

Study of Invasive Plants Species *Typha angustifolia*, It's Morphological Characteristics and Impact on the Tas Lake, Bhiwapur, Nagpur District, Maharashtra (India)

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ABSTRACT

Nagpur is the third- largest city of the Indian State of Maharashtra. Nagpur district lies between 21.1458°N and 79.0882°E in the plain to which it gives its name at the southern base of the Satpura hill. Invasive plant species are non-native, aggressive plants that spread rapidly disrupting local ecosystem and causing harm to the environment, economy and human health by outcompeting native species and altering habitats. The characteristics include fast growth, high reproduction and competitive ability, leading to loss of biodiversity, reduced ecosystem productivity and significant ecological damage. In this article, efforts are taken to gather the information of character of *Typha angustifolia* which is the invasive plants species has great impact on the Tas Lake, Bhiwapur, Nagpur District, Maharashtra (India).

Keywords: *Typha angustifolia*, It's Characteristics, Impact on Bhiwapur Lake.

Introduction

Bhiwapur is a town and a tehsil in Umred subdivision of Nagpur district in Nagpur revenue division in the Berar region in the state of Maharashtra (India). Bhiwapur tehsil is located East from Nagpur at 74km having 20.7677°N latitude and 79.5107°E longitude. Tas lake Bhiwapur, a wetland area in Nagpur, Maharashtra. The lake is one of the key water resources in the area and is critical for both economy and local climate. Scientific studies have raised concerns about the lake's water quality, primarily due to human activities like sewage disposal, encroachment, and contamination from agricultural and industrial resources. These is the high rate of pollution is a significant problem that could lead to water issues in the future. Despite pollution issues, the lake is supporting a variety of aquatic flora and fauna, including zooplankton, fish, birds and phytoplankton. Due to the high rate of pollution there is growth several of invasive plants species, but *Typha angustifolia* is the major problem.

BHIWAPUR (TAS LAKE)



Typha angustifolia narrow-leaved cattail, is an obligate wetland plant found in freshwater and brackish habitats like lakes, ponds, marshes, ditches, and along riverbanks and stream margins. It prefers full sun and can tolerate deep water, unstable environments, and soils rich in silt and nutrients. This species is found globally, thriving in temperate to subtropical regions and is known for its ability to spread rapidly and outcompete other wetland species. Floating mats can be found on floating bog mats. It is a tall, herbaceous perennial aquatic emergent plant that grows up to 3 meters tall from extensive rhizomes. Its habit includes forming dense, long-lived colonies in marshy fields, wetlands, and other wet, disturbed habitats like ditches. The plant has unbranched, upright stems with long, linear, and stiff green leaves, and it is known for its vigorous growth and ability to spread rapidly in its preferred wet environment. A perennial herb that reproduces through rhizomes and colonies, forming dense stands over time. Spreads vegetatively by spreading rhizomes, forming dense, sometimes monospecific (single-species) colonies.



Morphological Characteristics

Root

Typha angustifolia roots are rhizomes, which are branched, underground stems that anchor the plant and store nutrients. These dense, fibrous roots serve as a food source for humans and animal, providing a rich source of carbohydrates and starches, can be ground into flour. The roots also play a crucial role in phytoremediation, helping to purify polluted water by absorbing heavy metals and excess nutrients, making *Typha angustifolia* a valuable component in wastewater treatment systems. These plants can spread aggressively through their roots in suitable aquatic environments, which can lead to significant weed problems in managed systems worldwide.

Stem

The stem of *Typha angustifolia*, or narrow-leaved cattail, is a stiff, unbranched, round, and smooth, green to light green stalk that typically grows between 1.5 and 3 meters (5 to 10



feet) tall. Grows to 1.5–3 meters (5–10 feet), often shorter than the leaves. Light green to green, becoming smoother near the tip. Stems are unbranched, with leaves emerging from the base and sheathing it. The stem supports a distinct inflorescence at its tip, which is a slender cylindrical spike. A gap of bare stem, typically 3-8 cm, separates the female and male spikes, which is a defining characteristic of the species. The stem, along with other parts of the plant, has traditional and modern uses, including being a source of biomass for insulation, weaving, and wetland restoration.

Leaf

Typha angustifolia leaves are long (3-6 feet), narrow (1/4-1/2 inch wide), and flat, growing from a vegetative shoot at the base of the plant. These narrow-leaved cattail leaves are deep green, linear, and erect, with parallel venation and a sheathed base. They are a key characteristic distinguishing this species from the broader leaves of *Typha angustifolia*. They are typically stiff, and have a planoconvex cross-section, meaning they are convex on the outside and flat or slightly concave on the inside. Leaves arise from a vegetative shoot at the plant's base. The leaves are deciduous, appearing in the spring and dying back in the fall. The strong, fibrous leaves can be processed to yield fibres resembling jute and can be used as a textile alternative to cotton and linen.

Inflorescence

The inflorescence of *Typha angustifolia*, is a dense, cylindrical spike at the tip of the stem, divided into two distinct parts, a compact upper section of male flowers and a denser, dark brown lower section of female flowers, with a naked stalk separating them. The male spike is the upper, typically yellow or straw-coloured section and sheds pollen, while the female spike contains the pistillate (female) flowers with white stigmas that turn brown, and denser section containing as they age. These are hair-like or strap-like, brown scales found on the male spike. Both male and female flowers are associated with bracteoles. Staminate (male) bracteoles are small and may be forked, while Pistillate (female) bracteoles are much darker and larger in proportion to the hairs and stigmas. In the female flower, the stigma is linear and white when fresh, later turning brown and deciduous in fruit.

Flower

The flower of *Typha angustifolia* is a dense, brown. Cylindrical spike with two distinct regions a male, yellowish section at the top and a female, brown section at the bottom, separated by a gap of about 0.5 to 2 inches. These wind-pollinated flowers are part of the plant's terminal spikes, which are topped by the fluffy, sausage-shaped flowering heads that are a hallmark of the cattail. There is a clear, open space between the male and female flower sections on the spike. The flowers are wind-pollinated. After pollination, the female part of the spike develops into a fluffy, cigar-shaped fruiting body containing tiny, light-brown seeds that are spread by the wind.

Floral Parts

Typha angustifolia has monoecious flowers arranged in a single, terminal spike with male (staminate) flowers at the top and female (pistillate) flowers below, separated by a gap. Male flowers consist of stamens on a slender stalk, while female flowers have a long-hairy



stalk, a single ovary with a persistent style and stigma, and are surrounded by long, thread-like, or hair-like structures. The plant produces many fine hairs that detach with the fruit, giving the ripe spike a cottony appearance for wind dispersal.

Inflorescence and Fruiting

The male flowers form a dense, yellowish spike above a female spike, with a distinct gap or bare stalk between them. The female spike disintegrates upon maturity, releasing tiny, wind-dispersed fruits (achenes) which are attached to fine hairs, resulting in a fluffy, cottony appearance.

Reproduction

Typha angustifolia (narrow-leaved cattail) reproduces both sexually through seeds and vegetatively through rhizomes, creating extensive clonal colonies, forming dense stands. Its elongated seeds, dispersed by wind, moist conditions and shallow water for germination, which is often a low percentage. The plant typically flowers from early to mid-summer, producing a single inflorescent. Wind carries pollen from the male portion of the inflorescence to the stigmas of the female florets. Each fruit has fine hairs for wind dispersal and is equipped to release its single seed upon contact with water. Seeds germinate under favourable conditions, such as warm temperatures, and low oxygen concentrations. The plant spreads by growing new shoots and rhizomes, forming dense, interconnected stands. Rhizomes can remain viable for a long time, maintaining a physiological connection between different parts of the same plant.

Adaptation

Typha angustifolia adaptations include aerenchyma tissue for oxygen transport, rhizomes for vegetative spread, flexible stalks for withstanding water flow, wind-dispersed seeds for colonization, tolerance to deeper water and slightly brackish conditions, and dense canopy formation to outcompete other plants. This spongy tissue with air spaces allows *Typha angustifolia* to transport oxygen from its stems to its submerged parts, which is crucial for survival in waterlogged environments. These underground stems allow the plant to spread vegetatively, quickly colonizing new areas and forming dense, interconnected stands. Its seeds are wind-dispersed, making it an excellent colonizer of new wetlands, especially areas with exposed wet mud. *Typha angustifolia* forms dense canopies that can outcompete native species for light and space. It grows faster and taller than *Typha angustifolia* in some areas, giving it a competitive edge. It also shows a tolerance for slightly brackish (salty) water conditions, allowing it to thrive in areas where other species cannot. Buried seeds can remain viable in the soil for extended periods, ready to germinate when conditions are right. The ability to tolerate deeper and more saline conditions makes *Typha angustifolia* a dominant and often invasive species in many wetlands, limiting biodiversity.

Ecological Significance

Typha angustifolia adaptations include aerenchyma tissue for oxygen transport, its stems to its submerged parts, which is crucial for survival in waterlogged environments, rhizomes for vegetative spread quickly colonizing new areas and forming dense, interconnected stands, flexible stalks for withstanding water flow, wind-dispersed seeds for colonization of new



wetlands, especially areas with exposed wet mud, tolerance to deeper water and slightly brackish conditions, and dense canopy formation to outcompete other plants.

Impacts on Tas lake Bhiwapur Nagpur Maharashtra

Chemical Impact on Lake Ecosystem

Tas Lake (Bhiwapur Lake), Nagpur, is facing ecological impacts due to anthropogenic pollution, including sewage and wastewater disposal, leading to high organic pollution, increased turbidity reduced water quality, and a tendency towards eutrophication. These factors threaten the lake's ecosystem, causing severe water quality issues, potential algal blooms, and overall environmental degradation. The increased nutrient levels and organic pollution create conditions favourable for the dominance of algal blooms, which can lead to a bluish-green coloration and changes in the lake's overall appearance and odour. High levels of anthropogenic pollution are pushing the lake toward eutrophication, a process where the lake becomes overly enriched with nutrients, leading to excessive plant growth and oxygen depletion. Changes in water quality and the onset of eutrophication negatively affect the diversity and health of aquatic organisms, potentially leading to a decline in zooplankton and other benthic macroinvertebrates that form a crucial part of the food web. As an urban wetland, its ability to properly function within the hydrological cycle is compromised by increased surface runoff from impervious surfaces and reduced groundwater recharge due to urbanization. Urbanization encroaching on wetland areas leads to habitat loss and a reduction in biodiversity, impacting the sensitive ecosystems that wetlands support. A primary source of pollution is the direct disposal of sewage and untreated wastewater into the lake. The expansion of urban areas leads to encroachment, which disrupts the natural habitat and increases the risk of pollution from commercial and residential activities. While not directly mentioned for Bhiwapur Lake, agricultural activities in the surrounding areas can contribute to nutrient and chemical runoff into water bodies.

Physical Impact on Lake Ecosystem

Tas Lake, Bhiwapur, like many similar urban and semi-urban lakes, is experiencing negative physical impacts from human activities such as pollution from sewage and agricultural runoff, leading to increased nutrient loading, eutrophication, and reduced water quality for both drinking and irrigation. Encroachment on the lakeshore and unchecked urban development also contribute to degradation, potentially affecting water flow, habitat stability, and overall ecosystem health. Discharges of domestic sewage into the lake increase nutrient loads (like nitrogen and phosphorus), which fuels the overgrowth of aquatic plants and algae. Runoff from farms, containing pesticides and fertilizers, further contributes to contamination and eutrophication. Overdevelopment and encroachment along the lake's edge disrupt the natural habitat and can lead to increased siltation. These changes in land use can alter the lake's natural hydrology, affecting water quality and making the lake less suitable for its intended purposes. Increased nutrient input causes excessive algal blooms, depleting oxygen levels and harming aquatic life. The lake water's physico-chemical characteristics change, making it



unsuitable for drinking and potentially impacting aquatic organisms. The encroachment and changes in water quality can reduce the biodiversity of the lake's flora and fauna. Many studies on lakes in and around Nagpur show similar trends of water quality deterioration and ecosystem degradation due to anthropogenic influences. The declining health of the lake negatively affects dependent communities, such as those involved in fishing or using the water for irrigation.

Productivity of Lake

Productivity in the Bhiwapur (Tas Lake) ecosystem is influenced by nutrient levels and water quality, as indicated by a study that found sufficient nutrients for aquatic life but noted the water's poor quality for drinking, especially in summer, due to human activities like pollution and fertilizer use. Seasonal variations in physicochemical parameters, such as temperature, pH, and dissolved oxygen, also impact the lake's aquatic organisms and overall health. Maintaining water quality through regular monitoring and implementing restoration measures like rejuvenation projects are crucial for the lake's long-term productivity and the surrounding ecosystem's health. The presence of sufficient nutrients, particularly phosphorus and nitrates, supports the growth of aquatic organisms and thus influences the lake's productivity. Seasonal variations in parameters such as temperature, pH, and dissolved oxygen directly affect the composition and abundance of aquatic life. The abundance and diversity of phytoplankton and zooplankton are key indicators of the lake's productivity, as they form the base of the aquatic food chain. Projects aimed at improving water quality and ecosystem health are essential for enhancing lake productivity. Reducing pollution from surrounding areas and controlling the use of fertilizers in the watershed can improve the overall quality of the lake. Protecting and promoting biodiversity through measures like planting vegetation can enhance the lake's aesthetic value and ecological stability, contributing to its overall health and productivity.

Ecological Impact on Lake Ecosystem

Recent studies show that Tas lake in Bhiwapur, Nagpur is suffering from severe ecological degradation due to high levels of pollution from anthropogenic activities. Research indicates the lake is moving toward a state of eutrophication, threatening its water quality and aquatic life. Anthropogenic pollution is leading to high levels of nutrients like phosphate and nitrate in the lake. The high concentration of nutrients can lead to excessive algal growth, including harmful algal blooms. Human activities around the lake have been identified as the main source of pollution. This is a common issue for many lakes in the Nagpur region, where unchecked urban development, solid waste disposal, and religious activities contribute to poor water quality. Long-term studies show a decline in the lake's water quality. The lake's turbidity increased, and its Dissolved Oxygen (DO) levels fell, indicating higher organic pollution. High levels of organic pollution are also indicated by an increase in the lake's Biochemical Oxygen Demand (BOD) over time. The chemical changes in the water are impacting the lake's aquatic life. The presence of high levels of certain plankton and algae indicates organic pollution and



eutrophication. The unchecked pollution and invasive weeds can threaten native fish populations and overall biodiversity. Studies warn that if left unmanaged, the high rate of pollution could lead to severe water issues in the region in the near future. Based on trends observed in similar urban lakes in Nagpur, continued neglect could lead to further decline in water quality, loss of biodiversity, and decreased aesthetic value. While no specific ongoing restoration projects were found for Bhiwapur Lake, solutions implemented in similar contexts could be applied. Treatment of sewage and prevention of untreated runoff from entering the lake is critical. Measures like dredging to remove nutrient-rich silt, removing invasive weeds, and planting native vegetation can help restore the ecosystem. Engaging local communities is vital for successful restoration and long-term sustainability. Continuous and reliable monitoring of water quality parameters is needed to track the lake's health and the effectiveness of interventions.

Conclusion

Typha angustifolia can pose several problems in lake environments. These include habitat alteration, reduced biodiversity, and decreased water quality. The plants aggressive growth can lead to monoculture formation, displacing native vegetation and impacting the food web. Flow, affecting fish populational and potentially contributing to water pollution. It can rapidly colonize wetlands and lakes, forming dense stands that outcompete other plants species. This can lead to a loss of plant diversity and a decrease in the structural complexity of the habitat which negatively impacts various animals species that rely on diverse vegetation for food and shelter. The plants dense growth can after water temperature and dissolved oxygen levels, creating unfavourable conditions for many fish species. The reduction in macro invertebrate diversity and density invaded areas can impact the food chain potentially affecting larger predators.

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