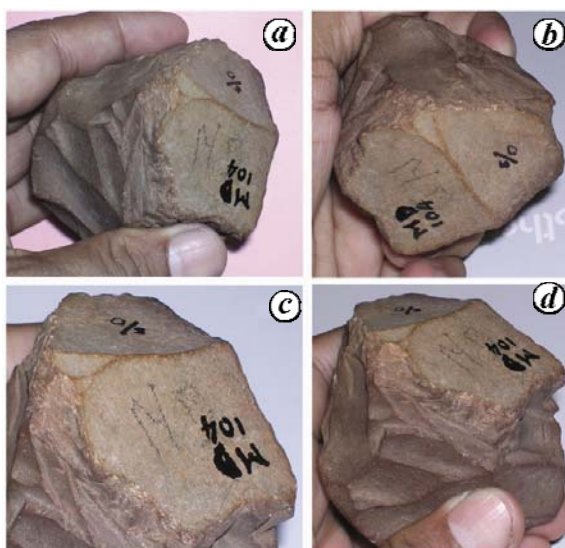




**Figure 2.** A core tool ( $9.5 \times 7.5 \times 6$  cm) re-used as scraper (**a**, closeup view of the freshly prepared working edge; **b**, the dorsal side of the specimen; **c**, the closeup view of old and new flake scars; **d**, the ventral side of the specimen).



**Figure 3.** A core on unidentified recycled specimen ( $7.2 \times 6.5 \times 5.5$  cm) (**a**, **b**, **c** and **d**, are four facets of the same showing two old patinated flake scars from earlier use; the flake scars are confirmed human works).

of stone tools have been recovered bearing signs of having been prepared from recycled large tools of an earlier phase. Thus, the large tool cultural remains of an earlier phase had possibly been greatly destroyed by subsequent microlith makers. Archaeological sites or cultural remains, whether based on ruins of earlier cultures (i.e. previous large tools users) or not, must be carefully studied to understand the Stone Age history of a region or the local cultural chronology. This has great methodological significance.

Successive use of recycled stone tools, over a long timeline, as evident in Mandla, is a significant observation. Flake scars of differential patination demonstrate successive reuse of a stone tool over a considerably long timeline, although it is not always convincing/true that all of them have resulted from human works.

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## Butterfly fauna of the Keibul Lamjao National Park, Manipur, North East India

Butterflies are one of the most fascinating creatures symbolically representing beauty and grace. India is a paradise for butterflies<sup>1</sup>, with a record of nearly 1501 species<sup>2</sup>, of which, the presence of nearly 962 species is known from the biodiversity rich hotspot sectors of North East India<sup>3,4</sup>. Records of the Zoological Survey of India published under the state fauna series have shown the occurrence of 106 species from Manipur<sup>5–7</sup>. A study carried out in the ecological parks of Bishnupur District, Manipur, has revealed

the presence of 136 species<sup>8,9</sup>. Here we report the diversity of butterflies from the highly protected natural habitats of the Keibul Lamjao National Park (KLNP), which is the only floating park in the world. It covers a total area of 40 sq. km and is situated between  $24^{\circ}27'N$  and  $24^{\circ}31'N$  lat. and  $93^{\circ}53'E$  and  $93^{\circ}55'E$  long. The park comprises distinct geographical zones such as 'Phumdis', which is a floating surface formed by conglomeration of vegetation along with the dead and decaying organic matter float-

ing over the water body. A number of hillocks, namely Pabotching, Toyaching, Chingjao and Chingmeiching exist in and around the National Park. The forest sector on the hillock side surrounding the park exhibits features similar to that of east Himalayan moist mixed deciduous forest. Such unique ecological condition with abundant floral diversity and salubrious climate ( $14 \pm 3^{\circ}C$  and  $28 \pm 2^{\circ}C$ ;  $70 \pm 5\%$  relative humidity and rainfall ranging from 1500 to 2000 mm per annum)<sup>10,11</sup> forms a conducive habitat for

## CORRESPONDENCE

insects in general and butterflies in particular.

Survey of the butterfly fauna in the KLNP and its surrounding area was conducted from 2005 to 2008 with permission from the Principal Chief Conservator of Forest (Wildlife), Government of Manipur. Butterflies were collected at random using a sweeping net during spring, summer and autumn. Known species were released soon after recording, but the unknown specimens were collected for further identification. Care was taken to collect only 2–3 specimens of each species so as to minimize the capturing and killing of butterflies. Collected specimens were sorted out with the help of standard keys available in the reference books<sup>1,2,12–14</sup>, and their identi-

ties were established with the help of experts from the Zoological Survey of India. The identified specimens are preserved in the insect museum at the Department of Life Sciences, Manipur University.

During the study, a total of 117 species belonging to 79 genera under 18 subfamilies were collected from the national park. Family-wise the collection indicated a maximum of 50 species under Nymphalidae, followed by 25, 17, 16 and 9 species respectively, under the families Lycaenidae, Hesperidae, Pieridae and Papilionidae (Figure 1). The collections under the family Nymphalidae consisted of species such as *Melanitis leda ismene* (Cramer), *M. phedima belo* Moore, *M. zitenius zitenius* (Herbst), *Mycalesis*

*mineus mineus* (Linn.), *M. persius blasius* (Fabricius), *Elymnias hypermnestra undularis* (Drury), *E. malelas* (Hewitson), *Ythima hubenri hubenri* Kirby, *Y. baldus baldus* (Fabricius), *Y. asterope maharatta* Moore, *Lethe europa niladana* Fruhstorfer, *L. chandica chandica* (Moore), *Neope confusa* Aurivillius, *Neope verma sintica* (Fruhstorfer), *Euploea core* (Cramer), *E. midamus rogenhoferi* Linn., *E. mulcibar mulcibar* Cramer, *Danaus chrysippus* (Linn.), *D. genutia* (Cramer), *Tirumala septentrionis* (Butler), *T. limniace leopardus* (Butler), *Charaxes polyxena* (Cramer), *Polyura athamas* Drury, *Parantica aglea melanoides* (Moore), *Precis atlites atlites* (Johanssen), *P. orythya ocyale* Hubener, *P. almana almana* (Linn.), *P. almonias*



**Figure 1.** Certain butterflies of the Keibul Lamjao National Park, Manipur. **a, b**, represent the family Papilionidae; **c, d**, family Pieridae; **e–g**, family Nymphalidae; **h–j**, family Lycaenidae, and **k, l**, family Hesperidae.

lemonias (Linn.), *P. iphita iphita* (Cramer), *P. hierta magna* Evans, *Neptis hylas vermona* Moore, *Lassipa viraja viraja* Moore, *Parathyma perius* (Linn.), *Phalanta phalantha* (Drury), *Cynthia cardui* (Linn.), *Vanessa indica indica* (Herbst), *Kaniska canace canace* (Linn.), *Symbrethia lilaea khasiana* Moore, *Hypolimnas misippus* (Linn.), *H. bolina* (Linn.), *Issoria sinha sinha* (Kollar), *Cirrochroa tyche mithila* Moore, *Euthalia aconthea suddhodana* Fruhstorfer, *Cupha erymanthis lotis* Sultz, *Ariadne merione assama* (Evans), *Argerius hyperbius hyperbius* (Johanssen), *Herona marathus marathus* Doubleday, *Vindula erota erota* (Fabricius), *Cethosia biblis tisamena* Fabricius and *C. cyane* Drury.

Species that have been recorded under the family Lycaenidae comprised *Helio-phorus epicles indicus* Fruhstorfer, *Curetis dentata* Moore, *Spalgis epius epius* (Westwood), *Taraka hamada mendesia* Fruhstorfer, *Rapala manae schistacae* (Moore), *Nilasera centaurus pirithous* (Moore), *Surendra quercetorum quercetorum* (Moore), *Hypolyceana erylus himavantus* Fruhstorfer, *Spindasis lohita* Horsfield, *Loxura atymnus continentalis* Fruhstorfer, *Arhopala amantes amantes* (Hewitson), *A. eumolphus* (Cramer), *Castalius rosimon rosimon* Fruhstorfer, *Acetolepis puspa gisca* Fruhstorfer, *Edales pandava* (Horsfield), *Jamides bochus* Stoll (Cramer), *J. elpis palisa* Fruhstorfer, *Euchrysops cnejus* (Fabricius), *Zizina otis* Fabricius, *Pseudozizeeria maha* Kollar, *Leptotis plinius* Fabricius, *Lampides boeticus* Linn., *Chilades laius* Stoll, *Zemeros flegyas indicus* Fabricius, *Abisara echerius suffuse* Moore. Butterflies collected under the family Pieridae were *Pieris brassicae nepalensis* Doubleday, *P. canidia* (Sparrman), *Pontia daplidice moorei* (Rober), *Cepora nerissa nerissa* (Fabricius), *C. nadina nadina* (Lucas), *Appias indra* Moore, *Delias aglaia* (Linn.), *D. descombesi descombesi* (Boisduval), *Ixias pyrene familiaris* Butler, *Hibomoea glaucippe* Linn., *Appias lyncida* Cramer, *Eurema blanda silhetana* (wallace), *E.*

*hecabe* (Linn.), *E. brigitta rubella* (Wallace), *Catopsilia crocale pamona* (Fabricius) and *C. pyranthe* Linn. Members of the family Hesperidae collected in the present study consisted of *Hasora chromus* (Cramer), *Bibasis jaina jaina* Moore, *Sarangesa dasahara* Moore, *Coladenia dan Evans*, *C. indrani indrani* (Moore), *Syrictus galba* (Fabricius), *Matapa aria* (Moore), *Pelopidas sinensis* (Mabille), *P. mathias mathias* (Fabricius), *Parnara naso* Fabricius, *Erionota thrax thrax* (Linn.), *Aeromachus jhora jhora* (De Niceville), *Udaspes folus* (Cramer), *Notocrypta curvifascia* (Felder), *Telicota ancilla* Mabille, *Potanthus pseudomaesa* Evans and *Ampittia dioscorides* (Fabricius). Members of Papilionids recorded from KLNP were *Graphium sarpedon* Linn., *G. agamemnon* Linn., *Papilio polytes Romulus* Cramer, *P. clytia* Linn., *P. demoleus* (Linn.), *P. helenus* (Linn.), *P. paris* Linn., *P. polyctor* Boisduval and *P. memnon agenor* Linn. Occurrence of a number of species in a particular habitat is generally attributed to the availability of larval plant hosts as well as flowering plants for adults during spring and autumn season. KLNP being a National Park, is well protected from various anthropogenic activities and other disturbances, including grazing by cattle. All these factors perhaps enable the Park to have an appreciable diversity of butterflies.

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