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Production Dynamics of *Typha domingensis* (Pers.) Kunth Populations in Cuba

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ABSTRACT

Above and underground biomass, plant density, net primary production, accumulation of autochthonous material and decomposition rates of *Typha domingensis* (Pers.) Kunth populations were measured in two zones of the San Juan River Reservoir in Cuba for seven years. Zone I was influenced by freshets and the second (zone II) was in an accumulation zone. The accumulation of biomass was 3.3 and 4.3 times higher than above ground biomass in zone I and II respectively, due to the low value of decomposition rates, about 50% per year. The balance between biomass production, accumulation, and decomposition provided a net accumulation which acted negatively on *T. domingensis* stands by permitting the invasion of the stands by other successional species, which leads to destruction of *Typha* populations.

Key words: net primary production, biomass, stem density, decomposition, detritus, succession.

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INTRODUCTION

Typha spp. have been reported as one of the first colonizers of man-made reservoirs (Fassett 1940, Smith 1967, Fiala and Kvet 1970). In Cuba, *Typha domingensis* (Pers.) Kunth frequently occurs in all the shallow water zones in reservoirs and channels. It is very common in pools and swamps, and occasionally it constitutes only a floristic element in different swamp-plant associations, but there is a tendency to form monotypic stands, at least, in early successional stages.

A characteristic of *Typha* stands is the high primary production which infers a high incorporation of organic matter to the environment. In temperate countries, the organic matter produced in the growth period can be removed from the stand during freezing conditions when production ceases. However, in tropical conditions there is a continuous growth with organic matter continuously accumulating in the population.

Net accumulation of organic matter is the main cause of *Typha* stand self-destruction because of the formation of soil and, of course, the subsequent invasion by out-stand species. On the other hand, it represents a negative effect on the waterbodies of man-made reservoirs because of the reduction of volume and obstruction of spillways. The knowledge of the dynamics of *Typha domingensis* stands, one of the most abundant helophytes in Cuba, will permit us to establish management programs for this vegetation in reservoirs to extend their usefulness and to diminish the negative effects of organic matter accumulation on the waterbodies.

METHODS AND MATERIALS

The San Juan River reservoir was selected to study the dynamics of *Typha domingensis* stands under Cuban climatic conditions. The reservoir is located in the Province of Pinar del Rio and is used as a water supply for the village "Las Terrazas". This reservoir was constructed in 1970, 156 m above sea level and initially covered 40,190 m^2 with a volume of 190,623 m^3 of water at spillway level. About 30% of the total area is less than 2 m deep although the reservoir has abundant sloping littoral areas. According to the shape of the reservoir, two characteristic zones of *Typha* were delineated, one corresponding to the spillway with the influence of freshets (zone I) and the other placed on a zone of accumulation without effects of freshets (zone II).

The development of *T. domingensis* stands was monitored from 1973, when the first *Typha* appeared, to 1980. Standing biomass was determined monthly by means of density and dry weight of individual shoots harvested randomly along permanent transects. Shoots were cut at the hydrosoil surface and dried at 105 C. Underground biomass was obtained by collecting plots of 0.5 X 0.5 X 0.25 m deep in zone I, and from individual clusters in zone II. In both cases, the underground biomass was divided into rhizomes, roots, and base of shoots, and the dry weight determined after drying at 105 C.

Net primary production (NPP) of the above ground biomass per unit area was estimated from primary production of individual shoots (biomass produced per shoot since its appearance to senescence or flowering), from mean annual density measured during 3 years, and from the average life cycle of shoots obtained for fertile and non fertile plants, which appeared in different months of the year (about nine months) and recorded in preceding investigations (Plasencia 1980, 1984).

The horizontal structure was determined by computing live shoots in random plots (0.25 x 0.25 m) along a transect 1 m wide and perpendicular to the shoreline. The vertical structure was calculated from the height of shoots measured between the hydrosoil surface and the upper part of the plants in five plots of 1 m^2.

Dead accumulated biomass was estimated by harvesting all the organic material present in three plots of 1 m^2. It was divided into leaves, base of shoots, and detritus, and the dry weight was obtained after drying at 105 C.

In order to determine decomposition rates, 1-g of predried leaves was placed in nylon bags of 5,000 and 250 micron mesh. Later, the bags were divided in 12 groups for each variant, and were put on the bottom in the *Typha* stand at a water depth of 0.5 m. One group per variant was removed monthly and the material was washed with distilled water, dried at 105 C and weighed.

RESULTS AND DISCUSSION

In 1973, *Typha domengensis* covered only 2% of the total area, but increased rapidly growing in all shallow zones up to 1.5 m of depth by 1979. The area of the reservoir covered with *Typha* was 27.3% by this time (Table 1). Where limiting factors were not present, (e.g. water depth or sand deposition by river), the mean horizontal growth of the stand was 9.8 m/year between 1976 and 1979. These were higher than horizontal growth reported by McDonald (1951) for *Typha latifolia* L. and *Typha x glauca* Gocdron (5.2 m/year), by Fiala and Kvet (1970) for *T. latifolia* (2 m/year), and by Fiala (1978) for *T. latifolia* and *T. angustifolila* L. one year old clones (4.0 and 3.4 m/year), respectively.

Annual above-ground biomass remained almost constant through the year with a small increase (p 0.05) during the flowering period occurring between January and March (Plasencia 1982). Mean annual biomass was greater in zone II, (p 0.01) although it was more evident during the flowering period. In spite of the slightly higher density in zone I (Table 2 and Figure 1), the mean height was less.

The underground biomass (Table 2) was lower than that reported in other studies on *Typha* spp. (Dykyjova and Kvet 1970, Dykyjova et al 1971, Husak 1971), although the ratios between underground and above ground biomasses were comparable with those previously reported. Correlations between both biomasses showed a strong relationship (r^2 = 0.82; p 0.01).

NPP was higher than mean above ground biomass (Table 2), similar to that reported for other species of aquatic plants with continuous growth (Borutsskii 1950, Westlake 1965, Ikusima 1978). Although biomass was less in zone I, NPP was slightly higher. As was pointed out, the effects of freshets on *Typha* stands cause a mechanical damage to shoots, but do not affect the accumulated or pro-

TABLE 1. AREA (M^2) OCCUPIED BY *TYPHA DOMINGENSIS* IN THE SAN JUAN RIVER RESERVOIR BETWEEN 1973 AND 1979. THE RESERVOIR WAS CONSTRUCTED IN 1970.

Zone	1973	1976	1977	1978	1979
I	–	1,314	2,044	2,620	3,052
II	–	2,401	3,175	3,670	5,623
Other areas	–	2,335	2,447	2,458	2,303
Total	800	5,950	7,666	8,728	10,978
% of total	2.0	16.8	19.0	21.0	27.3

TABLE 2. BALANCE OF BIOMASS IN THE *T. DOMINGENSIS* POPULATION IN ZONES I AND II IN SAN JUAN RIVER RESERVOIR, CUBA.

	Zone I	Zone II
Density (Shoots/m²)	10.0	8.0
Above soil biomass (g/m²)	328	420
Underground biomass (g/m²)		
Rhizomes	86	50
Roots and shoot bases	343	273
Total	429	323
NPP (g/m²/year)	1,514	1,324
NPP/Above ground biomass	4.92	3.25
Dead biomass (g/m²)		
leaves	270	685
base of shoots	360	920
detritus	400	410
total	1,030	2,015

duced biomass during the whole life. It should also be considered that density was slightly higher in zone I.

Both biomasses, maximum and mean, recorded in zone I and II were lower than those reported by other authors for *T. domingensis* and other *Typha* spp. (Dulepova 1961, Boyd and Hess 1970, Dykyjova 1971, Kaul 1971, Kvet 1971, Boyd and Walley 1972, Polisini and Boyd 1972, Howard-Williams 1975, Gopal and Sharma 1978, Sharma and Prahdan 1983). However, NPP was comparable with the data recorded by those authors. It is possible that the low values of biomass are mainly due to the environmental conditions under which *T. domingensis* populations are developed, although it is necessary to consider the specific characteristic of each species.

Autochthonous organic matter accumulation (Table 2) has a negative influence on density, and therefore on the horizontal structure. Along the transects taken at random in both zones (Figure 1), the places with lowest *Typha* density occurred where organic matter was highest. It is evident that the differences between zone I and II occur because autochthonous material may be removed during freshets, which has a great influence on soil conditions. In zone II, where the accumulated material can only be eliminated by decomposition, much more dead biomass and detritus were observed (Table 2). Decomposition rates in bags (250 micron mesh) were only about 50% of initial weight after a year. However, in larger mesh bags, the decomposition was about 62%. In these bags we found *Tarebia granifera* L. (Mollusca) consuming enclosed leaves. This mollusc was very abundant in the San Juan River reservoir and is considered as detritophagous (Hruska and Otero, pers. com.).

The decomposition rate of *T. domingensis* obtained from the nylon bags may be considered low relative to the tropical conditions in Cuba, but is comparable to those obtained for *Typha* spp. in temperate countries (Masson and Briant 1975, Davis and Van der Valk 1978, Kufel and Kufel 1988).

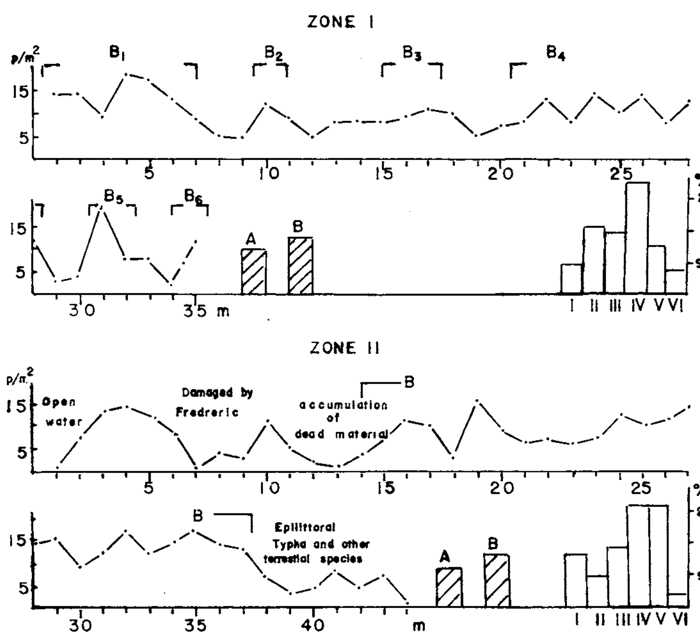

Figure 1. Transects in zone I and II. Lined bars signed with A = mean total destiny; signed with B = mean density in segments B. Empty bars represent the distribution of height as follows: I < 140 cm; II 140 to 179 cm; III 180 to 219 cm; IV 220 to 259 cm; V, 260 to 299 cm and VI > 300 cm.

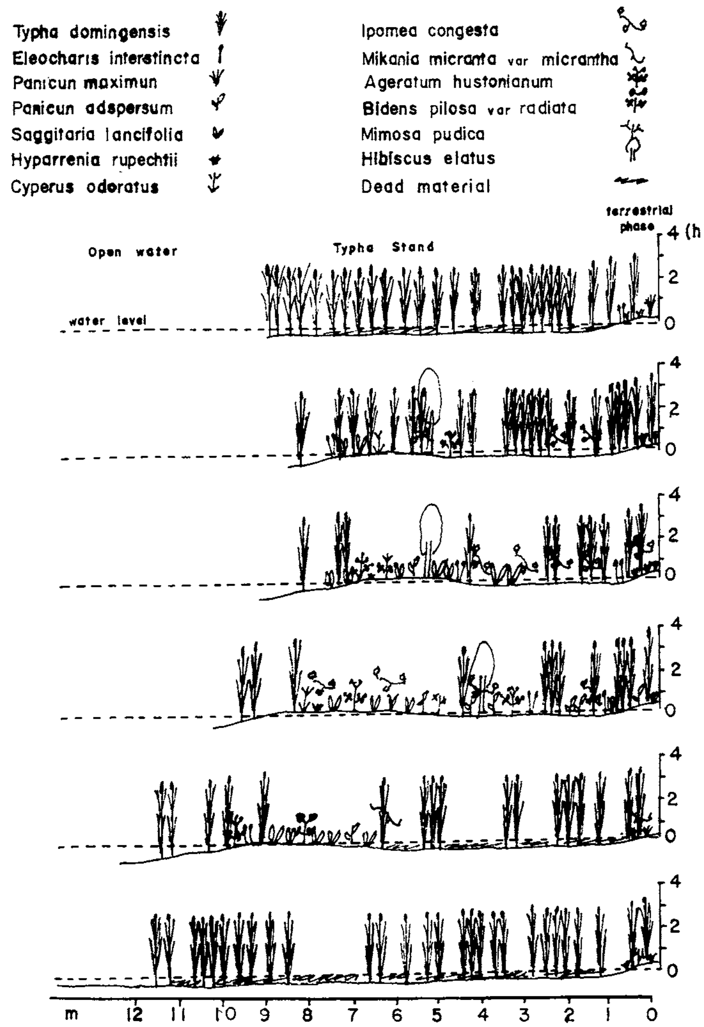

Figure 2. Transects taken in a part of zone II invaded by out-stand species.

The balances of biomass produced, accumulated, and decomposed provide an estimate of net accumulation of autochthonous material in *T. domingensis* populations. As we pointed out, this process facilitates soil formation and the intrusion of out-stand species and ultimately self-destruction of the stand. This process occurred in part of zone II (Figure 2) and some species e.g. *Hibiscus ellatus* Sw., typical of terrestrial ecosystems, appeared in the stand. In a *T. domingensis* stand at Niña Bonita reservoir near Havana City, we observed an increase of shoot density from 14.6 to 20 shoots/m^2, one year after the stand had been burned. These results support the negative effect of the accumulation of dead material on *Typha* populations and suggest the possibility that fire may maintain *Typha* populations. Burning has been proposed to prevent self-destruction in other helophyte stands (Haslam 1971).

The most important characteristic of *T. domingensis* stands is a constant growth pattern which constitutes the basis of their functioning. Due to this growth, the production of autochthonous organic matter accumulates in the population causing gradually reduced values of density and biomass, and in the end the destruction of the stand.

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