

Morphological study and Biological Control of *Typha* Grass Proliferation around Nguru Lake Nigeria

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ARTICLE INFORMATION	ABSTRACT
Article history: Published on 12 Oct 2025	This study investigates the invasive proliferation of <i>Typha</i> spp. (Cattail) in Nguru Lake, a critical wetland in Nigeria's Hadejia-Nguru ecosystem. The research confirms the presence of both <i>Typha latifolia</i> (broad leaf) and <i>Typha angustifolia</i> (narrow leaf) through morphological analysis, noting key distinguishing characteristics. The invasion has severely impacted local agriculture and fishing economies by obstructing waterways and overtaking farmland. The study evaluates biological control as a sustainable management strategy, focusing on the efficacy of three agents: the native reed <i>Phragmites karka</i> (for competition and shade), the grass carp (<i>Ctenopharyngodon idella</i>) for consuming young shoots, and the cattail borer (<i>Bellura obliqua</i>) for destroying mature stems. Findings suggest that an integrated approach using these biological controls is an effective, eco-friendly, and permanent solution for mitigating <i>Typha</i> proliferation, though it requires strategic implementation and community education for long term success.
Keywords: <i>Typha</i> Grass <i>Typha latifolia</i> <i>Typha angustifolia</i> Morphological Proliferation Nguru Lake	

1. Introduction

Early *Typha* spp. also known as Reedmace, is one of the genus in the family Typhaceae (Avci, Cerit, Hamk;Yilmazer, 2023). Locally referred to as “Kachala” by the people living around Nguru lake (Aliero, Singh and Keta, 2022). The plant is rhizomatous, herbaceous perennial plant and can grow up to two or more meters in height with higher growth rate than any other aquatic plant in its family (Avci et al., 2023). *Typha* were characterized by distinct morphological features (Sethuraman and Sanjayan, 2013). These perennial grasses exhibit long, linear leaves that can reach up to 3 meters in height, with a spongy, strap-like structure (Sethuraman and Sanjayan, 2013). The inflorescence is a dense, cylindrical spike divided into upper male (staminate) and a lower female (pistillate), which turns brown and fluffy upon maturity due to seed dispersal (Babagana, Adamu, Magama, and Suleiman, 2018). The rhizomes are thick and creeping, facilitating vegetative propagation. Morphological traits such as leaf width, spike color, and plant height are often used to differentiate between species like *Typha latifolia* broad-leaved cattail and *Typha angustifolia* narrow-leaved cattail (Zungum et al., 2019).

Typha latifolia (broadleaf) and *Typha angustifolia* (narrow leaf) are two common species of *Typha* (Avci et al., 2023). *Typha x glauca* is a hybrid between *T. latifolia* and *T. angustifolia*, exhibiting intermediate traits and *Typha domingensis* another species that is found in North America. *Typha* grass invasion has colonized most irrigated lands, channels and reservoirs for agricultural practices at the Hadejia-Nguru wetland (Sabo, Karaye, Garba and Jafaru, 2016). The agricultural activities which includes: fishing, crop farming, livestock farming etc. are seriously threatened by the menace (Babagana, Adamu, Magama, and Suleiman, 2018). Many hectares of farming and grazing fields have been taken over by the invasion in the study area (Abdullahi, Balarabe, Khan, and Adamu, 2019). Some communities migrated while others are planning to migrate do to the failure of government to rescue their farmlands from invasion of *Typha* spp. (Babagana et al., 2018). The livelihoods of the people living around the lake depend on the economic importance of the lake for farming and fishing activities (Abubakar and Auta, 2012).

Considerable portion of Nguru lake was covered by *Typha* grass which threatened the agricultural and economic activities of the local people (Babagana et al., 2018). *Typha* is an invasive plant species that causes major problems in the Nguru lake and Hadejia Valley Irrigation Scheme (HVIS) in Northern Nigeria (Babagana et al., 2018). The grass was discovered in the lake Chad Basin in Africa and was noticed in Nguru lake about 40 years ago by the locals in the Marma channel Hadejia-Nguru wetland on longitude

10.4086E and latitude 12.3565N in Yobe state (Kutama et al., 2016). Most of the areas covered by *Typha* grass fall within the critical areas that are best suitable for flood rice farming and recession farming, these are the margins of lakes with slow moving water where the soils do not dry out completely (Sabo et al., 2016).

There is a reduced or complete loss of cultivation of some crops, particularly irrigated crops such as maize, wheat, rice and vegetables, and the blockages caused by *Typha* grass on the water channels has resulted in reduced flow of water in the area where it reduces the fish catch providing a hiding ground for the fish (Sabo et al., 2016). *Typha* spp. around villages, are used for roofing huts, thatching, as firewood for cooking, use leaves to cover kola nuts, and use for construction of local storage facility (Sabo et al., 2016). Fish catches from Kashin Zama and Sabiyal wetlands contributed about 8% of the annual national income of inland fish sales in the Aliero local government, Kebbi State and Nigeria at large but now reduced to 0.8% (Aliero et al., 2022).

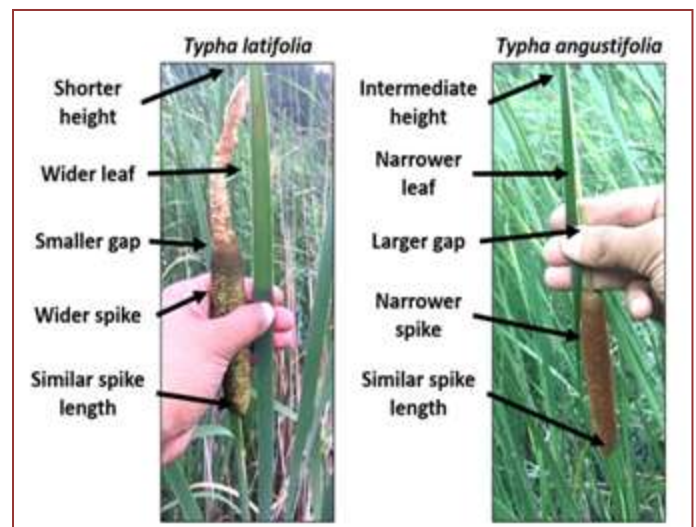


Plate 1: Depicted images of *Typha* grass showing the morphological characteristics of *Typha latifolia* and *Typha angustifolia* adopted from (Tangen et al., 2022)

The biological control of *Typha* grass proliferation involves the introduction of natural enemies such as organisms like grass carp, *P. karka* and Cattail borer (*Bellura oblique*). Cattail borer is a species of cutworm, the insect belongs to the order Lepidoptera and family noctuidae from North America (Ravikumar, Kesharbhaj, Dhruv, and Harisinh, 2023). This is one of the three species of *Bellura* found in Florida in the south eastern United States (Nguru, Sabo, and Mustapha, 2022). The host plant of this insect is the *Typha* species that has the extend of destroying the *Typha* (Nguru et al., 2022; Ravikumar et al., 2023). Grass carp (*Ctenopharyngodon idella*) a fresh water species introduced worldwide including North America, used in the biological control of aquatic vegetation, it has been proved to be a cost effective aquatic weed management control methods (Jones and Cudmore, 2017).

Biological control with *P. karka* reduced *Typha* species proliferation by 25%, with manual cutting at 15 cm below water level with about 95% of overall control (Abdullahi et al., 2019). The proliferation of *Typha* grass was reduced by 54% when a black tarpaulin provided shade (Abdullahi et al., 2019). Farmers should be educated on proper farming practices to know when is the right time to control *Typha* grass especially when their density is low during the wet season (Abdullahi et al., 2019). Biological control methods is not quick fix, but a slow and working control method (Abdullahi et al., 2019). The biological control measures are non-labour intensive method but an agents targeting specific parts of a plant, such as the leaves, roots, stems, flowers, seeds or fruits (Stafford, 2014). Most types of biological control agents have different feeding habits and is achieve by a combination of agents feeding on different parts of the weed (Stafford, 2014). It is a relatively cheap and safe in weed control compared to other risk control methods (Du Plessis, 2008; Stafford, 2014). Biological control offers an eco-friendly solution, integrating it with mechanical removal and regulated herbicide use may be necessary for effective long-term management (Nguru et al., 2022; Ravikumar et al., 2023).

Biological control is efficient and permanent environmentally friendly method and their impacts was documented and confirmed several years in Argentina, Australia and India (Abdullahi et al., 2019). Lack of knowledge about the biological control methods leads to abandonment of potentially effective control methods of weed proliferation (Stafford, 2014).



Plate 2: Image of Cattail borer (*Bellura oblique*), Grass carp (*Ctenopharyngodon idella*) and *P. karka* for biological control adopted from (Nguru et al., 2022; Ravikumar et al., 2023).

Many researchers are of the view that an integration approach of different management techniques proves to be most effective in reducing the proliferation (Abdullahi, 2011; Mukhtar and Abdullahi, 2020). The collaboration of Yobe state government and the Raw Material Research and Development Council (RMRDC) developed a technology to form charcoal with *Typha* grass of the HNW for fuel pellet for local use and export in neighbouring Mali (Babagana et al., 2018). The two northeastern states of Yobe, Bauchi and Jigawa from northwest has embarked on mechanical clearance of the grass in attempt to control the proliferation of the grass (Babagana et al., 2018). Despite the efforts by governments and NGOs, the proliferation of *Typha* persists detrimenting the livelihood of the local communities living around the wetland (Babagana et al., 2018).

2. Materials and Methods

Nguru lake is located in Yobe state in the northeastern part of Nigeria (Abubakar and Abubakar, 2013). The lake lies between the coordinates 12.6502° N, 10.5918° E in a semi-arid zone (Abubakar and Abubakar, 2013). It has an area of 58,100 ha and an elevation of 340-345m and has a maximum depth of 8 m and mean pH 6.5 (Kutama et al., 2016). Temperature range in the area is 19-45 °C and average rainfall 550mm. the lake, is a wetland of international importance and Ramsar site (Abubakar and Abubakar, 2013).

Morphological study was conducted through survey and biological control involves the use of organisms like Grass carp, *P. karka* and Cattail borer (*Bellura oblique*). This species were used in Florida, Argentina and India to control *Typha* grass proliferation (Inusa Nguru, Sabo and Mustapha, 2022). The host plant to this species is *Typha*, not very much is known about the extent of destruction caused by this specie. They normally bore through the stem of *Typha* plant. A high population of this species could lead to dramatic impact to cattail (Inusa Nguru et al., 2022).

Statistical analysis was conducted to derive meaningful insights and validate the research findings. Initially, descriptive statistics were employed to summarize the dataset, with results expressed

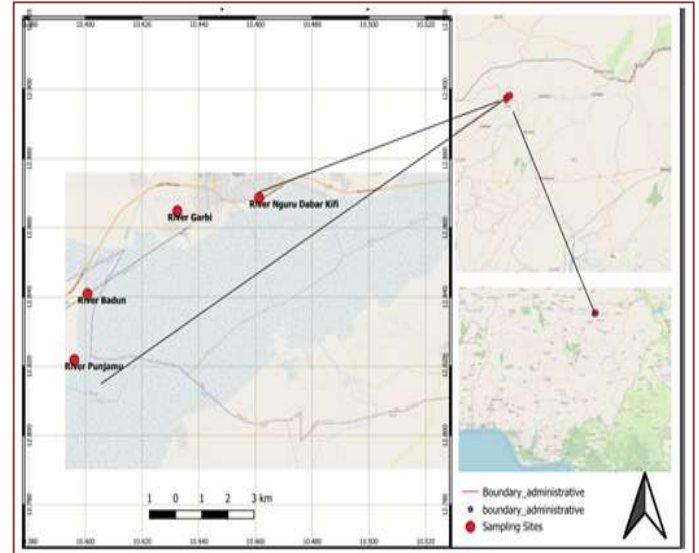


Fig 1: Map of Nguru Lake showing the four sampling sites (Googole map)

3. Result and Discussion

The results of the morphological study revealed a variation in the morphology of the *Typha* species which appeared to have *T. latifolia* with Broad leaves measures (1.7 ± 0.6), male flower length (18.2 ± 0.8), female flower length (22.1 ± 0.2) and *T. angustifolia* Narrow leaf measuring (1.1 ± 0.2), male flower length (21.2 ± 0.5) and female flower length (16.3 ± 0.6) with other features as presented in (Table 1).

Table 1: Morphological study of *Typha* spp. from Nguru Lake

Species Name	Leaf width (cm)	Length (m)	Flower gap (cm)	Male flower (cm)	Female flower (cm)
<i>T. latifolia</i>	(Broad) 1.7 ± 0.6	3.5 ± 0.8	0.5 ± 0.2	18.2 ± 0.8	22.1 ± 0.2
<i>T. angustifolia</i>	(Narrow) 1.1 ± 0.2	2.2 ± 0.6	3.3 ± 0.3	21.2 ± 0.5	16.3 ± 0.6

(Source: Field survey from Nguru Lake 2025)

The invasive *Typha* grass can be managed through biological control using *Pragmites karka*, a native reed that competes with *Typha* for resources like light, nutrients, and space. *P. karka* suppresses *Typha* growth through allelopathy, releasing chemicals that inhibit its development, while its dense growth physically blocks sunlight. This method is particularly effective in wetland margins, where *P. karka* can stabilize soils and reduce *Typha* colonization. However, its slow establishment requires strategic planting and monitoring to ensure it outcompetes *Typha* without becoming invasive itself.

Grass carp (*Ctenopharyngodon idella*) offer another biocontrol solution, especially in aquatic environments. These herbivorous fish feed on young *Typha* shoots and rhizomes, reducing biomass and preventing spread. While effective for large-scale infestations, grass carp are non-selective and may also consume beneficial native vegetation. To mitigate this, sterile (triploid) carp are often used, and their populations must be carefully

regulated. Additionally, grass carp are less effective in areas with dense, mature *Typha* stands, as they prefer softer, younger growth. For targeted control of mature *Typha*, the cattail borer (*Bellura obliqua*) is a highly specific biological agent. The larvae of this native moth tunnel into *Typha* stems, disrupting nutrient flow and causing significant dieback. This reduces seed production and weakens plants over time. However, the cattail borer's effectiveness depends on climate and population density, and it may require supplemental releases in colder regions. When combined with *P. karka* and grass carp, these biocontrol methods create a synergistic approach, addressing *Typha* at different growth stages and habitats for more sustainable, long-term management. The biological control of *Typha* grass proliferation is slow but proven effective. The use of *Phragmites karka* (Plate 3 A) which provide shade by reducing sunlight exposure limiting *Typha* growth by 54%. Grass carp (*Ctenopharyngodon idella* Plate 3 C) is used as a biological control agent for *Typha* grass proliferation. They are known to feed on aquatic plants, including cattails, and this help in controlling their growth. Cattail borer (*Bellura obliqua* Plate 3 B) is used as a biological control against *Typha* grass proliferation and Plate 3 D image of the affected area. Cattail borer feed on the stem of *Typha* species, potentially reducing their population by causing huge destruction by stopping its proliferation. The larvae of the cattail borer bore into the stems of *Typha* plants, causing damage and potentially leading to reduced growth and mortality of the plants.



Plate 3: Images of the Biological techniques against the proliferation of *Typha* grass

The morphological characteristics of *Typha* spp. from Nguru lake such as flower length, gap length, or width of leaf or spike, typically are used to differentiate between *Typha* genus which finds the characteristics of *T. latifolia* and *T. angustifolia* from the study area corroborating with findings documented by (Tangen et al., 2022). The biological control methods against *Typha* grass proliferation was achieved through the use of organisms like *Phragmites karka*, cattail borer (*Bellura obliqua*) and Grass carp (*Ctenopharyngodon idella*) (Ravikumar et al., 2023). The organisms were proven effective in the management of *Typha* grass proliferation by previous researchers (Ravikumar et al., 2023). Biological control is perfectly used and permanent environmental friendly method. The impacts were documented in Argentina, Australia and India and should be encouraged for permanent control (Ravikumar et al., 2023).

4. Conclusion

In conclusion, the study confirms the significant morphological variation between *Typha latifolia* and *T. angustifolia* in Nguru Lake, characterized by differences in leaf width, flower length, and the gap between male and female flowers. These findings align with global taxonomic records and underscore the need for accurate species identification as a foundational step in managing its invasion. The proliferation of these species has severely impacted the Hadejia-Nguru wetland, threatening agricultural livelihoods, reducing fish catches, and displacing local communities. This highlights the critical necessity for effective, sustainable control strategies to mitigate the socio-economic and ecological damage caused by this invasive plant.

The research demonstrates that biological control offers a promising, eco-friendly solution for long-term management. The integration of multiple agents *Phragmites karka* for competition and allelopathy, grass carp for consuming young shoots and rhizomes, and the cattail borer for targeting and destroying mature stems creates a synergistic approach that addresses the weed at different growth stages and habitats. While biological methods are slower than mechanical or chemical controls, they are cost-effective, permanent, and environmentally sustainable, as evidenced by their success in countries like Argentina, Australia, and India. For optimal effectiveness, this approach should be part of an integrated management plan that includes community education on timely intervention and supplementary measures like mechanical clearing, ensuring the restoration of the wetland's ecological balance and the preservation of local livelihoods.

5. Recommendations

1. Implement integrated biological control by introducing a combination of natural agents like the native reed *Phragmites karka* (to shade and outcompete *Typha*), grass carp (to eat young shoots in waterways), and the cattail borer insect (to target and destroy mature stems). This eco-friendly method is sustainable and proven effective in other countries.
2. Government and NGOs should support initiatives that convert harvested *Typha* into marketable products like fuel pellets, charcoal, or construction materials. This creates economic incentive for local communities to clear the plant and provides an alternative source of income.
3. Launch community education and mechanical clearing by educating local farmers on early identification and the most effective timing (e.g., during the wet season) to control *Typha*. This should be combined with sustained government efforts to mechanically clear critical irrigation channels and farmlands to provide immediate relief and restore water flow.

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Declaration of authors' conflict of interest:

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