



Preliminary assessment on water quality and biodiversity in and around Palak Dil in southern Mizoram, India

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ABSTRACT

The present study was conducted during March to September 2013 at Palak Dil, the largest lake in Mizoram, which is located between 92°52'-92°55'E longitude and 22°10'-22°13'N latitude in the remote part of Mara Autonomous District Council in the southern part of Mizoram near the border of Indo-Burma hotspots region. The Palak Dil is a nationally recognized natural lake and the catchment area is approximately 18.5 sq km and the total water body is around 1.5 sq km only. The water quality, *viz.* temperature, pH, total dissolved solids, electrical conductivity, acidity, alkalinity, dissolved oxygen, biological oxygen demand, carbon dioxide, total hardness, chloride, nitrate, phosphate and iron were analyzed and found that all the parameters are within the standard limits given by various scientific agencies, but the water is not pure as expected. This can be accrued to the developmental works that were undergoing around the lake. Study on biodiversity was carried out by field enumeration, collection and identification of the flora and fauna. It was observed that the ecosystem in which birds and animals living there is gradually degrading due to anthropogenic activity and developmental works.

Key words: Assessment; water quality; biodiversity; Palak Dil; Mizoram.

INTRODUCTION

Lakes are one of the important natural wetlands. Wetlands are the transitional zones that occupy the intermediate position between dry land and open water. They encompass diverse and heterogeneous habitat ranging from rivers flood plains and rain fed lakes to swamp, estuaries, and salt marshes.¹ Generally, wetlands com-

munities are highly dynamic as they are located at the interface of terrestrial and aquatic ecosystem. The species richness and the biodiversity in such area are quite high, as they offer special habitat for many macrophytes, planktons, invertebrates, and vertebrates. The richness is mainly attributed to the spatial heterogeneity, that is, the greater the number of niches the greater is the opportunity for successful invasion by species. Due to developmental activities and needs for human consumption, the ecology of wetlands is depleting in different ways. Mizoram is

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one of the north-eastern States of India having a total geographical area of 21,081 sq km with a small population of 1,091,014, the density being 52 per sq km.² Developmental works that were going-on can severely affect the ecological aspects of the wetland. Palak Dil is a small but a recognized national wetland in Mizoram. Lakes are locally called “Dil”. There are just a few such ‘Dil’ which scattered here and there, but they are tiny pools or marshy depressions, such as, Rengdil (0.6 sq km radius), Rungdil (0.75 sq km radius), Diltlang (0.5 sq km radius), Hmawngbu (0.7 sq km radius) and Tamdil (0.8 sq km radius).³

MATERIALS AND METHODS

Study site

Palak Dil is located between 92°52'- 92°55'E longitude and 22°10'-22°13'N latitude. The lake

is unique and pristine in nature and situated in a remote part of the Mara Autonomous District Council in Saiha District in the international border of Indo-Burma hotspots region and falls under the Palak Wildlife Sanctuary of Mizoram (Fig. 1). The distance from Aizawl is 390 km to the south and 97 km from Saiha, the district headquarters. The catchment area is approximately 18.5 sq km and the total water body is around 1.5 sq km. The Mara community called the lake as “Pala Tipo”. Pala Tipo is the only natural lake in Mizoram and is fairly rich in flora and fauna. The lake lies in between Phura and Tokalo villages; and the Tokalo Village Council (the grass root governance institution) is responsible for regulating the use of the lake as well as the land and forests surrounding it. Beyond the lake and towards Myanmar lie large swathes of forests that are exposed to very limited and low intensity local use.

Water quality

The water samples were taken from five sampling sites, viz., Site-1 (East), Site-2 (North), Site-

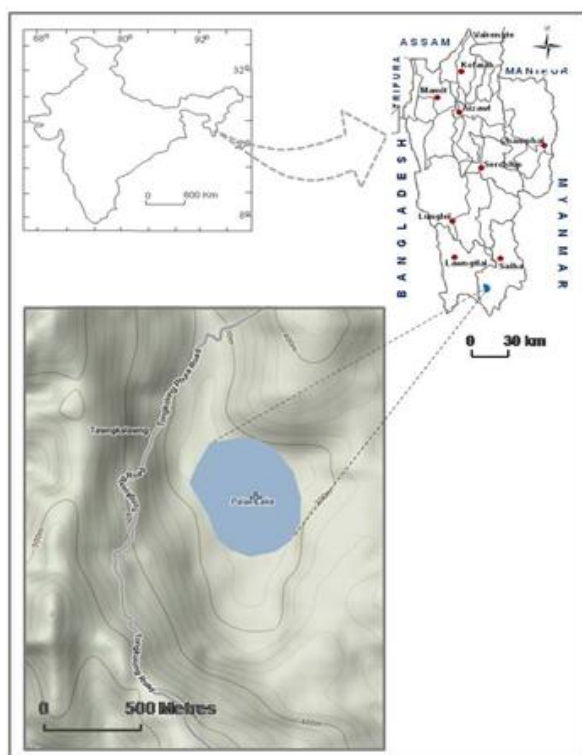


Figure 1. Location map of Palak Dil.



Figure 2. Photograph of Palak Dil.

3 (West), Site-4 (South) and Site-5 at the centre of the lake every two months from March- September 2013. The American Public Health Agency (APHA) 1998 was employed for analyzing the water quality.⁴ All the water samples were tested in the field by Hanna Soil & Water Analysis Kit, except iron and biological oxygen demand which were tested in the laboratory of PHE Department, Saiha.

Biodiversity

Biodiversity was studied by field investigation, collection and identification of the flora and fauna during the study period. Plant collection and processing was done using standard methods given by Bridson and Forman,⁵ Jain and Rao⁶ and Womersly⁷. Zoological specimens were identified with the help from Department of Zoology, Mizoram University, Aizawl, and Zoological Survey of India, Kolkata.

RESULTS AND DISCUSSION

Water quality

The water sample collected from five different sampling sites were analyzed by using portable Hanna Water Testing Kit for the physico-chemical properties of water, viz. temperature, pH, electrical conductivity (EC). Total dissolved solids (TDS), acidity, alkalinity, carbon dioxide, (CO₂) dissolved oxygen (DO), biological oxygen demand (BOD), total hardness, nitrate, phosphate, chloride and iron. All the water samples were tested at the field itself except iron biological oxygen demand for want of appropriate equipments but were tested in the laboratory. The average reading taken from all the sites during March–September 2013 is presented in Table 1, and histograms showing the physical and chemical parameters in Fig. 3 and 4.

Temperature decreases from April due to change in season and decrease in surface temperature. There was a slight decrease in pH and alkalinity possibly due to increase in water vol-

ume which was raised by construction of 1m high retention wall above the natural water volume during rainy season which decreases the ion concentration in the water. The same reason was found with the results of TDS which decreases from March to September. Acidity was found to be lowest in May-June. Dissolved oxygen was almost same during the sampling period, but the reading was low rather than expected. However, all the parameters were found within the standard limits given by World Health Organization.

Biodiversity

Biodiversity was studied by field investigation, collection and identification of the flora and fauna during the study period.

Flora

The lake is bounded by tropical evergreen mixed with moist deciduous forests. The flora in and around the Palak Dil was reported by Lalramnghinglova *et al.*⁸ The dominant and emergent species is *Dipterocarpus retusus*. The highly valued timber yielding species include *Dipterocarpus turbinatus*, *Terminalia myriocarpus*, *Gmelina orborea*; ethno-medicinal plants include *Bombax insigne*, *Carralia brachiata*, *Dendroxnide sinuata*, *Anacolosa cresipes*, *Bacauria sapida*, *Psychotria calocarpa* and *Buettneria aspera*, *Pasderia foetida*, *Mikania micrantha* among climbers; and, *Trapa natans* var. *bisnosa*, *Hydrilla* and tall reeds among macrophytes. The common plant species are presented in Table 2-5.

Fauna

Robertson,⁹ a Scottist naturalist reported the avifauna of Palak Dil in 2006. The list of birds include *Buceros bicornis*, *Anthracoceros albirostris*, *A. malabaricus*, *Garullex leucoluphus*, *Polyplectron bicalcaratum*, *Trachybaptus ruficollis*, *Gallus gallus*, *Ardeo grayii*, *Porphyrion porphyrio*, and *Upupa epops*. Migratory birds used to visit this place;

Table 1. Water quality of Palak Dil (April- September 2013). n=5.

Parameters	Months		
	March–April	May–June	July–Sep
Temperature °C	32	30.2	29.4
pH	8.0	8.3	6.5
Electrical Conductivity	70	77	57
TDS ppm	51.03	39	28
Acidity mg/l	2	1	2
Alkalinity mg/l	8	6	4
Carbon dioxide	2	4	4
Dissolved oxygen	5.8	5.2	5.6
Biological oxygen demand	3.4	3	3
Total hardness	6	8	8
Nitrate mg/l	>47	>47	>47
Iron mg/l	1	1	1
Chloride	8	10	10
Phosphate	0.42	0.46	0.44

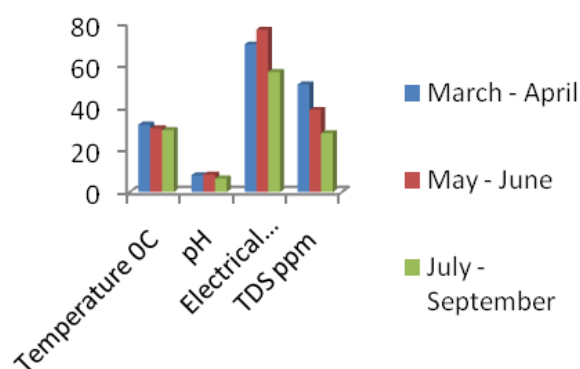


Figure 3. Graph showing physical parameters.

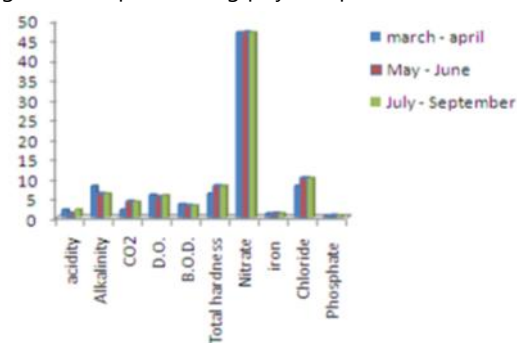


Figure 4. Graph representing chemical parameters.

Table 2. Common tree species in and around Palak Dil.

Scientific name	Family	Local name
<i>Albizzia procera</i> Roxburgh	Mimosaceae	Kangtek
<i>Artocarpus chaplasha</i> Roxburgh	Moraceae	Tatkawng
<i>Artocarpus lakoocha</i> Roxburgh	Moraceae	Theitat
<i>Chukrasia tabularis</i> Anthony Juss	Melaiceae	Zawng-tei
<i>Dipterocarpus retusus</i> Blume	Dipterocarpaceae	Thingsen
<i>Dipterocarpus turbinatus</i> Gaertn C.F	Dipterocarpaceae	Lawngthing
<i>Dendrocnide sinuate</i> Blume	Urtacaceae	Thakpui
<i>Duabanga grandiflora</i> (DC.) Walpers	Sonneratiaceae	Zuang
<i>Ficus</i> sp.	Moraceae	Hmawng
<i>Gmelina arborea</i> Roxburgh	Verbenaceae	Thlanvawng
<i>Haematocarpus validus</i> Miers	Menispermaceae	Theichhungsen
<i>Lagerstromia speciosus</i> Persoon	Lythraceae	Thlado
<i>Mesua ferra</i> Linneus	Clusiaceae	Herhse
<i>Michelia champaca</i> Linneus	Magnoliaceae	Ngjau
<i>Schima wallichii</i> Choisy, J.D	Theaceae	Khiang
<i>Terminalia myriocarpa</i> Van Heurck & Mueller Argoviencis	Combrataceae	Char
<i>Tetrameles nudiflora</i> R. Br.	Datisceae	Thingdawl
<i>Toona ciliate</i> Roemer, M.J	Meliaceae	Teipui
<i>Willughbeia edulis</i> Roxburgh	Apocyanaceae	Vuakdup

Table 3. Climbers and herbs.

Scientific name	Family	Local name
<i>Bacaura ramniflora</i> Loureiro	Euphorbiaceae	Pangkai
<i>Clerodendrum infortunatum</i> Linnaeus	Verbanaceae	Phuihnamchhia
<i>Cheilocostus speciosus</i> C. Specht	Costaceae	Sumbul
<i>Homalomena aromatic</i> Schott	Araceae	Anchiri
<i>Mikania micrantha</i> Kunth	Compositae	Japanhlo
<i>Pandanus pseudofortis</i> Martelli	Pandanaceae	Ramlakhuithiei
<i>Phrygnium placentarium</i> Blume	Marantaceae	Hnahtial

Table 4. Cane species.

Scientific name	Family	Local name
<i>Arenga pinnata</i> Merrill	Arecaceae	Thangtung
<i>Bambusa tulda</i> Roxburgh	Poaceae	Rawthing
<i>Borassus flabellifer</i> Linnaeus	Arecaceae	Siallu
<i>Calamus erectus</i> Roxburgh	Arecaceae	Thilthek
<i>Calamus flagellum</i> Griffith, W.	Palmae	Hruipui
<i>Calamus tenuis</i> Roxburgh	Arecaceae	Thilte
<i>Caryota mitis</i> Loureiro	Arecaceae	Meihle
<i>Caryota urens</i> Loureiro	Arecaceae	Tum
<i>Daemonorops jenkinsiana</i> Griffith, W.	Arecaceae	Raichhawk
<i>Dendrocalamus longispatus</i> Kurz, W.S	Poaceae	Rawnal
<i>Salaca secunda</i> Griffith, W.	Arecaceae	Hruitung

Table 5. Aqua flora.

Scientific name	Family	Local name
<i>Eichhornea sp.</i>	Pontederiaceae	Dumpar
<i>Hedychuim Gracile</i> Roxburgh	Zingiberaceae	Aichhia
<i>Lasia spinosa</i> Thw.	Araceae	Zawngzang

Table 6. The common animals of Palak Wildlife Sanctuary.

Reptiles	Family	Birds	
<i>Calotes vesicolor</i>	Agamidae	<i>Anthraceros alborosthris</i>	Bucerotidae
<i>Chrysopelea ornate</i>	Culubridae	<i>Buceros bicornis</i>	Bucerotidae
<i>Cosymbotus patyrus</i>	Gekkonidae	<i>Ceyx erithacus</i>	Alcenidae
<i>Draco maculates</i>	Agamidae	<i>Cyprinus</i> sps.	Cyprinidae
<i>Hemidactylus frenatus</i>	Gekkonidae	<i>Cuculus</i> sp.	Cuculidae
<i>H. garnoti</i>	Gekkonidae	<i>Dendrocygna janica</i>	Dendrocygnidae
<i>Manouria emys</i>	Testunidae	<i>Gallinula chloropus</i>	Podicipitidae
<i>Ptychozoon lionotum</i>	Gekkonidae	<i>Gallus gallus</i>	Phasianidae
<i>Ptyctolaemus gularis</i>	Agamidae	<i>G. chloropus</i>	ralidae
<i>Python reticulates</i>	Boidae	<i>Loriculus vernalis</i>	Psittacidae
<i>Ramphotyphlops braninus</i>	Typhopidae	<i>Meglaima viren</i>	Meglaimidae
<i>Rhaphodphis subminiatus</i>	Colubridae	<i>Nyctyornis athertoni</i>	Meropidae
<i>c.cf.alticristataus</i>		<i>Picus chlorophis</i>	Picidae
<i>Varanus bengalensis</i>	Scinidae	<i>Podiceps ruficollis</i>	Podicipitidae
		<i>Polyoectron bicalcaratum</i>	Phasiandae

Common Animals species	
<i>Berylmys boversi</i>	Muridae
<i>Callosciurus erythracus</i>	Sciuridae
<i>Capricornis rubidus</i>	Bovidae
<i>Hoolock gibbon</i>	Hylobatidae
<i>Macaca spp.</i>	Cercopithecidea
<i>Muntiacus vaginalis</i>	Cervidae
<i>Pardofelis marmolata</i>	Felidae
<i>Prionai bengalensis</i>	Felidae
<i>Rusa unicolor</i>	Cervidae
<i>Ratufa bicolor</i>	Sciuridae
<i>Sus scrofa</i>	Elephantidae
<i>Tamiops mmaccllellandi</i>	Sciuridae

over 70 species of birds were recorded from the area during a three day IBA survey,¹⁰ while the presence of 136 species of avifauna and 42 species of mammals including rare and threatened primates like the Phayre's leaf monkey (*Trachypithecus obscurus phayrei*) and the Western hoolock gibbon (*Hoolock hoolock hoolock*).¹¹ Reptiles such as snakes and lizards and amphibians were found near the lake. A variety of fish exists in the lake, some of which were locally found, others being introduced. The lake is abounding with reeds, fishes and few crabs. Bear, tiger, deer, wild pig are common animals. In Mizoram, Palak Dil is the only abode of aquatic birds, with the wild duck of few species. Common animals are presented in Table 6.

CONCLUSIONS

Palak Dil has a unique feature of biodiversity richness which differs from a survey conducted by Lalramnghinglova in 2003 and 2006 that the lake losses its value as the water quality and biodiversity are degraded. The water quality was expected to be very pure but it was found that the water quality is degrading due to developmental works and human interventions. Migratory birds which lodged on Ficus trees growing in the lake which were died because of raising up of the water volume which submerged the Ficus trees retarded the visits of migratory birds. More research is needed to see that if this is the keystone species for migratory birds that may

halt their visitations. This leaves the area marshy where *Eichhornea crasipes* grows on it. The area is very odorous and makes the water very dirty. The pathways, rest house and viewpoints that were made near the lake also pollute the water. Apart from the terrestrial vegetation, aquatic plants mainly hydrophytes are floating on the lake surface. These hydrophytes played a significant role in the lake ecology, since the roots of these species (*Trapa natans* var. *bipinosa*) acts as purifier of water, thus preventing the water from ferruginous. Alien species of fish introduced to the lake competes with the indigenous species. The indigenous species losses their chance of survival, so, they are almost extinct from the lake. A couple and a calf of wild elephants that were survived in 2003 no longer exists in the sanctuary in 2013. Human-induced alteration of the ecosystems disrupt the ecological balance. In situ biological conservation and eco-restoration is paramount important and need of the hour before it further deteriorates the wetland, biodiversity and bio-aesthetic value.

The present investigation provides a preliminary data which laid upon a base line data for monitoring the water quality and the biodiversity of the sanctuary.

SUGGESTIONS AND RECOMMENDATIONS

- 1) The most important thing is to lower the water level and try to restore the original ecosystem by nature conservation and re-introduction processes.
- 2) Construction of alternative approach route to Miepu and Tokalo villages through Border Development Works is recommended with prior consent by giving awareness to the local people.
- 3) Replacement of exotic fish species by re-introduction of indigenous fish species.
- 4) Rest House is very near from the lake; human sound and music played by student- visitors will surely chase away the animals, so it should be prohibited.
- 5) Settlements, if any be made, at least half a kilometer away from the lake is desirable

- to avoid discrimination to the animals.
- 6) Many on-going developmental works degrade the environment, pollute the water quality and disturb the unique biodiversity. So, preserving the lake and its area in its natural entity would be most desirable and attractive to the visitors to fetch earnings.
 - 7) Engagement of local tourist guides can generate better income than the disastrous socio-economic ruin of the retaining wall of the lake.
 - 8) If development works must go on, national eco-tourism norms should be followed, keeping in mind the future generations; and try to manage with least destruction of the natural beauty.
 - 9) Clearance of the peripheral region of the lake beyond 2 m is not advocated.

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