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Taxonomic Enumeration of Natma Taung National Park Vol. 1

Makinoa New Series
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The Kochi Prefectural Makino Botanical Garden, Japan
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Taxonomic Enumeration of Natma Taung National Park Vol. 1

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The Kochi Prefectural Makino Botanical Garden (MBK) & Forest Department (FD)

Foreword

I am delighted to have the opportunity to write a foreword for the annotated checklist entitled *Taxonomic Enumeration of Natma Taung National Park Vol. 1*.

Myanmar lies at the convergence of different ecoregions, resulting in remarkable ecological diversity and species richness. Conservation, effective management, and sustainable use are primary objectives to preserve the biological resources of Myanmar. Scientific information is the core element in conserving and managing biodiversity effectively. In this regard, the Forest Department (FD) is promoting scientific cooperation and joint research on biodiversity with international and national organizations.

The *Taxonomic Enumeration of Natma Taung National Park* is one of the fruitful results of scientific cooperation and research between the FD and the Kochi Prefectural Makino Botanical Garden (MBK) which focuses on plant diversity. This checklist is an extremely useful and important document for biological conservation in Natma Taung area.

Furthermore, this is a welcome contribution, because the more we know about the flora of Myanmar, the greater the potential to conserve and manage these valuable forest resources. I do believe that this checklist will become a valuable resource for educational purposes, a good reference for botanists and conservationists.

Last but not least, I offer my sincere gratitude to MBK for diligence and scientific rigor in producing the *Taxonomic Enumeration of Natma Taung National Park* and for enduring efforts to understand and conserve biodiversity of an important protected area. It is my hope that the FD and MBK can produce more publications from long and continuous scientific cooperation and research on the biodiversity of Myanmar.

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Preface

Myanmar is home to an array of ecosystems, from tropical forests along the coast to alpine vegetation in the north, leading to its rich plant diversity, with over 16,000 estimated species of vascular plants. The Kochi Prefectural Makino Botanical Garden (MBK) started a joint research venture with the Forest Department of the Ministry of Forestry (currently, the Ministry of Natural Resources and Environmental Conservation), Myanmar, to unravel the plant diversity in Myanmar, by signing a memorandum of understanding in 2000.

We carried out an inventory program by collaborating with scientists and staff belonging to international and local organizations, with expeditions to Chin, Shan, Kachin, Kayin, Sagaing, and Mandalay. So far, approximately 32,000 specimens have been collected. As a result, a checklist of flowering plants in Mt. Popa was published and several new species have been described. One of the focal areas of our field expedition was the Natma Taung National Park. We started a field inventory in March 2002 and collected more than 15,500 specimens in the area in collaboration with international and local botanists.

In line with these activities, with great pleasure, the MBK is publishing the first volume of Enumeration of Natma Taung National Park Myanmar, focusing on pteridophytes and gymnosperms. I believe that this, together with the following volumes on angiosperms, will be an important step toward unraveling the flora of Myanmar. It will also help in diversity conservation and sustainable utilization of plant resources in Myanmar.

I would like to express my sincere thanks to Dr. Tetsuo Koyama, a former Director General of MBK, for the leadership to commence and operate our “Flora of Myanmar” project and to all the scientists and staff who are engaged in the project under harsh environment.

Hajime Mizukami, Ph.D.
Director General
The Kochi Prefectural Makino Botanical Garden

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Part 1. Overview of Natma Taung National Park

Rhododendron arboreum Sm.

Water Environment and Land Use in Natma Taung National Park

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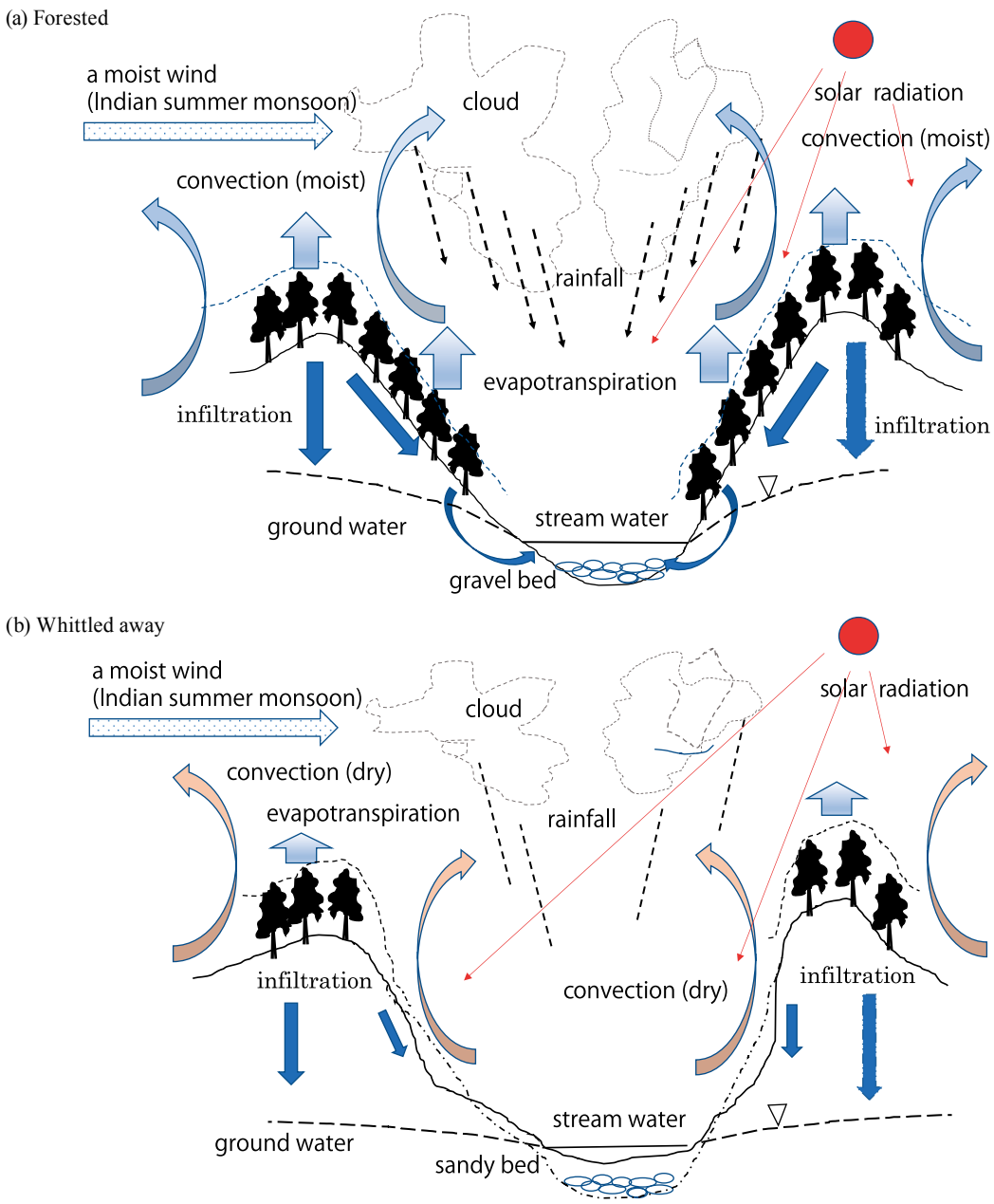
Rainfall and hydrological cycle

Although there is a brief risk of water shortage in the Ayeyarwady river basin every February, data collected between 1996 and 2005 indicate that water is otherwise stable throughout the year (Hoekstra & Mekonnen 2011). Over the long term, however, the flow volume of the basin shows a significant declining trend when compared to records from the 1870s (Furuuchi et al. 2009). Past rainfall data for the Southern Chin State has never been recorded, but the annual rainfall for Falam and Hakha in Northern Chin State is 1,457 mm and 1,811 mm, respectively (MNPED 2010). In addition, the annual rainfall in the western part of the State reaches 4,000–6,000 mm due to the Indian summer monsoons (FAO 2015). In Mindat, the wet season starts in April and continues until October (Weather Outlook 2015). As a consequence, the water retaining function of forests is important for preserving water resources during the dry season. Indeed, reduction in forest cover due to slash-and-burn agriculture during the 1990s and early 2000s has been a concern for maintaining both water quality and quantity (Fujino et al. 2013). However, minimal deforestation occurred in the Chin State between 2001 and 2010 (0.28%), and currently, it is the most protected region in Myanmar (Wang & Myint 2016).

The Natma Taung National Park contains extensive broad-leaved forests, and evapotranspiration from these forests plays an important role in the regional water budget. Due to its steep topography, the regional water cycle is easy to establish and measure (Fig. 1). Theoretically, approximately 40% of rainfall in forested areas cycles back into the atmosphere as evapotranspiration, 25% is transferred to the shallow and deep soil layers as infiltration, while 10% is discharged to river catchments (Allan & Castillo 2007). Therefore, when forests are destroyed through slash-and-burn agriculture, transpiration rates decrease and discharge and infiltration rates into the catchments increase substantially. Over the long term, decreasing evapotranspiration contributes to declining rainfall, which in turn affects the quantity of water retained in the system, eventually resulting in decreasing river flows. On the other hand, sudden heavy rainfall can cause landslides in such steep topography. For example, in August 2015, western Myanmar experienced the largest rainfall event ever recorded, causing widespread damage and landslides throughout the region, including the Chin State.

Appropriate forest management can help to mitigate the effects of such disasters, especially from unpredictable weather patterns that are expected to increase due to climate change, such as irregular rainfall and storm events. However, the poorly planned widening of arterial roads and mountain track linking of Mindat to the Magway Region have impacted entire slope faces, exacerbating the effects of heavy rainfall, and leading to an increased likelihood of landslides. The effects of these projects also have had a major effect on biodiversity in the region.



Figs. 1. Changes in hydrological cycles with loosing in catchment.

Water quality and river environment

The Chee river catchment provides high quality water to local people and communities, with an annual water temperature between 12 and 26ºC at 735 m altitude near Mindat (Fig. 2). The diurnal range of the surface water temperature is 3–5ºC (Fig. 3). The water chemistry (pH) and electric conductivity (EC) are stable throughout the year, with pH ranging between 7.5–8.0 and

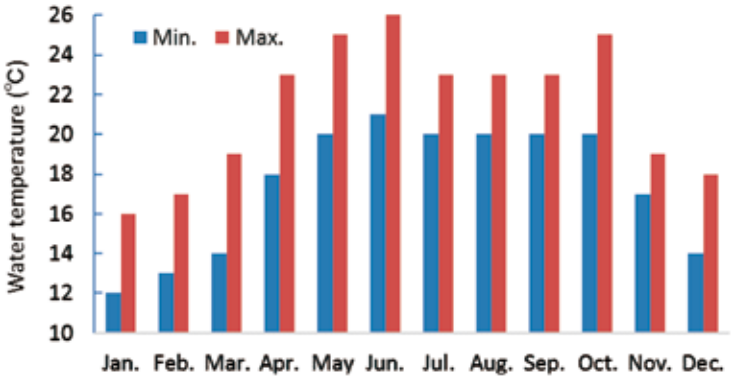


Fig. 2 Annual Chee river water temperature in 2013.

Table 1. Electric components and hardness of streams and rainwater in 2014.

	Chee-C Mindat	Chee-C Magway	Saw-C Kampetlet	Rainfall Kampetlet
Na, mg/L	9.5	10.9	4.5	1.1
NH_4, mg/L	0.0	0.0	0.0	0.0
K, mg/L	0.7	1.0	0.1	0.6
Mg, mg/L	6.2	6.9	3.4	0.2
Ca, mg/L	38.6	45.1	37.2	1.2
Hardness, mg/L	122	141	107	4

At pH 7.5-8.0

EC varying between 0.1 and 0.2 mS/cm. Dissolved calcium (38 mg/L) and magnesium ions (6.2 mg/L) are in the middle of the hardness range, according to WHO guidelines. The EC of the rainwater at Kanpetlet was 0.032 mS/cm, indicating that there is much less aerial pollution there than in urban areas (Table 1). Nevertheless, alterations to the riverscape (see below) have been confirmed from recent observations.


Fig. 3. Chee river before excessive precipitation in August 2015, Mindat (Feb. 7, 2015).

Planarization of the riverbed;

Due to annual large-scale heavy rainfall in recent years, the shape of the Chee river has been altered, and the gap in the riverbed has been filled by fine soil, which has been transferred to the catchment from the surrounding mountain slopes. In the hot season between April and May, filamentous algae grow in areas of slow current along the riverside. Nutrients supplied from slash-and-burn agriculture are inferred (Figs. 4 & 5).

Pollution from organic substances is induced, and the microhabitats of various benthic invertebrates are affected or destroyed. Overall, diversity in the aquatic biota is reduced, which in turn contributes to a decrease in predatory fish species.

Fig. 4. Chee river after excessive precipitation in August 2015, Mindat (Nov. 26, 2015).

Fig. 5. Vagrant filamentous algae on Chee river bed, Mindat (May 15, 2016).

Hydropower construction without environmental impact assessments

Fig. 6. Hydropower dam construction at Saw river (Mar. 4, 2014).

The construction of a dam for hydropower began in 2014 on the Saw river near Kanpetlet, but no environmental impact assessment was completed prior to beginning production. In addition, baseline investigations of the flow regime and sediment transport have not been conducted. Subsequently, construction was suspended due to a large-scale flood in August 2015. Due to the steep topography in the catchment and deforestation, it appears that infilling the dam is inevitable. Moreover, crude construction techniques and poor development planning have led us to conclude that the dam footprint likely will have considerable environmental impacts (Fig. 6) .

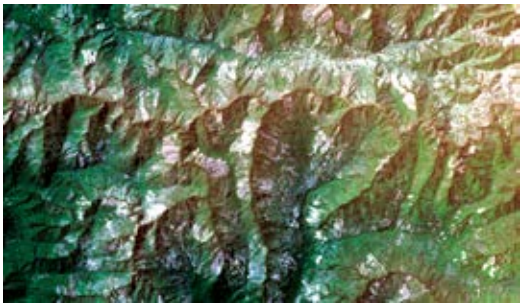
No scientific information for water supply source

The first water supply system in Mindat was constructed in the 1970s, and it is located far from the center of the village. Tap water must be transported by narrow plastic pipes. Access to the source is very difficult, as only the ranger can monitor the station. Since 2012, UNICEF constructed water supply systems in other remote areas in Natma Taung. However, there is no scientific information about water quality. The local government should recognize the importance of the water supply source and take advantage of scientific input regarding conservation (Fig. 7) .

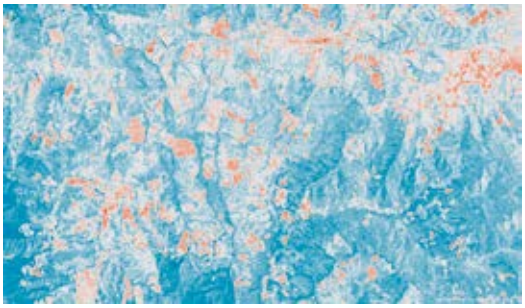
Land use in the Chee river catchment

Satellite images and normalized difference vegetation index (NDVI) maps of the Chee river catchment from February 1993 to January, 2017 show a transition in land use (Figs. 8a-f). Until 2005, areas of slash-and-burn agriculture were distributed widely along the main channel and branches of the Chee river. Within 1 km of the channels, about half of the slash-and-burn agriculture could be located. As a result, nutrient rich soil was transferred into the river during the rainy season (Fujino et al. 2013). After 2009, the burned area was significantly reduced and

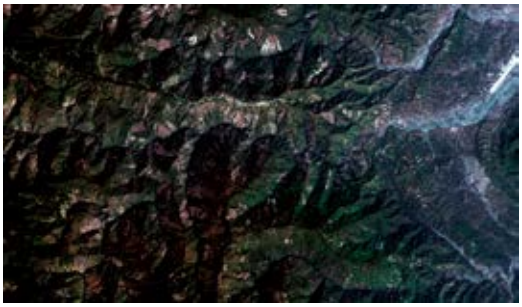
Fig. 7. The first water supply systems in Mindat (April. 17, 2017).



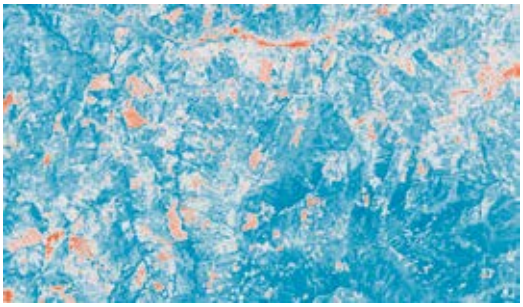
a. True color image on Feb. 27, 1993.



b. NDVI distribution on Feb. 27, 1993.



c. True color image on Jan. 27, 2005.



d. NDVI distribution on Jan. 27, 2005.

e. True color image on Jan. 2016 with showing object region of Satellite image data.

f. NDVI distribution on Jan. 19, 2017. Color: negatives, green: positives.

Fig. 8. Landsat TM true color image and NDVI distribution for Chee river catchment.

the very low NDVI areas were limited to residential areas. On the other hand, the arterial roads and mountain tracks were clearly recognized in 2017 and were the result of increased road widening. Previous studies have shown that high nitrogen and phosphorus concentrations were observed for a few weeks after the forests were burned. The concentrations decreased at sites of steep topography but persisted for 3–5 years in sites with more gentle topography (Hauer & Spencer 1998). In the case of the Chee river catchment, a change in the river water quality becomes more apparent after May, when the wet season begins. The duration of this change in water quality is not known, because rainfall intensity has not been estimated. However, if farmers start applying chemical fertilizers to increase production of crops, then proper management to mitigate the effects on water quality and minimize pollution will be required (Fig. 9).

Fig. 9. Slope face of arterial road (right) and mountain track (left) linking Mindat to the Magway Region and to the Victoria mountain (Apr. 7, 2016).

The comprehensive management of water and land

To preserve natural forests in the upstream region of Natma Taung, it is important to extend the fallow period and control the heavy use of fertilizers for slash-and-burn agriculture. This will have important consequences in the downstream Magway Region, which is the grain belt for the people of Chin and Magway. The Chin tribes are in the process of transitioning to an increasingly modern lifestyle, and comprehensive water and land management plans are required in Natma Taung for sustainable development in the region. Tourism is likely to be an important part of the local economy in the future, and promotion of ecotourism is surely an important step in the direction of sustainable development.

References

Allan, J.D. & Castillo, M.M. 2007. Chapter 2 Streamflow. *In:* Stream Ecology 2. pp. 13–32 Springer. Netherlands.

FAO. 2010. Global Forest Resources Assessment 2010 Main Report (FRA 2010). Food and Agriculture Organizations of United Nations. Room. Italy.

Fujino, T., Wityi, H. & Nanda, A. 2013. Aquatic invertebrate monitoring in least developed areas in Myanmar – effect of shifting cultivation on water quality. Advances in River Sediment Research. Taylor & Francis Group: 1611–1617.

Furuuchi, T., Win, Z. & Wasson, R.J. 2009. Discharge and suspended sediment transport in the

Ayeyarwady river, Myanmar: Centennial and decadal changes. Hydrological Processes 23: 1631–1641.

Hauer, F.R. & Spencer, C.N. 1998. Phosphorus and nitrogen dynamics in streams associated with wildfire: A study of immediate and long-term effects. Int. J. Wildland Fire 8: 183–198.

Hoekstra, A.Y., Mekonnen, M.M., Chapagain, A.K., Mathews, R.E. & Richter, B.D. 2012. Global monthly water scarcity: Blue water footprints versus blue water availability. PloS One. 7(2): e32688.

Ministry of Natural Planning and Economic Development. 2010. Myanmar Statistical Yearbook.

Taft, L. & Evers, M. 2016. A review of current and possible future human-water dynamics in Myanmar's river basins. Hydrology and Earth System Science 20: 4913–4928.

Tun, L. 2015. Weather Outlook, prepared, Former DG of DMH and PR of Myanmar with WMO, CEO, Myanmar Climate Change Watch, TODAY.

Wang, C. & Myint, S.W. 2016. Environmental Concerns of deforestation in Myanmar 2001-2010, Remote Sensing 8: 728.