm SL were encountered and believed to be caused by an irregular growth of the sagittea. Significant linear relationship was found between the standard length and estimated age of 28 and 26 juveniles from each sampling area. Although environmental parameters such as temperature, dissolved oxygen and salinity were quite dissimilar between these two areas studied, no significant difference was found between the condition factors or growth rates of tarpon populations from both sites (1992 and 1993).

Short term use of external tags (mini-spaghetti and dangling tags) in the backwater pools yielded high retention and recovery rates (43% and 74% respectively) over a period of 140 days. Growth rates measured from recaptured tarpon were below those calculated from daily ring readings. This discrepancy is believed to be caused by stresses associated with handling during tagging or OTC injection. The maximum observed size and residency for tarpon in the backwater areas was 56 days and180 mm SL.

INTRODUCTION

Megalops atlanticus is a valuable sport fish species that supports a substantial fishery resource in Florida and the Caribbean (Cyr 1991; Chaverri 1992). However, their early-life history is poorly understood. Except of one brief mention by Erdman (1960), no other report of juvenile tarpon habitat utilization has been made from Puerto Rican waters. Recruitment of tarpon into nursery areas, habitat use, and growth in these areas has not been well documented (Crabtree and Cyr 1993). Moreover, these areas are under increased pressures for development and subjected to other human activities which may endanger the existence of these nursery grounds. It is necessary then, to understand the early life history of tarpon in order to implement proper management and conservation policies if we wish to conserve this resource.

Tarpon spawn offshore and their larvae colonize inshore waters rich in nutrients, e.g.; estuaries, lagoons, and channels where they spend most of their early life (Chaverri 1992; Crabtree and Cyr 1993). Juveniles inhabit inshore waters with a wide range of habitats (Rickards 1968), however, comparative information linking growth and habitat is lacking. Investigators have speculated (Harrington 1966; Crabtree and Cyr 1993) that since juvenile tarpon can overcome waters of low dissolved oxygen (D.O.) through atmospheric respiration, they inhabit waters of poor water quality to escape most predatory fish. However, while juvenile survival might be increased by inhabiting waters of extreme and variable salinity, temperature, pH, and D.O., the constant metabolic demand due to these conditions should also be limiting to their growth (Cyr 1991). More information is needed on how physical factors affect juvenile tarpon growth.

Age and growth of tarpon have been incompletely documented (Crabtree and Cyr 1993). The majority of the published work on growth of juvenile tarpon has been descriptive and provides little useful quantitative information (Cyr 1991). Early investigators reported juvenile tarpon growth based of length frequencies relationships (Harrington 1966; Rickards 1968). However, growth estimates based on length frequency analyses are often imprecise as they are confounded by recruitment, movements, mortality, sampling bias, and variation in individual growth rates (Beckman, Fitzhugh and Wilson 1988).

Later studies by Cyr (1991) and Nichols (1994) have focused on estimating growth rates through correlation of otolith weight with estimated age and standard length. Yet, theses same investigators have assumed otolith increment formation to be daily and have acknowledged the need of validation studies for accurate representation of age and growth. Validation of presumed daily increments is required for accurate results in the data obtained from otoliths (Beamish and MacFarlane 1983). With the exception of one juvenile tarpon (518 mm SL) injected by Cyr in 1989 with oxytetracycline hydrochloride (OTC) to validate annual annulus increment formation, no other otolith ring validation studies have ever been published on juvenile tarpon.

A mark and recapture experiment in combination with tetracycline injection as age validation technique, would provide direct measurements of growth, and reliable estimates of age. In addition, regular samplings of estuarine pools and creeks may provide reliable data for habitat characterization, usage, and distribution of tarpon juveniles that could further increase our understanding of their biology.

OBJECTIVES

The objectives of this study were:

1. to directly measure growth rates of juvenile tarpon by mark and recapture techniques;
2. to validate otolith aging by oxytetracycline hydrochloride injection; and
3. to describe the physical and biological characteristics of tarpon nursery areas of an impoundment in southwestern Puerto Rico .

METHODS

Study location

The Boquerón Wildlife Refuge (BWR) is a mangrove impoundment created in 1965 and managed by the Puerto Rico Department of Natural Resources. Located in southwestern Puerto Rico next to Boquerón Bay, it comprises 177 ha of mangrove forest and wet lands. Our area of study was within the drain channel of the impoundment and the backwater areas (spillway) landward from the mangrove forests.

Mark and Recapture Experiment of juvenile tarpon

To determine age and residency time of juvenile tarpon, a mark and recapture experiment was conducted in small ephemeral pools of the backwater areas of the BWR impoundment. From September 9, 1992, to January 8, 1993, tarpon were collected, tagged, fin clipped and injected with oxytetracycline hydrochloride (OTC) in situ. Sampling of these pools was performed bi-weekly with a small bag seine (8 m x 1.2 m high and 1.5 mm square mesh). During samplings, fish were weighed, measured (SL) and either kept, re-marked, retagged or released systematically.

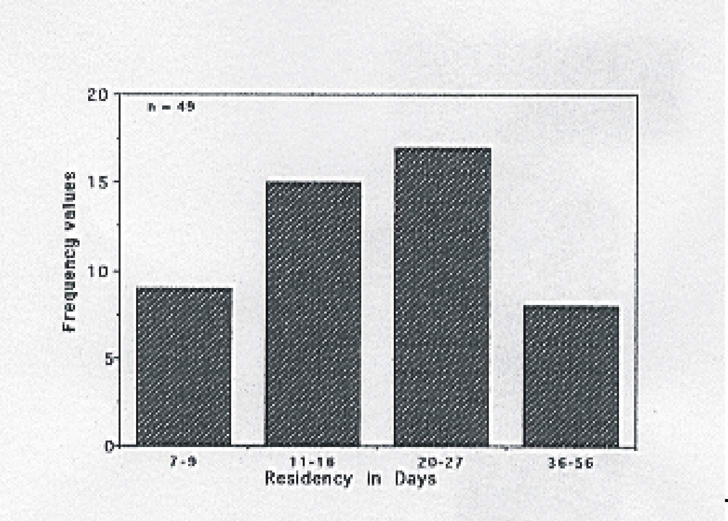

Figure 1. Observed Residency (days) of recapture juvenile tarpon *Megalops atlanticus* from the BWR Back water (Spillway) in 1992.

Two different types of tags were utilized in combination with fin clips to insure identification of recaptured individuals in the event of tag loss. Dangling tags consisted of numbered round flat plastic disks (5 mm diameter) attached with monofilament line (0.1 mm diameter) to the dorsal fin base of larger (size 65 to 123 mm SL) juvenile tarpon. Mini-spaghetti tags made of monofilament (0.1 mm diameter) and coded with combinations of paint beads following the methods explained by Chapman & Bevan (1990), were implanted on the dorsal fin base of tarpon ranging from 40 to 80 mm SL.

Fin clipping methods successfully used by Rinne (1976) on Tilapias were employed on juvenile tarpon. Hard fin rays were carefully cut but remained attached so that after healing, callouses would form on clipped spines. Different 'coded' combination of clips were used in an attempt identify the individual tarpon.

To validate otolith daily ring formation, otoliths were marked by injecting tarpon either intramuscularly or intraperitoneally with 100 mg/kg doses of OTC following techniques described by Alhossaini & Pitcher (1988). Two different concentrations of OTC were utilized; one of 4 mg/ml of OTC and a second solution of 8 mg/ml. The more diluted solution was used in small tarpon (50 to 80 mm SL) while the latter was used on larger juveniles (80 to 123 mm SL). When possible, individuals were marked more than once to insure better reading references.

Otolith Preparation

Otoliths were dissected from recaptured tarpon and cleaned with 70% ethyl alcohol, rinsed with distilled water, and place in dark containers to prevent excessive exposure to light. From each pair of otoliths, one sagittae was randomly chosen and embedded in resin block. Transversal sectioning and polishing were then performed. Micro increments (rings) were counted at least three times under visible light microscope at 1250x magnification. Indirect ultraviolet illumination was used to reveal presence of the OTC mark.

Growth Estimates

Juvenile tarpon growth rate was estimated by two methods; direct measurement of standard length increments from recaptured tarpon, and an indirect method based on linear regression of age and standard length. The growth rate estimates resulting from both methods (direct and indirect) were compared.

Aquarium Evaluation

To investigate the possible effects of tagging and OTC injections, eight juvenile tarpons (SL ranged from 59 mm to 72) were collected from Spillway on September 20, 1993 and transferred into a 30 gallon aquarium. On September 30, 1993, six juvenile tarpon were tagged with mini-spaghetti tags and injected with OTC. Three individuals were injected intramuscularly, while three others were injected intraperitoneally. The remaining two tarpon served as 'control' and were not tagged nor injected with OTC. The purpose of the two 'control' tarpon was to compare their behavior and survival against those juveniles tagged or treated with OTC. OTC was administered at 100 mg of OTC per kg of fish utilizing a solution of 4 mg of OTC /ml of solution. Tarpon were fed live foods ad lib daily. Tarpon were measured and weighed on September 30, October 21, and November 25, 1993. OTC injection was repeated 21 days later on October 21, 1993. All eight tarpon were eventually sacrificed on November 25, 1993.

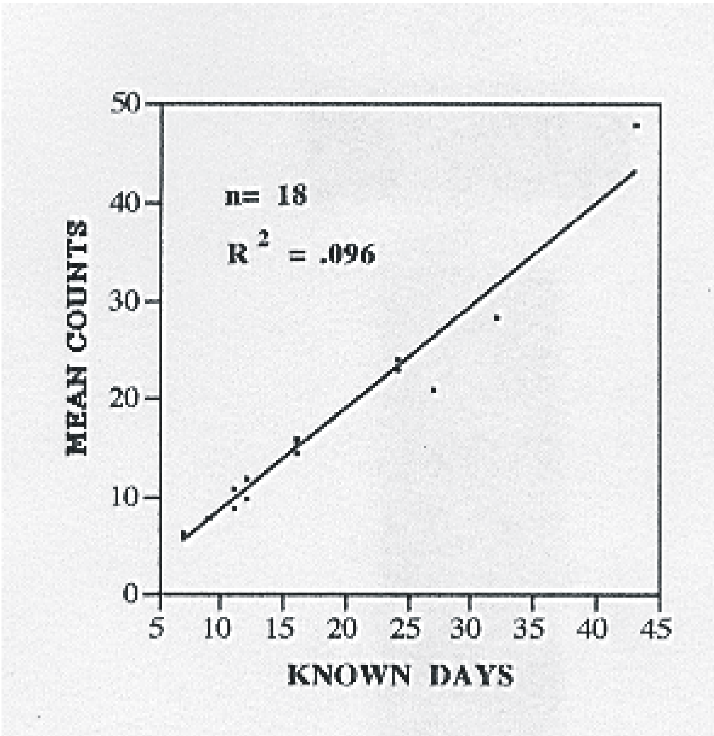

Figure 2. Linear regression of Mean ring count and known days between OTC mark of 18 juvenile Tarpon *Megalops atlanticus*, from BWR.

Description and Comparison of Nursery Areas

Nursery areas were described by measuring and comparing physical parameters e.g.; salinity, pH, dissolved oxygen, water temperature, depth, and water clarity of sampling areas where juveniles were found. Notes of biological descriptors e.g.; other species, vegetation and bottoms were taken. To verify if a sampling area provided a better habitat, condition factors and estimated growth rates of juvenile tarpon (SL 30 to 130 mm) captured in each sampling area during 1992 were compared. Condition factors were calculated based on the following formula:

$$CF = wt/(SL)^3$$

were wt is the weight of the fish in grams and SL is the standard length of the fish in millimeters.

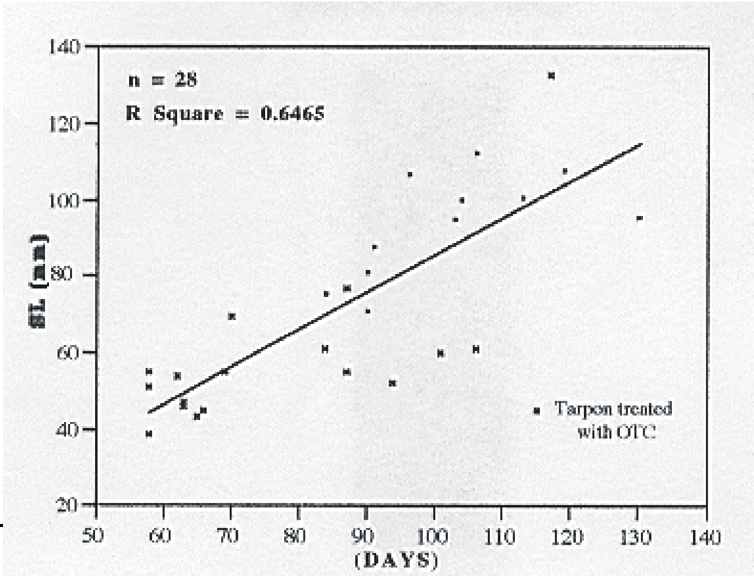

Figure 3. Liniar regression of estimated age and length frequencies of 28 juvenile Tarpon *Megalops atlanticus*, from the BWR Spillway 1992.

Recruitment And Distribution

To determine recruitment occurrence of tarpon juveniles, active and passive sampling schemes were used in the backwater areas (spillway) and drain channels of the BWR impoundment. Active sampling was done in channels and backwater area by use of a small bag seine (8 m x 1.2 m high) and cast net (3 m diameter). This sampling was combined with passive sampling, which included the deployment of experimental gill nets and hoopnets along the drain channel. Sampling was performed on a bi-monthly basis from July 1992 to December 1993.

RESULTS

Mark And Recapture Field Experiment

Field tagging results are summarized on Table 1. A total of 132 juvenile tarpon were tagged using either dangling tags or mini-spaghetti tags in the spillway area of BWR in 1992. Recapture rate was high, 49% (n = 21) for dangling tags and 39% (n= 21) for mini-spaghetti tags. Tag retention was high for both types of tags (78% and 70% or dangling and mini-spaghetti tags, respectively) for the duration of this test. From the overall 57 recapture tarpon, 38 were released while 19 were kept after the second capture. Twenty-one juveniles were recaptured a third time, from which, 10 were kept and 11 were released again. Two tarpon were recaptured for a fourth time. Field mark and recapture tests produced a total of 28 juvenile tarpon treated with OTC which were kept for daily ring validation.

The maximum recorded period of juvenile tarpon utilization in ephemeral pools of the backwater area was 56 days. The observed minimum residency among tagged tarpon is displayed on Figure 1. The median recorded residency period among recaptured tarpon was from 20 to 27 days.

Otolith Ring Validation

The mark and recapture experiment produced 28 tarpon marked with OTC. Validation of daily ring formation in otoliths of juvenile tarpon was performed on 18 individuals, 10 otoliths were discarded due to wildly varying or unreadable counts. Daily ring count means were compared with known days between marks utilizing a Wilcoxon-Signed Rank non-parametric test (Steel and Torrie 1980). No significant difference ($p = 0.05$) was found between micro increments mean counts and days between flourescent marks. A linear regression (see Figure 2.)was fitted on mean ring count (RC) versus the known days (KD) between flourescent mark. The linear regression found was :

$$RC = 1.0397\ (\pm\ 0.05285) * (KD) - 1.58012$$

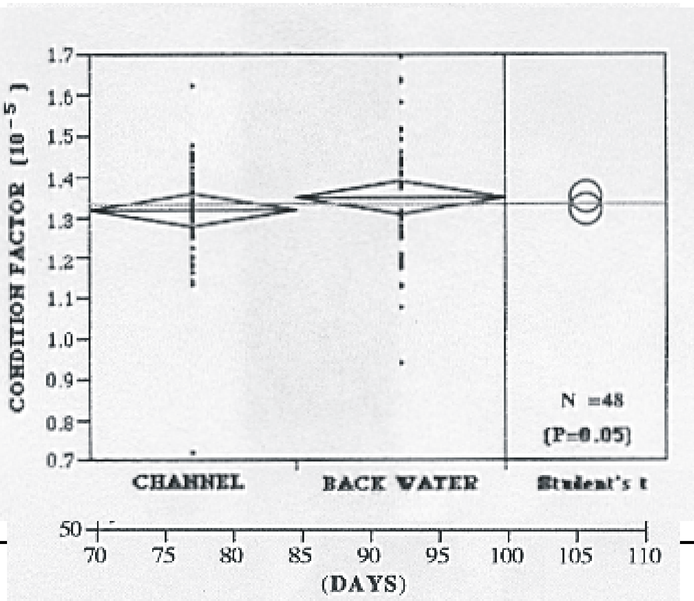

Figure 4. Liniar regression of estimated age and length frequencies of 26 juvenile Tarpon *Megalops atlanticus*, from the BWR Drain Channel in 1992.

The estimated slope was not significantly different from 1 ($p = 0.05$; Rsquare = 0.96). From this information it was possible to conclude that tarpon micro increment deposition is daily.

Growth Rate Estimates

Indirect growth rate was estimated from age and standard length relationships of 28 tarpon caught in the spillway area and 26 tarpon captured in the drain channel during 1992 (See Figures 3 & 4). A significant linear relationship ($p = 0.05$) was found between standard lengths and age estimates of juvenile tarpon (40 to 100 mm SL) caught in both sampling sites (see Figure 3 and Figure 4), (Rsquare = 0.6465 and Rsquare = 0.5615 for spillway and drain channel, respectively).

Figure 5. Wilcoxon Test comparison of condition factors (CF) from 48 pairs of Juvenile Tarpon *Megalops atlanticus*, captured in the Drain Channel and Spillway area of BWR (1992)

Daily growth rates based on age estimates of juvenile tarpon (40 to 100 mm SL) were 1.07 ± 0.19 (standard error) mm/day and 0.97 ± 0.14 (standard error) mm per day for juvenile tarpon captured in spillway area and the drain channel respectively. Although estimates of daily growth rate in the spillway area were slightly higher than those in the drain channel (0.97 mm/d), this difference was not statistically significant ($p = 0.05$) (Wilcoxon test). This data although preliminary, suggests that Megalops atlanticus juveniles of standard lengths from 40 to 100 mm grow about 1.1 % their standard lengths per day.

Direct growth increments were measured for 61 recaptured juveniles treated with OTC (SL 39 to 180 mm). Mean direct growth rate found was 0.45 ± 0.06 standard error mm per day. This estimate is rather low and did not agree with estimates derived from aging.

Habitat Description And Comparison

Juvenile tarpon were found in habitats with a wide range of physical and biological parameters. Both sampling sites differed dramatically on cover, sunlight and physical characteristics. While pools of the back water are exposed to sunlight, wind and tide, the drain channel was a more stable environment consisting of fresh stagnant water with ample cover and shade.

Table 2 shows the yearly means for BWR during 1992-93 of D.O., water temperature, Secchi, and pH. Water quality parameters at the high end of the drain channel, remained constant with little change during the day. Bottoms were extremely soft, black, anoxic mud with strong hydrogen sulfide smell and rotting vegetation. Little species variability was observed at the high end of the channel. The only concurrent species with tarpon here were Poecilia sp, *Tilapia mossambica*, and *Dormitor maculatus*.

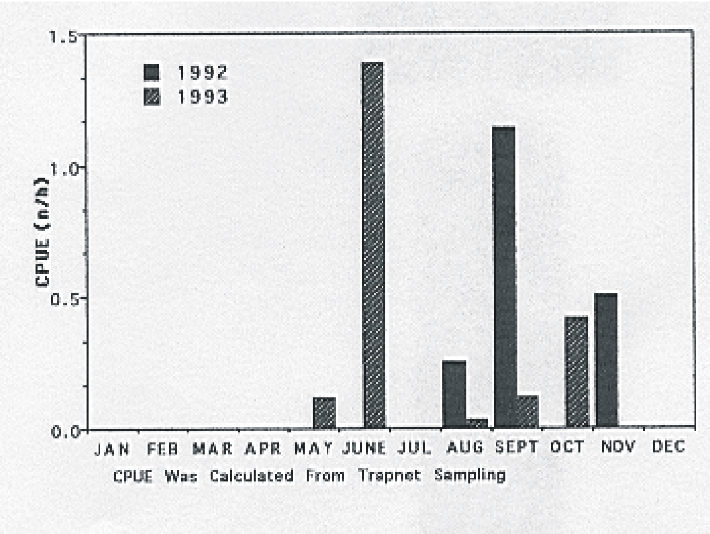

Figure 6. Catch Per Unit Effort (CPUE) of Tarpon *Megalops atlanticus*, leptocephali larvae at the BWR Drain Channel in 1992

Pools in the back water areas by contrasts, were subjected to extreme changes in salinity and temperature during the day. The bottom mud was hard and very saline. Table 2 displays the mean values (by site) for 1992-93 of water temp, salinity, dissolved oxygen, pH and Secchi. Non-parametric tests (Wilcoxon) found significant difference ($p = 0.05$) between both sites for all the parameters. We can conclude that the spillway area is a hotter, saltier, clearer, and more oxygenated body of water than the drain channel, subjected to a wider diurnal variability. Species composition varied greatly seasonally in this area. The same fresh water species present in the drain channel were found here at times of little connection with the lagoons (dry season) or when freshwater flowed over the spillway during the peak of the rainy season. However, during times of high water (flood tides), juveniles of saltwater species became abundant. The most significant in terms of biomass were *Elops saurus, Mugil curema,* and *Centropomus* species. Elops saurus appeared in very high densities and seemed to displace other species including juvenile tarpon.

The mean distribution of the condition factors from 48 juvenile tarpon (30 to 130 mm SL) captured in each area during 1992 is compared on Figure 5. Although mean condition factors are higher for the tarpons from the spillway area, (1.35 X 10 -5 vs. 1.31 x 10 -5) a Students' T test ($p= 0.05$) showed that this difference was not significant .

Juvenile Tarpon Distribution

Active sampling techniques produced better results at trapping juvenile tarpon than passive sampling schemes. In Table 3 we can see that for 688 hours of passive sampling only 29 juvenile tarpon were captured at BWR during 1992 and 1993. In contrasts, 84 juveniles were captured in the drain channel during the same period with active sampling gears (see Table 4). However, passive sampling in the drain channel proved to be efficient at catching *Megalops atlanticus* larvae, 172 were captured in this period (see Table 3). Table 5 shows a decrease in tarpon numbers from 1992 to 1993. Although this decrease may be part of a natural cycle, it was observed that these pools filled up with sediment during 1993 from runoff of a near by development. In Table 5 we can observe a significant difference in the amount of captured tarpon outside and inside the pools (1992 and 1993). Of 309 tarpon captured in the backwater area, only one was captured in the open mud flats while the rest (308) were captured inside the pools.

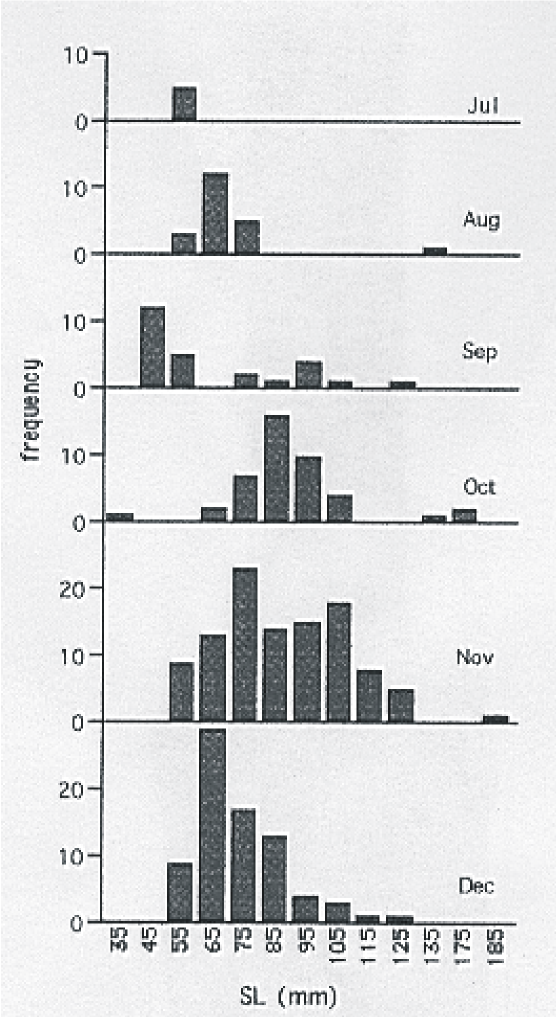

Figure 7. Monthly Standard length (SL) Size class frequencies of juvenile Tarpon *Megalops atlanticus*, capture at the BWR Spillway in 1992.

Figure 6. shows the Catch Per Unit Effort (CPUE) of tarpon leptocephali captured in the drain channel with trap nets in 1992 and 1993. We can observe two

recruitment peaks in 1992, September and November. Peak recruitment in 1993 was in June and October. Larval recruitment coincides with time of high water connection or rainy season. Colonization by tarpon larvae is thought to be a function of tide, currents, wind, distance and accessibility (Chaverri 1992). A StudentÕs t test ($p = 0.05$), showed a significant difference between tides and CPUE of tarpon leptocephali caught with trap nets in the BWR drain channel between 1992 and 1993. Significantly higher CPUE were found during times of flood tide, which suggests that tarpon leptocephali utilize the tidal effect to colonize nursery areas.

Monthly size frequencies of juvenile tarpon captured in the backwater pools during 1992 are presented in Figure 7. Recruits arrived here from June to November at about 40 mm SL. Juvenile tarpon utilize this area until the end of January. This area becomes completely dry from February to March. The maximum observed size reached before juveniles exit the mud flats was 180 mm SL.

Aquarium Evaluation 1993

No mortality occurred among 8 juvenile tarpon injected with OTC and kept in an aquarium for 57 days. Both methods, intramuscular and intraperitoneal injection of OTC produced marks on sagittae otoliths of juvenile tarpon. No difference in behavior patterns were observed between tagged tarpon and control tarpon during the duration of this experiment.

DISCUSSION

Tagging experiments conducted in 1992 suggest that juvenile tarpon residency of the mud flats is very ephemeral, limited to a few months in a period of high water connection with the lagoon (from June to January). The maximum observed residency in 1992 by this study for the mud flat areas was 56 days with a maximum size of 180 mm SL. Juveniles must exit the mud flats before the area becomes completely dry (February and March). Comparisons of numbers of juveniles captured in 1992 and 1993 between the drain channel and the mud flats, and their respective standard length means and size ranges, suggest that the primary nursery area of the BWR impoundment is the mud flats, while the drain channel supports older juveniles. While the 90 tarpons caught in the drain channel in 1992-93, had a size range from 27 to 770 mm SL (mean SL was 175.2 mm ± 153.7 SD), the 321 tarpon captured at the spillway during the same period, exhibit a narrower standard length size range (from 28.6 to 180 mm) and a smaller SL mean (77.8 mm ± 21.8 SD).

Tag and recapture experiment produced high short term recapture rates (74%) with both types of external tags used. Although no histopathological examination were performed, visual examination showed little damage or ulceration caused by external tag. Unfortunately, algal growth presented problems with both types of tags which affected the readings of tags and increased tag drag (similar problems were observed by Chapman & Bevan (1990) on Poecilia. gilli). Future tagging experiments with juvenile tarpon should employ a more innocuous type of tag with less undesirable effects. The use of visual implanted tags have been recommended since they produce less biological effects than dangling tags (Bergman et al, 1992).

Oxytetracycline hydrochloride injections applied at 100 mg/ml, either intramuscularly or intraperitoneally were successful in age validation of juvenile tarpon (SL 40 to 100 mm). It was shown from 18 recaptured tarpon, that otolith ring micro increment deposition is daily. However, increased variation was observed in sagittae readings of tarpon 90 mm SL or larger. This increased difficulty was attributed to irregularities in otolith growth which apparently occurs at this size. Although work by Casselman (1983), question the reliability of age estimates based on scale counts for long-lived fishes, scale ring counts may still be useful in determining daily increments. Therefore, attempts are being made to validate daily scale ring increments with OTC in order to estimate age and growth of larger juvenile tarpon (over 100 mm SL).

Indirect methods used in this study to estimate growth rate produced results comparable to growth rates observed by Rickards (1968) with tarpon in Georgia (1.01% SL/day). However, some investigators have found a high seasonal variability in growth rate of juvenile tarpon (Rickards 1968; Harrington 1966; and Cyr 1991). More recently Nichols (1994) reported size specific growth difference for juvenile tarpons. Therefore, growth rate comparisons of juvenile tarpons should be made considering juveniles of similar size (age), season and geographic location. With this in mind, the indirect growth rate estimated in this study (1.1% SL per day) for tarpon (39 to 130 mm SL) was slower than that reported by Nichols (1994) for Costa Rican tarpon (2.54% SL per day for tarpon 46.5 to 212 mm SL). Moreover, direct growth measurements of 61 recaptured juvenile tarpon (SL from 39 to 180mm) by this in 1992 resulted in even lower estimate 0.5% SL per day.

It is possible that growth estimates (direct or indirect) reported here, resulting from recaptured tarpon are confounded by adverse effects of handling or OTC treatment. Beckman et al, (1988) reported decreased growth of Red Drum juveniles, Sciaenops ocellatus, due to handling while injecting tetracycline for otolith validation. Alhossaini and Pitcher (1988) report growth depression due to feeding suppression possibly caused by OTC injection on juvenile Pleuronectes platessa.

If the growth rate of tarpon was affected by handling or OTC injection, this would explain why discrepancies were found between measured (direct) and indirect estimates resulting from the same population of juvenile tarpon. Direct estimates from measured growth rates would be more affected than estimates resulting from linear regressions, since the latter reflects the overall growth, while direct measurements consider only a short period of time during which the mark and recapture experiment was being implemented.

However, tarpon captured in the drain channel during 1992 were not subjected to OTC treatment or tagging and yet their estimated growth rate based on age and standard length regressions was slow (0.97 mm per day). Probably our estimate reflects the actual growth of these tarpon under the anoxic conditions of the drain channel. We may reason that the low oxygen content of the drain channel water causes a high metabolic demand on tarpon which slows down their growth rate.

Because of the limited number of tarpon captured in 1992, no field comparisons between tagged, marked and un-marked tarpon were possible. Such comparisons are necessary in order to investigate the negative effects of handling and tetracycline injection. Future studies with juvenile tarpon, possibly with other fluorescent markers like calcein, should be performed to clarify the impacts of handling and injecting tarpon.

Juvenile tarpon were found to be unequally distributed among habitats of BWR, and to utilize habitats with wide range of physical parameters. Higher densities of juvenile tarpon were found in a few shallow pools next to the spillway area as opposed to the rest of the open mud flats. It is possible that tarpons juveniles are being actively attracted to these pools. We may theorize two reasons for this to occur; 1) the pools provide refuge from bird predators and extremes changes in water temperature and salinity, 2) or since the pools receive more fresh water input than the rest of the mud flat (from the spillway when it floods), maybe the juveniles are being attracted by the fresh water input. It is hoped that manipulative field tests in combination with additional sampling, will help to explain this observed disproportionate distribution. Such information could prove to be very useful for the future management of tarpon nurseries.

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Table 1. Tag and recapture results of juvenile Tarpon *Megalops atlanticus*, from the Boquerón Wildlife Refuge Spill way (1992).

	Total Tagged	% Recap from total	# Recap Times	# Recap with Tags
Dangling Tag	55	49	43	21
Mini-Spaghetti	77	39	40	21
Combined	132	43	83	42

	# Recap Lost tag	Tag Ret %	Residency Days
Dangling Tag	6	78	56
Mini-Spaghetti	9	70	43
Combined	15	74	

Table 2. Physical Parameter Summary for Boquerón (BWR) (1992-1993).

DRAIN CHANNEL				
	TEMP C°	SALINITY	DO (ppm)	pH
MEAN	26.3	8.9	1.4	7.2
S.D.	1.67	7.1	1.04	0.25

MINIMUM	21.8	0	0.1	6.53
MAXIMUM	29.6	29	4.6	8
n	189	187	191	162
SPILLWAY AREA				
	TEMP C°	SALINITY	DO (ppm)	pH
MEAN	30.1	23.1	5.01	8.07
S.D.	3.51	11.65	2.22	0.38
MINIMUM	24	6	1.4	7.49
MAXIMUM	36.9	40	9.9	8.85
n	28	28	28	22

Table 3. Passive sampling catch of juvenile Tarpon *Megalops atlanticus*, from the BWR Drain Channel (1992-1993).

YEARS	GEAR	EFFORT (HRS)	LARVAE CPUE	JUVENILE CPUE
1992	TRAP NET	231	0.33	0.013
1993	TRAP NET	423	0.22	0.04

	GILL NET	34	NA	0.23
TOTAL # CAPTURED			172	29
TOTAL EFFORT		688		

Table 4. Active sampling catch of juvenile Tarpon *Megalops atlanticus*, from the BWR Drain Channel (1992-1993).

YEARS	GEAR	EFFORT (M-SQ)	JUVENILE CPUE	JUVENILE NUMBERS
1992	CAST NET	21.4	0.031	6
	SEINE	104	0.081	76
1993	CAST NET	8.3	0	0
	SEINE	22.2	0.01	2
TOTAL		152.9	TOTAL	84
SEINE= 8 M LONG X 1.2 M HIGH 1.5 SQ-MESH				

Table 5. Active sampling catch of juvenile Tarpon *Megalops atlanticus*, from the BWR Back Water (1992-1993).

SPILLWAY POOLS				
YEARS	GEAR	EFFORT (M-SQ)	JUVENILE CPUE	JUVENILE NUMBERS
1992	CAST NET	10.1	0.66	6
	SEINE	235.6	0.13	272
1993	SEINE	223.3	0.02	30

OPEN MUDFLATS				
1992	SEINE	155.5	0	0
1993	SEINE	176.7	0.0006	1
TOTAL EFFORT		801.2	TOTAL NO.	309
SEINE= 8 M LONG X 1.2 M HIGH 1.5 SQ-MESH				