Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2018, 8(4), 243-247

ORIGINAL ARTICLE

Ecological interaction of Typha And Phragmites aquatic weeds species in 'Kadawa' reservior, Kano River irrigation system

A. Sani, I.L. Abdullahi, M. Bilkisu

Uman National University of Horticulture, Institutska St. Uman, Cherkasy region, 20305, Ukraine.
E-mail: asani.bio@buk.edu.ng
Received: 10.12.2018. Accepted: 19.12.2018

Major surface water, the Kano River was impounded over 30 years ago with the ambition of irrigating 180,000 Ha of land. In this study, a major reservoir of the Tiga lake irrigation system was invaded by two emergent weed species, Typha and Phragmites. Understanding the growth, water parameters of these species growing zones, nutrient concentration, phenology, plant stand density per square meter and the type of interaction between the two species were investigated for about a year. Modified transect and quadrant sampling techniques were adopted for plant density. Weekly water samples were analyzed for various physico-chemical parameters using standard water procedures. The result showed that water parameters of the growing zones of the both species were relatively similar. However, DO and BOD of Typha growing site was higher. *Typha domingensis* had an average plant height of 2.50 m less than the usual height of the species found in some habitats in the area. Similarly the height of *Phragmites australis* was 3.7 m less than the normal height of 4-5 meters reported. Phragmites had a higher stand density of about 107 per (sq meters) compared to 61 per m for Typha. The capacity of Phragmites to maximize space given its density per square meter, the species could expand faster and affect existing interaction between the two species in the reservoir over space and time.
Keywords: Aquatic plants; interaction; reservoir; ecology

Introduction

In Kano region water is most vital resource for the vast majority of the population whose mainstay is agriculture, crops & livestock. However, Typha species constitutes a major constrain to livelihood issues in the area. For the farmers and other water users, elimination or eradication of Typha is regarded as necessary. Farmers and others employed various measures at controlling Typha in the area for the last 25 years with little success. Governments at different levels are also engaged in the control of this weed yet the species has persisted. In the last 10 to 15 years, Phragmites species appeared in some habitats particularly in urban Kano and the irrigation areas. Human interaction with either Typha or Phragmites as regards to uses was less pronounced in the area. Cultural use for fencing and roofing was common in small settlements/villages that are close to Typha sites. Domestic animals in the areas rarely feed on the plants. The vast number of grass species of the Savanna provides sufficient forage for livestock's in the area.

These habitats have range of physical and chemical conditions that the species are adapted to based on their morphology, physiology and behavior. Emergent species including Typha and Phragmites are also adapted directly or indirectly to the range of conditions imposed by other organisms in the habitat (Star & Taggart, 1989). The appearance of Phragmites in the irrigation structures of Kano River and some ponds in urban Kano attracted ecological interest. It is important to understand how the two emergent aquatic species interact in a particular habitat. Are the species engaged in some sort of competition in the habitat? Could it be that the niches of the two species' overlap and may lead to negative interaction between the species? Answers to the questions are important and would help for a better understanding of the ecology of this two species in the area. The study was therefore aimed at defining ecological interaction in relation to niches of Typha and Phragmites species in the 'Kadawa' irrigation Reservoir, Kano west.

Material and methods

The study area

The study was conducted at the Kano River irrigation West zone I at 'Kadawa' along Kano-Zaria highway. The 'Kadawa' reservoir is a major water distribution structure selected for the study. Kano State Nigeria`s most populous state has an estimated population of 9,401,288,000 (National Population Commission, 2006) and located at 11.99 °N latitude 8.51 East longitude and 479 meters elevation above sea level (www.maps-streetview.com/Nigeria/Kano).

The two emergent aquatic species Typha and Phragmites occupied separate zones in the reservoir. Figure 1 showed the

reservoir and the sites of each species.

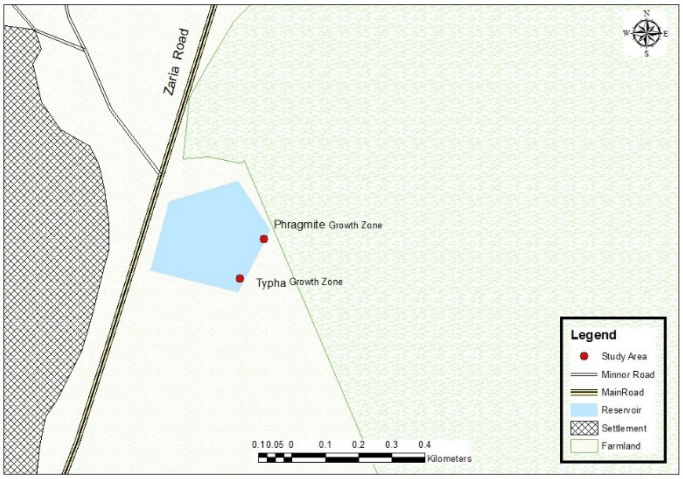

Figure 1. Map showing the study area and plant species sites.

Water depth

An improvised but calibrated pole was used to measure water depth at each species growing zone. Measurements were taken at four different positions on weekly basis. The average/mean water depth foe each species zone per month was obtained.

Water sampling for physico-chemical and nutrients determination

Water samples were collected in 2 liters plastic bottles covered by black material and transported to the laboratory at the Department of Plant Biology, Bayero University Kano for further analysis. At the study site, parameters including transparency, pH and temperature were determined by Qureshimatva et al., (2015). Determination of electrical conductivity (EC)

Dissolved Oxygen (DO), Biological Oxygen Demand (B.O.D) 5 were carried out by method of Qureshimatva et al., (2015).

Sampling and description of plant species parameters

The samples species of Typha and Phragmites were collected from their respective growing zones at 'Kadawa' reservoir. They were described and appropriately identified at the herbarium of Plant Biology Department, Bayero University Kano. The procedure was repeated at 3 locations twice each month in the respective species growing zone. Other measurement of plant features such as number of leaves, leaf width and length, plant height, number of nodes, thickness of stem, period of emergence of flowers and length of inflorescence/flower stalk were determined appropriately.

Results and their discussion

Table 1. Monthly Mean values of water Parameters at Typha species growth zone in 'Kadawa' reservoir 2015/2016.

Months	pH	Temperature (°C)	Transparency (cm)	Electrolyte conductivity (msm^{-1})	D.O (g/l)	B.O.D (mg/l)
Sept	7.2	29.5	17.2	29.7	6.3	3.09
Oct	7.9	31.2	7.65	58.2	6.72	4.05
Nov	7.2	30.3	8.3	40.35	5.31	3.16
Dec	7.3	23.9	15.8	6.49	6.4	3.02
Jan	7.4	26.2	36	37.9	5.84	2
Feb	7.6	30.8	33.1	40.7	6.88	3.13
Mar	8.3	30.5	52.5	128	7.12	4.06
Mean	7.56	28.91	24.36	48.76	6.37	3.22
SD	0.41	2.77	16.66	38.24	0.63	0.7

Source: Field work, 2016.

Table 2. Monthly mean values of Water Parameters at Phragmites growth zone in 'Kadawa' reservoir, 2015/2016.

Months	pH	Temperature (°C)	Transparency (cm)	Electrolyte conductivity (msm^{-1})	D.O (g/l)	B.O.D (mg/l)
Sept	7.32	29	17.3	31.7	6.31	3.21
Oct	7.87	30.2	17.3	57.1	5.27	2.07
Nov	7.46	30.3	15.7	37.7	5.05	3
Dec	7.27	23.9	15.8	6.62	6.34	3.17

Jan	7.38	27.3	30.6	37.8	5.52	2.27
Feb	7.59	30.9	35.8	410	6.92	3.12
Mar	8.27	29.8	26.9	128	7.21	4.08
Mean	7.59	28.77	22.77	48.56	6.09	2.99
SD	0.36	2.45	8.23	38.12	2.99	0.67

Source: Field work, 2016.

Table 3. Mean Monthly Values of Plant Parameters of *Typha domingensis* in 'Kadawa' reservoir, 2015/2016.

Months	**Water depth (m)**	**Plant Height (m)**	**No. of leaves per stand**	**Presence and length of reproductive structures (m)**		**Separating Gap between male & female stalk (m)**
				Male stalk	Female Stalk	
Sept	1.14	2.78	9	NARS	NARS	NIL
Oct	0.39	2.6	13	NARS	NARS	NIL
Nov	0.26	2.72	10	NARS	NARS	NIL
Dec	0.96	2.56	13	NARS	NARS	NIL
Jan	0.99	2.63	13	NARS	NARS	NIL
Feb	1.06	2.26	10	0.24	0.17	0.023
Mar	1.03	2.45	9	0.22	0.16	0.034

Source: Field work, 2016.
Key: NARS-Non Appearance of Reproductive Structures.

Table 4. Mean Monthly Values of Plant Parameters of *Phragmites australis* in 'Kadawa' reservoir, 2015/2016.

Months	**Water depth (m)**	**Plant height (m)**	**No. of leaves per stand**	**Length of internodes' (m)**	**Length of inflorescences (m)**	**Stand density per m^2**
Sept	1.29	4.16	8	0.16	NARS	152
Oct	0.71	4.17	13	0.12	NARS	156
Nov	0.55	3.6	8	0.07	NARS	75
Dec	0.99	3.96	11	0.17	0.38	94
Jan	1.1	3.54	14	0.21	0.57	90
Feb	1.39	3.89	10	0.19	0.32	87
Mar	1.44	3.79	12	0.23	NARS	92
Mean	1.15	3.73	10	0.17	0.424	107

Source: Field work, 2016.
Key: NARS-Non Appearance of Reproductive Structures.

Data collected from the various activities carried out for this study were organized, presented as tables and figure and discussed appropriately.

Plant specimens were identified at the herbarium of the Department of Plant, Biology Bayero University Kano as *Typha domingensis* locally called 'Geron Tsunsu' and *Phragmites australis* species. In the Kano region, *Typha domingensis* (Pers.) has been identified by other researchers including Abdullahi, (2010), as the species widely growing in the area.

From Tables 1 and 2, the temperature of water of the two sites was similar across the months. Water temperature in the study area was relatively stable for most part of the year. Water Transparency at both sites/zones however, was rather low in September, October, November and December respectively which indicated turbulence/ turbidity therefore poor light penetration.

As regards the condition of electrolyte/conductivity (ms/cm), both plant species growth zones have virtually same condition of electrolyte across the period of study. Plant's growth is also facilitated by water movement through the process of evapo-transpiration and leave behind most of the dissolved salts, thus increased salt concentration in the soil water (Yaron, 1989). The pH of water at Phragmites site was slightly basic compared to that of Typha site.

The values for D.O (Dissolve Oxygen) of the water were relatively high at both sites. There was slight difference in the month of October where the value was higher at the Typha site. Both species are reported to raise oxygen levels in water through activities in the rhizomes (Gao and Song, 2008). Sermiento and Gruber, (2006) reported that the overall partitioning of oxygen between the atmosphere and the water is sensitive to mixing and biological production as well as temperature and salinity. The highest $B.O.D_5$ values recorded at Typha growing zone was in October 4.05 mg/l and March 4.06 mg/l, while the lowest value was in January 2.00 mg/l. However at Phragmites species growing zone the highest value of B.O.D was in the month of March 4.08mg/l. Sadhuram et al., (2005) reported that water with a $B.O.D_5$ of 4 mg/l to 5 mg/l are considered reasonable clean because It indicates low concentration of degradable organic matter.

For the plant parameters, the two species *Typha domingensis* and *Phragmites australis* were found in area the water depth was favourable for their growth. The mean water depth at Typha zone was less than 1meter while at Phragmites zone it was above 1metres. According to Wilcox et al., (1984) *T. domingensis* thrives in shallow water while the hybrid of *T. domingensis* and T. angustifolia, Typha x glauca preferred deeper and more saline water (Motivan and Apfelbaum, 1987). As regards plant height, *T. domingensis* the species identified in the study area could grow up to a maximum height of 3 meters (Wilcox et al., 1984; Motivan and Apfelbaum, 1987 and Abdullahi, 2010). Armstrong et al., (1992) attributed Phragmites ability to grow in variable water depths to Venturi – induced convention a phenomenon that facilitates oxygen transfer via broken shoots into the rhizome. Another attractive plant parameter of this study was plant density or stand density. As regards *Typha domingensis*, the stand density per m^2 varied during the period of study. For Phragmites species, the mean value of 107/m^2 was obtained.

Chun and Choi (2009) reported that *P. australis* expanded into Typha species wetlands and caused decline in aboveground biomass of Typha from 11.3 g.m^{-2} without Phragmites to 8.1 g.m^{-2} with Phragmites. In a previous study by Amsberry et al., (2000) identified physical factors, competitive interactions and clonal integration influenced the expansion and invasion of habitats by *Phragmites australis* .

The number of leaves per stand also varies across the month. A Typha plant has a basal aggregation of leaves ranging from 9 to 13 in number. Similarly the closely parked nature of Typha stands contributes to the collapse of these leaves before maturity. Mitch, (2000) described the detailed changes the reproductive structures undergoes to maturity. For Phragmites species, the reproductive structures appeared in December. The plant commenced flowering and the length of inflorescence recorded in December was 0.38 m, January 0.57 m and February 0.32 m.

In February the stalk bearing male staminate measures 0.24 m long which was slightly above the mean of 0.23 m. The difference was negligible where as the length of female pistillate measure 0.17 m and was above mean of 0.16 m long. However, the gap separating the two structures was 0.02 m long. Similarly in March the male stalk measures 0.22 m and the female stalk measures 0.16 m and the gap separating the male and female stalk measures 0.03m which was also slightly above the mean value of 0.02 m. The reddish brown staminate flower could be 7 to 13 cm long whereas the dark brown pistillate flower grows between 2.5 cm to -20 cm long (Mitch, 2000).

Table 4 shows the mean monthly values of plant parameters of *Phragmites australis* in the study habitat. The value recorded for October, November and December were 0.71, 0.55 and 0.99 m respectively. However, in the months of January, February and March the water depth were 1.10 m, 1.39 m and 1.44 m respectively and were relatively above the mean of 1.15 m. Vretare et al., (2001) found that Phragmites experiences decreased growth and have less ability to spread in deeper water than in shallow water.

As regards plants height of *Phragmites australis* during the period of the study, the values recorded in September and October were similar. However, from November and March, the values recorded for the plant height were 3.50 m and 3.96 m which were relatively close to the mean of 3.73 m. Compared to Typha species, Phragmites in this study are much taller than *Typha domingensis*, Capotosto and Wolf (2007) stated that Phragmites species can grow as tall as 6m. The no of leaves also varies across the month of the study, the number ranged from 8 to 14.

The leave length recorded across the month of the study was relatively similar, the values ranged from 0.41 m to 0.60 m the mean value was 0.47. Leave width recorded ranged from 0.01 to 0.03 m across the month while the mean value was 0.02 m. This finding is in line with the findings of (Hara et al., 1993) which reported that leaves are generally, flat at maturity and measures between 0.1 to 0.5 m long and 0.01 to 0.05 m wide. The number of node also varies, the number ranged from 9 to 30 and the mean value was 24. The length of internodes', also varies, the value recoded from September to December were relatively similar 0.1 m. However from January to March there was an increased in the length of internodes from 0.1 m to 0.2 m but the mean was also 0.2 m.

As regard length of inflorescence, the Phragmites species reproductive structures were absent from September to November, because this period was not the time for its flowering. However from December to February, the plant commenced flowering. The increase in stand density in the month of September and October were as a result of new shoots from the rhizome and not necessary from germination of seeds. In November there was a rapid decreased in stand density to 75/m^2. However in December and January there was an increased in stand density to 94/m^2 and 90/m^2 respectively, this was due to growth of new shoots. In February the stand density slightly declined to 87/m^2 but increased to 92/m^2 in March. From November to March the stand density per square meter were below the mean values. Changes in environmental condition such as dry weather coupled with the fluctuations in water level from obstruction for crop irrigation to plant removal for water across and other uses contributed to the declined in plant stand density. The above ground biomass for *Phragmites australis* recorded in Septembers was 280 g which was less than the mean of 337 g. However, in October and November the values recorded were 377 g and 365 g respectively which were relatively above the mean of 337 g. However in December and January the biomass declined to 307 g and 303 g but increased to 358 g in February and 371 g in March and above the mean value of 337 g.

Conclusions

Typha domingensis and *Phragmites australis* exhibited mutual ecological interaction at the 'Kadawa' reservoir of Kano River Irrigation System in this study. The science of interaction between organisms and their environment is rather complex but fascinating because it allows for prediction of what may happen in the future and the implications. For a better understanding of the findings of this study, it is important to note the relevance of the description by Roven and Johnson (1996) that a complete portrait of niche must take into account not only space, food, temperature, appropriate condition for growth and reproduction, requirement for moisture but also the behavior and the ways the behavior changes at different times and

season.

Recommendations

1. Further research is required on the expansion of the two species in the habitat over a longer period of at least 5 years.
2. The findings of this study on the phenology of the species could be employed by water resources managers of the Hadejia Jama'are River Basin Development Authority in the management of this invasive water weed species spreading across aquatic systems in the dry land areas of Nigeria.

References

Abdullahi, I. L., (2010). Typhaceae in the Kano River Irrigation Project (West) Zone and Management Issues 2010, by Curvillier Verlag Gottingen, Germany, ISBN 978–3–86955–624–6.

Amsberry, L., Baker, M. A., Ewanchuk, P. J., & Bertness, M. D. (2000). Clonal integration and the expansion of *Phragmites australis* . Ecological Applications, 10, 1110-1118.

Armstrong, J., Armstrong, W., & Beckett, P. (1992). *Phragmites australis* : Venturi- and Humidity- Induced Pressure Flows EnhancerRhizome aeration and rhizosphere oxidation. New Phytologist, 120(2), 197-207.

Capotosto, P., & Wolfe, R. (2007). Controlling *Phragmites australis* in Connecticut's Fresh and Salt Water Marshes. Connecticut Department of Environmental Protection.

Chun, Y. M., & Choi, Y. D. (2009). Expansion of Phtagmites australis (Cav). Trin. Ex Steud. (Common reed) into Typha spp. (Cattail) Wetlands in Northwestern Indiana. J. plant Biol, 52, 220-228.

Gao, X., & Song, J. (2008). Dissolved Oxygen and O2 flux Across the Water–air interface of the Changjiang Estuary in May 2003. Journal of Marine Systems, 74, 343-350.

Hara, T., van Der Toorn, J., & Mook, J. H. (1993). Growth Dynamics and Size Structure of Shoots of *Phragmites australis* , A Clonal Plant. Journal of Ecology, 81(1): 47-60.

Mitch, L. M. (2000). Common cattail, Typha latifolia L. Weed Technology, 14, 446-450.

Motivans, K., & Apfelbaum, S. (1987). Element Stewardship Abstract for Typha spp., North American cattails.

NPC, (2006). National Population Commission's Figures for Nigeria States for 2006 Population and Housing Census-National Population Commission. www.population.gov.ng

Qureshimatva, U. M., Maurya, R. R., Gamit, S. B., Patel, R. D., & Solanki, H. A. (2015). Determination of Physico-Chemical Parameters and Water Quality Index (Wqi) of Chandlodia Lake, Ahmedabad, Gujarat, India. J Environ Anal Toxicol, 5, 288. doi:10.4172/2161-0525.1000288

Roven, P. H., and Johnson, G. B. (1996). Biology. Fourth Edition WBC/McGraw – Hill Companies. Inc., 533, 548-551. ISBN: 0–696–37560–9.

Sadhuram, Y., Sarma, V. V., Ramana, M. T. V., & Prabhakara, R. B. (2005). Seasonal Variability of Physico-Chemical Characteristics of the Haldia channel of Hooghly estuary, India J Earth Syst Sci., 114(1), 37-49.

Sarmiento, J. L. S., & Gruber, N. (2006). Ocean Biogeochemical Dynamics. Princton Univ Press, Princeton, N. J. Restoration Ecologists. Restoration Ecology, 5, 350-354, 185-208.

Starr, C., & Taggart, R. (1989). Biology: the unity and diversity of life. Wadsworth Publishing Company, California, USA.

Vretare, V., Weisner., S. E., Strand, J. A., & Graneli, W. (2001). Phenotypic plasticity in *Phragmites australis* as a Functional Response to Water Depth. Aquatic Botany, 69, 127-145.

Wilcox, D. A., Apfelbaum, S. I., & Hiebert, R. D. (1984). Cattail Invasion of Sedge Meadows Following Hydrologic Disturbance in the Cowles Bog Wetland Complex, Indiana Dunes National Lakeshore. Wetlands, 4(1), 115-128.

Yaron, D. (1989). Salinity in Irrigation and Water Resources. Civil Engineering. In: Yaron, D.(ed). Marcels Dekker-New York, USA.

Citation: Sani, A., Abdullahi, I.L., Bilkisu, M. (2018). Ecological interaction of Typha And Phragmites aquatic weeds species in 'Kadawa' reservior, Kano River irrigation system. Ukrainian Journal of Ecology, 8(4), 243-247.