



Ecological Variables of Some Ponds Inhabited by an Invasive *Typha* Species in Kano Metropolis, North-Western Nigeria

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ABSTRACT

In this study, *Typha* - an aquatic invasive weed with a widespread growth in some ponds of Kano metropolis was examined with the aim of assessing some morphological characteristics due to ecological locations of the weed. The species found in the ponds has the following characteristics: narrowed leaves reaching 1-3m long above water level and 1-2.3cm wide that have a spongy cross-section exhibiting air channels which when sutured look like a bee house, 8-16 number of leaves arising from a single shoot forming very dense population (estimated size of 1,440,648 stands per hectare of pond), very thick roots that are capable of perennation having fibrous root system and naked fruits with very small, slender and hairy edible seeds. Based on these morphologies, the species is identified as *Typha domingensis*. The water environment where *Typha* dominated comprises of 0.8m depth, 25.06 °C mean temperature, a pH of 6.5 and a mean conductivity of 902 $\mu\text{s/cm}$ with average concentration of nitrate as 51.8 mg/L and 9.95 mg/L phosphate. However, a comparison of the water analysis between inlet and outlet of the *Typha* pond in relation to heavy metal concentration showed that *Typha* species often regarded as weed had the capacity to remove aluminium, copper and zinc concentrations in water.

Keywords: *Typha* species, Kano ponds, Morphology, Ecology

INTRODUCTION

The environmental degradations induced frequently by factors such as domestic or industrial discharges and to some extent farming activities in Northern Nigeria, are significantly improving the relationship between aquatic surrounding and the plants living in it (aquatic plants), as they are remarkably increasing the essential nutrients for plants growth. Regarded as most serious aquatic weed, *Typha* (cattails) occur naturally where there is disruption of hydrology, wildfire suppression or systems enrichment (Wilcox *et al.*, 1994; Hussaini *et al.*, 2012). In urban Kano, many perennial ponds are gradually becoming overgrown by aggressive growth of emergent aquatic weeds such as *Typha*. Once it becomes established in a pond or open waters, this plant presents a difficult situation in terms of the use of the water as well as controlling them. People using the pond for various purposes usually employ fire as a means of controlling these weeds. However, the measure has proved to be ineffective because, the growth of the weeds in the pond has somehow increased after each fire treatment. On the contrary, cattails (*Typha*) aggressiveness has been described as a gift from God especially in North America where the weeds often help to stabilize shorelines and protect channels from wave erosion action or ice heaving. Similarly, it can be positively in many other ways (Hellsten *et al.*, 1999; Krus *et al.*, 2014; Patil and Anand, 2015). This research work therefore, focused mainly on the identification of the species and the assessment of its ability to filter out some selected heavy metals concentration so as to encourage its utilization as a sustainable source of treating water contaminated with high concentrations of Aluminium, Copper, Lead and Zinc.

MATERIALS AND METHODS

The study was conducted in June, July and August of 2018 at three ponds of Kano Metropolitan City, namely Hauren shanu, Hajj Camp and Kabuga ponds. Kano is located between latitude 11°58'50' and 11°98'18', longitude 8°28'46'E and 8°48'01' and altitude 486.5m (Ibrahim, 2014). For identification purpose, the morphology of the plant was studied both qualitatively and quantitatively using instruments like ruler, which was used to measure the plant height and width, whereas sampling quadrat (2 x 2m) was used for the determination of population characteristics and extent of coverage as adopted from Lado *et al.* (2016). Other relevant parameters such as temperatures, pH, depth and conductivity of the pond waters were all determined using the appropriate instruments. In addition, the ability of cattails to filter heavy metals was determined through analysis of water samples for four (4) important heavy metals namely zinc, lead, aluminum and copper. For the heavy metals determination, analysis of water from both inlet and outlet of *Typha* ponds were carried out using the two steps procedure described by Williams (1996).

The experimental analysis involved stock preparation meant to obtain standard solution from which the calibration curves for individual heavy metals were acquired and finally absorbance of each sample was measured using spectrophotometer. The actual concentrations of the heavy metals in the samples were then obtained using graphical method by relating the absorbance on the Y-axis of the calibration curve obtained from the standard solution. The point of interception on the X-axis is however, the concentration of each metal in the

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sample. Analysis on phosphate and nitrate were also carried out using spectrophotometer as they all affect the cattail-environment relationship (AOAC, 2003). Data obtained on the variation of heavy metals concentration at inlet and outlet samples were subjected to T-test. Analysis of variance was also performed to determine the variation of phosphate and nitrate contents among the three ponds and Fisher's Least Significant Difference was used to separate the mean at $p \leq 0.05$.

RESULTS AND DISCUSSION

For the species identification, the *Typha* plants sampled in the ponds were carefully examined and morphological characters measured were summarized in Table 1. Morphological studies showed that cattails or *Typha* species usually referred to by the Hausa locals as 'Geron Amadu' or 'Takobin Kwado' is very long perennial grass which has much narrower leaves reaching 1-3.2m long above the water surface and 0.8-2.3cm wide. The leaves have a spongy cross-section exhibiting air channels which when sutured look like a bee house. 8-16 number of leaves normally arise from a single shoot. The plant has very thick roots (i. e. storage roots) that are capable of perennating as well as joining and intertwining with one another. This nature of the rooting pattern enables the plant to regenerate whenever disruption in growth occurs, for example, when there is fire outbreak, shortage of water and so on, therefore, the arrangement and occurrence of the roots (rooting system) is simply fibrous, having many roots arising from the same shoot.

Seeds of the examined cattails are naked, very small, slender, hairy in appearance and are dispersed normally by wind. These seeds are edible at their initial stage of formation (i.e., before they become fully matured). Research results on its long-term usage indicate that the locals in contact with the plant have witnessed the edibility of its seeds when mixed with sugar. The way cattails seed disperses undoubtedly have a linkage with the plant aggressiveness which is mostly by wind and thus ensures rapid spread and establishment within a limited time. The average population size of cattail was measured to be 1440648 per hectare. This indicated that the population is highly dense with each stand growing in a very close proximity with another and may probably be the reason

why occurrence of other plant species in the pond was almost impossible. In addition, cattail population seems to be resistant to the disruption in the pond by fast spreading vegetatively. Some studies (Wilcox *et al.*, 1994; Ringim *et al.*, 2015; Lado *et al.*, 2016) remarked that disruption of the aquatic environment in which *Typha species* grows, predisposes it to react by growing very fast. The anthropogenic effect observed in the pond clearly reflects the constant disruption of water by human activities around the pond. This condition of the ponds provided the plant with opportunity to regenerate new leaves from the dense rhizome, there by forming a colony which makes it very difficult for other aquatic plant species to grow or survive in the same pond with *Typha*. In addition, the dense canopy of the *Typha* plants prevents light penetration and reduces nutrient availability for the growth and survival of smaller aquatic flora as reported by Nelson and Dietz (1966).

Although, *Typha species* as found in this research has serious negative effects but its ability to reduce or remove substantial level of pollutant such as Lead by 11%, Zinc by 39%, Copper by 23% and Aluminum by 36% in the water have been observed (Table 3). It therefore, reduces the risk associated with the consumption of such contaminated water by humans, fishes and other aquatic organisms, which can accumulate these substances in their system. The removal of these metal substances in the water by the *Typha* indicates that the plant uses it in metabolic processes as revealed by Koch and Reddy (2012), who stated that zinc is an essential component of Auxin synthesis, and that this plant uses zinc to synthesize this very important growth hormone.

The two most important nutrients for the growth of cattails are phosphorous and nitrogen which are very vital in its physiological processes. However, these substances occur mainly as phosphates and nitrates in the water. Results obtained from analysis of phosphate and nitrate (Table 4) showed very high concentration of phosphates about 9.95ppm and nitrates 51.8ppm which usually come from domestic waste. The work of Koch and Reddy (2012) conducted in Everglades west of Fort Lauderdale found that accumulation of these nutrients is biologically mediated by about 70% associated organic matter.

Table 1: Morphological features of the *Typha species* and depth of the ponds

Parameters	Observations on average scale
Leaves measurements	Leaves height = 1 – 3.2m Leaves width = 0.8 – 2.3cm
Seeds	Naked, long, slender and hairy
Rooting system	Fibrous
Pond depth	1.2m
Population	1,440,648 per hectare

Table 2: Mean physicochemical properties of the water from the three ponds in June – August, 2018

Ponds	Water temperature (°C)	Water pH	Conductivity (µs/cm)
Kabuga	26.13	6.18	910
Hauren Shanu	24.60	6.52	903
Hajj Camp	24.43	6.80	895

Table 3: Mean concentrations (ppm) of some heavy metals in water samples from the ponds inhabited by the *Typha species*

Metals	Inlet water	Outlet water
Zinc	10.2 ^a	6.2 ^b
Copper	8.7 ^a	4.7 ^b
Aluminium	11.2 ^a	7.2 ^b
Lead	3.8 ^a	3.4 ^a

Means followed by different superscript along rows are significantly different ($p \leq 0.05$)

Table 4: Mean concentrations of phosphate and nitrate in the *Typha* inhabited ponds (mg/L)

Parameter	Kabuga	Hauren Shanu	Hajj Camp
Phosphate	7.4 ^b	12.5 ^a	9.95 ^{ab}
Nitrate	50.9 ^a	52.7 ^a	50.7 ^a

Means followed by different superscript along rows are significantly different ($p \leq 0.05$) using Fisher's LSD

CONCLUSION

Based on its characteristic features, the *Typha species* sampled at Hauren Shanu, Hajj Camp and Kabuga ponds of Kano Metropolis closely resembles *Typha domingensis*. The physicochemical properties measured were also similar to those reported in the habitat of *Typha domingensis*. Another important finding is the low concentration of some heavy metals determined at the outlet of the ponds. This confirmed the findings reported by others that *Typha* has the capacity to reduce concentrations of heavy metals in polluted water.

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