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Cover: Dorsal view of Mantis Shrimp Cladorina ichneuemon (Fabricius, 1798) & Gonodactyurus demanii (Henderson, 1893). © Fisheries Research Station, Junagadh Agricultural University, Sikka.
Plant species diversity in a tropical semi-evergreen forest in Mizoram (northeastern India): assessing the effectiveness of community conservation

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Abstract: Community conservation of forest as a means of biodiversity conservation has gained broad acceptance in recent years. However, there are not many studies in India on how effective they really are for conservation of plants and how they compare to formal protected areas. This study was carried out in Reiek forest, a community conserved forest protected for more than a century, initially by the village Chiefs and after the abolishment of chieftainship, by the community of the nearby villages. An attempt was made to study the plant species diversity of this forest which falls under the Indo-Myanmar diversity hotspot and it was compared to two ecologically similar formal protected areas within Mizoram. A total of 265 species belonging to 213 genera and 89 families were recorded. Two vulnerable species Eleocarpus rogusus and Saraca asoca were identified. It was found that this community conserved forest contained more plant species than the two protected areas. But endemic and threatened species were found to decline in the community conserved forest.

Keywords: Biodiversity, community conservation, life forms, plant diversity, protected area.
INTRODUCTION

Tropical forest contains the most diverse plant communities on earth and are disappearing at an alarming rate due to wide-spread land use changes with detrimental consequences for biodiversity, climate, and other ecosystem services (Givnish 1999; Lambin & Geist 2006). This ongoing loss of biodiversity has led to many studies which explores how effective the various approaches are for preventing ecosystem degradation and species extinction while providing sustainable use of resources (Shahabuddin & Rao 2010). The most important and commonly used measure for conserving biodiversity and reducing deforestation is the use of formal protected areas (Millennium Ecosystem Assessment 2005; Bajracharya et al. 2005) which has proven to be effective by studies such as Naughton-Treves et al. (2005) and Oliveira et al. (2007). However, while previous research has estimated the effectiveness of formal protected areas in reducing deforestation rates to be 65%, more recent studies in Costa Rica suggest only a 10% reduction within the protected areas (Andam et al. 2008).

In the last few decades, community conservation of biodiversity rich area, whether partial or complete as an effective method to prevent species extinction has gained broader acceptance (Kothari 2006). Various studies have shown that within the same region, forests which are conserved and managed by local or indigenous communities can be as effective in reducing deforestation as compared to officially designated protected areas committed to sole protection without community involvement (Porter-Bolland et al. 2012; Bray et al. 2008; Nepstad et al. 2006). Hayes (2006) found that the state of a forest in formally protected areas and community conserved forest were similar and suggested that the forest was in a better state when the rules of management were set and enforced by locals as compared to those without such rules. However, the use of community-based conservation for tropical forests is disputed with many prominent conservationists advocating for authoritarian enforcement of protected areas (Brockington 2007; Wilshusen et al. 2002).

Mizoram, situated in the north eastern part of India is composed of steep, rugged hill ranges and interspersed valleys. It has rich flora and fauna and the highest percentage of forest cover (84.53%) in the country (FSI 2021). The forests of the state are under a three tier management viz. those owned and controlled by the state, district councils, and village councils. The extent of forest under community control is 20.53% (FSI 2019). Traditionally, forest management in Mizoram was carried out by the ‘Chieftain’, helped by his advisors, who had the absolute decision making authority. Under the Mizo District (Land and Revenue) Act of 1956, the Chief was made the Chairman of the Village Authority without any discretionary authority. Another important traditional institution is ‘Zawlbuk’, a bachelor dormitory run by an important official of village government called ‘Val Upa’ (youth commander). Val upa through Zawlbuk imparted discipline and training in the art of tribal warfare and defence to male youth of the village. Zawlbuk no longer exists, and this traditional institution is now represented by Young Mizo Association (YMA) which may be considered the modern form of Val Upa. With people still depending on resources of forests and common land, village level YMA plays an important role in managing common property resources. YMA with the support of village council take the responsibility for management of community forest. (Tiwari et al. 2013)

Reiek forest in Mizoram is one such community conserved forest which is managed by the Young Mizo Association (YMA) and the village council of the two villages falling within the forest area. Shifting cultivation, being the main mode of agriculture in Mizoram, has destroyed much of the virgin forest and led to formation of secondary communities in the disturbed sites. However, this forest has been protected and conserved by the descendants of Sailo Chiefs since the 1890’s. The Village Chief prohibited the killing of animals and plants in the forest and introduced a modern method of conservation with stringent protection. Shifting cultivation in this area was banned and as a result, while most of the area around this conserved area is degraded, this forest represents a forest ecosystem relatively less degraded by anthropogenic disturbances. There is an ongoing debate on what measures are the best for the forest and biodiversity conservation with some in favour of strict protection and others advocating for a more community driven form of conservation. The question remains on whether community conservation of forest is as effective as designating them as protected areas. With this in mind, the present study has been undertaken. The plant species diversity of a community conserved tropical semi-evergreen forest in Mizoram was determined and compared with the plant diversity of protected areas in the state and another community conserved forest outside the state.
MATERIALS AND METHODS

Study area
This research study was conducted in Reiek forest located between longitude 92.6039908 and latitude 23.6994866 in Mamit district of Mizoram, northeast India. This forest corresponds to Champion & Seth’s (1968) Cachar Tropical Semi-evergreen Forest (2B/C2) and covers an area of 10 km². The highest point of Reiek Mountain is at 1485 m asl. The annual temperature in Mamit district ranges between 8–22 °C in winter and 20–28 °C in summer. Average annual rainfall received during the study period from 2008–2012 was 2,585 mm which is mainly brought in by the southwest monsoon. Rainy season starts in early April, with interrupted showers, but incessant rain begins in June and continues until September, often stretching until October. The soil is composed of silt-loam in the upper portion and medium grain sandstone stone plates in the peak region and the rest of the area is mostly sandy-loam to black humus top-soils depending on thickness of the vegetation and nature of landscape.

Methods
Vegetation analysis was carried out using the methods outlined by Misra (1968) and Domboise & Ellenberg (1974) during the year 2008–2012. To study the woody species, 50 quadrats of 10 m² in area were laid randomly and diameter at breast height (dbh) of trees were measured and recorded. Within each quadrat, five smaller quadrats of 1 m² were laid down for herbs and shrubs, one in each corner and one in the centre. All the understory plants viz. herbs (non-woody small plants *1–1.5 m tall), shrubs (*1.5–3 m tall with thick stem and branching at ground level without a distinct trunk) and herbaceous climbers were enumerated. Species diversity was determined by computing the Shannon diversity index (Shannon and Weaver 1949). Species identification was carried out using regional flora publications (Kanjilal et al., 1940; Singh et al., 2002; Lalramnghinglova, 2003; Sawmliana, 2003) and counterchecked with the herbarium of the Botanical Survey of India, Eastern Circle, Shillong. The conservation status of the identified species were assessed using Red Data book of India (Nayar & Sastry 1987–1990) and Red List of Threatened Vascular Plant Species in India (Rao et al. 2003). The results were compared with the plant diversity of two protected areas in Mizoram which are...
ecologically similar- Phawngpui which was declared a National park in 1997 with an area of 50 km\(^2\) and Tawi Wildlife Sanctuary notified in 1999 with an area of 35.75 km\(^2\).

RESULTS

Family
A total of 89 families were recorded out of which 84 were native while 5 were non-native. Out of the native families, 76 were angiosperms, 2 families were gymnosperms and 6 families were pteridophytes while the non-native families were all angiosperms. Dicotyledons comprised of 69 families (65 native and 4 non-native) and monocotyledons comprised of 12 families (11 native and 1 non-native). Five families with the highest species diversity (dominant families), accounting only 5.43% of total families represented 28.27% of the total species, and 26% of genera. Family with the highest number of species was Orchidaceae (23 native species) followed by Poaceae (19 native and 2 non-native species), Arecaceae (11 native species and 3 non-native species) and Rubiaceae (11 native species and 1 non-native species) In contrast to the dominant families, 42 families (38 native and 4 non-native) were represented by only one species each.

Genera
A total of 213 genera were recorded (194 native and 19 non-native) out of which 31 genera are multi-species while the rest were represented by only one species. Among the multi species genera, the largest genus was *Dendrobium* with seven species and among trees, *Ficus* and *Elaeocarpus* had five species each. The ratio of genera to species was 1:1.24 for native species which means that almost any one of the species of this site belongs to a different genus.

Species
A total of 265 species were recorded out of which 241 were native species and 24 were non-native species Habitat-wise analysis of flora showed 103 species of trees (97 native species and 6 non-native species), 32 species of shrubs (28 native species and 4 non-native species), 48 species of herbs (45 native species and 3 non-native species), 25 species of climbers/lianas (19 native species and 6 non-native species), 15 species of canes and palms (12 native species and 3 non-native species), 17 species of grasses (15 native species and 2 non-native species) and 25 species of epiphytes (native species) (Table 1)

Out of the total native plant species identified in the study site, 96% were found to be angiosperms, 3.5% gymnosperms and the rest were pteridophytes. All the non-native species identified were angiosperms. Among the native angiosperms, dicotyledons represented 74.2% while monocots represented 25.8% while for the non-native angiosperms, dicotyledons represented 80% while monocots represented 20%. The ratio of monocotyledons to dicotyledons was 1:2.89 for native species.

Diversity of life-form
Life forms of plants in Reiek forest were determined based on the classification of Raunkiaer (1934). All species were classified by life forms (Misra 1968; Domoise & Ellenberg 1974). The existence of a variety of life forms reflects the typically tropical characteristics of the flora of Reiek forest. Phanerophytes were the most dominant life form with about 50% of total plant species in the area. Out of the phanerophytes, Megaphanerophytes, i.e., trees exceeding 30 m were absent. Mesophanerophytes accounted for 32.45% of the total life form (78 native species and 8 non-native species), microphenarophytes accounted for 13.96% (36 native species and 1 non-native species), nanophanerophytes accounted for 6.04%, (15 native species and 1 non-native species), Chamaephytes accounted for 9.81% (24 native species and 2 non-native species), Hemicryptophytes accounted for 4.15% (9 native species and 2 non-native species), Therophytes accounted for 5.66% (13 native species and 2 non-native species), Epiphytes accounted for 11.32 % (30 species) and lianas accounted for 8.68% (17 native species and 6 non-native species) of the total life form.

Species diversity index
The species diversity index (Shannon diversity H') for native species was highest among trees (3.9) followed by herb (3.45) and then shrubs (3.05)

Conservation status: Rare and threatened species
Out of the 265 species identified, only 15 have been assessed by the IUCN out of which two species have been identified as vulnerable which are *Elaeocarpus rogusus* and *Saraca asoca*. One species *Amomum dealbatum* is placed under Data Deficient.
DISCUSSION

Despite rampant deforestation for shifting cultivation in the state of Mizoram, the community conserved Reiek forest in Mamit district of Mizoram. It was found to have rich plant diversity comparable to protected areas under strict protection of the Forest Department, Government of Mizoram and to other community conserved sacred groves outside Mizoram. The climatic conditions of the area, its geographic proximity to the species-rich eastern Himalayas, Burma and the Malayan peninsula may be responsible for the formation of this rich biodiversity area but maintenance of this rich ecosystem may be attributed solely to its prolonged protection by the community.

Reiek forest containing 241 native species was found to support more plant species diversity than two formal protected area viz Phawngpui National Park and Tawi Wildlife Sanctuary. Phawngpui National Park was reported to have 208 species belonging to 150 genera and 71 families (Malsawmsanga 2011) while Tawi Wildlife Sanctuary was reported to have 219 species belonging to 167 genera and 73 families (Lallawmkimi 2011). Outside Mizoram, Namdapha National Park, a protected area with tropical wet evergreen vegetation was reported to have 200 species (Nath et al. 2005) and a community conserved sacred groves of Jaintia Hills was reported to have 395 species (Jamir and Pandey 2003). This is not an unusual finding. For example, Garcia and Pascal (2005) in their comparison of sacred groves to formal protected area in the Western Ghats of Karnataka, India found that the number of woody plant species were higher in the sacred groves than the adjacent Brahmagiri wildlife sanctuary. Similar results were also reported by Shackleton (2000) in their comparison of plant diversity in protected and communal lands in South Africa.

The percentage of angiosperms, gymnosperms and pteridophytes present in Reiek forest were almost similar to those reported in the sacred grove of Jaintia hill (Jamir & Pandey 2003) which have been under traditional community conservation for centuries. In Tawi Wildlife Sanctuary, 86.7% were angiosperms, 1.2% were gymnosperms, and 12.05% were pteridophytes (Lallawmkimi 2011).

The ratio of genera to species for native species was 1:1.24 while a ratio of 1:1.3 have been reported by Lallawmkimi (2011) for Tawi Wildlife Sanctuary.

The life form spectrum of plant community of Reiek forest closely resembles that of Tawi Wildlife Sanctuary where Megaphanerophyte were also absent and mesophanerophytes with 28.27% was the dominant life form followed by microphanerophyte 20.25%, nanophanerophyte 11.39%, chamaephyte 10.97 %, geophytes 3.38%, therophytes 3.80%, epiphytes 10.97% and climbers 10.97% (Lallawmkimi 2011). The dominance of Phanerophytes is a feature of tropical humid forest life form spectra (Richard, 1996). The life form spectrum of plant community of Reiek forest reveals that Hemicryptophytes and Therophytes were lower than the normal spectrum of Raunkiaers. Hemicryptophytes are characteristics of cooler region and therophytes are characteristics of desert climate (Cain & Castro 1959; Shimwell 1971).

| Criteria                  | Reiek Forest (Native) | Reiek Forest (Non- native) | Phawngpui National Park | Tawi Wildlife Sanctuary |
|---------------------------|-----------------------|---------------------------|-------------------------|-------------------------|
| Number of families        | 84                    | 5                         | 71                      | 83                      |
| Number of genera          | 194                   | 19                        | 150                     | 167                     |
| Number of species         | 241                   | 24                        | 208                     | 219                     |
| Trees                     | 97                    | 6                         | 84                      | 83                      |
| Shrubs                    | 28                    | 4                         | 31                      | 31                      |
| Herbs                     | 45                    | 3                         | 45                      | 41                      |
| Climbers and epiphytes    | 44                    | 6                         | 33                      | 52                      |
| Grasses                   | 15                    | 2                         | 10                      | 17                      |
| Canes and palms           | 12                    | 3                         | 5                       | 10                      |
| Species Diversity (Shannon diversity index) | | | | |
| Trees                     | 3.9                   | 3.68                      | 3.86                    |                         |
| Shrubs                    | 3.05                  | 2.8                       | 3.14                    | 3.14                    |
| Herbs                     | 3.45                  | 2.96                      | 3.26                    |                         |
Table 2. List a plant species recorded in community conserved Reiek forest of Mamit district in Mizoram, India.

| Name of species               | Family       | Native/ Non-native species |
|-------------------------------|--------------|---------------------------|
| **Tree species**              |              |                           |
| 1. Acer laevigatum Wall.      | Aceraceae    | Native                    |
| 2. Acronychia pendunculata (L.) Miq. | Rutaceae    | Native                    |
| 3. Alangium chinense (Lour.) Harms | Alangiaceae | Native                    |
| 4. Alphonsea ventricosa (Roxb.) Hook. f. & Thomson | Annonaceae | Native                    |
| 5. AlSeaophyne petaloloris (Meisn.) Hook. f. | Lauraceae | Native                    |
| 6. Amoora chittagonga (Miq.) Hiern | Meliaceae | Native                    |
| 7. Anogeissus acuminata (Roxb. ex DC.) Guillaumin et al. | Combretaceae | Native                    |
| 8. Betula cylindrostachys Wall. | Betulaceae   | Native                    |
| 9. Bombax insigne Wall         | Bombacaceae  | Native                    |
| 10. Bruniasia polyserma (C.B. Clarke) Steenis | Styracaceae | Native                    |
| 11. Calliandra umbrosa (Wall.) Benth. | Mimosaceae | Native                    |
| 12. Calophyllum polyanthum Wall. ex Choisy | Guittferae | Native                    |
| 13. Camellia kissi Wallich     | Theaceae     | Native                    |
| 14. Carallia brachiata (Lour.) Merr. | Rhizophoraceae | Native                    |
| 15. Castanopsis echinocarpa Miq. | Fagaceae    | Native                    |
| 16. Castanopsis indica (Roxb. ex Lindl.) A.DC. | Fagaceae | Native                    |
| 17. Castanopsis tribuloides (Sm.) A.DC. | Fagaceae | Native                    |
| 18. Celtis timorensis Span.    | Ulmaceae     | Native                    |
| 19. Cephalotaxus griffithii Hook. f. | Cephalotaxaceae | Native                    |
| 20. Cinnamomum glanduliferum (Wall.) Meisler | Lauraceae | Native                    |
| 21. Cinnamomum abutusfolium (Roxb.) Nees. | Lauraceae | Native                    |
| 22. Cinnamomum verum J.Presl | Lauraceae    | Non-native                |
| 23. Coffea khasiana (Korth.) Hook.f. | Rubiaceae | Native                    |
| 24. Colona floribunda (Wall. ex Kurz) Craib | Tiliaceae | Native                    |
| 25. Croton hookeri Veitch     | Euphorbiaceae| Native                    |
| 26. Cycas pectinata Buch.-Ham | Cycadaceae   | Native                    |
| 27. Debregeasia longifolia (Burm. f.) Wedd. | Urticaceae | Native                    |
| 28. Diospyros lancifolia Wallich ex Hiern | Ebenaceae | Native                    |
| 29. Drimycarpus racemosus (Roxb.) Hook.f. | Anacardiaceae | Native                    |
| 30. Dyssoxylum gabora (Buch.-Ham.) Merr. | Meliaceae | Native                    |
| 31. Elaeocarpus floribundus Blume | Tiliaceae | Native                    |
| 32. Elaeocarpus lanceaefolius Roxb. | Tiliaceae | Native                    |
| 33. Elaeocarpus rugosus Roxb. | Tiliaceae    | Native                    |
| 34. Elaeocarpus tectorius (Lour.) Poir. | Tiliaceae | Native                    |
| 35. Embelia tijeri-am-cottam A.DC. | Myrsinaceae | Native                    |
| 36. Engelhardita roxburghiana Wall. | Juglandaceae | Native                    |
| 37. Engelhardita spicata Leschen, ex. Blume | Juglandaceae | Native                    |
| 38. Eriobotrya bengalensis (Roxb.) Hook. f. | Rosaceae | Native                    |
| 39. Eurya cerasifolia (D. Don) Kobuski | Pentaphylacaceae | Native                    |
| 40. Eurya loquiana Dunn | Pentaphylacaceae | Non-native                |
| 41. Ficus benghalensis L. | Moraceae     | Native                    |
| Name of species          | Family         | Native/ Non-native species |
|-------------------------|----------------|----------------------------|
| 44 Ficus benjamina L.   | Moraceae       | Native                     |
| 45 Ficus prostrata (Wall. ex Miq.) Miq. | Moraceae | Native                     |
| 46 Ficus religiosa L.   | Moraceae       | Native                     |
| 47 Ficus semicordata Buch.-Ham. ex Sm. | Moraceae | Non-native                 |
| 48 Garcinia xanthochymus Hook. f. ex T. Anderson | Guttiferae | Native                     |
| 49 Glochidion khassicum (Müll.Arg.) Hook. f. | Euphorbiaceae | Native                     |
| 50 Grevillea robusta A. Cunn. ex R. Br. | Proteaceae | Non-native                 |
| 51 Gymnocladia odorata R. Br. | Flacourtiaeae | Native                     |
| 52 Helicia erratica Roxb. | Proteaceae     | Native                     |
| 53 Heteropanax fragrans (Roxb.) Seem | Araliaceae | Native                     |
| 54 Holigarna longifolia Buch.-Ham. ex Roxb | Anacardiaceae | Native                     |
| 55 Lithocarpus elegans (Blume) Hatus. ex Soepadmo | Fagaceae | Native                     |
| 56 Lithocarpus pachyphyllus (Kurz) Rehder | Fagaceae | Native                     |
| 57 Litsea lancifolia Roxb. ex Nees | Lauraceae | Native                     |
| 58 Litsea monopetala (Roxb.) Pers. | Lauraceae | Native                     |
| 59 Macaranga indica Wight | Euphorbiaceae | Native                     |
| 60 Macropanax undulatus (Wall. ex G.Don) Seem. | Araliaceae | Native                     |
| 61 Magnolia hodgsonii (Hook.f. & Thomson) H.Keng | Magnoliaceae | Native                     |
| 62 Mallotus philippensis (Lam.) Müll.Arg. | Euphorbiaceae | Native                     |
| 63 Mangifera sylvestrica Roxb. | Anacardiaceae | Native                     |
| 64 Memecylon celastrinum Kurz | Melastomataceae | Native                     |
| 65 Messua ferrea Linn. | Guttiferae     | Native                     |
| 66 Michelia champaca Linn. | Magnoliaceae | Native                     |
| 67 Musa sylvestris LA Colla | Musaceae | Non-native                 |
| 68 Neolomandra cadiamba (Roxb.) Bosser | Rubiaceae | Native                     |
| 69 Olea dioica Roxb. | Oleaceae       | Native                     |
| 70 Olea salicifolia Wall. ex G.Don | Oleaceae | Native                     |
| 71 Ostodes paniculata Blume | Euphorbiaceae | Native                     |
| 72 Persea glaucescens Nees. | Lauraceae | Native                     |
| 73 Persea villosa (Roxb.) Kosterm. | Lauraceae | Native                     |
| 74 Phoebe lanceolata (Nees) Nees | Lauraceae | Native                     |
| 75 Pithecellobium bigeminum (L.) Mart. | Mimosaceae | Native                     |
| 76 Premna razemosi Wall. ex Schauer | Lamiaceae | Native                     |
| 77 Prunus jenkinsii Hook. f. & Thomson | Rosaceae | Native                     |
| 78 Pterospermum semisagittatum Buch.-Ham. ex Roxb. | Sterculiaceae | Native                     |
| 79 Quercus glauca Thunb.in A.Murray | Fagaceae | Native                     |
| 80 Quercus leiocnichophora A.Camus | Fagaceae | Native                     |
| 81 Randia wallachii Hook.f. | Rubiaceae | Native                     |
| 82 Rhus semialata Murray. | Anacardiaceae | Native                     |
| 83 Rhus succedanea (L.) Kuntze | Anacardiaceae | Native                     |
| 84 Sapium baccatum Roxb. | Euphorbiaceae | Native                     |
| 85 Saraca asoca (Roxb.) Wild. | Fabaceae | Native                     |
| 86 Schima wallichii (DC.) Korthals | Theaceae | Native                     |
| 87 Securinega virosa (Roxb. ex Wild.) Baill. | Euphorbiaceae | Native                     |
| 88 Stephkeyne diversifolia (Wall. ex G.Don) Brandis | Rubiaceae | Non-native                 |
### Plant species diversity in a tropical semi-evergreen forest in Mizoram

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| Name of species | Family | Native/ Non-native species |
|-----------------|--------|----------------------------|
| 89 Sterculia hamiltonii (Kuntze) Adelb. | Sterculiaceae | Native |
| 90 Sterculia villosa Roxb. | Malvaceae | Native |
| 91 Stereospermum coloasi Buch.-Ham. Ex Dillwyn | Bignoniaceae | Native |
| 92 Styax serrulatum (Roxb.) | Styracaceae | Native |
| 93 Syzygium claviflorum (Roxb.) Wall. ex A.M.Cowan & Cowan | Myrtaceae | Native |
| 94 Syzygium cumini (L.) Skeels | Myrtaceae | Native |
| 95 Syzygium fruticosum DC. | Myrtaceae | Native |
| 96 Trema orientalis (L.) Blume | Ulmaceae | Native |
| 97 Ulmus lanceifolia Roxb. | Ulmaceae | Native |
| 98 Vernonia arborea Buch.-Ham | Asteraceae | Native |
| 99 Vernonia volkameriifolia Bedd | Compositae | Native |
| 100 Vitex quinata (Lour.) F. N. Williams | Verbenaceae | Native |
| 101 Wendlandia grandis (Hook.f.) Cowan | Rubiaceae | Native |
| 102 Wightia speciosissima (D. Don) Merr | Scrophulariaceae | Native |
| 103 Ziziphus incurva Roxb. | Rhamnaceae | Native |

#### Shrub species

| Name of species | Family | Native/ Non-native species |
|-----------------|--------|----------------------------|
| 1 Amomum dealbatum Roxb. | Zingiberaceae | Native |
| 2 Antidesma diandrum (Roxb.) B.Heyne ex Roth | Euphorbiaceae | Native |
| 3 Blumea lanceolaria (Roxb.) Druce | Asteraceae | Native |
| 4 Callicarpa dichotoma (Lour.) K. Koch | Lamiaceae | Non-native |
| 5 Chromolaena odorata (L.) R.M. King & H.Rob. | Compositae | Non-native |
| 6 Clerodendrum viscosum Vent. | Verbenaceae | Native |
| 7 Disporum cantoniense (Lour.) Merr. | Liliaceae | Native |
| 8 Elaeagnus pyriformis Hook.f | Elaeagnaceae | Native |
| 9 Ipomoea batatas (L.) Lam. | Convolvulaceae | Non-native |
| 10 Lasianthus hookeri C. B. Clarke ex J. D. Hooker | Rubiaceae | Native |
| 11 Leea indica (Burm.f.) Merr | Vitaceae | Native |
| 12 Lepisanthes senegalensis (Juss. ex Poir.) Leenh. | Sapindaceae | Native |
| 13 Moesa indica (Roxb.) A. DC. | Primulaceae | Native |
| 14 Mallotus albus (Roxb. ex Jack) Müll.Arg | Euphorbiaceae | Native |
| 15 Melastoma nepalensis Lodg. | Melastomataceae | Native |
| 16 Muraya kaenigii (L.) Spreng. | Rutaceae | Native |
| 17 Myceta longifolia (Wall.) Kuntze | Rubiaceae | Native |
| 18 Osbeckia chinensis L. | Melastomataceae | Native |
| 19 Osbeckia crinita Benth. ex Naudin | Melastomataceae | Native |
| 20 Polygonum chinense L. | Polygonaceae | Native |
| 21 Randia fasciculata (Roxb.) DC. | Rubiaceae | Native |
| 22 Rauvolfia densiflora (Wall.) Benth. ex Hook. f. | Apocynaceae | Native |
| 23 Rhamnus nepalensis M. Laws. | Rhamnaceae | Native |
| 24 Rubus buergeri Miq | Rosaceae | Non-native |
| 25 Strabilanthes cusia (Nees) Kuntze | Acanthaceae | Native |
| 26 Strabilanthes discolor (Nees) T. Anderson | Acanthaceae | Native |
| 27 Strabilanthes parryorum T. Anders. | Acanthaceae | Native |
| 28 Symplacos lanceolata Siebold et Zucc. | Symphoricarpaceae | Native |
| 29 Tabernaemontana divaricata (L.) R. Br. ex Roem. & Schult. | Apocynaceae | Native |
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| Name of species | Family | Native/ Non-native species |
|-----------------|--------|----------------------------|
| 30 Toddalia asiatica L. | Rutaceae | Native |
| 31 Viburnum fortium Wall | Caprifoliaceae | Native |
| 32 Woodfordia fruticosa (L.) Kurz | Lythraceae | Native |

**Herb species**

| No. | Name of species | Family | Native/ Non-native species |
|-----|-----------------|--------|----------------------------|
| 1   | Adiantum caudatum Linn | Adiantaceae | Native |
| 2   | Arisaema album N.E.Br. | Araceae | Native |
| 3   | Arisaema speciosum (Wall.) Mart. | Araceae | Native |
| 4   | Asparagus racemosus Willd. | Asparagusaceae | Native |
| 5   | Begonia dioica Buch.-Ham. ex D.Don | Begoniaceae | Native |
| 6   | Blumea alata (D.Don) DC | Asteraceae | Native |
| 7   | Boenninghausenia albiflora Reichb. | Rutaceae | Native |
| 8   | Centellia asiatica L. | Umbelliferae | Native |
| 9   | Cheilocostus lacerus (Gagnep.) C.D. Specht | Zingiberaceae | Native |
| 10  | Chlorophytum khasianum Hook.f | Liliaceae | Native |
| 11  | Commelina benghalensis Linn. | Commelinaeae | Native |
| 12  | Conyza stricta Willd. | Asteraceae | Native |
| 13  | Costus speciosus (J.König) Sm. | Zingiberaceae | Native |
| 14  | Curculigo crassifolia (Baker) Hook. f. | Hypoxidaceae | Native |
| 15  | Curcuma caesia 'Ailaidum' | Zingiberaceae | Native |
| 16  | Dichrocephalum integrifolia (L.f.) Kunze | Asteraceae | Native |
| 17  | Diplazium dilatatum Blume | Polypodiaceae | Native |
| 18  | Diplazium maximum (D.Don) Chatt ‘Cha-kawk’ | Polypodiaceae | Native |
| 19  | Elatostema dissectum Wedd. | Urticaceae | Native |
| 20  | Elatostema sesquifolium (Reinw. ex Blume) Hassk. | Urticaceae | Native |
| 21  | Gleichenia linearis (Burm.f.) C.B.Clarke 'Arthladawn' | Gleicheniaceae | Native |
| 22  | Gnaphalium lutetianum Linn | Asteraceae | Native |
| 23  | Hedychium coccineum Buch.-Ham. ex Sm. | Zingiberaceae | Native |
| 24  | Hedychium villosum Wall. | Zingiberaceae | Native |
| 25  | Houttuynia cordata Thunb. | Saururaceae | Native |
| 26  | Impatiens laevigata Wall. ex Hook. f. & Thomson | Balsaminaceae | Native |
| 27  | Kalanchoe integrata (Medik.) Kunze. ‘Kangdamdawi’ | Crassulaceae | Native |
| 28  | Leucas mollissima Wall | Lamiaceae | Native |
| 29  | Lindernia rueilioides (Colsm.) Pennell ‘Thasuh’ | Linderniaceae | Native |
| 30  | Lycopodium cernuum Linn | Lycopodiaceae | Native |
| 31  | Lycopodium flexuosum (Linn.) Swartz | Lycopodiaceae | Native |
| 32  | Microlepia rhomboidea (Wall.ex Kunze) Prantl, Arb. | Dennstaedtiaceae | Native |
| 33  | Mimosa pudica L. ‘Hiansu’ | Mimosaceae | Non-native |
| 34  | Ophiopogon mungos L. | Rubiaceae | Native |
| 35  | Ophiopogon oppositiflora Hook.f. | Rubiaceae | Native |
| 36  | Persicaria hydropiper (L.) Opiz | Polygonaceae | Native |
| 37  | Phaius mishmensis (Lindl. & Paxton) Rchb.f. | Orchidaceae | Native |
| 38  | Plantago major Linn | Plantaginaceae | Non-native |
| 39  | Plectranthus coetse Buch.-Ham. Ex D. Don | Lamiaceae | Native |
| 40  | Polygonatum oppositifolium (Wall.) Royle | Liliaceae | Native |
| 41  | Polygonum barbatum L. ‘Dawngria’ | Polygonaceae | Native |
| 42  | Pouzolzia bennettiana Wight | Urticaceae | Native |
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#### Name of Species | Family | Native / Non-native Species
--- | --- | ---
43. *Pronephrium lakhimpurense* (Rosenst.) Holtt. | Thelypteridaceae | Native
44. *Pteridium aquilinum* (Linn.) Kuhn. | Polypodiaceae | Non-native
45. *Rhaphidophora decursiva* (Roxb.) Schott | Araceae | Native
46. *Scleria terrestris* (L.) Fass | Cyperaceae | Native
47. *Torenia violacea* (Azaola ex Blanco) Pennell | Linderniaceae | Native
48. *Urena lobata* Linn | Malvaceae | Native

**Climbers and Lianas**

| Name of Species | Family | Native / Non-native Species |
|----------------|-------|-----------------------------|
1. *Acacia oxyphylla* Benth. | Fabaceae | Native |
2. *Aganope thrysiflora* (Benth.) Polhill | Fabaceae | Native |
3. *Bauhinia scandens* L. | Fabaceae | Native |
4. *Caesalpinia cucullata* Roxb. | Fabaceae | Native |
5. *Cissampelos pareira* L. | Menispermaceae | Native |
6. *Cissus javana* DC | Vitaceae | Native |
7. *Clematis siamensis* Drumm. et Craib | Ranunculaceae | Native |
8. *Dioscorea glabra* Roxb. | Dioscoreaceae | Native |
9. *Entada rheedei* Spreng. Subsp. Rheedei | Mimosaceae | Native |
10. *Ipomoea hederifolia* L. | Convolvulaceae | Native |
11. *Marsdenia formosana* Masam. | Apocynaceae | Non-native |
12. *Mimica micrantha* Kunth | Asteraceae | Non-native |
13. *Milletia pachycoma* Benth. | Papilionaceae | Native |
14. *Mucuna gigantea* (Wild.) DC. | Fabaceae | Native |
15. *Passiflora edulis* Sims | Passifloraceae | Native |
16. *Passiflora nepalensis* Wallich | Passifloraceae | Native |
17. *Poederia foetida* L. | Rubiaceae | Native |
18. *Piper betle* L. | Piperaceae | Non-native |
19. *Shuteria vestita* var. *glabrata* (Wight & Arn.) Baker | Fabaceae | Native |
20. *Smilax glabra* Roxb. | Liliaceae | Native |
21. *Smilax lancefolia* Roxb. | Liliaceae | Native |
22. *Tetrapogon dubium* (M. A. Lawson) Planch. | Vitaceae | Native |
23. *Tetrapogon leucostaphylum* (Dennst.) N.P. Balakr. | Vitaceae | Native |
24. *Trichosanthes quinquangulata* A. Gray | Cucurbitaceae | Non-native |
25. *Uncaria sessilifructus* Roxb. | Rubiaceae | Native |

**Grasses**

| Name of Species | Family | Native / Non-native Species |
|----------------|-------|-----------------------------|
1. *Bambusa khasiana* Munro | Poaceae | Native |
2. *Bambusa tulda* Roxb | Poaceae | Native |
3. *Cephlochrysum latifolium* Munro | Poaceae | Native |
4. *Dendrocalamus hamiltonii* Nees & Arn. ex Munro | Poaceae | Native |
5. *Dendrocalamus longispathus* (Kurz) Kurz | Poaceae | Native |
6. *Dendrocalamus sikkimensis* Gamble ex Oliv. | Poaceae | Native |
7. *Dinachloa compactiflora* Kurz. Mc Clure | Poaceae | Native |
8. *Drepanostachyum intermedium* (Munro) Keng f. | Poaceae | Native |
9. *Erianthus longisepalous* Anderss. ex Benth | Poaceae | Native |
10. *Eulalia trispicata* (Schult.) Henrard | Poaceae | Native |
11. *Imperata cylindrica* (L.) Raeusch | Poaceae | Non-native |
12. *Melocanna baccifera* (Roxb.) Kurz | Poaceae | Native |
13. *Pseudostachyum polymorphum* Munro | Poaceae | Native |
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### Epiphytes

| No. | Name of species                  | Family       | Native/ Non-native species |
|-----|----------------------------------|--------------|---------------------------|
| 1   | Aerides odorata Lour.             | Orchidaceae  | Native                    |
| 2   | Aeschynanthus maculatus Lindl.    | Gesneriaceae | Native                    |
| 3   | Bulbophyllum elatum (Hook.f.) Sm | Orchidaceae  | Native                    |
| 4   | Bulbophyllum khasianum Griff.     | Orchidaceae  | Native                    |
| 5   | Bulbophyllum umbellatum Lindl.    | Orchidaceae  | Native                    |
| 6   | Cleisostoma filiforme (Lindl.) Garay | Orchidaceae  | Native                    |
| 7   | Cleisostoma racemiferum (Lindl.) Garay | Orchidaceae  | Native                    |
| 8   | Coelogyne prolifera Lindl.        | Orchidaceae  | Native                    |
| 9   | Dendrobium chrysanthum Lindl.     | Orchidaceae  | Native                    |
| 10  | Dendrobium chrysotakum Lindl.     | Orchidaceae  | Native                    |
| 11  | Dendrobium densiflorum Lindl.     | Orchidaceae  | Native                    |
| 12  | Dendrobium formosum Lindl.        | Orchidaceae  | Native                    |
| 13  | Dendrobium ochreatum Lindl.       | Orchidaceae  | Native                    |
| 14  | Dendrobium parishii Reichb.f.     | Orchidaceae  | Native                    |
| 15  | Dendrobium transparens Wall. ex Lindl. | Orchidaceae  | Native                    |
| 16  | Drynaria coronans (Wall. ex Mett.) J. Sm. ex T | Poly podiaceae | Native |
| 17  | Eria paniculata Lindl.            | Orchidaceae  | Native                    |
| 18  | Eria pannea Lindl.                | Orchidaceae  | Native                    |
| 19  | Mycaranthes stricta Lindl.        | Orchidaceae  | Native                    |
| 20  | Oberonia indifolia (Roxb.) Lindl. | Orchidaceae  | Native                    |
| 21  | Papilionanthe vandarum (Rchb.f.)Garay | Orchidaceae  | Native                    |
| 22  | Pholidota imbricata Hook          | Orchidaceae  | Native                    |
| 23  | Premna coriacea C.B.Clarke        | Verbenaceae  | Native                    |
| 24  | Rhynchostylis retusa (Lindl.) Bl. | Orchidaceae  | Native                    |
| 25  | Vanda coerulea Griff. ex Lindl.   | Orchidaceae  | Native                    |

### Canes and Palms

| No. | Name of species                  | Family       | Native/ Non-native species |
|-----|----------------------------------|--------------|---------------------------|
| 1   | Arenga pinnata (Wurmb) Merr.     | Are caceae   | Native                    |
| 2   | Borassus madagascariensis Bojer ex Jum. & H.Perrier | Are caceae | Non-native |
| 3   | Calamus inermis Griff.           | Are caceae   | Native                    |
| 4   | Calamus khasianus Kurz           | Are caceae   | Native                    |
| 5   | Calamus erectus Roxb.            | Are caceae   | Native                    |
| 6   | Calamus flagellum Griff. ex Mart | Are caceae   | Native                    |
| 7   | Calamus guruba Buch.-Ham. ex Mart. | Are caceae   | Native                    |
| 8   | Calamus acanthophathus Roxb.     | Are caceae   | Native                    |
| 9   | Caryota mitis Lour. ‘Mei-hle’    | Are caceae   | Native                    |
| 10  | Caryota urens L.                 | Are caceae   | Non-native                |
| 11  | Livistona chinensis (Jacq.) R.Br. ex Mart | Are caceae | Non-native |
| 12  | Pandanus odorifer (Forssk.) Kuntze | Pandanaeae | Native |
| 13  | Pinanga gracilis Blume           | Are caceae   | Native                    |
| 14  | Wallichia nana Griff.            | Are caceae   | Native                    |
| 15  | Zalacca secunda Griff.           | Are caceae   | Native                    |
Phanerophytes, Cryptophytes, and Epiphytes were higher than normal spectrum while Chamaephytes came the closest to normal spectrum. The abundance of epiphytes is indicative of tropical humid forest as epiphytes are so tightly associated with wet tropics, as definitions of tropical rain forests frequently include the presence of this growth form (Richards 1952, 1996; Webb 1959). Lianas are most abundant in tropical forests where wide array of dimensions, shapes and morphological characters of the trees provides support for them (Clark & Clark 1990). They form an important structural and functional component of tropical rain forests (Hegarty & Caballe 1991). The percentage of lianas was quite high which according to Whitmore (1990) it is another characteristic feature of tropical moist and humid forest.

The species diversity index (Shannon diversity H') in the study site were comparable to that of Tawi Wildlife Sanctuary and Phawngpui National Park. In Tawi wildlife sanctuary, Lallawmkimi (2011) reported species diversity index of 3.86 for trees, 3.26 for herbs and 3.14 for shrubs and in Phawngpui National Park, Malsawmsanga (2011) reported species diversity index to 3.68 for trees, 2.96 for herbs and 2.8 for reported for lower elevations (1500–1700 m) (Table 1) There may be several reasons for species richness in community conserved forests. Bajracharya et al (2005) studied the effectiveness of community based approach for conservation of biodiversity in Annapurna Conservation Area (ACA), Nepal which is an experimental model considered to be a pioneer in promoting the concepts of protected area using an integrated, community based conservation and development approach. They found that the forest basal area and tree species diversity were significantly higher inside ACA than in neighbouring areas outside which they have attributed to increased conservation awareness among the local people leading to a change in their behaviour and use of resource. Comparison of deforestation rates by various research have also shown no significance difference in community conserved areas and strictly protected areas (Nepstad et al. 2006; Bray et al. 2008) which suggests that community conservation is just as effective as state-controlled protected areas in reducing deforestation rates.

However, comparison of community conserved forest and formal protected areas reveal a change in species composition in areas that are ecologically comparable and endemic and threatened species tend to decline in community conserved forest (Shahabuddin & Rao 2010). This trend has been observed in this study which reveals only two vulnerable species in the community conserved Reiek forest while Lallawmkimi (2011) reported 3 endemic species which are critically endangered from Tawi wildlife sanctuary and Malsawmsanga (2011) reported 7 rare, endemic and endangered species and 3 critically endangered species from Phawngpui National Park.

The whole study area although protected jointly by the village councils of Reiek and Ailawng village and a non-governmental organisation viz Young Mizo Association of the two villages, is still not free from encroachment which is the main threat to the rich biodiversity of the area. Although a formal conservation action is desired from the Government, this study has shown that the community has carried out conservation that is locally effective in terms of species diversity.

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