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No. 12, Thiruvannamalai Nagar, Saravanampatti - Kalapatti Road, Saravanampatti,
Coimbatore, Tamil Nadu 641035, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

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continued on the back inside cover

Cover: Dorsal view of Mantis Shrimp *Cloridina ichneumon* (Fabricius, 1798) & *Gonodactylellus demanii* (Henderson, 1893). © Fisheries Research Station, Junagadh Agricultural University, Sikka.

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COMMUNICATION

Plant species diversity in a tropical semi-evergreen forest in Mizoram (northeastern India): assessing the effectiveness of community conservation

S.T. Lalzarzovi [1] & Lalnuntluanga [2]

[1,2] Department of Environmental Science, Mizoram University, Tanhril, Aizawl, Mizoram 796009, India.
[1] mzut197@mzu.edu.in (corresponding author), [2] tluanga_249@rediffmail.com

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 asocas* 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.

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Author details: S.T. Lalzarzovi, Assistant Professor in the Department of Environmental Science, Mizoram University. Lalnuntluanga, Professor in the Department of Environmental Science, Mizoram University, currently holding the position of Controller of Examinations of Mizoram University.

Author contributions: STL and L developed the hypotheses and designed the methodology. STL collected the data in the field.. STL and L prepared the manuscript and gave approval for publication.

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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 km^2. The highest point of Reiek Mountain is at 1485m asl. The annual temperature in Mamit district ranges between 8–22 ^{0}C in winter and 20–28 ^{0}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 m^2 in area were laid randomly and diameter at breast height (dbh) of trees were measured and recorded. Within each quadrat, five smaller quadrats of 1m^2 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

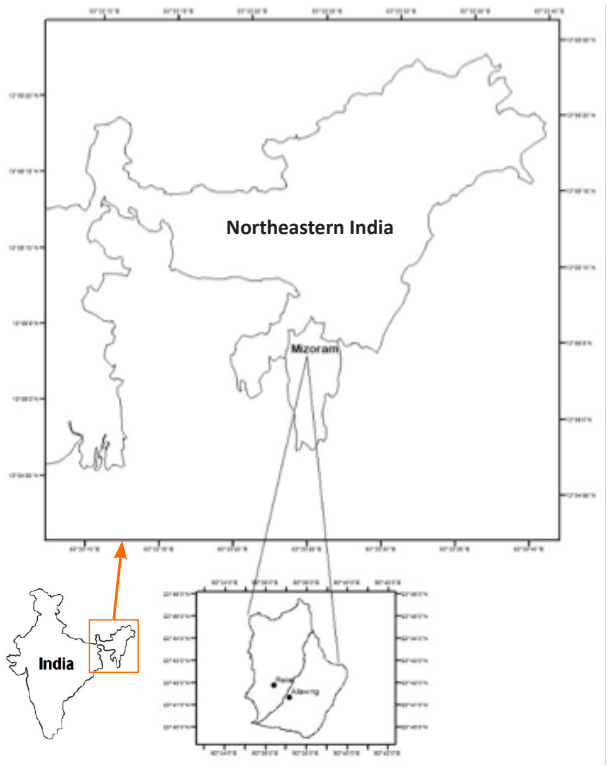

Figure 1. Location map of Reiek forest, a community conserved forest in Mizoram.

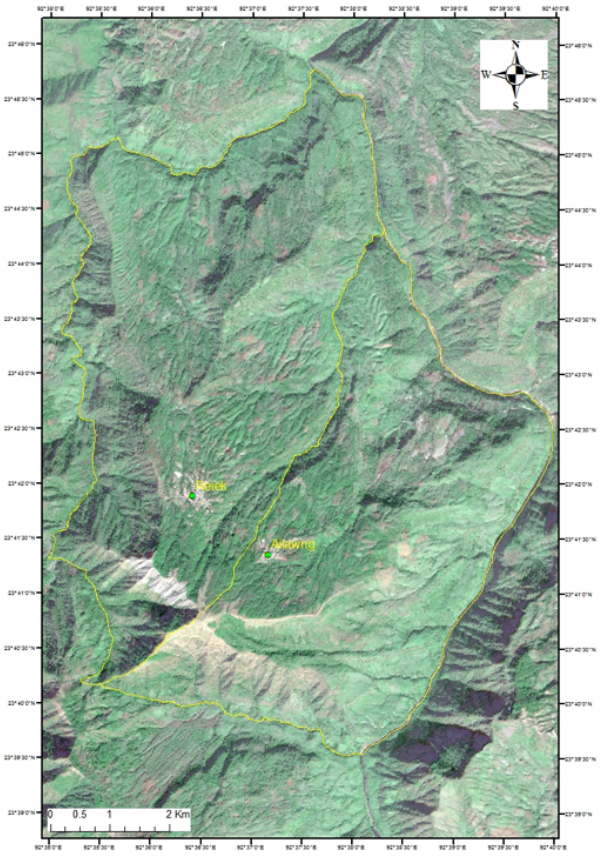

Figure 2. Map of the study area.

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 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 and19 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; Domboise & 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. Mesophenorophytes 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) , Cryptophytes or geophytes accounted for 7.92 % (19 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.

Table 1. Comparison of plant diversity of Community conserved Reiek forest, Phawngpui National Park and Tawi Wildlife Sanctuary

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
Herbs	3.45		2.96	3.26

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, gymnospersms 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 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 temperate region and therophytes are characteristics of desert climate (Cain & Castro 1959; Shimwell 1971).

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	*Aglaia spectabilis* (Miq.) S.S.Jain & S.Bennet.	Meliaceae	Native
4	*Alangium chinense* (Lour.) Harms	Alangiaceae	Native
5	*Alphonsea ventricosa* (Roxb.) Hook. f. & Thomson	Annonaceae	Native
6	*Alseodaphne petiolaris* (Meissn.) Hook. f.	Lauraceae	Native
7	*Amoora chittagonga* (Miq.) Hiern	Meliaceae	Native
8	*Anogeissus acuminata* (Roxb. ex DC.) Guillaumin et al.	Combretaceae	Native
9	*Betula cylindrostachys* Wall. ex Diels	Betulaceae	Native
10	*Bombax insigne* Wall	Bombacaceae	Native
11	*Bruinsmia polysperma* (C.B. Clarke) Steenis	Styracaceae	Native
12	*Calliandra umbrosa* (Wall.) Benth.	Mimosaceae	Native
13	*Calophyllum polyanthum* Wall. ex Choisy	Guttiferae	Native
14	*Camellia kissi* Wallich	Theaceae	Native
15	*Carallia brachiata* (Lour.) Merr.	Rhizophoraceae	Native
16	*Castanopsis echinocarpa* Miq.	Fagaceae	Native
17	*Castanopsis indica* (Roxb. ex Lindl.) A.DC.	Fagaceae	Native
18	*Castanopsis tribuloides* (Sm.) A.DC.	Fagaceae	Native
19	*Celtis timorensis* Span.	Ulmaceae	Native
20	*Cephalotaxus griffithii* Hook. f.	Cephalotaxaceae	Native
21	*Cinnamomum glanduliferum* (Wall.) Meisner	Lauraceae	Native
22	*Cinnamomum obtusifolium* (Roxb.) Nees.	Lauraceae	Native
23	*Cinnamomum verum* J.Presl	Lauraceae	Non-native
24	*Coffea khasiana* (Korth.) Hook.f.	Rubiaceae	Native
25	*Colona floribunda* (Wall. ex Kurz) Craib	Tiliaceae	Native
26	*Croton hookeri* Veitch	Euphorbiaceae	Native
27	*Cryptocarya amygdalina* Nees Bauch.Ham	Lauraceae	Native
28	*Cycas pectinata* Buch.-Ham	Cycadaceae	Native
29	*Debregeasia longifolia* (Burm. f.) Wedd.	Urticaceae	Native
30	*Diospyros lancifolia* Wallich ex Hiern	Ebenaceae	Native
31	*Drimycarpus racemosus* (Roxb.) Hook.f.	Anacardiaceae	Native
32	*Dysoxylum gobara* (Buch.-Ham.) Merr.	Meliaceae	Native
33	*Elaeocarpus floribundus* Blume	Tiliaceae	Native
34	*Elaeocarpus lanceaefolius* Roxb.	Tiliaceae	Native
35	*Elaeocarpus rugosus* Roxb.	Tiliaceae	Native
36	*Elaeocarpus tectorius* (Lour.) Poir.	Tiliaceae	Native
37	*Embelia tsjeriam-cottam* A.DC.	Myrsinaceae	Native
38	*Engelhardtia roxburghiana* Wall.	Juglandaceae	Native
39	*Engelhardtia spicata* Leschen, ex. Blume	Juglandaceae	Native
40	*Eriobotrya bengalensis* (Roxb.) Hook. f.	Rosaceae	Native
41	*Eurya cerasifolia* (D. Don) Kobuski	Pentaphylacaceae	Native
42	*Eurya loquaiana* Dunn	Pentaphylacaceae	Non-native
43	*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 khasicum* (Müll.Arg.) Hook. f.	Euphorbiaceae	Native
50	*Grevillea robusta* A. Cunn. ex R. Br.	Proteaceae	Non-native
51	*Gynocardia odorata* R. Br.	Flacourtiaceae	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 sylvatica* Roxb.	Anacardiaceae	Native
64	*Memecylon celastrinum* Kurz	Melastomataceae	Native
65	*Mesua ferrea* Linn.	Guttiferae	Native
66	*Michelia champaca* Linn.	Magnoliaceae	Native
67	*Musa sylvestris* LA Colla	Musaceae	Non-native
68	*Neolamarckia cadamba* (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 racemosa* 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 leucotrichophora* A.Camus	Fagaceae	Native
81	*Randia wallichii* 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.) Willd.	Fabaceae	Native
86	*Schima wallichii* (DC.) Korthals	Theaceae	Native
87	*Securinega virosa* (Roxb. ex Willd.) Baill.	Euphorbiaceae	Native
88	*Stephegyne diversifolia* (Wall. ex G.Don) Brandis	Rubiaceae	Non-native

	Name of species	Family	Native/ Non-native species
89	*Sterculia hamiltonii* (Kuntze) Adelb.	Sterculiaceae	Native
90	*Sterculia villosa* Roxb.	Malvaceae	Native
91	*Stereospermum colais* Buch.-Ham. Ex Dillwyn	Bignoniaceae	Native
92	*Styrax 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			
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	*Maesa indica* (Roxb.) A. DC.	Primulaceae	Native
14	*Mallotus albus* (Roxb. ex Jack) Müll.Arg	Euphorbiaceae	Native
15	*Melastoma nepalensis* Lodd.	Melastomataceae	Native
16	*Murraya koenigii* (L.) Spreng.	Rutaceae	Native
17	*Mycetia longifolia* (Wall.) Kuntze	Rubiaceae	Native
18	*Osbeckia chinensis* L.	Melastomtaceae	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	*Strobilanthes cusia* (Nees) Kuntze	Acanthaceae	Native
26	*Strobilanthes discolor* (Nees) T. Anderson	Acanthaceae	Native
27	*Strobilanthes parryorum* T. Anders.	Acanthaceae	Native
28	*Symplocos lancifolia* Siebold et Zucc.	Symplocaceae	Native
29	*Tabernaemontana divaricata* (L.) R. Br. ex Roem. & Schult.	Apocynaceae	Native

	Name of species	Family	Native/ Non-native species
30	*Toddalia asiatica* L.	Rutaceae	Native
31	*Viburnum foetidum* Wall	*Caprifoliaceae*	Native
32	*Woodfordia fruticosa* (L.) Kurz	*Lythraceae*	Native
Herb 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.	Asparagaceae	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	*Centella asiatica* L.	Umbelliferae	Native
9	*Cheilocostus lacerus* (Gagnep.) C.D. Specht	Zingiberaceae	Native
10	*Chlorophytum khasianum* Hook.f	Liliaceae	Native
11	*Commelina benghalensis* Linn.	Commelinaceae	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* Roxb. *'Ailaidum'*	Zingiberaceae	Native
16	*Dichrocephala integrifolia* (L.f.) Kuntze	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 luteoalbum* 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 integra* (Medik.) Kuntze. 'Kangdamdawi'	Crassulaceae	Native
28	*Leucas mollissima* Wall	Lamiaceae	Native
29	*Lindernia ruellioides* (Colsm.) Pennell 'Thasuih'	Linderniaceae	Native
30	*Lycopodium cernuum* Linn	Lycopodiaceae	Native
31	*Lygodium flexuosum* (Linn.) Swartz	Lycopodiaceae	Native
32	*Microlepia rhomboidea* (Wall.*ex* Kunze) Prantl, Arb.	Dennstaedtiaceae	Native
33	*Mimosa pudica* L. 'Hlonuar'	Mimosaceae	Non-native
34	*Ophiorrhiza mungos* L.	Rubiaceae	Native
35	*Ophiorrhiza 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 coetsa* 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

	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			
1	*Acacia oxyphylla* Benth	Fabaceae	Native
2	*Aganope thyrsiflora* (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	Non-native
11	*Marsdenia formosana* Masam.	Apocynaceae	Non-native
12	*Mikania micrantha* Kunth	Asteraceae	Non-native
13	*Millettia pachycarpa* Benth.	Papilionaceae	Native
14	*Mucuna gigantea* (Willd.) DC.	Fabaceae	Native
15	*Passiflora edulis* Sims	Passifloraceae	Non-native
16	*Passiflora nepalensis* Wallich	Passifloraceae	Native
17	*Paederia 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 lanceifolia* Roxb.	Liliaceae	Native
22	*Tetrastigma dubium* (M. A. Lawson) Planch	Vitaceae	Native
23	*Tetrastigma leucostaphylum* (Dennst.) N.P. Balakr.	Vitaceae	Native
24	*Trichosanthes quinquangulata* A. Gray	Cucurbitaceae	Non-native
25	*Uncaria sessilifructus* Roxb.	Rubiaceae	Native
Grasses			
1	*Bambusa khasiana* Munro	Poaceae	Native
2	*Bambusa tulda* Roxb	Poaceae	Native
3	*Cephalostachyum 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	*Dinochloa compactiflora* Kurz. Mc Clure	Poaceae	Native
8	*Drepanostachyum intermedium* (Munro) Keng f.	Poaceae	Native
9	*Erianthus longisetosus* 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

	Name of species	Family	Native/ Non-native species
14	*Schizostachyum dulloa* (Gamble) Majumdar 'Rawthla'	Poaceae	Native
15	*Setaria glauca* (L.) P. Beauv	Poaceae	Non-native
16	*Themeda villosa (Poir.)* A. Camus	Poaceae	Native
17	*Thysanolaena maxima* (Roxb.) Kuntze	Poaceae	Native
Epiphytes			
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 chrysotoxum* 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	Polypodiaceae	Native
17	*Eria paniculata* Lindl	Orchidaceae	Native
18	*Eria pannea* Lindl.	Orchidaceae	Native
19	*Mycaranthes stricta* Lindk.	Orchidaceae	Native
20	*Oberonia iridifolia* (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			
1	*Arenga pinnata* (Wurmb) Merr.	Arecaceae	Native
2	*Borassus madagascariensis* Bojer ex Jum. & H.Perrier	Arecaceae	Non-native
3	*Calamus inermis* Griff.	Arecaceae	Native
4	*Calamus khasianus* Kurz	Arecaceae	Native
5	*Calamus erectus* Roxb.	Arecaceae	Native
6	*Calamus flagellum* Griff. ex Mart	Arecaceae	Native
7	*Calamus guruba* Buch.-Ham. ex Mart.	Arecaceae	Native
8	*Calamus acanthospathus* Roxb.	Arecaceae	Native
9	*Caryota mitis* Lour. 'Mei-hle'	Arecaceae	Native
10	*Caryota urens* L.	Arecaceae	Non-native
11	*Livistona chinensis* (Jacq.) R.Br. ex Mart	Arecaceae	Non-native
12	*Pandanus odorifer* (Forssk.) Kuntze	Pandanaceae	Native
13	*Pinanga gracilis* Blume	Arecaceae	Native
14	*Wallichia nana* Griff.	Arecaceae	Native
15	*Zalacca secunda* Griff	Arecaceae	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 approached 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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