Effects of Predation by Tucunaré (*Cichla ocellaris*) on *Tilapia nilotica* in Ponds[1]

Andrew S. McGinty[2]

ABSTRACT

Three ponds were stocked with 3,000 *Tilapia nilotica* (6–7 cm total length) per hectare, and 17 days later with tucunaré (2–3 cm total length) at 380, 380, or 790 fish/ha. After 124 days, survival of tucunaré was 26–30% and they averaged 191 g, 21 g, and 17 g, respectively. Growth of tucunaré was related to availability of prey, i.e., tilapia recruits, and density of predators. Tucunaré in two ponds had equal densities at harvest but grew at substantially different rates probably because of differential rates of mortality. Total fish production was 71% less in the pond with the largest tucunaré than in the other two ponds. The decrease in tilapia biomass by predation resulted in a decrease in total fish production.

INTRODUCTION

Many ponds in Puerto Rico may be available for the production of fish. Several factors determine the best way to manage these ponds. Whether or not they can be drained, seined, and refilled easily is important, while the amount of knowledge, interest, and time devoted by the fish culturist is also important.

For ponds without suitable drainage systems or for persons lacking time, a management program resulting in a balanced population of predators and prey may be appropriate. Balanced populations should be capable of producing harvestable fish on a sustained basis. Such management programs have been developed for many states and are reviewed by Modde (2).

People with easily drained ponds may be more interested in maximizing fish production over time. Tilapia have been identified as important species for culture in Puerto Rico (3); however, in monoculture these fish may become overcrowded and stunted (1).

The objectives of this study were to determine the effects of using tucunaré, *Cichla ocellaris*, as a predator on *Tilapia nilotica*. The effects of predation on rates of growth, recruitment, and fish production were also studied.

MATERIALS AND METHODS

This study was conducted at the Lajas Substation, Agricultural Experiment Station of the University of Puerto Rico in three earthen ponds (0.07–0.13 hectares). *Tilapia nilotica* averaging 6–7 cm in total length

[1] Manuscript submitted to Editorial Board February 11, 1983.

[2] Department of Marine Sciences, University of Puerto Rico, Mayagüez, P. R.

were stocked at a rate of 3,000 per hectare. Seventeen days later these ponds were stocked with tucunaré *Cichla ocellaris* averaging 2–3 cm in total length at a rate of 380 per hectare in ponds B-11 and B-12, and 790 per hectare in pond C-8.

Ten biweekly applications of triple superphosphate fertilizer were made at the rate of 10 kg/hectare. Supplemental food was not given.

Sixty and 121 days after tilapia were stocked, fish in each pond were sampled with a 30 m long, 1 cm mesh seine. All fish captured were separated by species and by 2-cm total length groups, and then counted and weighed accordingly. Ponds were drained 143 days after tilapia were stocked, and all fish were removed and classified as above.

RESULTS AND DISCUSSION

Table 1 shows final production of fish by species and size groups. Survival of tucunaré was low (26–30%), and they comprised only a small portion of the total biomass. Gains of tucunaré were greater in pond B-11 than in the other ponds (fig. 1). This resulted from prey being more abundant in pond B-11.

Predators consume prey of the largest size they can easily ingest in order to maximize their growth (6). Since tucunaré in pond B-11 grew rapidly, they had a broader size range of tilapia available as prey. It was estimated by force feeding that tucunaré in pond B-11 could easily consume tilapia up to 6 cm in total length, whereas those in ponds B-12 and C-8 could consume tilapia no longer than 3 cm. Almost 23% of the tilapia population in B-11 were available as prey for tucunaré at the end of this study, whereas no measurable prey were recovered from the other ponds. Fish smaller than 3 cm may have existed but would have contributed insignificantly to the total biomass.

Competition for food depends on availability of food and the number of competing animals (4), i.e., density of predators in this case. Even though the final density of tucunaré in ponds B-11 and B-12 was equal, growth rates of tucunaré were considerably different. This fact could be attributed either to differences in reproductive rates of tilapia or mortality rates of tucunaré.

Bimodal distributions of total length groups of tilapia separating original stock from recruits were found for all ponds (table 1). Fish longer than 10 cm were considered to be original stock; and those 10 cm or smaller, their offspring. Some negligible overlap no doubt occurred. Tilapia recruits were captured from all ponds after 60 days, and recruits 7–8 cm long were abundant in all ponds at harvest. Therefore, no reason existed to suspect differences in spawning rates or time of earliest recruitment between ponds.

It is more likely that mortality of tucunaré in ponds B-11 and B-12

TABLE 1.—*Production of tucunaré* Cichla ocellaris *and* Tilapia nilotica *cultured 143 days in ponds*

Pond	Yield of tucunaré	Yield of tilapia by length group (cm)									
		3–4	5–6	7–8	9–10	11–12	13–14	15–16	17–18	Total	Grand total
B-11	21.8[1]	13.9[1]	16.1	23.1	8.1	22.8	34.4	13.6	0.0	132.0	153.8
	114[2]	17,466[2]	7,140	3,976	486	873	850	243	0		
		10.5[3]	12.2	17.5	6.1	17.3	26.1	10.3	0.0		
B-12	2.4	0.0	0.2	30.0	79.8	17.0	42.7	47.3	5.8	222.8	225.2
	114	0	53	3,612	7,201	645	994	789	68		
		0.0	0.0	13.5	35.8	7.6	19.2	21.2	2.6		
	3.4	0.0	11.0	64.8	39.8	25.2	56.6	10.9	0.0	208.3	211.7
	205	0	3,549	8,186	3,565	962	1,420	221	0		
	0.0	0.0	5.3	31.1	19.1	12.1	27.2	5.2	0.0		

[1] Kg per hectare.
[2] Number per hectare.
[3] percent of total weight of tilapia.

occurred at different rates. A low rate of mortality would result in more competition among surviving predators for available forage, and thus in slower growth. Competition for forage was severe in pond B-12. Mortality of tucunaré was probably lower in this pond during their first month than in B-11. This initially higher density did not allow tucunaré to reach more than about 20 g. Once they attained this size, subsequent recruitment by tilapia as prey was sufficient for maintenance only. Even if tilapia spawned frequently, the small biomass of newly released fry could contribute little to growth of tucunaré.

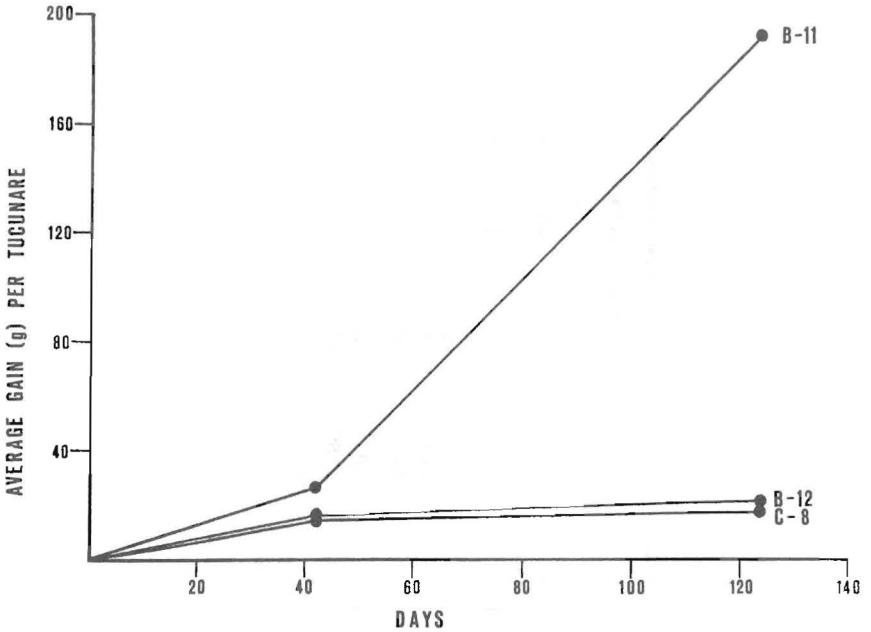

FIG. 1.—Growth rates of tucunaré *Cichla ocellaris* in three ponds also stocked with *Tilapia nilotica*.

Swingle (5) states that fish production may be increased by utilizing species with shorter food chains. In this study, total fish production was 71% less in pond B-11 than the average of ponds B-12 and C-8, while production of tucunaré was 750% greater. Approximately half of the biomass of tilapia in each pond was composed of recruits; however, half of those recruits in pond B-11 were available as prey for tucunaré. Since tilapia grow more efficiently than tucunaré, any decrease in tilapia biomass by predation results in a decrease in total fish production. The biomass of tucunaré in ponds with insufficient prey (B-12 and C-8) was low, and nearly equal, regardless of the density of predators. Thus,

biomass of predators rather than their numbers was more important to the dynamics of these fish populations.

Rapid growth of predators occurs when forage is available, however, insufficient predation pressure may still result in overcrowded, stunted prey. Certain densities of each species will result in good growth of both predators and prey, whereas if too many predators exist they will attain only a small size. Depending on the primary species of interest and their desired size, uses for any of these scenarios can be found. Further work on size of fish stocked and relative times of stocking is needed for determining optimal densities of tucunaré and tilapia in ponds.

RESUMEN

Tilapia nilotica de 6 a 7 cm de largo total y tucunaré de 2 a 3 cm de largo total se echaron en tres charcas de arcilla. La densidad de siembra de la tilapia fue equivalente a 3,000 peces/ha. El tucunaré se echó a densidades de 380, 380 y 790 peces/ha. El tucunaré se introdujo en las charcas 17 días después que la tilapia. A los 24 días la supervivencia del tucunaré fue de 26 a 30% y su peso medio 191, 21 y 17 g, respectivamente. El crecimiento del tucunaré estuvo relacionado con la disponibilidad de su presa (la progenie de la tilapia) y la densidad de los predatores. Aunque la densidad en que se estableció el tucunaré era la misma en dos de las charcas, su crecimiento fue sustancialmente diferente debido probablemente a las diferentes proporciones de mortalidad. La producción total de peces fue 71% menos en la charca con los tucunarés más grandes que en las otras dos. La reducción en la biomassa de la tilapia causada por los predatores redujo la producción total de peces.

LITERATURE CITED

1. Bardach, J. E., Ryther, J. H., and McLarney, W. O. 1972. Aquaculture. The farming and husbandry of freshwater and marine organisms, Wiley-Interscience, New York, New York.
2. Modde, T., 1980. State stocking policies for small warmwater impoundments, Fisheries 5 (5): 13–7.
3. Pagán, F. A., 1974. Tilapia introductions in Puerto Rico, FAO Aquaculture Bull. 6 (4): 17–8.
4. Powers, J. E., 1974. Competition for food: an evaluation of Ivlev's model, Trans. Am. Fish. Soc. 103: 772–76.
5. Swingle, H. S., 1966. Biological means of increasing productivity in ponds, FAO Fish. Rep. 44 (4): 243–57.
6. Werner, E. E., 1974. The fish size, prey size, handling time relation in several sunfishes and some implications, J. Fish. Res. Board Can. 31: 1531–536.