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A HISTORY OF ANIMAL DIVERSITY OF THE BAU LIMESTONE AREA

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ABSTRACT

Three levels of historical record of animal diversity are considered. Earliest is the evidence of the fossils of the marine fauna of the shallow Jurassic/Cretaceous seas in which the Bau limestones were originally deposited. Second is evidence of regional Pleistocene animal diversity, both through fossils and by inference from present biogeography. Thirdly, the evidence from the historical period, through published writings and collected specimens. Fortunately, from the earliest time of Rajah James Brooke (i.e., 1840) the Bau Limestone Area was visited by a succession of notable naturalists who left museum specimens and written records of their discoveries. Among these, A.R. Wallace's collections in early 1856 have established Serambu Hill as an entomological type locality of world importance. Material from excavations by A.H. Everett in 1878 has been re-examined in 2003, and potentially identifies the eastern mouth of the large cave in Bukit Bak, Jambusan, as a significant palaeontological site.

Keywords: Sarawak, Bau, geology, palaeontology, archaeology, history, swiftlets

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GEOLOGICAL BIODIVERSITY

The limestones near Kuching (Figure 1) are among the oldest in Sarawak, originating in Upper Jurassic to (Lower) Cretaceous times, i.e., about 150-170 million years ago. The limestone beds are lenticular, the thickest known being exposed near Bau where some are at least 1,000 feet (~300 m) thick (Wilford, 1955a,b). These were coral reefs, formed on a pre-existing ridge of older rocks in a shallow, subsiding sea. As the rate of subsidence increased and the sea deepened, the reefs were overwhelmed by marine sediments which now overlie the limestone conformably, as the Padawan shale. Marine animals occurring as fossils in the limestone include corals, sponges (Plate 1) and gastropods, along with Foraminifera and algae. Their distribution reflects the variety of past reef habitats (de Coo and Lau, 1977). Taking a very long view of history, these organisms were constituents of the marine biodiversity of this area at an ancient time when dinosaurs ruled the world. Consideration of key fossil localities should therefore be part of an overall strategy for biodiversity conservation and management of the limestone.

The caves in these hills contain a wealth of natural features, some commonplace and others rare and unusual. The study of these features is essential for the proper understanding of the origins and development of cave system. Many have been surveyed by Wilford (1964), but so far there is no complete inventory of speleological sites of special interest in the Bau Limestone Area. Such information would be a valuable tool to guide sustainable management policies for the limestone resource.

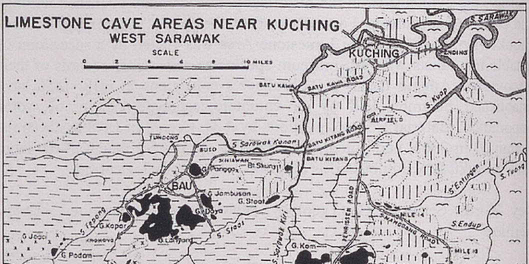

Figure 1: Map of limestone near Kuching, showing geological formations (from Wilford, 1964, Figure 18).

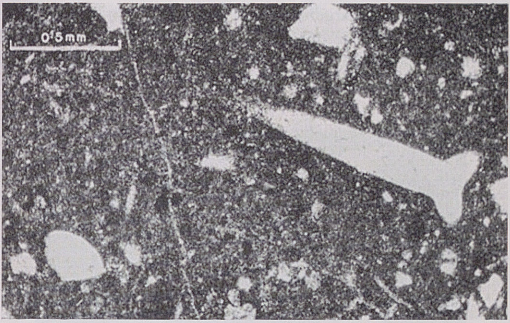

Plate 1: Sponge spicules from Poh Kwong Quarry (de Coo and Lau, 1977, p. 75).

PALAEONTOLOGICAL BIODIVERSITY

On a time scale of thousands, rather than millions of years, aspects of the animal diversity of Quaternary and early Holocene times are more closely relevant to the present fauna. It has long been recognised that, during Quaternary glaciations, global recession of sea-level periodically exposed large areas of the bed of the South China Sea (Verstappen, 1975). At such times, land links existed between Borneo, Sumatra and Java and, through the Malay Peninsula, to the Asian continent. Such intermittent connections facilitated the movement of terrestrial animals between these areas. During the intervening shorter, warm interglacial periods, isolation of Borneo by high sea levels fostered the local selection of endemic races or species. Eastward, the permanent deep waters of the Makassar Straits impeded faunal exchange between Borneo and Sulawesi (Cranbrook, 1981).

Fossils show that, in late Pliocene and early to mid-Pleistocene times, Java was initially occupied by an assemblage of vertebrates related to the Asian fauna known from strata in the Siwalik Hills of north India, and hence conventionally called the Siva-Malayan fauna (Medway, 1972). In Borneo, the Siva-Malayan assemblage is represented by very few fossils, all of insecure provenance (Cranbrook *et al.,* 2000). It is none the less plausible to assume that representative groups such as stegodonts, primitive elephants and hippopotamuses did occur, and would have ranged across the Bau area.

In the mid-Pleistocene another assemblage appeared in the region, of east Asian affinity and hence distinguished as the Sino-Malayan fauna. Key indicator species among large mammals included the orangutan, lesser two-horned or Sumatran rhinoceros (Plate 2) and tapir. Although not one of these mammals is now present, or expected, among the living fauna, all three have been found among cave remains at Bau (see below).

Plate 2: Fossil Sumatran rhino hind foot bones from Bau (Cranbrook, 1986). Left and right external (4^{th}) metatarsals. M 4154, Everett Collection, Natural History Museum, London

The upper Pleistocene was marked by the most severe period of cooling. The final phase (the 'Last Glacial Maximum', LGM), when global temperatures fell to averages of –5-6°C below present, occurred only ~18-23,000 years ago. Recession of the sea by some 116 m exposed a huge Sunda subcontinent connecting Borneo, Java, Sumatra and the Malay Peninsula, across which terrestrial animals could move unimpeded by water barriers. Pollen samples show that in tropical South-east Asia the altitudinal boundary between lowland and montane forest floras migrated down hill during this cool phase (Morley and Flenley, 1987). At the LGM, the lowland/montane ecotone was lowered by as much as 1,000 m in New Guinea mountains (Hope and Golson, 1995).

In archaeological deposits at Niah, in the lowlands of northeastern Sarawak, remains of specialised montane mammals were recovered from deep strata of the excavations (Medway, 1979), confirming that altitudinal zonation was depressed during the late Pleistocene. A past period of lowered temperatures is also indicated by the present relic distribution of montane species of vertebrates on isolated uplands. For example, a small, nectarivorous bird, the Mountain Black-eye *Chlorocaris emiliae*, is found on widely separated mountain peaks extending from Kinabalu to the Tamu Abu range, and elsewhere far across lowland Sarawak in the Penrissen-Nyiut block and the Pueh-Berumput range (Figure 2).

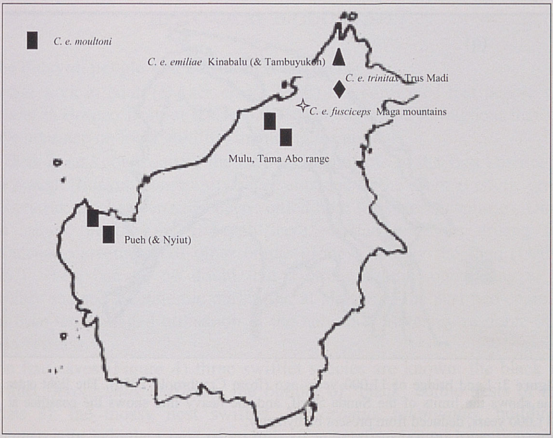

Figure 2: Distribution of the Mountain Black-eye *Chlorocaris emiliae* and its subspecies in Borneo (from Cranbrook, 2000, Fig. 1).

As well as general cooling, there is evidence that a drier and more seasonal climate prevailed across a broad central swathe of the exposed Sunda subcontinent. Provisional mapping places the Bau Limestone Area near the northern border of this region (Urushibara-Yoshino and Yoshino, 1997). Such climatic changes must have affected the composition of the vertebrate fauna of the Bau Limestone Area at that time. Evidence may be found in archaeological deposits in cave soils.

From about 18,000 years ago, warming of the global climate began to melt landfast ice that had accumulated at high latitudes and high altitudes, progressively releasing huge volumes of surface water. The consequent rise in sea level ultimately isolated Borneo. Plots based on simple bathymetry may need modification in the light of evidence of episodes of high sea level at Niah (Barker *et al.* in press, 2003). However, present interpretations show