Effects of Water Withdrawal on Aquatic Vegetation

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ABSTRACT

The ever increasing demand for drinking water linked with excessive withdrawals lower the water level of lakes and exposes its littoral areas and biota. In the recent days there is a mounting concern towards the distribution of littoral species and communities in relation to changing environmental issues. The special effects of such factors on the structure and function of the littoral areas of lake ecosystems have not been extensively studied. Upper Bhopal Lake, Madhya Pradesh, located in the Vindhyan plateau is the principal drinking water source for the Bhopal city. 3/4 of the lake area is shallow and fully infested with aquatic vegetation. The constant lowering of water levels due to withdrawal of drinking water from the lake is mainly responsible for the enormous destruction of the shoreline biota. In the present study an attempt has been made to observe the impact of continuous drawdown of potable water and fluctuating water levels on the shoreline communities of Upper Bhopal Lake ecosystem.

INTRODUCTION

Shorelines filter the undesired releases into the lake and acts as a bufferzone, which levels out the impacts on the lake from its surroundings (Jorgensen and Loffler, 1990). These transition zones (mainly the supra littoral and littoral zones) have been shown to remove organic and inorganic material from water that flows through them. These vulnerable areas can provide suitable habitat for plants and animals and also serves as breeding and spawning ground for certain species. Increasing awareness towards the distribution of shoreline species and communities in relation to environmental factors (Armstrong, 1978; Crawford, 1992 and Van der Valk, 1987) has been identified by several workers. The effects of such factors on the structure and function of the shorelines in lakes/wetlands has not been extensively studied (Frazer, 1972). In the present study an attempt is made to observe the impact of continuous drawdown of potable water and fluctuating waterlevels on the aquatic vegetation of a tropical lake ecosystem.

METHODOLOGY

Upper Bhopal Lake is located (494 m.a.s.l.) in the Vindhyan plateau is the chief drinking water source for the Bhopal city with a surface area of 19.6 Sq. km (Fig.1). The maximum and mean depths are 7.3 mt. and 3.5 mt. respectively. 3/4 of the lake area is shallow and fully infested with macrophytic vegetation. The lowering of

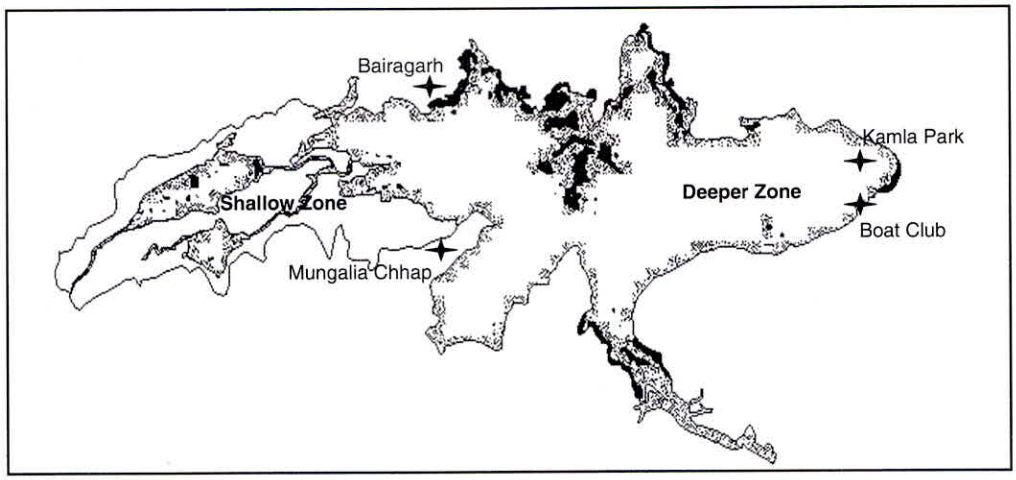

Fig. 1 : Upper Lake showing the Deeper and Shallow Areas Sampling Locations

waterlevels due to summer drawdown is mainly responsible for the enormous destruction of the aquatic vegetation of this lake resulting in a large diversification in its biological status.

Biomass distribution in the lake over the period March 2003 to February 2004 was estimated. Four sampling points two at shallow region (Bairagarh and Mungalia Chhap) and two at deeper region (Kamla Park and Boat club) were selected (Fig. 1). The density and biomass changes of macrophytes in both shallow and deeper regions were assessed after Vollenweider (1969).

RESULTS AND DISCUSSION

Water use for drinking, irrigation etc., are the cause of lowering water levels in man made as well as natural aquatic ecosystems. The effect of maintaining lake levels within narrow limits may reduce the width of the littoral zone and lessens productivity, especially in small lakes.

Monthly variations in standing crop biomass (gm^2 DW) of macrophytes at shallow and deeper areas were recorded during March 03 to February 04 (Fig's. 2-5). The maximum biomass was observed in the shallow areas, while the minimum in deeper

region. In the shallow area "Bairagarh" recorded the maximum (592.1 gm^2 DW), while Mungalia Chhap recorded the minimum (112.5 gm^2 DW) biomass concentration. No biomass was observed during July and Aug.03 in Bairagarh and Aug. 04 in Mungalia Chhap. Kamla Park recorded the maximum (442.1 gm^2 DW) and boat club recorded the minimum (21.4 gm^2 DW) biomass in deeper region. Generally winter season recorded maximum biomass in comparison to other seasons.

The effect of lake drawdown for example may be either beneficial or detrimental to the littoral ecosystem, depending on the duration of the fluctuation (Godshalk and Barko, 1988). Upper Lake is a major source of water supply to Bhopal city. Under normal circumstances it has a supply capacity of 27 MGD drinking water through its ten intake points (Table 1). According to the future water demands the present waterbody is considered to be under severe pressures. Due to the decreased amount of water volume and potable water drawdown, mainly in summer months has tremendously exposed the lake's shoreline, which is responsible for a great habitat loss. The primary mode of action of this summer drawdown in the lake exposes the macrophytes especially the root system to dry and hot conditions, which leads to massive destruction. Crosson (1990) reported that water level drawdown at lake Bomoseen, VT, produced major impacts on a wetland which contained several threatened and endangered species. Effects on invertebrates were also severe. He further emphasized that the elimination of plants particularly, native species from the exposed littoral areas may also allow nuisance from deep water to invade the areas, which had been exposed.

Table 1 : Water Supply intake facilities in Upper Lake

Managed by	No.	Name of intake	Pumping capacity	
			(MGD)	(MLD)
Public Health Engineering Department	1	Kamla Park	5.0	22.7
	2	Yatch Club	2.0	9.1
	3	Bairagarh	1.0	4.5
	4	Retghat (Medical Campus)	0.5	2.3
Bhopal Municipal Corporation	5	Yatch Club	3.0	13.6
	6	Karbala	4.0	18.2
	7	Pulpukhta (Tunnel)	3.0	13.6
Railways	8	Kamla Park	0.5	2.3
Military Engineering Services	9	Bairagarh	1.0	4.5
Bhopal Heavy Electrical Limited	10	Kamla Park	7.0	31.8
		Total	27.0	122.7

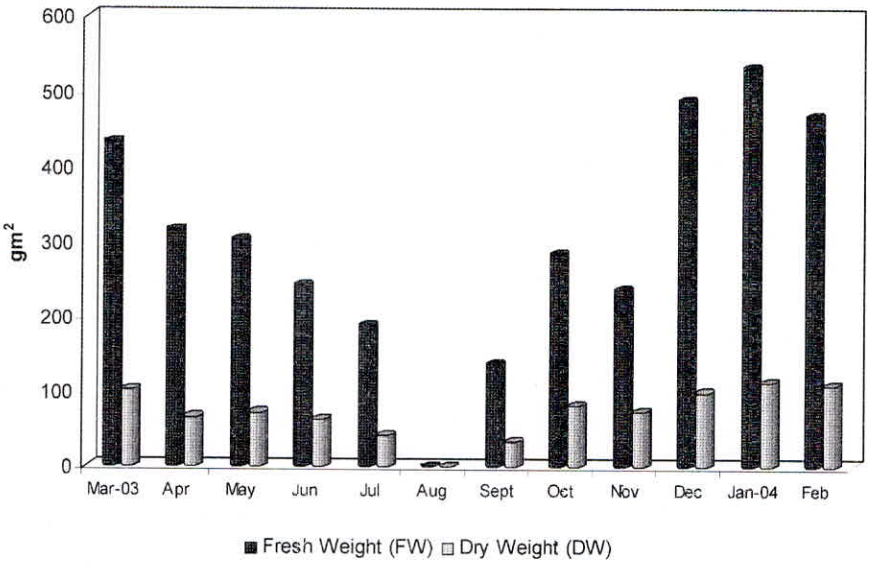

Fig. 2 : Biomass of Shallow Area Mungalia Chhap

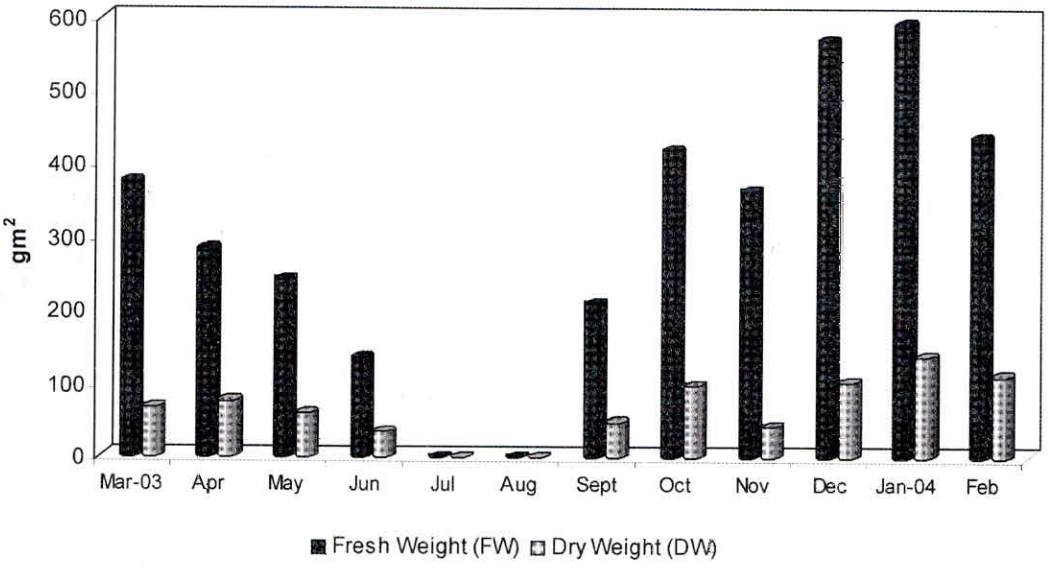

Fig. 3 : Biomass of Shallow Area - Bairagarh

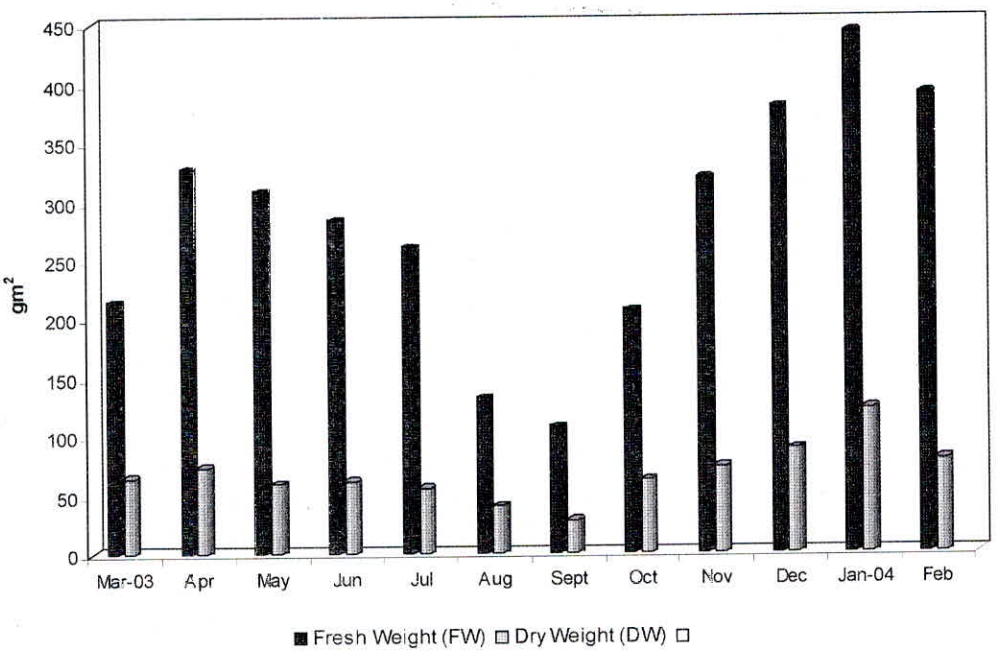

Fig. 4 : Biomass of Deeper Area – Kamla Park

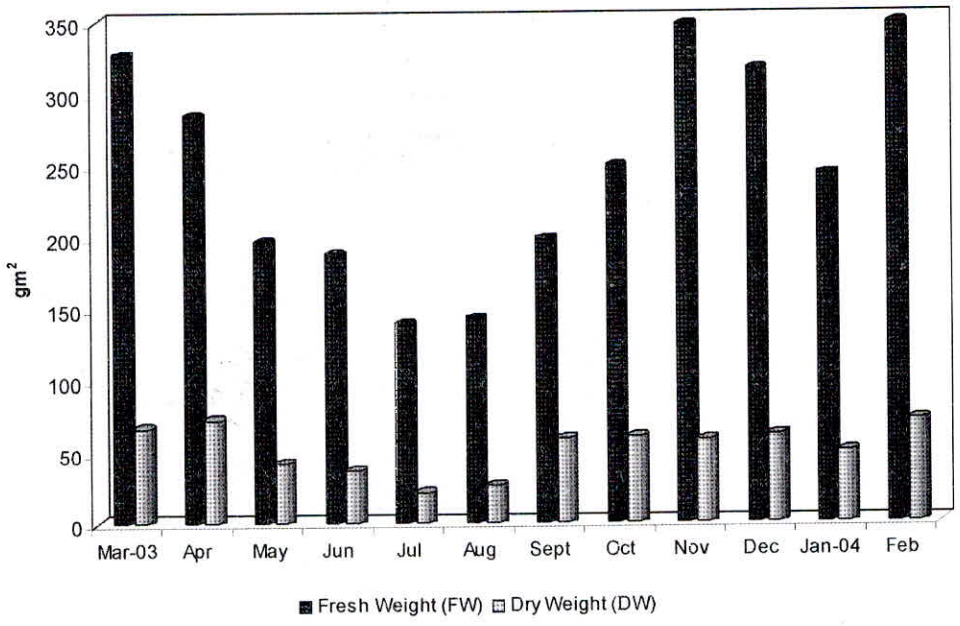

Fig. 5 : Biomass of Deeper Area – Boat Club

In general, it is admitted that predictions of productivity in reservoirs and lakes with disturbed water levels is most difficult. Drawdown of water level in small and / or shallow lakes could lead to reduced diversity and overall decline of ecosystem productivity (Bartell and Breck, 1979; Breck and Kitchell, 1979; Carpente and Lodge, 1986). 3/4 of the wetland area (14.25 Sq.km) is very shallow and providing suitable habitat for littoral biota. The shallow areas (Bairagarh and Mungalia Chhap) are contributing maximum biomass to the wetland. The species observed in this area are : *Ipomea fistulaosa, polygonum glabrum, Eichhornia crassipes, Trapa bispinosa, Scirpus royeli, Nelumbo nucifera, Azolla pinnata, Nymphoides indicum, Potamogeton crispus, Myriophyllum spathulatum, Ceratophyllum demersum* and *Hydrilla verticillata.* The deeper areas (Kamla park and Yacht club) are less in macrophytic diversity in comparison to shallow areas. *Potamogeton crispus, Myriophyllum spathulatum, Ceratophyllum demersum Hydrilla verticillata* and *Vallisnaria spiralis* are the dominant ones among others. The lowering of water volume especially in summer season is responsible for the mass destruction of macrophytes and its attached fauna in the shoreline of this wetland.

Ecologically speaking, natural shoreline should be preserved as far as possible in order to assure the water cleaning capacity and high biological productivity. The water cleaning function of wetland vegetation is not limited to nutrient removal of synthetic detergents, toxic chemicals and noxious microbes such as coliform bacteria. Aside from the standpoints of fisheries and landscape conservation, lake shore ecosystems must be carefully managed in order to maintain good water quality, particularly in the planning of development projects. Most important aspects in this are the protection of emergent plants in tropical regions. They are well adapted to water fluctuations and wave action, and thereby protect shoreline effectively. They also serve as breeding and spawning grounds for certain fishes and other animals, playing a very important role in fishery resource conservation and in sustaining the whole lake ecosystem. The preservation of submerged plant communities is also important for the same reasons.

CONCLUSION

The present study was conducted to observe the impact of continuous drawdown of potable water and fluctuating water levels on the shoreline communities of Upper Bhopal Lake ecosystem.

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