Wetland flora of Betkot lake, far western Nepal

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ABSTRACT
The tropical wetland flora from western Nepal is less explored in comparison to the temperate and alpine region. This study was therefore undertaken to document the vascular plants found on the foot trail of surrounding Betkot Lake, in Chure (Siwalik) hills of Kanchanpur in far western Nepal. The study documented a total of 63 plant species of 40 families belonging to 4 life forms: herbs (31 species), shrubs (14 species), trees (15 species) and climbers (3 species). This present study could be a baseline for further research.

Keywords: Betkot lake, flora documentation, wetland vegetation

INTRODUCTION
The Ramsar Convention in 1971 uses a broad definition of the types of wetlands covered in its mission, including swamps and marshes, lakes and rivers, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans (http://wwf.panda.org/what_we_do/how_we_work/policy/conventions/ramsar/). Wetlands are regarded as the most productive and dynamic ecosystem of the earth and also called as biological supermarket, natural infrastructure, kidneys of the landscape, carbon dioxide sink and climate stabilizer. Nepal Biodiversity Strategy 2002 has recognized wetland as one of the sectoral strategies (others are forest, conserved area, rangeland, mountain and agriculture). The wetlands are in vulnerable status around the world. In fact, wetlands are not wasting land, but they are waiting land (Bhandari et al., 1994).

Nepal is rich in wetlands. It has 6,000 rivers and 5,358 lakes (http://www.nepallake.gov.np/). There are some studies about flora of wetlands in Nepal. Siwakoti (2006) recorded 720 species of vascular plants from the study of wetland flora of Terai regions. Sah (1997) summarized the biological resources of Koshi Tappu Wildlife Reserve, eastern Terai. Likewise, Lamsal et al. (2014) documented 45 species of aquatic macrophytes and 54 species of terrestrial/riparian species from the study of Ghodaghodilake of Kailali district. In addition to Terai wetlands, wetland flora of Chitwan (Dangol, 2000-2001; Dangol et al., 2014) and Myagdi (Basnet et al., 2012) were also reported. The information about wetland flora of Nepal is not sufficient (Bhandari, 2008; Siwakoti, 2006). The tropical wetland flora from the Western part of Nepal is less explored in comparison to the temperate and alpine region. Hence, this study was conducted to document the plants of the Betkot lake area to provide baseline information useful for the 'Nepal Flora' publication.
MATERIALS AND METHODS

Study area

The scenic Betkot lake has special value for maintaining genetic and ecological diversity that merit legal protection (MFSC, 2002). It is situated at Daijee-5, Kanchanpur district at the altitude 490 m asl, having water body size 4 ha. and 915 m perimeter including foot trail, representing the geologically and hydrologically fragile Chure/Siwalik region. The study route was the complete foot trail of the lake. It can be reached by Kathmandu-Dhangadi-Daijee-Betkot.

Plant collections

Plants samples (mainly phanerogams, however ferns and mushrooms) were collected during February 1-4 and June 21-24 of 2013 following standard plant collection methods. Plants were identified with the help of experts and standard literatures (Stainton, 1972; Bhandari, 1998; DPR, 2001, 2002; Siwakoti, 2006;, Basnet et al., 2012; Fraser-Jenkins et al., 2015) and the deposited herbarium in the National Herbarium and Plant Laboratories (NHPL/KATH), Lalitpur.

FIG. 1a. Map of study area.
RESULTS AND DISCUSSION

A total of 63 plant species representing 40 families were recorded from the present study area (table 1). Of the total species, majority were angiosperms (60 species) and the rest were ferns (2 species) and mushroom (1 species). Asteraceae was the largest family with 6 species followed by Fabaceae (4 species), and Solanaceae, Malvaceae, Acanthaceae (3 species). The rest 35 families composed of 1-2 species. Among the total plants, Agele marmelos (Bel), Ficus religiosa (Pipal) and Sesamum indicum (Til) were the religious plants. These plants were occurred because of a great religious spot for the Hindus especially in ‘Shiva Ratri’ (Lord Shiva’s Night). Likewise, present study also recorded some common medicinal plants such as Achyranthes aspera (Datiwan), Xeromphis spinosa (Mainphal), Syzygium cumini (Jamun), and Phyllanthus emblica (Amala). Quisqualis indica L. (Combretaceae) and Lygodium japonicum (Lygodiaceae) were the two climbers with aesthetic ornamental value. The uses of plants of Beeshazar Tal and Rampur Ghol was also reported as medicine, food, aesthetic, fodder, fuelwood, etc. (Dangol, 2000-2001; Dangolet al., 2014). The Ageratum conyzoides and Parthenium hysterophorus were two invasivespecies recorded in the study area. Different invasive species (such as Mikania micrantha, Ageratum houstonianum, Eichhorna crassipes) were reported from other wetlands of Nepal (Dangolet al., 2014).

Betkotlake shows typical tropical forest type with Shorea robusta, Haldina cordifolia, Mallotus philippensis, Syzygium cumini, and Bombax ceiba. This study added information on plant species which is helpful to understand the wetland flora. Further research is recommended to study the aquatic and semi-aquatic plants including algae of the area to understand the total plant life of the lake to generate the baseline information (local flora) for the ‘Nepal Flora’ publication.
TABLE 1. Plant species from Betkot Lake, far western Nepal.

| S.N. | Scientific name | Family | Local name | Life forms | Coll. nr. |
|------|-----------------|--------|------------|------------|-----------|
| 1.   | Achyranthes aspera L. | Amaranthaceae | Datiwan | Herb | 05 BT |
| 2.   | Agele marmelos (L.) Corr | Rutaceae | Bel | Tree | 09 BT |
| 3.   | Ageratum conyzoides L.¹ | Asteraceae | Gandhe | Herb | 022 BT |
| 4.   | Aleuritopteris bicolor (Roxb.) Fraser-Jenk. | Pteridaceae | Fern | Herb | 031 BT |
| 5.   | Amanita sp. | Amanitaceae | Chyau | Herb | 049 BT |
| 6.   | Arisaema intermedium Bl. | Araceae | Sarpakomakai | Herb | 015 BT |
| 7.   | Artemisia vulgaris L. | Asteraceae | Pati | Herb | 031 BT |
| 8.   | Bident spilosa L. | Asteraceae | Kurro | Herb | 032 BT |
| 9.   | Bombax ceiba L.² | Bombaceae | Simal | Tree | 044 BT |
| 10.  | Canscora decussate Schult. | Gentianaceae | Aakankuriphul | Herb | 037 BT |
| 11.  | Capillipedium assimile (Steud.) A. Camus | Poaceae | Musa khari | Herb | 028 BT |
| 12.  | Cassia fistula L. | Fabaceae | Rajbriskya | Tree | 035 BT |
| 13.  | Cassia tora L. | Fabaceae | | Shrub | 033 BT |
| 14.  | Centella asiatica (L.) Urb. | Apiaceae | Ghodtapre | Herb | 039 BT |
| 15.  | Cissamo pelospareira L. | Menispermaceae | Batulpate | Climber (Herb) | 038 BT |
| 16.  | Clerodendrum indicum (L.) Kurtze | Verbenaceae | Bhargi | Shrub | 046 BT |
| 17.  | Colebrooke aoppostifolia Sm. | Lamiaceae | Dhashure | Shrub | 036 BT |
| 18.  | Colocasia sculenta (L.) Schott. | Araceae | Jaluko | Herb | 033 BT |
| 19.  | Crotalaria albidaHeyne ex. Roth. | Fabaceae | Pataliphul | Herb | 037 BT |
| 20.  | Curculigo orthioides Gaertn. | Hypoxidaceae | Kalomusali | Herb | 055 BT |
| 21.  | Cyperus rymbosus Rottb. | Cyperaceae | Mothe | Herb | 062 BT |
| 22.  | Dioscore abulbifera L. | Dioscoreaceae | Githetarul | Herb | 048 BT |
| 23.  | Diospyros smalabarica (Desr.) Kostel | Ebenaceae | Khallu/Tezu | Tree | 056 BT |
| 24.  | Diploknema butyraceae (Roxb.) H.J. Lam.³ | Sapotaceae | Chiuri | Tree | 064 BT |
| 25.  | Ficus religiosa L.⁴ | Moraceae | Pipal | Tree | 039 BT |
| 26.  | Flemingia paniculata Wall. ex. Benth. | Fabaceae | | Herb | 044 BT |
| 27.  | Gossypium arboreum L. | Malvaceae | Kupas | Tree | 07 BT |
| 28.  | Grangea maderaspatana (L.) | Asteraceae | | Herb | 029 BT |
| No. | Scientific Name | Family | Common Name | Growth Form | BT |
|-----|----------------|--------|-------------|-------------|----|
| 29. | *Haldina cordifolia* (Willd.exRoxb.) Ridsdale | Rubiaceae | Haldu/Karma | Tree | 08 BT |
| 30. | *Hemidesmus indicus* R.Br. | Asclepiadaceae | Anantmul | Herb | 040 BT |
| 31. | *Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don⁵ | Apocynaceae | Indrajau | Shrub | 031 BT |
| 32. | *Hygrophila aurialata* (Schumach) Hein. | Acanthaceae | Herb | 057 BT |
| 33. | *Lagerstroemia parviflora* Roxb. | Lythraceae | Bod Dhayro | Tree | 035 BT |
| 34. | *Lepidagathis incurva* Buch.-Ham. ex D. Don | Acanthaceae | Herb | 03 BT |
| 35. | *Lygodium japonicum* (Thum.) Sw. | Lygodiaceae | Fern | Climber (Herb) | 017 BT |
| 36. | *Mallotus philippensis* (Lam.) Muell.-Arn. | Euphorbiaceae | Sindhure | Tree | 049 BT |
| 37. | *Mangifera indica* L. | Anacardiaceae | Aanp | Tree | 050 BT |
| 38. | *Murraya koenigii* (L.) Spreng. | Rutaceae | Mithanim | Shrub | 044 BT |
| 39. | *Nerium indicum* L. | Apocynaceae | Karvir | Shrub | 047 BT |
| 40. | *Parthenium hysterophorus* L.¹ | Asteraceae | Herb, | 011 BT |
| 41. | *Persicaria barbata* (L.) H.Hara | Polygonaceae | Herb | 062 BT |
| 42. | *Phyla nodiflora* (L.) Greene | Verbenaceae | Herb | 064 BT |
| 43. | *Phyllanthus emblica* L.⁵ | Euphorbiaceae | Amala | Tree | 040 BT |
| 44. | *Pogostemom benghalenis* (Bur.m.f.) Kuntze. | Lamiaceae | Rudilo | Herb | 057 BT |
| 45. | *Psidium gujava* L. | Myrtaceae | Amba | Tree | 034 BT |
| 46. | *Quisqualis indica* L.⁶ | Combretaceae | Climber | 025 BT |
| 47. | *Rungia parviflora* (Retz.) Nees | Acanthaceae | Ukuchejhar | Herb | 022 BT |
| 48. | *Salix babylonica* L. | Salicaceae | Bains | Tree | 053 BT |
| 49. | *Schleichera oleosa* (Lour.) Okm | Sapindaceae | Kusum | Tree | 039 BT |
| 50. | *Semecarpus anacardium* L.f. | Anacardiaceae | Bhalayo | Tree | 030 BT |
| 51. | *Sesamum indicum* L.⁴ | Pedaliaceae | Till | Herb | 04 BT |
| 52. | *Shorea robusta* Gaertn.⁷ | Dipterocarpaceae | Sal | Tree | 019 BT |
| 53. | *Sida rhombifolia* M. Wight & Arn | Malvaceae | Herb | 016 BT |
| 54. | *Smilax zeylanica*L. | Liliaceae | Kukurdiano | Climber (Shrub) | 08 BT |
These species represented 31 herbs, 16 shrubs, 15 trees and 3 climbers (fig. 1). Dominance of herbs in the wetland study areas in Nepal were also reported by other authors (Sah, 1997; Siwakoti, 2006; Dangol et al., 2014; Lamsal et al., 2014).

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