A survey of amphibians, reptiles, and birds in Northeast India

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It was over a warm cup of tea on a cold Ankara afternoon in the winter of 1999, that we first talked about a survey in the 'unexplored tropical jungles' of Northeast India. Two years later, as we submit this report, we feel overwhelmed by the brief but rewarding glimpses that we have had of a wonderful region and its ever-smiling people. It has truly been an exciting and fulfilling experience, and somewhere along the way, we began calling this undertaking almost affectionately, "The Northeast Survey".

Numerous people provided us timely help us during the last two years, often in very difficult circumstances. We would not have gotten this far without their contribution. The Northeast survey has been a blur of people, places, and situations, and we apologise at the outset for any lapses in this note of gratitude; we promise to make up for it by inflicting ourselves upon the same unsuspecting souls soon again!

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SUMMARY

Northeast India, an important part of the Indo-Myanmar biodiversity hotspot, supports some of the biologically richest areas in the world, which affords it recognition as an area of global importance. Today, the forest cover in this region is merely one third of its geographical area, and the rate of habitat loss here is of serious concern. The low- to mid-elevation moist forests of this region are particularly important, as they not only support most of its biological diversity, but are also more vulnerable to human exploitation and settlement due their relatively easier access. Despite its importance, this region has remained poorly explored, and all evidence suggests much of the region's diversity is being lost without even being recorded. A serious problem that hinders effective prioritisation and evaluation for site-specific conservation attention is the lack of baseline biological data.

We undertook a survey of amphibians, reptiles, and birds in low- to mid-elevation sites along the montane tracts of Northeast India. Nine sites were covered over a period of eight months, with a special focus on inventorying forest species. The survey yielded a number of range records in the three faunal groups, and in the case of amphibians and reptiles, species new to science as well. *Excluding* records that are new for Northeast India, species seen during this survey comprise about 54%, 53%, and 32% of all the frog, reptile, and bird species, respectively, known from the region. In general, the survey gave a good indication of the extent to which biological information is lacking in the region, and highlighted areas and issues that need urgent scientific and conservation attention.

Amphibians, reptiles and birds comprise a significant proportion of the region's vertebrate diversity, and along with basic inventorying, we also investigated the role that they can play in evaluation and prioritisation for conservation attention. We compared patterns in diversity and distribution of forest frogs, lizards and birds across surveyed areas, and explored anthropogenic (e.g., habitat fragmentation) and natural environmental correlates of these patterns. These analyses showed disparate patterns for the three faunal groups. In general, tests for congruence showed poor agreement between groups, not just in terms of species richness, but in patterns of turnover as well. This is not surprising, considering the fact that they have divergent biological properties and evolutionary history.

From a conservation evaluation / prioritisation perspective, this implies that any one of these groups may not necessarily be a good indicator of richness patterns of the other two. Moreover, of the total species known from the region, an updated list for these nine areas *alone* now accounts for a sizable 87%, 56% and 60% respectively, for amphibians, reptiles, and birds. After comparing turnover between groups, and taking the inequality of survey effort between these groups, we estimate that in the montane tracts of this region, a greater proportion of frog and lizard species are likely to be present *outside* the protected area network in comparison to birds. This suggests that there may be a greater loss of forest species diversity of amphibians and reptiles from non-protected areas than of birds, given the present extent of habitat-loss in the region. This strongly suggests that patterns in more biotic groups (including invertebrates and plants) need to be closely examined and compared for more effective prioritisation of areas for conservation attention. The existing initiatives for conservation prioritisation and evaluation in the region need to be reviewed with this perspective. Indeed, if the chief objective of a protected area network is to *minimise* the loss of biodiversity at the regional scale, a prioritisation policy with focus on more faunal groups will have much better success in attaining this goal in Northeast India.

PART I – INTRODUCTION

The scale and rate of tropical forest degradation and loss of biological diversity is of worldwide concern. An initiative for prioritising areas of global importance has been the identification of Earth's biologically richest and most endangered terrestrial eco-regions (Collins et al., 1991). With limited resources available for conservation, these biodiversity 'hotspots' have been seen as a practical way to minimise biodiversity loss (Mittermeier et al., 1999; Myers et al., 2000; Prins and Wind, 1993). Indo-Burma (Myanmar), nested in the severely threatened and data-deficient Asia-Pacific region (UNEP, 1999; UNEP, 2000a), is known to be exceptionally rich in flora and fauna (van Dijk et al., 1999)[1]. Covering the tropical evergreen and temperate broadleaved forests from Northeast India and Bangladesh up to Vietnam, this region is one of the 25 hotspots in the world (Mittermeier et al., 1999), and has even been considered a contender for the title "hottest of the hotspots" (van Dijk et al., 1999).

The foothills along the northern boundary of this hotspot, including those of Northeast India, are of particular importance as they support a high proportion the region's biological diversity (van Dijk et al., 1999). However, as will be apparent in the following discourse, these forests are also the most threatened, and much of their diversity is being lost without even basic documentation. We present here the results of a survey we undertook in Northeast India, which was aimed at inventorying amphibians, reptiles and birds, and supplementing existing information on specific conservation problems in selected areas. The results included a number of distributional records for the three faunal groups, as well as re-discoveries and even species new to science in the case of amphibians and reptiles. Based on species lists of the three groups, we attempted to answer questions about diversity and distribution patterns of the three vertebrate groups, and possible environmental factors underlying them. A key objective behind this was to see whether these patterns converged across groups, as a biologically sound criterion for conservation evaluation and prioritisation in Northeast India.

BACKGROUND

Northeast (NE) India, the region of focus in this work, is situated at the confluence of the Indo-Malayan, Indo-Chinese and Indian biogeographical regions. This unique position, coupled with its physiography, has laid a foundation for the proliferation of a variety of habitats, which harbour a diverse biota with a high level of endemism (Mani, 1974). In general, its biological affinities are close to Southeast Asia, and it is considered a distinct biogeographic zone within the Indian Subcontinent (Mani, 1974; Rodgers and Panwar, 1988). Based on its physiography and broad biological composition, the region can be broadly differentiated into the Eastern Himalayas, NE Hills and the Brahmaputra Plains (cf., Mani, 1974; Rodgers and Panwar, 1988). Of these, the first two zones are primarily montane, with contrasting geological origin and morphology, while the latter consists of the flood plains of the Brahmaputra and Surma rivers.

In general, the region receives high rainfall (>2000 mm annually in most montane tracts), most of it during the southwest (post-summer) and northeast (winter) monsoons. However, the microclimate varies locally with physiography (Ramdas, 1974), and, under the influence of the humid Brahmaputra and Surma River plains, some ranges trap

[1] About 13,500 flowering and gymnosperm plant spp. with 51.9% regional endemics, 329 mammal spp. with 22% endemics, 1170 bird spp. with 12% local or regional endemics, 202 amphibian spp. with 56.4% regional endemics, and 484 reptile spp. with 41.5% regional endemics.

remarkable amounts of rainfall (e.g., >10,000 mm annually in parts of the Khasi hills). The Eastern Himalayas are one of the richest areas in India in terms of its habitat diversity, which ranges from wet tropical forests to alpine meadows. Moreover, its low elevation moist evergreen forests are considered the northernmost limit of true tropical rainforests in the world (e.g., Namdapha Tiger Reserve, at 27° 31' N 96° 24'E; Procter et al., 1998). The NE Hills, which run from north to south, are allied to the Burmese Arc. Though for the most part much lower than the Eastern Himalayas, these ranges encompass considerable altitudinal and habitat diversity as well, ranging from wet tropical to temperate, and even alpine in some crests along the more lofty ranges adjoining Myanmar.

A Hotspot in Danger: Threats…

The history of land use and habitat degradation of the Eastern Himalayas and NE Hills is best understood in contrast with that of the Brahmaputra and allied plains. Systematic exploitation of these well settled plains started as early as mid-19th century (op. cit., Singh, 1996), and today they support a sizeable human population of 26.6 million (340 persons km^2 Census of India, 2001). Around 85% of this population is rural, largely sustained by permanent plain cultivation, and the little primary habitat that remains, is constantly under threat from exploitation and conversion to agriculture. Similar factors have also resulted in extensive loss of lowland forest along the undulating foothills and accessible hill tracts around the Brahmaputra and Surma river basins, where timber (e.g. Teak *Tectona grandis*) and non-timber (e.g. Tea[1] *Camellia sinensis*) plantations gain importance as a source of income (Forest Survey of India, 1999). On the other hand, much of the adjoining montane tracts support a relatively sparse population which hitherto subsisted largely on traditional slash-and-burn or shifting cultivation (regionally known as *jhum*), and regular utilisation of non timber forest produce. Previously, these traditional modes of land use, presumably sustainable due to low population densities, coupled with inaccessible terrain and prevalence of malaria, had largely shielded the Eastern Himalayas and the NE Hills from large scale habitat degradation[2].

However, across most of the NE Hills and much of the Eastern Himalayas today, a situation exists where extensive conversion of natural habitat can be foreseen. The reasons for this scenario are complex, foremost among them being rapidly changing demography[3]. The relatively accessible low- to mid-elevation forests have suffered the most, and they continue to come under ever-increasing pressure from tree felling, NTFP extraction and heavy *jhuming*[4]. These problems have been compounded by external commercial influences, and often, poorly conceived development and impractical land-use reform measures (e.g., Singh, 1996 pages 202-209).

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[1] About 2300 km^2 of the undulating foothill tracts in Assam state are covered with tea plantations, producing 425,430 tonnes of tea annually; more than any other country except China (North Eastern Development Finance Corporation, 2001).

[2] See Gadgil & Guha (1993), Ramakrishnan (1992) and National Research Council (1993) for discussions pertinent to past patterns of land use by hill communities.

[3] For instance, Arunachal Pradesh, which has one of the lowest population densities in India (13 persons / km^2, as against the national average of 324 persons / km^2 Census of India, 2001), also has one of the highest population growth rates, particularly along the tracts adjoining the plains (five districts along the Assam border have an annual growth rate of 7.5% against the national average of 1.93%; Singh, 1999b).

[4] Between 1987 and 1997, 17,300 km^2 (6.8% of total area) in the region was estimated to be affected by *jhuming*, most of it in the NE Hill states (14.7% of total area), followed by Arunachal Pradesh (2.7% of total area) (Forest Survey of India, 1999).

At present, the forest cover[1] is 62.7% (~160,000 km^2) in the Eastern Himalayas and NE Hills, of which 44.1% (~71,000 km^2) is 'unclassed' forest (a large proportion of it owned by local/village communities Forest Survey of India, 1999). Approximately 5.5% (~14,000 km^2) of the total geographical is currently under protection[2] (Forest Survey of India, 1999).

…Conservation Prioritisation, and Evaluation

Although much concern has been expressed about the scenario that we briefly outline above, a failure to find a viable solution to the needs of local communities has hindered most conservation efforts in the region, and problems continue to grow at an alarming rate. Across the world, establishment of state protected areas is seen as the most effective step towards biodiversity conservation (Bruner et al., 2001; UNEP, 1999). However, the delineation and management of parks in the tropics is a challenging task (Balmford et al., 2001; Bruner et al., 2001), especially with the limited resources that are generally available. This situation not only makes it increasingly difficult to bring more areas under protection, but also threatens existing state protected areas (PAs). In these circumstances then, it is imperative to develop a workable, coordinated scheme for prioritisation of areas for conservation attention, and also for *evaluation of existing PA networks* (PANs) as had been advocated (e.g., Balmford and Gaston, 1999; Mace et al., 2000) and attempted elsewhere in the world (e.g., Africa; da Fonseca et al., 2000).

Considering its importance, the NE Indian region remains appallingly deficient in data on area-specific biological attributes and conservation problems. Among other things, uneven knowledge of the taxonomy and distribution of species and groups in Indo-Burma has retarded attempts to estimate the species diversity and endemism for the region (van Dijk et al., 1999). Prioritisation initiatives are futile until site-specific information is collected, especially in neglected geographical areas and for poorly surveyed biotic groups. In the last decade or so, some surveys have been undertaken in this region, but the effort has been skewed towards certain faunal groups (large vertebrates) and particular areas, either because they are more accessible, or for their apparent conservation value[3]. Also, with increasing biological information, an integration of data into a broader perspective is necessary, with a close examination and juxtaposition of diversity and endemism patterns from various biotic groups.

A convergence in patterns of species richness across disparate biotic groups such as vascular plants, birds, mammals and insects can be used to rank areas in order of their coverage of biodiversity, a sound criterion for prioritisation as well as evaluation of an existing PAN for conservation attention. This criterion is termed as *congruence.* A second, closely related criterion, termed as *complementarity*, examines the level of turnover of species composition across areas, the underlying rationale being that a set of areas which complement each other's biological diversity (greater turnover) will be the most successful towards the goal of retaining *most* of a region's biological diversity. In recent years, an increasing number of studies have appeared in literature which have taken this approach towards offering solutions for conservation prioritisation (Crisp et al., 1998; Faith and Walker, 1996; Howard and Viskanic, 1998; e.g., Kitching, 1996; Reid, 1998).

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[1] This figure needs to be interpreted with caution, as it combines "dense" and "open" forests and the latter probably includes plantations and bamboo brakes; dense forest is merely 37.4% of the total area (Forest Survey of India, 1999).

[2] Including only national parks and wildlife sanctuaries.

[3] For instance, till date, 12 bird surveys have been carried out in Namdapha Tiger Reserve alone, though it is difficult to find a single published bird list for most other areas in NE hills or Eastern Himalayas.

Amphibians, Reptiles, and Birds

Amphibians, reptiles, and birds account for most the region's vertebrate diversity. However, the biological attributes of these three groups differ considerably. For instance, birds are homeotherms (endotherms or 'warm blooded'), with good dispersal ability, while amphibians and reptiles are poikilotherms (ectotherms or 'cold blooded') with poor dispersal ability, of which the former are strongly dependent on moist environments. These differences mean that data on these groups are an important aspect of this region's biological profile, and crucial for prioritising conservation values. However, information on all three groups in this region is very poor, though to different levels and for dissimilar reasons.

All evidence suggests that NE India is a region very rich in amphibians as well as reptiles, and that much of this diversity still remains to be discovered. Since the latter half of the 19th century, species have sporadically been added to the list of amphibians and reptiles of the region, albeit with a distinct bias towards areas in the Assam valley and fringing montane tracts (e.g., Annandale, 1912a; Annandale, 1912b; Boulenger, 1890; Chanda, 1994; op. cit., Dutta, 1997; Frazier and Das, 1994; Romer, 1949; Sarkar and Sanyal, 1985). The interior hill states, especially those south of the Assam valley, viz., Nagaland, Manipur, Tripura, Meghalaya and Mizoram, remain poorly surveyed in comparison. It is not surprising therefore, that recent exploration in NE India continues to yield fresh information in the form of new, often dramatic range records as well as species new to science (e.g., Choudhury et al., 1999; Das and Sengupta, 2000; Dutta et al., 2000; Pawar and Choudhury, 2000; Slowinski et al., 2001). However, our knowledge of the diversity distribution, and biology of this region's amphibians and reptiles remains patchy at best, more so in the case of amphibians (see Ahmed, 2001), in comparison to reptiles (see Annandale, 1912b, p. 37).

Information exists at a higher level for birds in this region, in contrast with amphibians and reptiles. More survey effort has been invested on avifauna, partly because the relatively unambiguous taxonomic resolution of this diverse vertebrate group makes inventorying easier. Initial avifaunal surveys date back to the end of 19th century (Ali and Ripley, 1987). After that period, there was a long period of ornithological inactivity in the region, followed by a sudden spate of work in the last decade or so (Athreya et al., 1997; Athreya and Karthikeyan, 1995; Choudhury, 2000; Datta et al., 1998; Kumar and Singh, 1999; Raman et al., 1998; Raman, 2001; Singh, 1994; Singh, 1999a) which has yielded invaluable information. However, in the case of avifauna as well, literature suggests that effort has been mostly restricted to parts of Assam and Arunachal Pradesh, and overall, the region remains poorly-studied in comparison to the Peninsular India and many other regions in SE Asia. One indication of this lack of baseline information on distribution and biology of the region's birds is that 68 species here have recently been cited as "*current status unknown*" (Grimmett et al., 1999).

Even with existing information, NE India is known to have about 836 of the 1200-odd bird species known from the Indian subcontinent, and it probably also supports the highest bird diversity in the Orient (Crosby, 1996). Of these birds, 24 species' global distributions are restricted only to the region. Two of the eight Endemic Bird Areas of Indo-Burma hotspot have been recognized in NE, viz. Eastern Himalayas / NE Hills and Assam Plains (ICBP, 1992). The richness of the region's avifauna principally reflects its diverse habitats associated with the wide range of altitudes, and the biogeographic continuity with SE Asia (Daniels et al., 1992). However, lowland evergreen forests attain the highest bird diversity for any given habitat, with one third of the total bird species present in the region (Grimmett et al., 1999).

PART II – METHODS

The survey was planned with the goal of covering a wide geographical swathe in a period of 8 months or so, with sufficient time in each area for a representative sample of its amphibians, reptiles, and birds. Areas were chosen on the basis of altitudinal range and forest types[1]. Accordingly nine sites (See Fig. 1) were selected and visited in Arunachal Pradesh, Assam, Meghalaya, and Mizoram states of NE India from October 2000 to June 2001:

Nameri National Park (NP) – Pakhui Tiger Reserve (TR)	:	24/Oct/00 – 25/Nov/00
Namdapha TR	:	05/Jan/01 – 25/Jan/01
Mouling NP	:	29/Jan/01 – 24/Feb/01
Balphakram NP	:	15/Mar/01 – 28/Mar/01
Barail Reserve Forest (RF)	:	05/Apr/01 – 15/Apr/01
Ngengpui Wildlife Sanctuary (WLS)[2] – Palak Lake Area	:	25/Apr/01 – 14/May/01
Dampa TR	:	21/May/01 – 31/May/01

We chose existing PAs, and not areas outside of the PAN for two main reasons: firstly, taking the region's conservation scenario into consideration, it is obvious that bringing additional land under the PAN may be difficult in many areas of NE India. Therefore, an evaluation of existing PA network in terms of biodiversity conservation could arguably be considered more imperetive. Moreover, this approach would still provide insights for the proritisation of additonal PAs. Secondly, NE India is a poorly connected region, and selecting PAs was logistically far more feasible than attempting to visit a number of non-PAs in a relatively short period of time[3].

Considering their geographical proximity, we combined all information for *Nameri NP-Pakhui TR* (the two areas are adjacent, with contiguous habitats) and *Ngengpui WLS-Palak Lake Area* (they lie within ~20 km from each other, and have similar biota and physiography), treating them as one in all analyses and discussions.

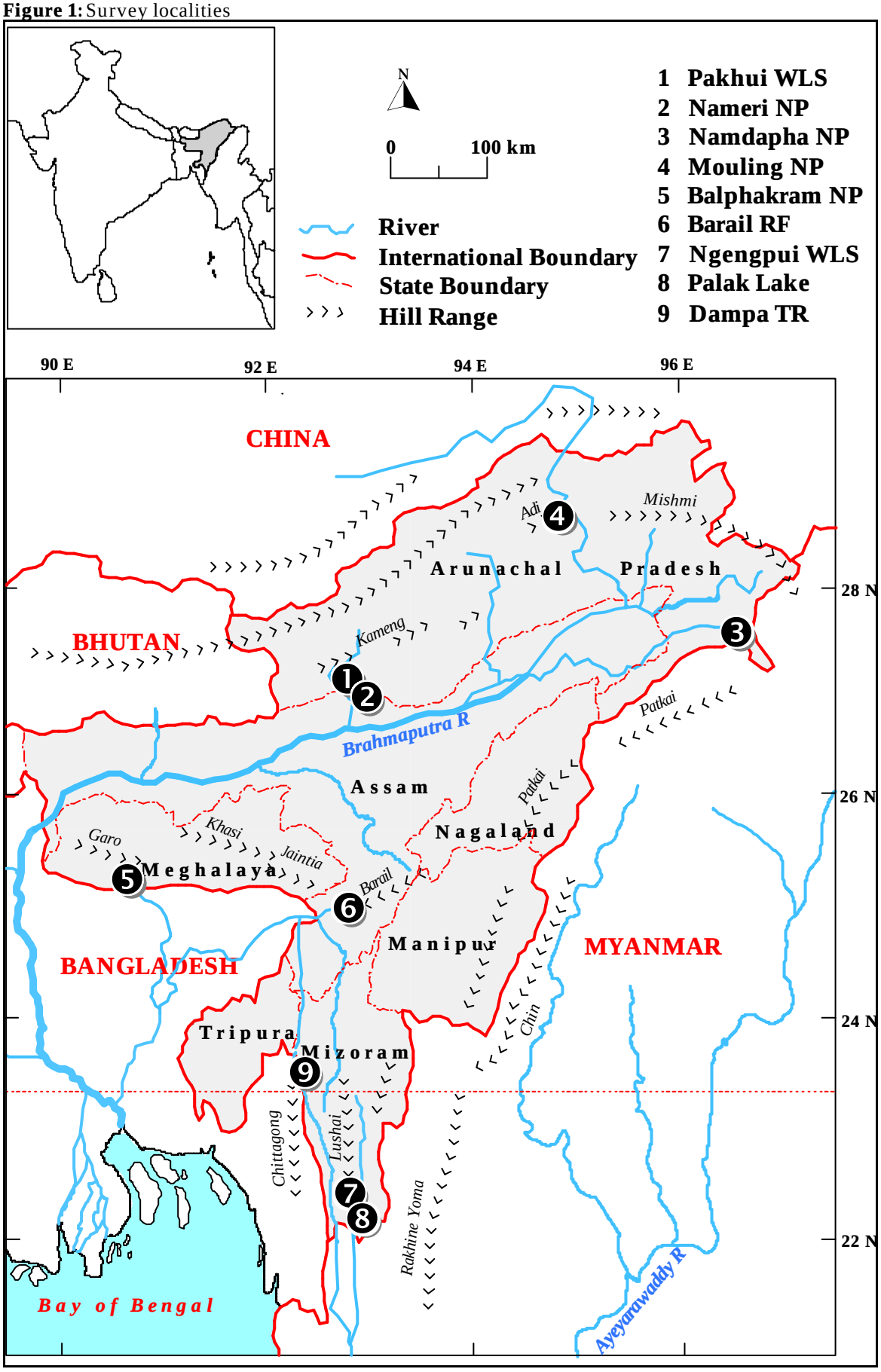
For each area, information on the attributes and past as well as present extent of natural vegetation, and land use patterns was collected by direct observations, from local people, and by consulting officials at the Forest Department and other government as well as non government institutions. These were supplemented with information collected by enquiries with other scientists and published area-specific literature.

[1] Our focus was within the range of tropical semi-evergreen to evergreen forests described by Champion & Seth (1968), Puri et al. (1989) and Wikramanayake et al. (1998), between an altitudinal range of ca. 100-1500 m msl.

[2] Data from SP's previous, unpublished work (Pawar, 1999) in Ngengpui WLS is incorporated in all subsequent results and discussions.

[3] As it is, logistical and political constraints imposed restrictions on the choice of areas, and potential sites in Nagaland, Manipur, and Tripura states had to be excluded.

Figure 1: Survey localities



Given the above time schedule, seasonal effects on faunal sampling was unavoidable. However, we have attempted to minimise this bias by including information from all existing sources in all the results, analyses, and subsequent discussions. In general, faunal sampling was focused on primary habitats[1]. We spent maximum time on surveying mature and primary forests, as our focus was forest species. Both diurnal and crepuscular-nocturnal surveys were carried out, by both observers, generally along with one or two field assistants.

Typically, all three groups were sampled on diurnal walks, during one composite survey extending from dawn to forenoon, with the initial morning hours dedicated to birds. Crepuscular-nocturnal walks began late in the evening and rarely extended beyond 2100 hrs. The period up to dusk was devoted to detecting pre-roosting birds, after which amphibians were searched for, especially along forest streams and ponds.

Though diurnal *bird* surveys were concentrated around early mornings, they generally lasted till afternoon. Each sighting was recorded with notes on locality, altitude, micro-habitat and behaviour. In cases where identification was difficult or doubtful, more detailed notes were taken on plumage and behaviour. In addition to direct sightings, calls were recorded with a cassette recorder whenever possible. Maximum time was spent in the first site visited, for a preliminary familiarization with the region's avifauna.

Amphibians and *reptiles* were sampled in terrestrial as well as aquatic forest habitats. Diurnal surveys included scanning with the naked eye and binoculars (whenever necessary, as in the case of gliding lizards) and far ranging, intensive microhabitat searching (under stones and fallen logs, in tree hollows, etc.). Frequent surveys were conducted along seasonal and perennial streams, and in directions orthogonal to, or away from existing trails. Animals were hand caught whenever possible, identified and released, except in cases where the individual posed problems for identification (possibly a new taxon or a new record), or was the first example of a species from that locality / region. In these situations, the individual was euthanised, preserved, labelled and retained as a voucher specimen (see Appendix IV). Collections were made with appropriate permits from the Forest Departments (FD). In the case of amphibians, apart from adults, representative samples of spawn and multiple larval / tadpole stages were collected, and vocalizations recorded. Portraits and close-up photographs of representatives of each taxon / species were taken, covering as much individual colour-pattern variation as possible.

Additional information was gathered from specimens already available in field museums and in private collections in NE, whenever such repositories were available. Animals were identified to levels allowed by the taxonomic information available for each taxon / species[2]. Comparative material was examined at the Zoological Survey of India (ZSI) and other, smaller, private collections. In cases where taxa appeared hitherto unknown to science, unique identification codes were allocated. In addition, photos of problematic and doubtful taxa were circulated among other scientists.

[1] Throughout this work, we use a system of classification while referring to the primary or secondary nature of habitats, the details of which are given in Appendix I.

[2] With reference to literature available on the biology, distribution and taxonomy of amphibians and reptiles of the region and the neighbouring regions (Bangladesh, Myanmar, Thailand, etc.), and based upon various cues from photographs, voucher specimens, call recordings (for frogs) and natural history notes.

Data Analyses

We compared distributional patterns of amphibians, reptiles and birds and examined their relation to sets of environmental parameters. As we have mentioned above, an important objective behind the analyses was to examine these patterns within the framework of evaluation / prioritisation criteria. We attempted to address the following questions:

1) *What are the patterns of richness and turnover across sites for forest birds, frogs, and lizards?*
2) *Are these patterns influenecd by similar environmental parameters across faunal groups, and to what extent does the interplay of geographical distance between sites and biological properties (dispersal ability) of fauna influence them?*
3) *How much turnover is there in forest species across sites/landscapes (complementarity between sites), and are these patterns similar for the three faunal groups (congruence between groups)?*

Environmental parameters: In addition to information from the survey, the following data were collected from published (see Area Accounts in Part III) as well as unpublished sources to have as a complete profile as possible for each of the surveyed sites and surrounding areas. Centered on each of the seven sites, we delineated circular 'landscapes' of 4000 km^2, using a 1:250,000 scale map, within which we estimated the following abiotic / environmental parameters:

Altitudinal attributes

Altitudinal range in the landscape (metres above mean sea level; *msl*), expressed as *m* x *n* table, where *m* = landscape, *n* = altitudinal classes of 200 m intervals. Each cell represents presence or absence of that altitudinal class in the landscape (termed as binary data).

Rainfall pattern

Total monthly rainfall (millimetres; *mm*), averaged across months for a few years (3-8 years, depending upon availability), from a recording station within or nearest to the landscape, obtained from statistical handbooks of each state.

Landscape fragmentation

Percentage dense forest cover in administrative districts (Forest Survey of India, 1999) relevant to the landscape. If the landscape was distributed in more than one district, average dense forest cover was taken, weighted by the proportion of the landscape accounted by each district. In addition, the size (square kilometers; km^2) of the single largest patch of contiguous forest in and around the surveyed area was estimated, which we consider a surrogate for primary habitat patchiness in the landscape (a larger single patch probably indicates that there is relatively less landscape patchiness).

Dispersal routes

To examine the influence of interplay between group-specific dispersal ability and geographical position of areas, road distances (kilometres; *km*) between landscapes were cartographically calculated. We argue that better dispersers (e.g. birds) would be more successful in dispersing across landscapes and geographic barriers (e.g., the Brahmaputra River) irrespective of dispersal routes, while poor dispersers would be more dependent upon terrestrial dispersal routes. Straight distance is not a satisfactory a measure to test the effect of dispersal distance, as it does not express differences in terrain between sites. Montane road networks of NE India follows tortuous paths, and we consider the length of the shortest road between sites as a surrogate for dispersal distance.

Fauna: Only the distributional records of forest species[1] was used in all analyses, as they mirror the natural attributes of an area and landscape most faithfully, and are also the most sensitive to habitat alteration.

To have as complete a list of amphibians, reptiles, and birds for each area as possible, the survey results were pooled with all previous records from the area after a careful screening of published (given at the end of each faunal checklist in Appendix I) as well as unpublished records (in consultation with others who had worked in the survey areas). In the case of amphibians and reptiles, data were particularly deficient, and records from nearby areas were included in analyses[2].

Generally, before making comparisons of species richness and distribution, it is always advisable to control for the effects of possible sampling inequity between sites (Magurran, 1988; Walther and Martin, 2001). However the surveys from which data was compiled are distributed over a span of more than 100 years, and were conducted with varying methodologies and unknown effort. Therefore, we tried to minimise error by pooling all records for the sites/landscapes, and excluding from all analyses those taxonomic subsets *within* each group, which were obviously and consistently more data poor than others (e.g., snakes, among reptiles; see checklists in Appendix I). These subsets also tended to have very different distributional patterns from the rest of the group, a difference that can be attributed to the fact that they have different evolutionary history and biology. Accordingly, we restrict the analyses to *frogs, lizards, and birds*. As subgroup differences are not so apparent in birds, in order to examine patterns within the group, we selected one taxonomic subset consisting of babblers, warblers and laughingthrushes (Family Sylviidae) for analyses along with the complete forest bird list.

Statistical methods: A direct correlation would be the most effective method to compare patterns across biotic groups, or relate biotic attributes with environmental attributes (Jongman et al., 1995). In the present situation however, we had limited sites (seven, after combining *Nameri NP-Pakhui TR* and *Ngengpui WLS-Palak Lake Area* sites) at our disposal, and multiple environmental variables recorded at disparate scales. Therefore a conventional correlation method was not justified and instead, we used the following strategy (Clarke, 1993; cf. Clarke and Warwick, 1994) to compare the distribution of frog, lizard and bird species', and relate them to environmental attributes:

(1) The between-landscape differences in sets of environmental variables (e.g. altitudinal attributes, rainfall, etc.) were extracted with a coefficient of dissimilarity into a triangular matrix of pair-wise differences between sites/landscapes. Euclidean distance was used to calculate dissimilarities using environmental variables measured in continuous scale, and Sorenson's coefficient for variables with binary data. Before calculating dissimilarities the continuous scale variables were subjected to power transformations ranging from $x^{0.5}$ to $x^{0.25}$ (fide Clarke and Warwick, 1994).

(2) Pair-wise dissimilarities between landscapes using forest frogs, lizards and bird species were calculated with the Jaccard coefficient, from simple presence-absence data of forest species in each survey site (data in similar tables as described for altitudinal data above).

[1] Based on literature and our observations, species which are at least partially dependent on primary forest are classified as 'forest species'.

[2] Approximately within a radius of 30 km from the actual survey site (for instance, records from Tura included in Balphakram NP area for analyses); these records and those from unpublished sources are not included in the checklists.

(3) Thereafter, depending upon the question, the triangular dissimilarity / distance matrices were correlated (e.g., frogs vs. birds, for testing *congruence*, and frog vs. rainfall for relating fauna to environmental attributes) using the non-parametric Kendall's coefficient of rank correlation, and the significance of association tested by the Mantel test (Sokal and Rohlf, 1995, pages 813-819) with 900 random permutations of rows and columns of one of the matrices. To control for the effect of correlation *between* environmental attributes, partial Mantel tests (Smouse et al., 1986) were used (e.g., correlation between dissimilarity matrices of frogs and altitudinal attributes, while controlling for the effect of rainfall pattern).

(4) For visual comparison, matrices of site relationships (dissimilarities) based on patterns of frogs, lizards, birds and the two bird sub-groups were mapped graphically using Multi-dimensional Scaling (Clarke and Warwick, 1994; MDS; Faith et al., 1987; Minchin, 1987). To facilitate visual comparisons between MDS plots, they were rotated and flipped relative to the position of areas that were consistent outliers to the others across all plots (*Mouling NP* and *Balphakram NP*; see Part III).

(5) To examine if all faunal groups and sub-groups had comparable turnover across areas (did the areas *complement* each other consistently for surveyed faunal species?), percentage dissimilarity between areas (from the dissimilarity matrices) for each faunal group / subgroup was averaged to obtain a single figure of turnover in that group. In addition, a coefficient of variance (CV) in site dissimilarities was calculated as an index of "turnover consistency", which gave an indication of which groups / subgroups of fauna had more consistent (and perhaps predictable) turnover across sites / landscapes.

PART III – FAUNAL DISTRIBUTION PATTERNS: LOOKING FOR CONGRUENCE

The survey yielded 45 amphibian (1 caecilian and 44 frogs), 58 reptile (28 lizards, 23 snakes, 8 turtles), and 265 bird species[1]. These include 7 new records (including 6 species possibly new to science) and 6 rediscoveries for the NE Indian region[2] for amphibians. For reptiles, there are 5 new region records (including 4 species possibly new to science) and 3 rediscoveries. Among birds, 10 globally threatened, 3 range-restricted, and 13 rare or "current status unknown" (Grimmett et al., 1999) species were sighted.

In the case of amphibians, 54% of about 71 species[3] known from the entire region[4] (cf. Dutta, 1997), were seen during this work, excluding new regional records / new species. In reptiles, 53% of about 175 species known from the entire region (excluding crocodilians; cf. Das, 1996), were recorded during this work, excluding new regional records / new species. The 265 birds sighted during the survey account for 32% of the 836 species known from the entire region[5].

Overall, compiled species lists for the nine survey areas now stands at 61 amphibians including 2 caecilians and 59 frogs (46 forest species), 98 reptiles including 32 lizards (25 forest species), 58 snakes and 8 turtles and 501 birds (259 forest species), which account for about 87%, 56% and 60% respectively, of the total species known from the entire region. The figure for reptiles may appear smallest of the three, but removing non-lizard reptiles from the calculation reveals these areas account for a sizeable proportion of region's known lizard species (32 / 41; 78%) as well.

The following table presents area-wise records from this survey, along with *all* records for the area[6].

	Amphibians		***Reptiles***		***Birds***	
***Area* (label[7])**	***Survey***	***All***	***Survey***	***All***	***Survey***	***All***
***Nameri NP & Pakhui WLS* (NP)**	13	30	22	36	119	283
***Namdapha TR* (NA)**	14	28	10	48	108	333
***Mouling NP* (MO)**	13	24	6	39	116	228
***Balphakram NP* (BL)**	8	22	12	33	82	199
***Barail RF Area* (BR)**	15	19	10	13	67	242
***Palak Lake & Ngengpui WLS* (PN)**	24	24	47	47	119	148
***Dampa TR* (DA)**	18	22	41	43	58	229
Total	45	61	58	98	265	501

In the following sections, after a brief comparison of species richness between and among forest frogs, lizards, and birds across sites, we explore environmental patterns

[1] See Appendix II for notes on selected species in surveyed fauna.

[2] Across Indo-Myanmar; new range records *within* the confines of NE India not enumerated.

[3] Taxonomic uncertainty and doubtful records make it impossible to estimate a precise species number for the region.

[4] Includes the Assam valley and parts of the Surma River plains.

[5] This includes 186 forest birds, which account for 64% of the *forest* birds known to occur in entire NE India.

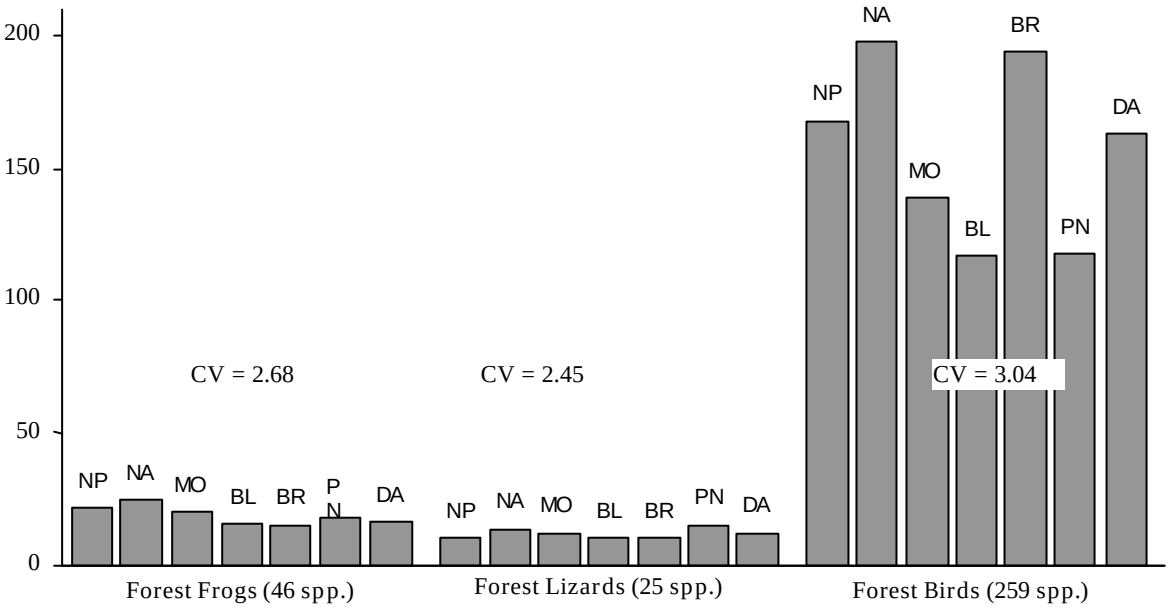
[6] Including the results of this work and published records, as well as unpublished information communicated by colleagues (not included in the checklists of Appendix I) and from our examination of museum / private collections.

[7] We use abbreviated labels for survey sites in tables and figures of subsequent sections.

that may determine these richness and distribution patterns. With these insights, we then make direct comparisons of the patterns between groups (see Methods section). Finally, we test the similarities of distribution patterns between the groups from the viewpoint of conservation prioritisation and evaluation criteria discussed earlier.

A Preliminary Look: Forest Species Richness Across Sites

A comparison of the number of species of forest taxa across sites (see Fig. 2) shows an obvious difference between species richness[1] in frogs and lizards on one hand, and birds on the other. This is a general pattern in the tropics, but is more pronounced in tropical South and Southeast Asia, where there are fewer forest frog and lizard species than many other areas of the world (Inger, 1980a; Inger, 1980b; May, 1980). Though the richness of frogs and lizards is comparable, there are differences in patterns among all three groups. For instance, in the case of frogs the two richest areas are in the Eastern Himalayas, while in the case of lizards and birds, one of the two richest areas lies at the eastern end of the Eastern Himalayas, while the other is in the NE Hills.



NP	22	10	168
NA	25	14	198
MO	20	12	139
BL	16	10	117
BR	15	10	194
PN	18	15	118
DA	17	12	163

Figure 2: Species richness of forest frogs, lizards and birds across surveyed sites.

Interestingly, though it may appear that the between site variation in species richness is much higher for birds, the relative variation is similar (see coefficient of variance (CV) values in Fig. 2). This superficial look does not give a complete picture of the differences

[1] As mentioned earlier, species lists for analyses were compiled from *all* records of forest birds, frogs and lizards from the area and nearby localities (see Methods section). Unpublished records are not included in the checklists, so total species richness figures quoted here, and used in the following sections will not match with those in the checklists.

in distribution pattern of the species richness of the groups. For instance, the frog species richness of sites account for about 30-55% of the total species pool (across sites), but for reptiles it is 40-60% of the total of 25 species, and for birds, it is as much as 45-77%. This suggests differences between the groups in turnover (species replacement) across sites.

Birds Fly, Frogs Hop and Lizards Run: Differences in Distribution Patterns

We explore these probable distributional differences between groups by using information on species presence-absence across sites (see Methods). Figures 3a to 3e show MDS configurations of sites based upon dissimilarities in turnover pattern of target taxa. At this stage of pattern exploration, one taxonomic subset of birds which includes babblers, warblers and laughingthrushes (Family Sylviidae)[1] is also included, to examine whether this subgroup responds differently from forest birds as a whole. Conversely, to see whether pooling across taxa is as informative as examining them in groups or subgroups, we include a plot of site configurations based on *all groups together* (Figure 3e). As a numerical measure of how dissimilar sites are on an average based upon each faunal group, we present one *dissimilarity* value for each plot, obtained by averaging dissimilarity matrix. This we consider a surrogate for group-wise species turnover across sites / landscapes (see Methods).

In terms of areas, Mouling NP consistently appears to be the most distinct for all biotic groups (compare between all MDS plots). The reason for this is a combination factors, including its unique topographical features and relatively isolated position[2].

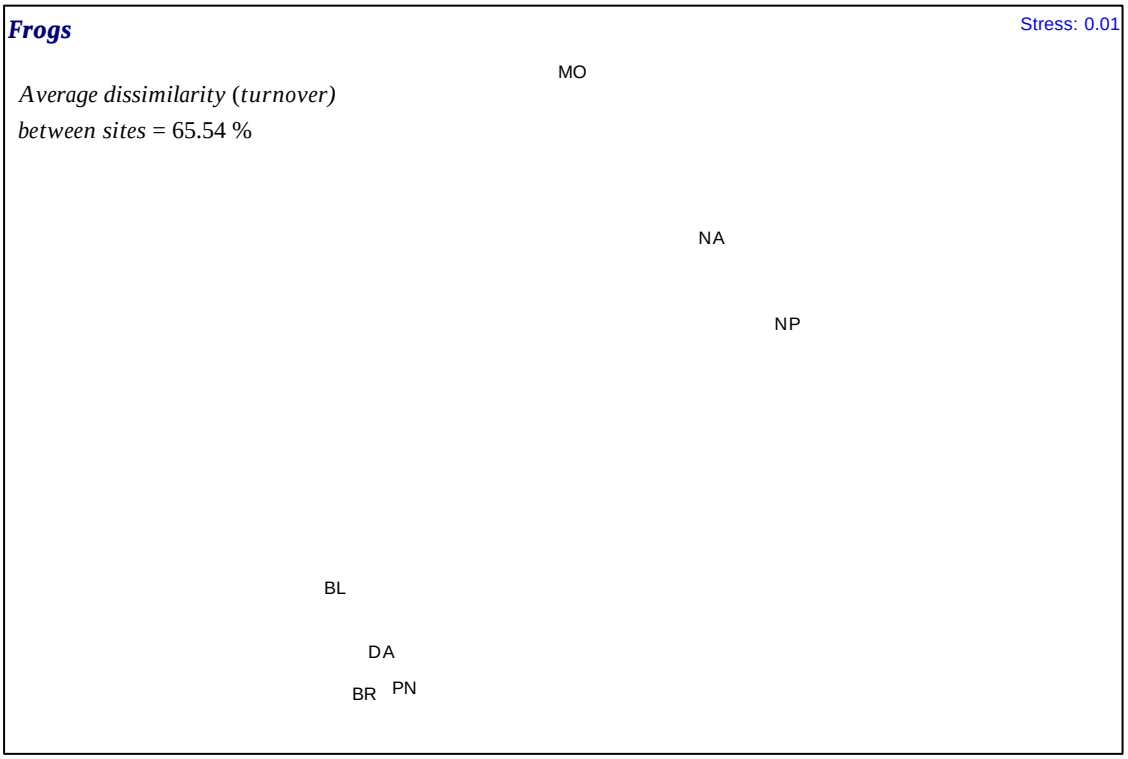


Figure 3a: MDS plot of surveyed areas based on dissimilarities in forest frog assemblages between sites. *This plot reproduces the actual geographical positions of sites (see Fig. 1) quite well, and suggests a restricted distribution of frogs. This is well supported by the high average turnover value, and clumping of sites below and above the Brahmaputra River.*

[1] This group includes a number of species with limited dispersal ability (mostly babblers and laughingthrushes).

[2] These factors are discussed in Area Accounts (Part V).

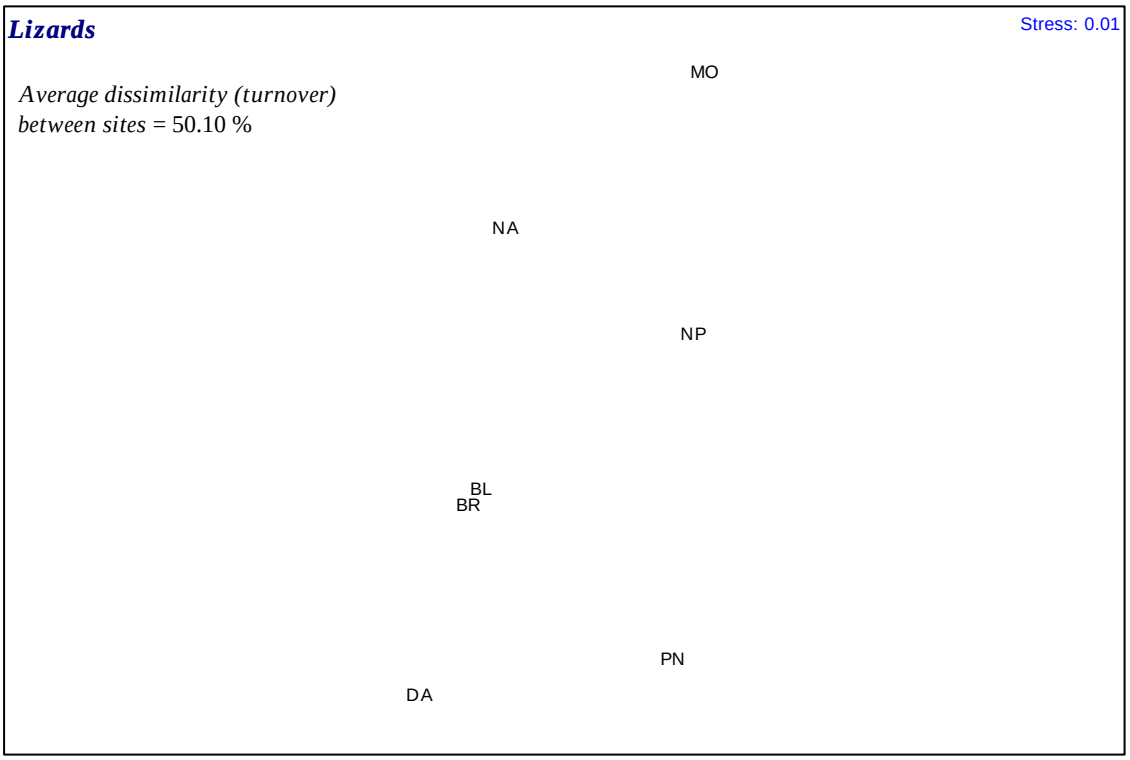


Figure 3b: MDS plot of surveyed areas based on dissimilarities in forest lizard assemblages between sites.
A faithful representation of actual geography, but much less accurate than that the frog plot. The average turnover of forest lizards is also high, again indicative of restricted distributions. The Brahmaputra River divide is apparent here as well.

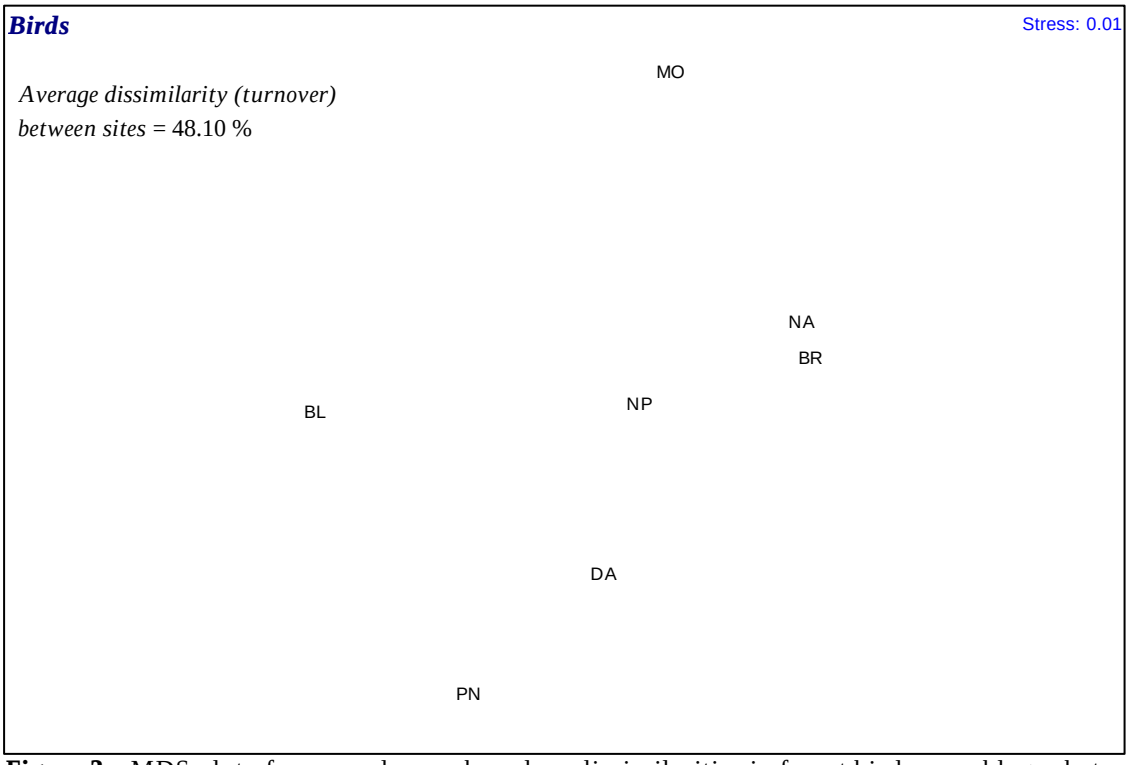


Figure 3c: MDS plot of surveyed areas based on dissimilarities in forest bird assemblages between sites. *Much less accurate geographically in comparison to the first two plots, with very little clumping of sites. No Brahmaputra River divide is seen here. This plot reflects the fact that forests birds have wider ranges, and more species are shared between sites. This is well supported by the average turnover value as well, which is lowest among all groups.*

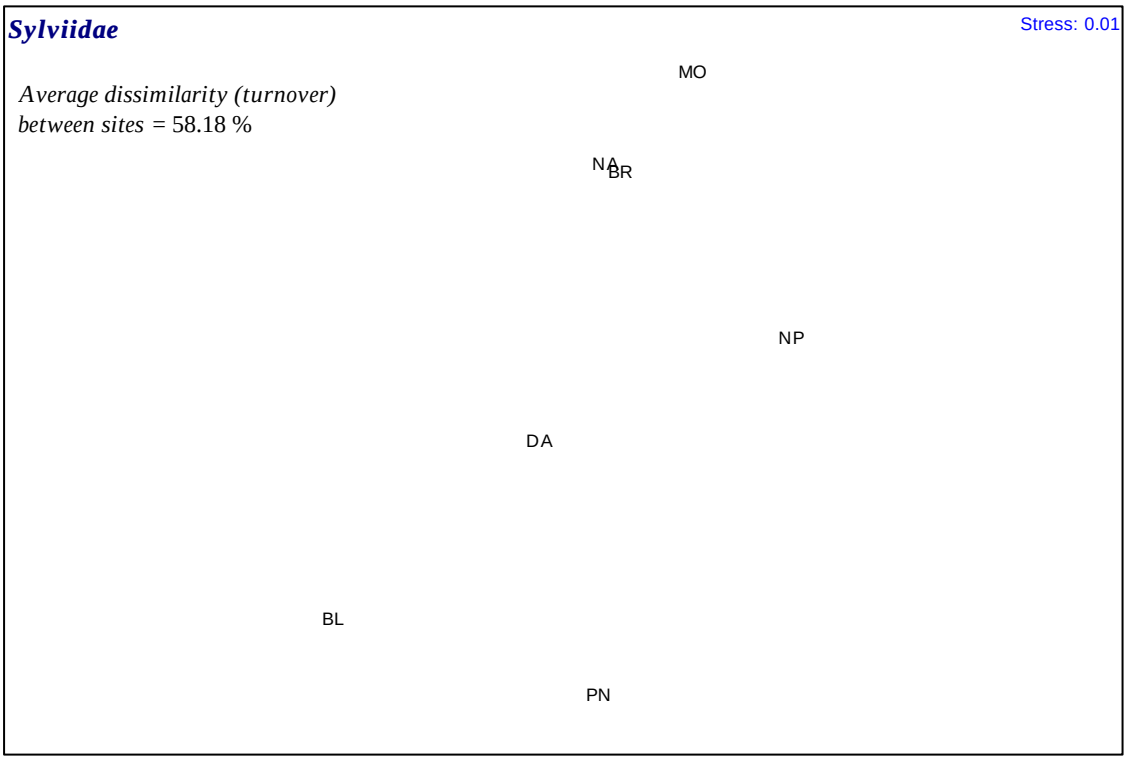


Figure 3d: MDS plot of surveyed areas based on dissimilarities in forest Sylviidae assemblages between sites. *Again, a geographically inaccurate configuration, but very different from that of all forest birds. The Brahmaputra River divide is not apparent here as well, but the average turnover here is high.*

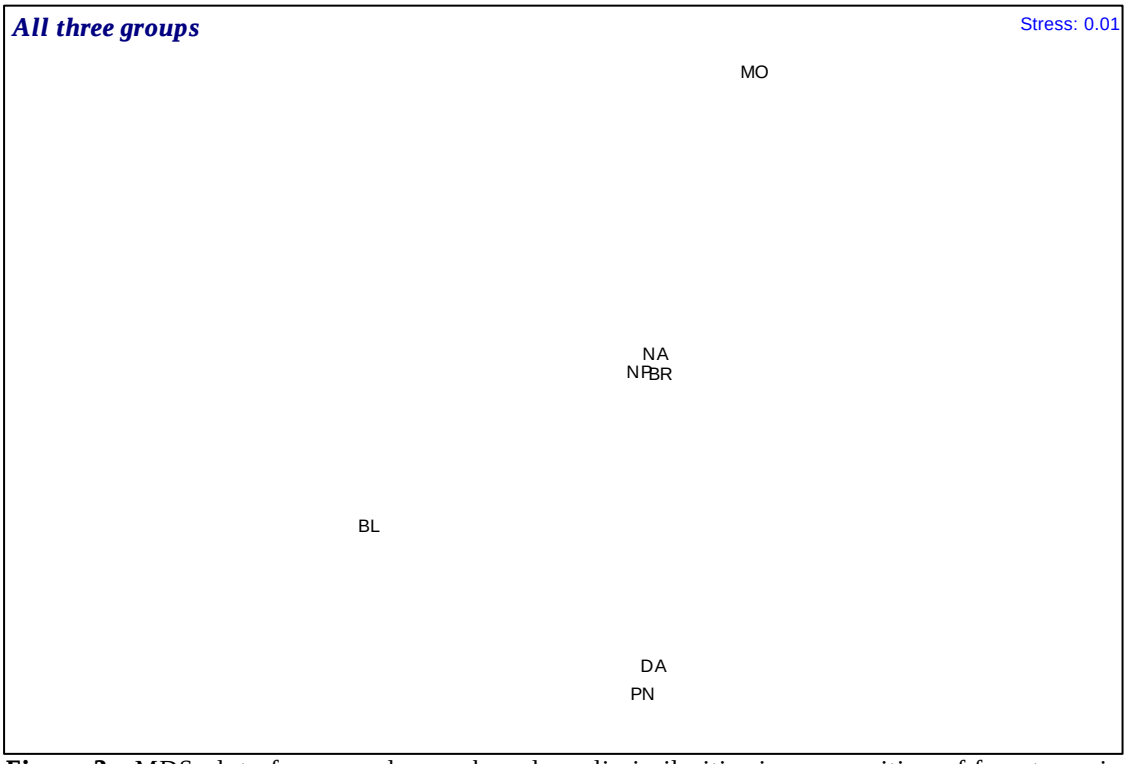


Figure 3e: MDS plot of surveyed areas based on dissimilarities in composition of forest species of all surveyed faunal groups together. *Apart from being geographically inaccurate, this configuration shows an inconsistent clumping of sites. This pattern is not similar to that of any one group, which suggests an effective masking of group-specific patterns. Turnover value is not included here as it is merely an average of the turnover of frogs, lizards, and birds.*

…Biogeography,

These plots are interesting to compare, as they are an approximate representation of biogeographic patterns of the faunal groups, as expressed by their distribution across a wide geographic range of sites in NE India. In the introductory discourse, we mentioned that birds are homeotherms (endotherms or 'warm blooded'), with good dispersal ability, while amphibians and reptiles are poikilotherms (ectotherms or 'cold blooded') with poor dispersal ability, of which the former are strongly dependent on moist environments. Considering their incongruent life history and ecology, it is not surprising that these groups should have very different patterns of richness and distribution. Frogs and lizards are poor dispersers compared to birds, and the MDS plots demonstrate this well. For instance, the pattern of site similarities based upon frogs indicates that their distribution is sensitive to geographical barriers (e.g., the Brahmputra River; see Jayaram, 1974), perhaps magnified by the effect of local environment. The patterns are similar in the case of forest lizards as well, but for birds on the other hand, and even the subset Sylviidae[1], the Brahmaputra River is apparently not such an important divide.

To test the hypothesis that poor dispersers (e.g., lizards) would show a stronger correlation with dispersal routes than good ones, we performed correlations between road distances and faunal dissimilarities between landscapes / sites. The results seem to support these conjectures: frogs ($p=0.002$) and lizards ($p=0.001$) are more strongly related to road distance than birds ($p=0.006$) and the family Sylviidae ($p=0.02$). Apart from poor dispersers such as babblers, the Sylviidae, also comprise good dispersers (mainly warblers), which perhaps confounds the pattern, resulting in a relatively weak correlation of the group with road distance. Additionally, this group may have dispersal pattern which does not match that of the other groups, and for which road distance is not a suitable surrogate.

…and Correlates of Distribution

Having pointed out broad biological and biogeographic differences, we now move on to compare the groups in terms of environmental correlates of these turnover patterns. Apart from the scale at which environmental parameters influence distribution of these groups, it is likely that fundamentally *different* parameters influence them, which we test with Mantel tests. Table 1 summarises correlations of faunal groups with selected environmental parameters (see Methods).

In such situations, it is important to consider the effect of one parameter on another. For instance, significant correlations were detected between landscape fragmentation and altitude (landscapes with similar topography have a similar level of fragmentation) and between road distance and altitudinal attributes[2]. To see the effect of each parameter in isolation, we controlled for interrelationships among environmental parameters by partial Mantel tests. The effectiveness of this approach is apparent from the fact that the significance of many of the fauna-environment associations in Table 1 change substantially after the effect of one parameter on another is controlled for.

A note on the interpretation of these results is in order here. It is evident from the values in Table 1 that frogs, lizards and birds have different environmental correlates. However, these apparent associations need to be interpreted cautiously. The data for estimation of differences in environmental attributes had to be obtained from varied sources across NE India (see Methods), and some resolution is bound to have been lost due to its

[1] As mentioned before, this family includes a number of poor dispersers.

[2] This also supports our use of road distance as a measure of dispersal routes across varying topography.

inaccuracy. Here again (see previous section), the group Sylviidae shows weak relationships in general. At present, we are unable to judge whether this is due to the group's biological properties, or because the data is not accurate enough to pinpoint associations.

	Frogs	**Lizards**	**Birds**	**Sylviidae**
Altitudinal attributes	0.018*	0.008**	*ns*	*ns*
Altitude x landscape	0.017*	0.01**	*ns*	*ns*
Altitude x rainfall	0.021*	0.01**	*ns*	*ns*
Altitude x road distance	0.050*	0.034*	*ns*	*ns*
Rainfall pattern	*ns*	*ns*	0.043*	*ns*
Rainfall x landscape	*ns*	*ns*	0.033*	*ns*
Rainfall x altitude	*ns*	*ns*	0.058*	*ns*
Rainfall x road distance	*ns*	*Ns*	*ns*	*ns*
Landscape fragmentation	0.026*	0.057*	*ns*	*ns*
Landscape x rainfall	0.019*	0.057*	*ns*	*ns*
Landscape x altitude	0.031*	*Ns*	0.022*	*ns*
Landscape x road distance	0.030*	*Ns*	*ns*	*ns*

Table 1: Association[1] of fauna with environmental parameters[2].

However, some clear patterns are worth mention here. Firstly, terrestrial dispersal routes apparently magnify the impacts of environmental parameters ('x road distance' correlations), but for different parameters for frogs and lizards on one hand, and birds on the other. For instance, the apparently strong association between altitudinal attributes and frog and lizard assemblages is reduced if the effect of dispersal distance is taken into consideration. These partial correlations also indicate that the scale (local to regional level) at which environmental parameters impact these groups varies across fauna[3].

Interestingly, landscape fragmentation is the only parameter that significantly affects frogs, lizards as well as birds. Moreover, the results also suggest a considerable difference in the scale at which this parameter affects frogs, lizards and birds. By itself, fragmentation seems to affect frogs and lizards, but not birds, but after controlling for altitude, it becomes the most significant correlate for birds. This in not surprising, as there are a number of altitudinal and latitudinal migrants among birds, and they are more likely to be affected by landscape level alteration of migratory routes. This effect will be amplified in the case of forest taxa, as they depend more on forest routes (as against straight flight routes) for dispersal and migration. Such effects have been demonstrated elsewhere (Brooks et al., 1997; Pimm and Askins, 2001). In the case of frogs and lizards on the other hand, there is no altitudinal or latitudinal migration, and the effects of landscape level fragmentation probably is important for them at the local scale. For instance, Knutson et al (1999) show that there is a strong dependence of frogs and

[1] Considered significant (*) at 'p' values = 0.06; highly significant (**) at p = 0.01; '*ns*'= non-significant association.

[2] 'x' stands for a controlled correlation; for instance, "Landscape x altitude" means that association of the faunal group with landscape fragmentation has been tested after controlling for the effect of altitude on landscape fragmentation pattern.

[3] For an insight into scale at which environmental patterns influence the distribution of fauna in general, and the groups under discussion here in particular, see and compare Bohning-Gaese (1997), Cornell (1993), Cueto and de Casenave (1999), Holt (1993), Huston (1999), Schluter & Ricklefs (1993), and Owen (1989).

toads on wetland distribution rather than fragmentation *per se*, and that for many frogs, forest patches are mainly important as refuge. These patterns may be true in some heavily fragmented areas in this region (see area accounts for Balphakram NP and Dampa TR in Part V).

There are very few studies in literature that have compared the response of different faunal groups to the same set of environmental parameters. Studies that have attempted such comparisons, mostly demonstrate an often show an dissimilar response of different biota (e.g., for resonse to habitat alteration, see Bowman et al., 1990; Lawton et al., 1998; for relationships with general habitat parameters, see Ricklefs and Lovette, 1999). For instance, Bowman et al (1990) reported a very different response for birds, butterflies and reptiles to the same regime of slash and burn agriculture in Papua New Guinea.

In the above results, birds appear to show the weakest habitat associations in general, a fact that can largely be attributed to the heterogeneity of the group. Families of water birds (Anatidae, Rallidae, and Ardeidae), raptors (Accipitridae and Falconidae), owls (Tytonidae and Strigidae), nightjars (Eurostopodidae and Caprimulgidae) and swifts (Apodidae) in particular, are known to show conflicting patterns, and probably have varying succeptibility to habitat alteration at various scales (Terborgh and Winter, 1980). In the results of these analyses as well, the Family Sylvidae exhibits patterns that are strikingly different from the group consisting of all birds.

Frogs, Lizards and Birds: Congruence

These results clearly demonstrate two important points: the faunal groups that we have examined here converge poorly in terms of species richness as well as turnover pattern. Before launching into a discussion about the implications of this within the viewpoint of criteria for conservation prioritisation or evaluation, we present two sets of figures: one that directly evaluates cross-taxon congruence in turnover (Figure 4), and the second that examines their relative contribution to the complementarity between sites / landscapes.

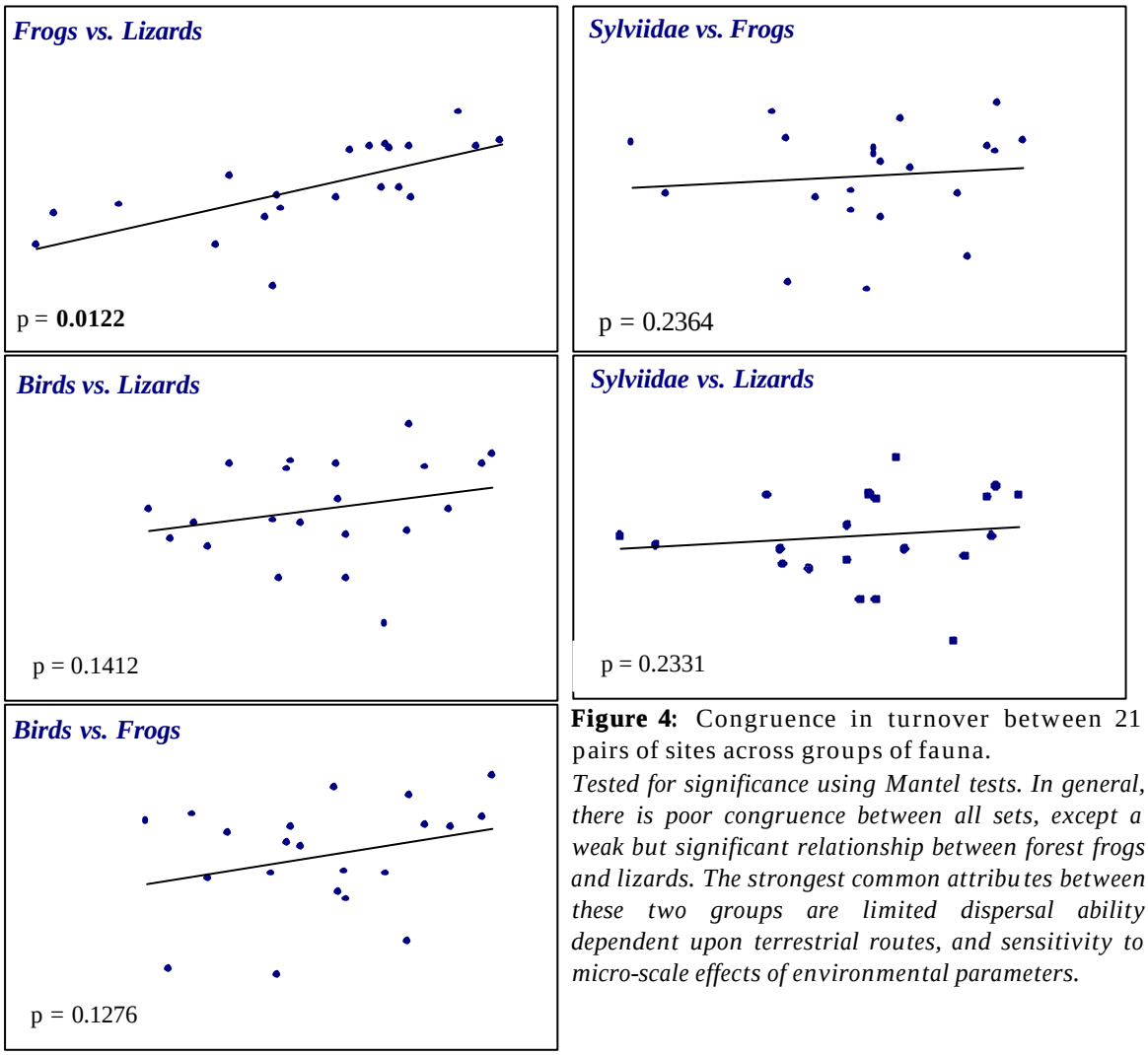


Figure 4: Congruence in turnover between 21 pairs of sites across groups of fauna.
Tested for significance using Mantel tests. In general, there is poor congruence between all sets, except a weak but significant relationship between forest frogs and lizards. The strongest common attributes between these two groups are limited dispersal ability dependent upon terrestrial routes, and sensitivity to micro-scale effects of environmental parameters.

…and Complementarity

In addition to the congruence estimate above, we again present the figures of average dissimilarity between sites (see MDS plots above), but include here the coefficient of variance as a measure of the consistency with which species replacement takes place across sites for each group:

	Mean dissimilarity of sites (turnover)	*CV of mean turnover*
Frogs	65.54%	29.96
Lizards	50.10%	26.71
Birds	48.10%	19.12
Sylviidae	58.18%	23.54

Clearly, the mean value of dissimilarity in each group indicates the level to which sites complement each other for that group. The CV values on the other hand, are a crude

estimate of the predictability of turnover in each group. For the same relative distances between sites, if one group shows more variability in turnover, it means that the group has a pattern less predictable than of another with a lower CV. A group with higher turnover need not necessarily have a higher CV as well. For instance, though the bird subset Sylviidae has a greater mean turnover across sites than lizards, its turnover pattern is more uniform (and perhaps predictable) than that of the lizards. Comparing this criterion across all groups, it is apparent that frogs not only have the highest turnover on average, but are also the least predictable in terms of species replacement across sites. In fact the variability in turnover of frogs is almost 57% more than that of birds, which have the lowest turnover and maximum evenness. Apart from the lack of congruence that has been demonstrated above, we consider that these values of turnover and 'turnover consistency' together are a strong indication that any one of these groups is a poor surrogate for the others in terms of species richness as well as tunover.

These trends suggest that the level of congruence across groups may fall sharply if a greater variety of biota is taken into consideration. Poor congruence should be expected between such groups, and using changes in species richness of only familiar and well-studied groups (such as birds or butterflies) as indicators of diversity patterns in in other taxa can give a misleading picture (Lawton et al., 1998).

How Much Can Seven Sites Hold?

A glance at the initial results shows that the seven surveyed areas account for 59/68 (87%) frogs, 32/41 (78%) lizards and 501/836 (60%) birds of the region's known species pool (forest and non-forest taxa). Removing all high altitude and open/secondary habitat species the seven areas account for approximately 46/55 (85%) frogs, 25/33 (76%) lizards and 259/290 (89%) birds of the of the region's *forest* taxa[1]. Superficially, these figures seem to suggest that the region's species pool is well represented in just these seven areas. However, a comparison of these figures with the turnover values of each group shows an interesting contradicton.

A faunal group with higher species turnover would be expected to have a poor representation in a set of only seven sites out of a region of the size of NE India. However, these figures indicate the opposite; the seven areas contain 85% of the region's known frog richness, though this group has the highest level of species turnover. The same disagreement between turnover and species proportional species richness is seen in the case of frogs as well as birds.

The reasons for these apparent contradictions are not diffcult to pinpoint. A quick look at the first part of the results will show that the survey yielded a number of new regional records for amphibians and reptiles, but none for birds. In fact, as we mentioned in the introduction, every survey amphibian and reptile in this region has been very productive in terms of fresh distribution records, as well as taxa new to science. The effort invested in bird surveys has been much more than that for amphibians and reptiles. Apart from the seven surveys nested in this work, we know only 10 other surveys that have *focused* on either or both amphibians and reptiles of NE India. Eight of these have been in or around the areas we visited, which leaves only 2 surveys in other areas! In the case of birds on the other hand, a number of surveys have been conducted in sites outside the landscapes we targeted, indicating a relatively even survey effort. This indicates that the 89% representation of the region's low- to mid-elevation forest bird pool in these seven sites probably reflects a relatively better documentation of the region's total bird species pool.

[1] This also reiterates that the low- to mid-elevation forests contain maximum diversity.

The same cannot be said for frogs and lizards though. Their between site turnover (especially that of frogs) is higher than that of birds, and this combined with the obvious taxon bias in inventorying outside of this set of sites, points at the possibility that a much lower proportion of the region's frog and lizard species pool is represented in these seven areas. Assuming that the three groups have been surveyed almost comparably in the seven survey sites, and that there has been negligible frog and lizards sampling outside of these areas, the proportion of species outside of the seven areas can be approximately gauged from the difference in turnover of frogs and lizards vis-à-vis birds. This suggests that as much as 25% more frogs and 6% more lizards than birds are likely to exist outside of these seven areas.

PART IV - SYNTHESIS

In today's scenario, PANs are probably the best chance that we have to conserve at least a majority of the global biological diversity (Bruner et al., 2001). There has been much discussion about the right approach towards conservation in India, and issues such as the needs of local communities have been intensely debated (Kothari et al., 1996). However, an issue that should be of serious concern is that there has been limited effort at an objective evaluation of areas for conservation attention. Substantial financial and material investment has to be made for maintaining a PAN (Alexander et al., 1999; Mace et al., 2000), and it is crucial that areas and strategies for conservation attention are chosen on sound biological criteria.

Area-specific Problems

In general, there has been a limited use of biological information for conservation planning in NE India. Apart from the fact that this region remains particularly neglected in terms of scientific attention, this is also partly a result of poor dissemination of existing information. In most of the areas we visited, FD personnel expressed a need for greater dissemination of information on the part of the scientific community, and that management/working plans would be much strengthened if better information on site-specific biological information were included. Such concerns have been expressed by other authors for situations worldwide; it is a major challenge for ecologists to extend general principles for providing specific scientific information needed for local land-use planning (Theobald et al., 2000). Generally, conservation practitioners have to deal with specific problems at manageable scales, and we feel that ecological studies can provide practical and useful guidelines for dealing with them.

After this part, we include a section that gives area-specific accounts on conservation problems and faunal attributes across the sites that we surveyed. A glance across these accounts will highlight an important point: although all these landscapes/sites are within a fixed range of physiography and habitat types, the conservation problems vary considerably across areas. In general, the broad differences between the NE Hills and Eastern Himalayas in patterns of land use and distribution are evident in the area accounts. This has implications not just for present conservation strategies, but for dealing with the future scenario as well. For instance, post-*jhum* regeneration follows very different patterns across the two montane zones of NE India. In the areas we visited in Arunachal Pradesh, the post *jhum* succession is dominated by woody plants and in some cases sympodial bamboo. In contrast, many areas in NE Hills have a regeneration pattern dominated by rapid establishment of monopodial bamboo brakes[1]. This is probably due to prolonged exposure of the latter areas to cultivation. In general, the rate of succession into forest habitat (Raman, 1995; Raman, 2001)) if quite different in these two situation. These factors need to be taken into account while framing conservation strategies[2].

Information Gaps

The preliminary insights from the survey indicate a number of obvious gaps in information in certain areas and biotic groups. A compromise has to be achieved between investing on surveys in the severely threatened low- to mid-elevation forests, and the more poorly surveyed but relatively less threatened interior and higher elevation

[1] For a detailed discussion of *jhuming* in NE India, see Ramakrishnan (1992), and Rao & Ramakrishnan (1988).

[2] For instance, see "Conservation scenario" in the area account for Dampa TR in Part V.

tracts of this montane region. In terms of faunal groups, information on lower vertebrates (including ichtyofauna), and inverebrates needs to be documented urgently. Apart from the need to undertake rapid evaluation / prioritisation attempts, there is also the need to take a fresh approach towards identifying problems for resource allocation in the existing high priority areas.

In conjunction with biodiversity inventorying, a more efficient incorporation of existing biological information into conservation strategy is possible by using Geographic Information Systems (GIS) for gap analysis (Burke, 2000; Flather et al., 2001; Jennings, 2000; Theobald et al., 2000). Spatially explicit landscape-scale models that predict species distributions can also be used, which by careful extrapolation can help bring even poorly known areas into the reckoning for conservation attention (e.g., Boone and Krohn, 2000).

Biological Indicators

Based upon surveys in nine protected areas in the montane zone of NE India, we attempted a preliminary evaluation of the biological attributes of seven sites, using information from amphibians, reptiles and birds. The results demonstrated a poor agreement between these three groups and also that pooling species lists across biotic groups is much less informative than taking selected subsets of faunal groups and comparing them. The fact that the seven selected sites apparently complement each other better for birds in comparison with amphibians and reptiles, has important implications for the choice of 'indicator' taxa, and conservation efficiency of the existing PAN in NE India.

The use of umbrella[1] and flagship[2] species as indicators (surrogates) for diversity and distribution of other, poorly known biota is a popular conservation strategy. However, many assumptions underlying the choice of indicators remain untested, creating grounds for a mis-assessment of biological values (Lawton et al., 1998), which can in turn result in wrongly directed investment of resources for conservation action (Andelman and Fagan, 2000). On the other hand, changes in whole faunal groups would be better indicators than a single group or species, as they reflect changes in ecosystem processes. In the case of birds for instance, altitudinal migrants are generally dependent on forest routes, and fragmentation can limit their wintering grounds. In such a situation then, loss of continuity between low and high elevation forests would result in loss of a substantial number of species on lower slopes and foothill tracts[3] (Stotz, 1998). Moreover, such effects are better understood by comparing between faunal groups (e.g., differences in effect of landscape fragmentation frogs, lizards and birds discussed in previous section).

These are strong indications that single species criteria (and attributes such as endemism and range / habitat restriction) are insufficient measures by themselves, and need to be supported by species richness estimates and inter-faunal group comparisons. These are better indicators of overall biotic coverage, and can also highlight functional changes or long term effects of habitat loss. At the same time, such results can also be refined by examining subsets of taxonomic groups, or guilds (Bierregaard, Jr. and Stouffer, 1997; Sieving and Karr, 1997; Terborgh and Robinson, 1986).

[1] Generally, a single faunal group such as butterflies, or birds.

[2] A charismatic species, such as the Tiger *Panthera tigris* and Asian Elephant *Elephas maximas.*

[3] In fact, such situations apparently exist in NE India. For example, compare Ngengpui WLS with Nameri NP-Pakhui WLS (see Area Accounts in Part V).

…Prioritisation Is Not Easy

The Biodiversity Conservation Prioritisation Project (BCPP) has taken considerable effort for conservation prioritization and evaluation in India (Singh et al., 2000b), including some hill states of NE India (Haridasan, 2000; e.g., Roy and Choudhury, 2000), with particular focus on the existing PAN (Mehta, 2000a). The methodology involved in these attempts (Mehta, 2000b; cf. Sharma and Singh, 2000) identifies the need to include flora and fauna in general. In practice however, data limitations have restricted these exercises to a subjective ranking of "biodiversity values" using taxa for whom information is available (e.g., Roy and Choudhury, 2000). In general, these prioritisation/evaluation methods focus exclusively on single species attributes such as endemism and range restrictedness (e.g., Khoshoo, 1984; Singh and Taneja, 2000). Having outlined the problems with a single species approach above, it is obvious that such assessments need to be expanded to include mora taxa, and analysed with greater objectivity[1].

The Important Bird Area (IBA) program, which is a part sponsor of this project, is another prioritisation initiative that is worth mentioning in this context. In NE India at present, 124 potential IBA's have been identified, which are distributed as follows (IBA-ICBP, 2001):

State (Biogeographical province)	**Proposed IBAs**	**WLS+NP**	**RF**
Arunachal Pradesh (E. Himalayas)	24	10	1
Assam (Brahmaputra Plains and NE Hills)	62	16	17
Manipur (NE Hills)	11	4	-
Mizoram (NE Hills)	8	7	1
Nagaland (NE Hills)	9	3	-
Tripura (NE Hills)	3	1	-
Meghalaya (NE Hills)	7	6	-

Interestingly, the overlap between potential IBAs and existing PAs is much higher in the states of the NE Hills than the Eastern Himalayas. This difference probably reflects the fact that there much less forest available outside the PAN in the NE Hills in comparison to the Eastern Himalayas (see Part I). This highlights an abstruse problem associated with prioritisation in the tropics, where humans and biodiversity rich areas often occur together (e.g., Balmford et al., 2001), severely restricting the choice of areas. Secondly, the disproportionate number of proposed IBAs in Assam suggests that the prioritisation effort may become biased towards the better-documented plains of NE India, in comparison to the inaccessible montane tracts. All of the nine sites covered in this survey are proposed IBAs. Across this small set of potential IBAs, our preliminary analyses demonstrate poor congruence between birds, amphibians and reptiles. Considering the possibility that this pattern may hold true across the entire proposed IBA network in NE India, it is worth considering the need to expand the taxonomic swathe of the program. This will add crucial criteria for the final selection of Important Bird Areas.

The basic premise underlying the prioritisation strategy of the IBA program is that birds are effective indicator taxa for other biota (ICBP, 1992). The IBA program can also draw information from *existing* attempts to determine conservation hotspots using other taxa (e.g., bats; see Mistry, 2001; a.k.a. the Important Bat Area programme!). Indeed, though we have argued against taxon-restricted initiatives, the IBA program will be extremely

[1] For instance, using diversity indices or species richness estimates across sites would be more effective then ranking biotic values.

useful for evaluating sites, provided that resources are invested for the inclusion of additional faunal groups.

In Conclusion

This survey was an unprecedented attempt at a simultaneous inventory of three faunal groups across the montane tracts of NE India. It yielded a number of interesting taxon records, but perhaps more importantly, provided additional insights into the conservation scenario of this biologically rich region. With the existing knowledge at hand, it is difficult to present an absolute measure of the level to which the existing PAN sites in NE India complement each others biotic diversity. However, the results from this work do point at the need to step up the level of biodiversity inventorying, not just in terms of areas, but also neglected biotic groups.

More attention needs to be drawn the NE Indian region, where even basic information on the taxonomy and distribution of the most taxa is still unknown[1]. Any survey here especially in the poorly explored montane tracts[2] is likely to be very productive in terms of new range records, and even new taxa to science. In addition, NE India is an extremely attractive region for ecological studies as well; to us, the potential topics for research here appear practically unlimited. The handful of ecological studies that have been carried out here, have provide invaluable insights into the effects of fragmentation and habitat alteration on biota, and possible solutions to deal with these problems (Datta, 1998; Datta, 2000; e.g., Datta and Goyal, 1997; Kakati, 1997; Pawar, 1999; Raman et al., 1998; Raman, 2001).

A collaborative, synchronised taxonomic and ecological investigation across selected sites will go a long way in filling information gaps. The future of this region's biological diversity will depend heavily on significant endeavours in research, education and conservation.

[1] Moreover, even existing information needs to be updated; distributional records in many groups are available only from surveys that were carried out in early 1900s.

[2] Even in terms or relatively well known taxa like birds (e.g., Kumar and Singh, 1999).(Alstrom and Olsson, 1995)

PART V: AREA ACCOUNTS

Based upon the results of the survey, and in consultation with previous literature, we present brief profiles of the landscape and survey site, along with our impressions on conservation problems of each area, followed by observations on the three faunal groups. Our objective here is to present relevant area-specific information and perspectives gathered during the survey, which we hope will help put the previous analyses and dicussions in perspective. We have made some broad biogeographical comments in each area, some of which may appear speculative[1]. However, we consider them worth mentioning, because they offer useful insights into the faunal composition in each area, and moreover, many of these biogeographical observations appear to be well supported by the results of distributional analyses (see section "…*biogeography*," in Part III).

NAMERI NATIONAL PARK & PAKHUI WILDLIFE SANCTUARY

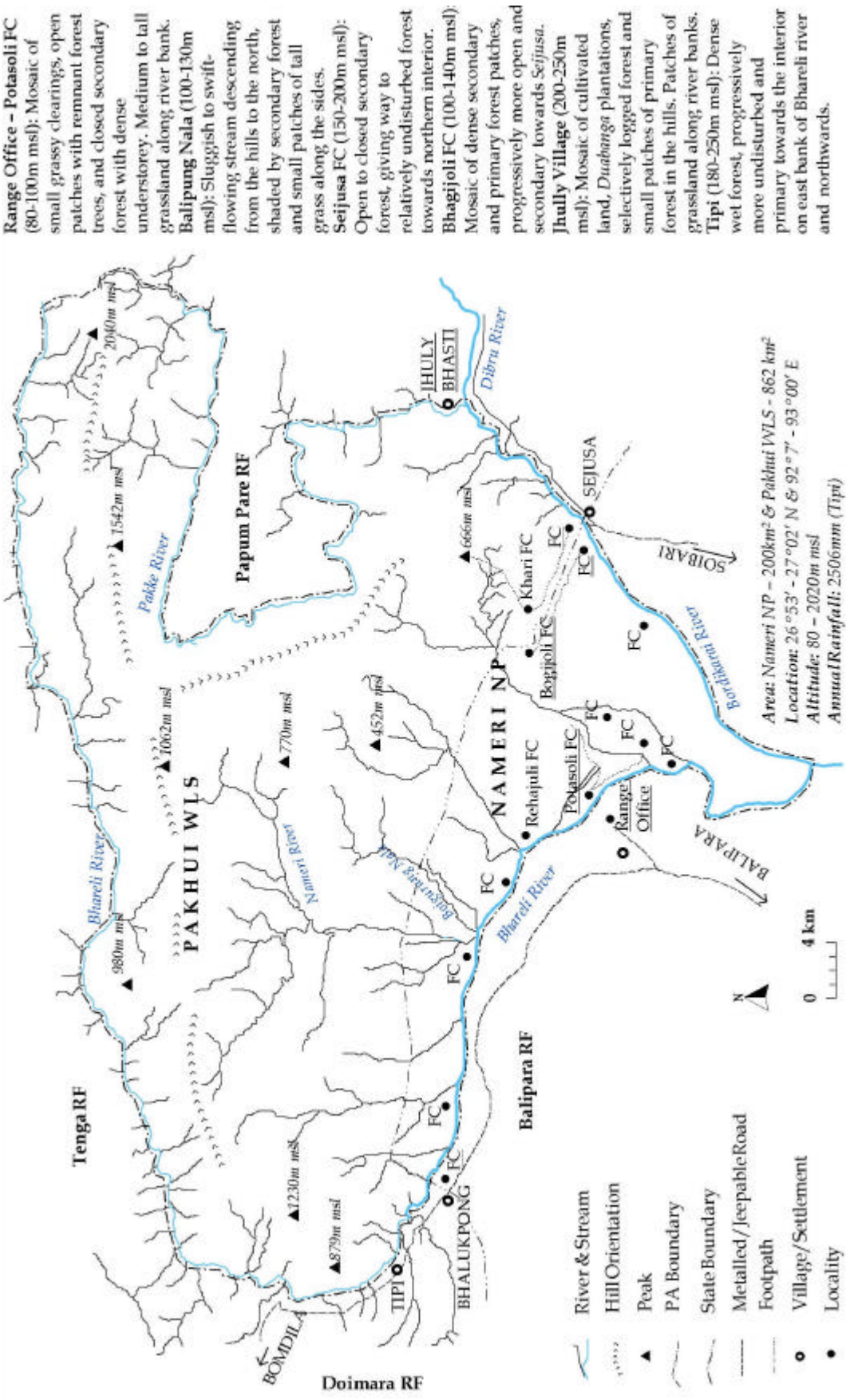
Landscape profile: Our survey effort was concentrated in *Nameri NP* and lower *Pakhui WLS*[2](see Fig. 5). The area is located in the outer range of the Himalayas, at the junction of the western end of Arunachal Pradesh and northwestern Assam. The terrain changes from flat and undulating at the Assam plains, to mountainous (>2500 m msl north of *Pakhui WLS*). The Kameng River (also known as Bhareli and Jia Bharoli towards the lower reaches), which originates from Greater Himalayan Range, and together with its tributaries, is the most important drainage system, covering most of western Arunachal Pradesh. The area receives high rainfall, most of which is concentrated during the monsoon, and there is a short, but distinct and predictable rainless season during the months of October and November. The forest changes from tropical evergreen/semi-evergreen in the foothills and valleys to temperate broad-leaved and coniferous towards the upper reaches. This landscape includes a very important network of protected areas over 2500 km^2 of connected forest areas centered on *Pakhui WLS* and *Nameri NP*– Doimara RF and Eagle Nest WLS (AP) in the west, Sessa Orchid Sanctury and Tenga RF (AP) in the north-nortwest, Papum Pare RF (AP) in the east, and Balipara RF (Assam) in the south (see Forest Survey of India, 1993; Forest Survey of India, 1999; Singh, 1999b). Consequently, the forest extent and contiguity appears to quite high in the landscape. The upper reaches appear to have large tracts of forests, only broken by natural gaps and perhaps *jhum* fields (however, shifting cultivation is not as extensive here as in other parts of Arunachal Pradesh and NE India. Natural habitat is more discontinuous towards the lower reaches, broken by paddy fields, logged open areas, and tree plantations (*Duabanga grandiflora*, *Terminalia myriocarpa*, *Bombax ceiba*, *Gmelina arborea*, and *Tectona grandis*). Human settlements are mostly concentrated along drainages (see Singh, 1999b). The concentration of settlements increases dramatically towards Assam, where permanent agricultural fields dominate the landscape.

Area-specific notes: *Pakhui WLS* and *Nameri NP* are enclosed by the clear, swift flowing Bhareli River and, its tributary Pakke (known as Bordikarai after the Dimbru River joins it). The vegetation in the area is a mosaic of tropical semi-evergreen and evergreen

[1] Especially in the case of amphibians and reptiles, as there is very little existing infortmation on distribution patterns in this region.

[2] The two PAs have continuous forests, and we treat them as one area.

Figure 5: Map of Nameri National Park and Pakhui Tiger Reserve



forests, largely corresponding to the Assam Valley Tropical Semi Evergreen Forest 2B / C1 (Champion and Seth, 1968), interspersed with more evergreen patches in moister areas, tending towards subtropical broadleaved forests at higher altitudes (Datta, 2001). The forest is more contiguous in *Pakhui WLS*, except for moderately disturbed patches in the accessible foothills and areas adjoining rivers. The multi-storied forests are rich in epiphytes, lianas, and creepers. Cane brakes and small patches of clump-forming bamboo (*Dendrocalamus* sp.) occur along streams. Wild bananas are more frequent towards the northern interior (e.g. around Tipi and north bank of Dimbru River). Steeper areas and those interior of the main drainages appear to have been less disturbed by selective logging in the past. On the other hand, *Nameri NP* is a mosaic of habitats dominated by forested patches, mainly a result of selective logging. Logging continued in the lower fringes of *Pakhui WLS* and many parts *Nameri NP* upto the early 1980s when both were declared as protected areas. The logged forest is distinctive by the lack of canopy emergents and presence of dense undergrowth. Some portions, presumably where heavy extraction occured, are now open habitats, with grassy clearings or covered with bushes and sparsely distributed remnant forest trees. Here, woody plant succession has apparently been arrested by a high density of wild herbivores (mainly gaur *Bos gaurus* and elephant *Elephas maximus*) along the lower areas. For instance, we saw ample sign of grazing by wild ungulates in open patches along the Potasoli–Bhagijoli camp stretch. It is worth mentioning here that apart from frequent sightings of gaur and elephant, we also saw tiger *Panthera tigris* once near Potasoli Camp, and other interesting mammals such as binturong *Arctictis binturong*. Strips of tall grassland occur along the flats of Bhareli River and larger tributaries, adding to the diversity of habitats in the area. Most villages in the area are situated along the southern boundary of *Nameri NP*, and along the western and eastern periphery of *Pakhui WLS*[1].

Conservation scenario: *Nameri NP* and *Pakhui WLS* together form an extremely important PA of over 1000 km^2. Among other things, they harbour one of the few remaining lowland evergreen forests in the Brahmaputra plains that are contiguous with the higher forests of the eastern Himalayas. Increased hunting may perhaps be one of the problems that this area may face under escalating human pressure in the future. At present, most of the human pressure that this area experiences is directed from the relatively well-settled foothill tracts and lower reaches. The rivers surrounding the protected areas do provide a natural barrier, especially in the upper areas. Many areas along the riverbanks in the lower reaches also appear to be favourite picnicking spots. Though commercial extraction of timber and cane had been stopped in the early 1990s, illegal extraction could be a threat to these areas in the future, as other forests in the vicinity vanish. The relatively less protected reserve forests in the plains are under constant pressure from livestock grazing, tree felling, and conversion to agriculture, and though the WLS and NP are at present shielded from heavy disturbance by the activities of the forest department and other natural factors mentioned above, these may develop into serious conservation problems in the not so distant future. A combination of ecological attributes make this area extremely attractive, not just for observing wildlife, but also because the swift rivers in the area have the Yellow-finned or Golden Mahseer *Tor putitora*, a popular angling fish. Any tourism initiative in the area can be a very effective conservation step (e.g. “Eco-camp”, a tourism initiative of the Assam Anglers' Association), provided there is a strong involvement of local people, perhaps in collaboration with the Forest Department. In general, the level of effort that the Assam as well as the Arunachal Pradesh Forest Departments invest in the area is impressive, and the camps that we visited seemed to be well staffed, more so in the smaller *Nameri NP*.

[1] For a detailed description of the area and PAs’ attributes, (see Athreya and Karthikeyan, 1995; Datta, 2001; Datta and Goyal, 1997).

Further collaboration between the Arunachal Pradesh and Assam FD's will ensure more effective conservation action for the area as a whole.

Notes on surveyed fauna:

	No. of species seen during this survey	*Total No. of species reported from the area*	*Forest species included in the analysis*
Amphibians	14	30	-
Frogs	14	30	22
Reptiles	22	36	-
Lizards	11	15	9
Birds	119	283	168

Amphibians– Our survey in *Nameri NP–Pakhui WLS* was moderately productive in terms of amphibians, as the period of visit was after the fag end of the monsoons, just before the winter set in. Interesting records (*see* Appendix II) during the survey include Daniel's Oriental Stream Frog *Rana danieli*, a species worth special mention due to its interesting taxonomic history and unique breeding biology, combined with the fact that it is locally exploited for meat during the breeding season. Another important record is the North-western Trickle Frog *Occodozyga borealis*, the last published record of which was almost 90 years ago from near *Mouling NP* (Annandale, 1912a).

Amphibian species richness of this area is definitely underestimated at present, particularly if the lack of effort in the interior hill tracts is taken into consideration. At present, limited conclusions can be drawn about the diversity and composition of amphibian fauna of this area. In general, the species composition in this area reflects high precipitation levels, close apposition of a range of habitats, and a situation at the extreme west of the NE region.

Reptiles– The reptile fauna here is particularly interesting, as this area is truly the frontier for Indo-Chinese and Indo-Malayan, as well Indian species. Notable records during the survey include the Blue-throated Forest Lizard *Ptyctolaemus gularis*, which appears to be the westernmost record of this species north of the Brahmaputra basin. The rare Black Kraits, *Bungarus niger* and *B. lividus* were also found. A keelback *Xenochrophis* sp. remains unidentified, and could either be a new species for the region, or perhaps even to science.

Although the species list of reptiles here is incomplete, the lizard diversity and composition suggests a strong Indo-Chinese and Indo-Malayan influence (cf. Das, 1996), perhaps giving way to predominance of Indo-Chinese species at higher altitudes. These higher reaches however, as we have mentioned earlier, remain particularly poorly surveyed.

Birds– The overall avifaunal richness here, which is the second highest of all the areas visited, reflects the diversity of habitats present in the area. A considerable proportion of this diversity is low- to mid-elevation forest species. Forest species composition shows a clear change from *Nameri NP* to *Pakhui WLS*, along a gradient of habitat influenced by changing elevation and terrain, coupled with differences in disturbance regimes. Red-vented and Red-Whiskered Bulbul, Large Cuckoo Shrike, Chestnut-tailed Starling, Lineated Barbet, Red-breasted Parakeet, Common Iora, Indian Roller and Dollarbird were the most common species sighted in the heavily disturbed open patches. Oriental

Turtle Dove, Emerald Dove, Green Magpie, Hill Myna and mixed foraging flocks of minivets, drongos, woodpeckers were characteristic assemblages of the small forest patches, forest edge grasslands/open areas along the foothills, and also heavily disturbed open patches surrounded with forest. Less disturbed/undisturbed forests were characterized by mixed flocks of small insectivores, including White-throated Fantail, Golden-spectacled Warbler, and White-Bellied Yuhina, and single species flocks of Silver-eared Mesias and Necklaced Laughingthrushes. Solitary flycatchers like Snowy-browed, Little-pied, and Pygmy Blue Flycatcher, broadbills, and large aggregations of frugivorous birds, including Wreathed, Oriental Pied and Great Hornbills were seen exclusively in such habitats. The frequency of the latter groups increases dramatically towards the hills of *Pakhui WLS*.

An important feature of this landscape is that it has one of the few remaining Brahmaputra plain forests contiguous with high altitude forests of the eastern Himalayas. This allows forest restricted altitudinal migrants to winter further down (for example, a pair of Golden Babblers were sighted at around 100 m msl in Seijusa, much lower than previously reported for this species; (see Ali and Ripley, 1987).

The area is also well-known as one of the few remaining refuges for the endangered White-winged Duck (Choudhury, 2000), two pairs of which were sighted during this survey (*see* Appendix II). This area is of great importance to the Wreathed, Great and Rufous-necked Hornbills as well. The first two species are frequently encountered in *Nameri NP* and the foothills of *Pakhui WLS*, while the latter is mostly restricted to higher altitudes (A. Datta; P. Sharma, *pers. comm.*). We observed large roosting aggregations of Wreathed Hornbills near the river bank close to Seijusa. Other notable species sighted during this survey include Pallas's Fish Eagle, Amur Falcon, and Lesser Adjutant, all globally threatened species, and the range restricted Yellow-vented Warbler. The latter was seen thrice during this survey, always in mixed foraging flocks, and is probably not uncommon here.

Previous Studies/Surveys: *(Athreya and Karthikeyan, 1995; Datta et al., 1998; Datta, 1998; Datta, 2000; Datta, 2001; Datta and Goyal, 1997; Fleming, 1997; Singh, 1994)*

NAMDAPHA TIGER RESERVE

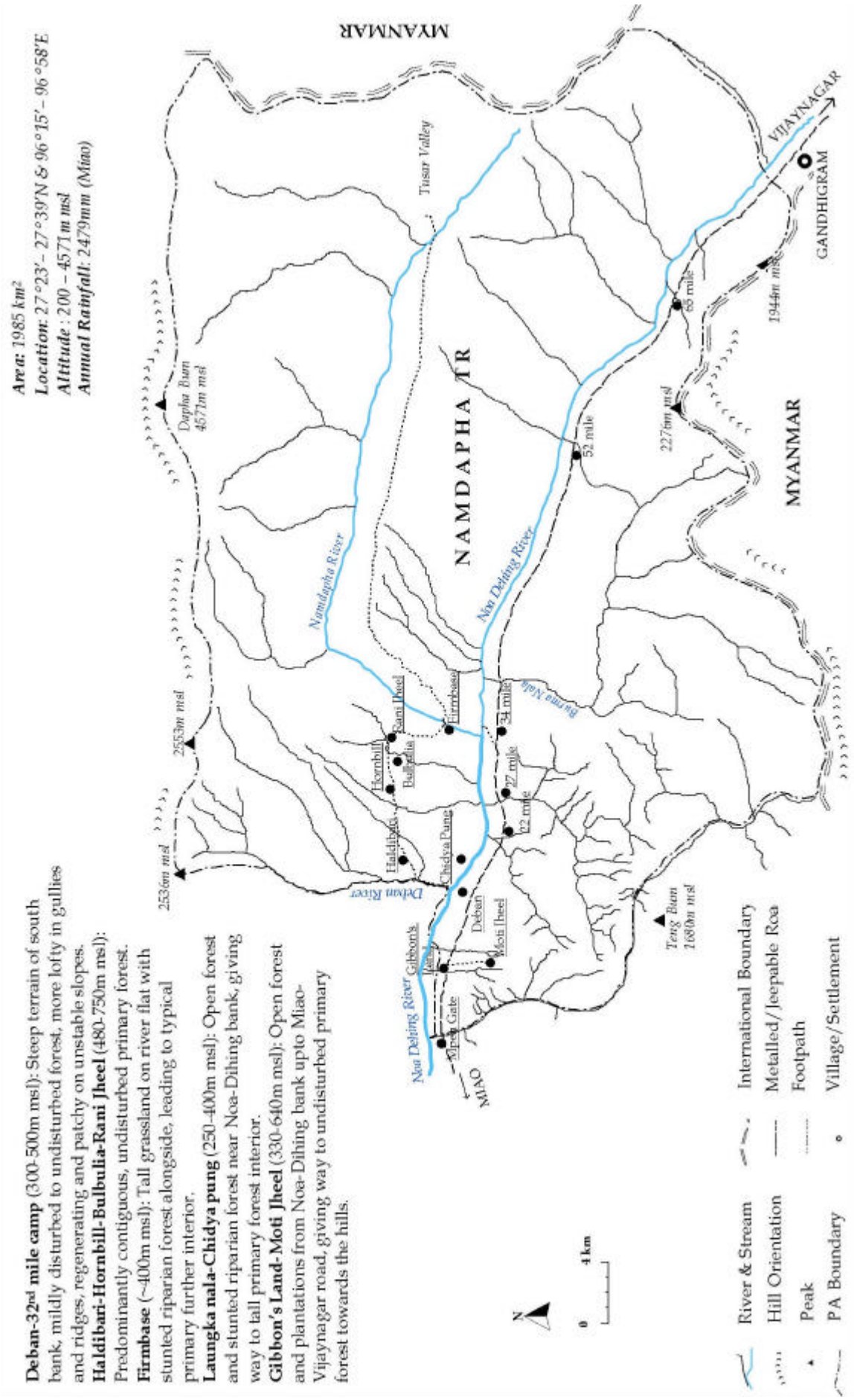
Landscape profile: This large park lies in the Changlang District of Arunachal Pradesh, sandwiched between the E. Himalayan and Patkai Ranges, where the Himalayan arc curves downwards at the eastern end of NE India (see Fig. 6). The terrain is mountainous (highest peak - 4571 m; Dapha Bum), drained by numerous rock strewn drainages which form the catchment of the Noa-Dehing River, which flows westwards through the middle of the reserve to join the Brahmaputra. The topography is flat or undulating along the main drainages, to steep in the upper reaches, and the wide altitudinal range accommodates tropical to alpine micro-climates and habitats in the same landscape. Rainfall is high, with no well defined or predictable dry period. The forest cover and contiguity is apparently high in this area (Changlang district; fide Forest Survey of India, 1999; Singh, 1999b), with similar forest tracts in Kamlang WLS to the north and in Myanmar at the Southern and eastern Boundary (UNEP, 2000b). The major secondary landscape elements are *jhum* fields and fallows, village gardens and towards the western side in the direction of Miao, plantations and secondary forest. Settlements in this landscape are scattered, with some concentration centred on Miao, and to the east around Gandhigram – Vijaynagar villages.

Area-specific notes: The low to mid-altitudes of *Namdapha TR* consist of large tracts of tropical evergreen and semi-evergreen forests, largely corresponding to the Assam valley tropical wet evergreen forest (1B/C1; Champion and Seth, 1968). These continue into subtropical and temperate habitats towards the upper reaches. The forest appears contiguous, only punctuated by small ridge/hill top ponds and marshes (e.g. Rani and Moti *Jheel*) and marshy *'pungs'* centered on mineral springs (e.g. Chidya *Pung* and Bulbulia), and natural tree fall gaps. The forest is relatively patchy and stunted on unstable slopes (e.g., Deban – 32 mile stretch) and along larger drainages. At the lower Dehing stretch along the Deban – 32 mile track, the forest appears wetter than that on the northern bank. This may be because the area remains in shadow during winter due to the orientation and steepness of the south bank. Clump-forming bamboo, palms, canes, wild banana, and *Colocasia* sp. are abundant in patches and along streams. There are a few open patches where forest camps are located (e.g. Hornbill and Haldibari), and at relocated village sites (e.g., an open patch on the Deban – Haldibari track). Stretches of grassland are found on flats at river junctions and along lower Noa-Dehing. There is a small *Gmelina* plantation in the Haldibari camp area, and an *Albizzia* plantation on the north bank of the Dehing opposite to Deban. Settlements in the area are mainly clustered around Miao town in the west and Gandhigram-Vijaynagar villages at the eastern end. There are a few scattered hamlets along the Miao - Gibbon's land stretch, along the Deban River, and beyond 32nd mile on the Deban-Vijaynagar stretch. Settlements exist along the Deban River up to the Lohit District border as well (Khoshoo, 1984)[1].

Conservation scenario: Compared to some of the other areas we have visited in the region, *Namdapha NP* appears less under threat from human pressure. However, this situation may be changing fast. The area is far from adequately mapped, and it is difficult to ascertain as to exactly how many settlements exist in and around the PA. The Miao-Vijaynagar track is frequently used by *Lisu* villagers from Gandhigram and Vijaynagar. Enquiries revealed that a few settlements have come up in the reserve area over the last 5-10 years, most of them along this track. There are a number of *Chakma*

[1] For a further a detailed description of the area's and the TR's attributes, (see Chatterjee and Chandiramani, 1986; Ghosh, 1987; Singh et al., 2000a).

Figure 6: Map of Namdapha Tiger Reserve



hamlets beyond the western side of the PA as well. In addition, it appears to be particularly difficult to map areas along the northern border of the reserve where it borders Kamlang WLS (Lohit District), and it is possible that there are undocumented threats from that direction. Forest loss has been recorded between 1983 – 89 along the northern limits of the park (Forest Survey of India, 1999), but this can also be due to natural reasons as that portion of the park is particularly steep. The area has apparently been scarcely, if at all, logged in the past and only near Miao were signs of past logging visible. A more complete mapping of the park will reveal a clearer picture upon which strategies for the area's habitat conservation can be developed.

Another concern is the clear danger that hunting activity poses to the larger vertebrates of the park. The Noa Dehing River is occasionally dynamited for fish by local people as well. In general, the extent and quality of the natural habitats in *Namdapha TR* may be able to withstand these threats at present, but it does appear that the situation might worsen substantially in the near future. The area appears to be understaffed as well; there were only 11 permanent staff posted in the park during our visit, none of them beyond Deban area. One crucial step that needs to be taken is that high quality inventorying and perhaps long term research work is initiated. The problem with balancing local people's needs and those for the area's conservation is knotty, and no easy solution can be offered. For instance, the Miao–Vijaynagar road is a lifeline for people living beyond the far eastern end of the park on the one hand, but is also a potential threat particularly if it is made jeepable along its entire stretch. *Namdapha TR* is a unique area with a lot of primary habitat, and eco-development programs with an orientation towards tourism may be worth attempting.

Notes on surveyed fauna:

	No. of species seen during this survey	*Total No. of species reported from the area*	*Forest species included in the analysis*
Amphibians	14	28	-
Frogs	14	28	25
Reptiles	10	48	-
Lizards	10	18	14
Birds	108	333	198

Amphibians– Although this survey only covered the lower reaches of this huge reserve, and moreover, during winter, the results are very encouraging. Notable records (*see* Appendix II) during this work include Daniel's Oriental Stream Frog *Rana danieli*, the Pied Theloderma *Theloderma asperum*, and Lineated Reedfrog *Chirixalus doriae*. The last two were last reported from this region almost 90 years ago (Annandale, 1912). Two unidentified species *Bufo* cf. *cryptotympanum* (a toad), and *Rana* cf. *tasanae* (a trickle frog) are perhaps new to science. Future work in this area is bound to uncover a number of new records and species.

The diversity and composition of the amphibians of *Namdapha TR* appears to be essentially that of a typical Eastern Himalayan area, with elements typically of NE Indian hills and also those that are from Upper Burma and Indo China (e.g. *B.* cf. *cryptotympanum* and *R.* cf. *tasanae*).

Reptiles– Apart from the excellent work by Captain and Bhatt (1997; 2000) on snakes, not much published information exists on the reptile fauna of *Namdapha TR*. We surveyed

the area in winter, which limited our sightings as reptiles are particularly sensitive to low temperatures. Interesting species we saw include the Indo-Myanmarese Bent-toed Gecko *Cyrtodactylus khasiensis*. Furthermore, our examination of collections at the Miao and Deban museums revealed three species that are first records for this region: the Horned Tree Lizard *Acanthosaura* cf. *crucigera* and Moustached Calotes *Calotes mystaceus* and an unconfirmed Softshell Turtle *Nissonia* sp. The nearest previous records for matching taxa to these three records are from Upper Myanmar (see Appendix III for details).

A more exhaustive list for this rich area will probably reveal an interesting admixture of Indo-Chinese and Indo-Malayan reptile species, with the reptile communities showing considerable similarities to those of neighbouring hill tracts of Upper Myanmar.

Birds– Among the other areas in the hills of the region, this area has been the most surveyed for birds, and the compiled checklist is the highest among all the other areas in the region. This strikingly diverse avifauna also includes a number of species of conservation importance. The White-cheeked Partridge, Blyth's Kingfisher, Great Hornbill, Rufous-necked Hornbill, Brown Hornbill, White-winged Duck, Lesser Adjutant, White-Tailed Eagle, Rusty-bellied Shortwing, and Beautiful Nuthatch are some of the 20-odd globally threatened species that occur here (Birdlife International, 2000). In addition to the first four species, other important records during this survey include Ashy Wood Pigeon, Black Stork, Yellow-vented Warbler, Spotted Wren Babbler, Long-tailed Sibia, and Coral-billed Scimitar Babbler.

With seventy-two species, the diversity of the family Slyviidae, which includes warblers, laughingthrushes, and babblers, is probably the most striking feature of the area. Mixed and sometimes single species foraging flocks including various warblers, babblers, and laughingthrushes were seen regularly, sometimes with as many as 40+ members. Of these, Rufous-faced Warblers, Black-eared Shrike-Babblers, Red-tailed Minlas, Silver-eared Mesias, Black-chinned Yuhinas, Long-tailed Sibias, White-crested and Necklaced Laughingthrushes were the most frequently seen. Tesias and wren-babblers, always solitary or in pairs, were particularly common, one in almost every other thicket next to roads and trails. Forktails were also regularly seen, even near puddles on roads apart from the streams in the forest. Of the five hornbill species known from this area, the Oriental Pied, Great, Wreathed and Rufous-necked Hornbills were often seen along the Haldibari-Hornbill-Bulbulia stretch. Barbets, pigeons, and leafbirds were regularly seen on fruiting trees. On one occasion, 250+ Pin-tailed Pigeons were seen on the bare branches of a tree, their sheer number giving the tree a leafy appearance. Drongos, woodpeckers, and minivets were common in the upper canopy and along forest edges.

Previous Studies/Surveys in the Area: *(Athreya et al., 1997; Choudhury, 1990; Datta, 1999)*

MOULING NATIONAL PARK

Landscape profile: *Mouling NP* is located in the Upper Siang district of Arunachal Pradesh, in the Adi Hills of the Eastern Himalayas, adjoining the Siang River Valley (see Fig. 7). The Siang River is an imposing feature in the landscape, carving through high, rugged mountains (highest peak, 4593m msl). The often steep slopes are well drained by a number of streams flowing swiftly into the deep valley of the Siang, which flows as low as 300 m msl in the vicinity of the park, and probably less than 600 m msl even near the Tibet Border. The area is extremely humid, with high rainfall and apparently no well-defined rainless seasons. This valley, which cuts so low and deep into the Himalayas, 'carries' wet tropical conditions with it, facilitating dispersal of lowland tropical elements along it, and into the inner valleys of the tributaries as well. The low to mid altitudes along these inner valleys are dominated by tropical wet evergreen and semi-evergreen forests, tending towards wet subtropical broad-leaved forest and temperate at upper reaches. The high snow-covered peaks in the background stand out in glaring contrast. In addition, areas along the lower reaches of the valley and other swift drainages remain ever-wet due to spray action. The conditions thus range from wet tropical and montane to temperate towards the upper reaches. The forest appears quite contiguous at the landscape level (Singh, 1999b). The contiguity is broken only by high altitudes, land slip zones, palm-dominated open patches on steep slopes, terraced agricultural fields, *jhum* fields and fallows, and village gardens dominated by orange plantations. The area is sparsely populated, most settlements being concentrated along the large rivers like the Siang, Siyom, and Sikke. The difficult terrain apparently discourages sustained agricultural activity far away from settlements.

Area-specific notes: Within *Mouling NP*, the highest peak is at ca. 3064m msl, and the park harbours varied habitats along its altitudinal range. Because of the conflicting characteristics of the vegetation at low to mid elevations, it is difficult to assign them to any of the classes defined by Champion and Seth (1968), and vegetation studies need to be taken up in this interesting area (K. Haridasan, *pers. comm.*). The vegetation along streams is wet and flourishing green, with moss-laden trunks and branches. Patches of canes and wild bananas abound, especially along streams. Much of the PA is possibly covered with undisturbed primary forest, with some level of disturbance in the fringes, mainly in the form of cane extraction. As a result of the inaccessibility of the PA, combined with certain local taboos associated with hills in the area, only villagers from Bomdo and settlements along the southern side visit the area with some regularity. The habitat in the vicinity of Eggong Asi (*Adi* vern.= stream) appears to be undisturbed, except for some cane extraction in the forests close to the park boundary. The forest in the PA, from the Bomdo approach at least, appears to be largely primary (Roshan Horo, DFO, *pers. comm.*).

Conservation scenario: All evidence points to the uniqueness of the biological attributes of *Mouling NP* (See notes on surveyed fauna below). Current level of human use in the PA appears to be negligible. Occasional forays for hunting made by local people who have better access to the area by virtue of the location of their village (e.g. Bomdo) appears to be the only human disturbance that the area experiences. The majority of the population is still directly dependent on *jhuming* and forest resources, which are met by the forested community-owned lands outside the NP. Areas near settlements (e.g. along the Pasighat – Tuting stretch) are dominated by *jhum* fields, fallows in various stages of woody succession, and patches of disturbed mature forest on steep hills and ridges,

Figure 7: Map of Mouling National Park

while those further away are mostly covered with mature forests. At present, though the effect of natural resource use by the local population is absorbed by the unclassified / community-owned areas outside the PA, the pressure will become more concentrated on the NP itself with changes in demographic patterns. One of the most urgent actions that need to be taken here is well coordinated, high quality surveys and ecological research.

Notes on surveyed fauna:

	No. of species seen during this survey	*Total No. of species reported from the area*	*Forest species included in the analysis*
Amphibians	13	24	-
Frogs	13	24	20
Reptiles	6	39	-
Lizards	4	14	12
Birds	116	228	139

Amphibians– The *Mouling NP* phase of the survey, conducted at the height of winter, yielded a list of species that is remarkable, not as much for numbers, but for its uniqueness. Notable records are dominated by 'rediscoveries' of species described / recorded during the "Abor Expedition" of 1912 (Annandale, 1912a), after a gap of almost a century. These include (see Appendix II) Boettger's Xenophrys *Xenophrys boettgeri*, the tree frogs *Rhacophorus naso*, *R. cf. jerdoni* and the Pied Theloderma *Theloderma asper*. The Green-spotted Amolops (*Amolops viridimaculatus*) is a new range record for a species that was hitherto known only from China. Needless to say, much inventorying needs to be done to document this area's rich amphibian diversity.

The uniqueness and diversity of this area's frogs, apart from the obvious contribution of its proximity to the Indo-Chinese biogeographical region, appears to be a result of the area's relatively interior location in the Eastern Himalayas as well.

Reptiles– The last survey of reptiles in this area was in early 1900 (Annandale, 1912b). The effectiveness of the reptile inventorying during this survey was limited retarded by the harshness of winter. The survey gave crucial insights about the ecological conditions of the low- to mid-elevation forests in this interior area of the E. Himalayas with respect to reptiles. A typical forest assemblage of the area would include geckoes (*Hemidactylus* spp.; the Tockay is apparently not found here), Jerdon's Green Calotes, *Draco maculates* (difficult to see during the cold winter months), and forest skinks.

In general, it appears that this area's climatic regime (especially, low winter temperatures) imposes restrictions on reptile diversity, particularly lizards. This appears to be particularly true when compared to the rich amphibian diversity here. However, its isolation suggests that the area's reptile fauna should exhibit a high level of uniqueness. Much survey effort has to be invested in this area before such conjectures can be supported.

Birds– The national park is a superb place for birds. We sighted 113 species, of which 41 were not reported previously by others (Sen and Mukhopadhyay, 1999; Singh, 1994). The family Slyviidae (warblers and babblers), with 53 species, was the striking assemblage here. Mixed foraging flocks comprising Lemon-rumped, Ashy-throated, Grey-hooded, and Chestnut-crowned Warblers, Golden Babblers and Nepal Fulvettas were regularly

seen. Six of the seven species of Yuhinas known from NE were frequently encountered, mostly as large single-species flocks. Interestingly, the range-restricted White-naped Yuhina was the most common of these. Flocks of Yellow-throated Fulvetta and Yellow-browed Tit were fairly common at altitudes above 1000 m msl. Other commonly seen species were White-cheeked, Greater and Lesser Necklaced Laughingthrushes and Silver-eared Mesias. Striated and Blue-winged Luaghingthrushes, Chestnut-bellied Nuthatch, Rufous-backed Sibia, Cutia and White-browed Shrike-Babbler, *i.e.* species foraging mainly on tree trunks were noticeably more abundant when compared to *Namdapha TR*, though *Namdapha TR* is apparently more diverse. Overall, *Mouling NP* and surrounding areas seemed to have a remarkably higher density of forest birds compared to all the other areas we visited.

Due to the reasons outlined in the landscape profile, this area seems to harbour avifaunal elements of conflicting altitudinal affinities, a pattern produced by both high and low altitude species occurring here, often at lower and higher limits of their range respectively. For instance, our record of Gould's Shortwing and Red Crossbill from ca. 700 m msl is a low-altitude record for both these characteristically upper Himalayan species (see Appendix II). Other notable species sighted during this survey include Mountain Scops Owl, Long-tailed Thrush, Indian Blue Robin, Beautiful Nuthatch, Beautiful Sibia, and Long-tailed Sibia. Local hunters recognized colour plates of the Eurasian Woodcock, White-winged Duck and Blue-naped Pitta. However, the first two species have not been sighted in the area during the last few years. Another point worth mentioning here is that no hornbills were seen during the survey. The only species reported from upper areas in the Siang Valley is the Rufous-throated Hornbill, paucity of which has been attributed to seasonal scarcity of fruits (Katti et al., 1992).

Previous Studies/Surveys: *(Katti et al., 1992; Sen and Mukhopadhyay, 1999; Singh, 1994; Singh, 1999a)*

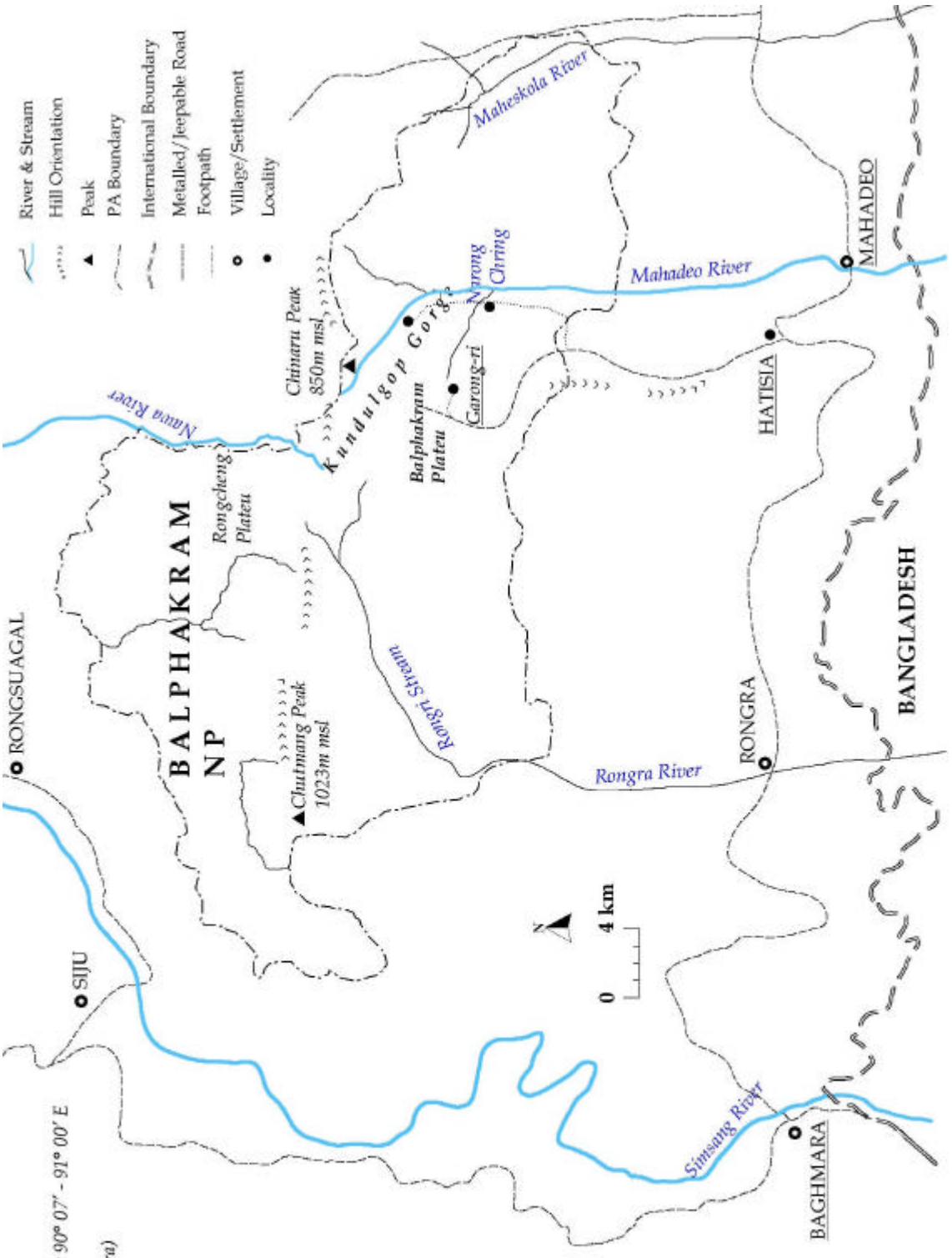
BALPHAKRAM NATIONAL PARK

Landscape profile: *Balphakram NP* is located at the southeast end of the Garo Hills of Meghalaya bordering the west Khasi Hills (see Fig. 8). These hill ranges have many unique physiographic and biological characteristics, much of which can be attributed to the fact that they are much older than the recently formed Eastern Himalayas and other NE Indian Hills (Krishnan, 1982). Extensive karstic limestone formations are the unique features of the Garo Hills. The terrain of the Garo Hills is, gentler than other hill ranges of the region, especially along the southern margin where the rolling hills overlook the plains of adjacent Bangladesh (highest peak 1412m msl; Nokrek Peak). The area forms a catchment for two sets of drainages; one set flowing northwards into the Brahmaputra, while the other flows southwards into the Surma valley of Bangladesh. The higher central and southern hills are the major catchment, for two major rivers in the area, the Simsang and Mahadeo. The climate is tropical, with temperatures rarely falling below 5-10 ^{o}C. The area receives high rainfall; Cherrapunjee and Mawsynram in the Khasi Hills, which often receive more than 10000 mm rainfall per year, are arguably the highest rainfall spots of the world. However, precipitation is distinctly seasonal, and November to February is the rainless period. The natural vegetation ranges from Sal *Shorea robusta* dominated tropical moist deciduous forests along the northern-western Garo Hills, where rainfall is lower, to semi-evergreen and evergreen forests along the Eastern and South Garo Hills. The landscape appears very fragmented, not just in the Garo Hills area itself, but there is little primary habitat contiguity with the Khasi and Jaintia Hills to the east, probably the last remaining habitat bridge with the other NE Hills. To the south lie the extensively cultivated plains of Bangladesh, while the north and west are bound by the Brahmaputra and its plain (see, Forest Survey of India, 1999; UNEP, 2001). The forest cover in the Garo Hills is only about one-third of the total landscape, and the area is a mosaic of natural vegetation interspersed with tree plantations (timber such as Sal, Teak *Tectona grandis* and Gomari *Gmelina arborea* as well as non-timber trees such as rubber, cashew, and cinnamon), *jhum* fields, village gardens, and bamboo brakes (Forest Survey of India, 1999; Kumar, 1998; Kumar et al., *in press*). This scenario is a result of the long history of land use here due of its relatively easy and accessible terrain, combined with the fact that this is one of the most populous of the hill states in NE India (~80persons/km2; Census of India, 2001). Much of the forest that remains in this landscape is in the form of sacred groves. The maximum concentration of settlements appears to be along the more accessible and lower north western and southern fringes of the area[1].

Area-specific notes: The *NP* consists of a large plateau (ca. 700 ha) adjoining a deep gorge (Kundulgop). The *Garo* people believe that every departed *Garo* soul flies to rest in Kundulgop, and the gorge and surrounding areas are considered sacred. This area and the hills beyond, which include the highest peak (*Chutmang hill*, 1023m msl) have the steepest terrain in the NP, and form the catchment of the Mahadeo River. The boulder-strewn river flows through the gorge and out into the Bangladesh Plains. The area is located on an extensive limestone belt, a striking but understated feature here. This may be the main reason why the area looks surprisingly dry, though located in one of the world's wettest belts. Limestone retains very little of the rainfall in the area, and most of it seeps into underground aquifers, for which these hills are famous. Along the slopes surrounding the gorge, and a few other places, the water trickles out and flows along rocky stream beds, such as the ones frequently encountered on the Narong Chring–

[1] For further details on the area's attributes, see Kumar et al. (1998; *in press*).

Figure 8: Map of Balphakram National Park



(*Garo* vern.= stream) Kundulgop stretch. In fact, it is very likely that the entire wet forest patch centred around the Kundulgop is sustained by such aquifers. In general, the limestone belt, along with the geological history of the area has apparently imparted unique biological properties to this and other such areas in the landscape. For instance, these hills have an unusually high number of endemic plants (K. Haridasan, *pers. comm.*). During this survey, the pitcher plant *Nepenthes khasiana*, which is endemic to these hills, was seen growing profusely along the Mahadeo River bank. The moist forest in the NP is closest in composition (but not entirely assignable) to the Cachar Tropical Semi-evergreen 2B/C2 and Tropical Evergreen 1B/C3 Forest of Champion and Seth (1968), and is largely confined to a contiguous tract in the moist Kundulgop gorge and surrounding slopes. Often growing on large bouldery patches, this forest is lofty in places (25-35 m) and mostly has a clear understorey. Canes and palms are sparsely distributed in the primary forest floor, but are concentrated mainly along streams. Interestingly, very little wild banana was seen in the gorge area during the survey; patches of the plant were seen mostly along the lower Mahadeo bank. Surrounding this moist forest tract are small patches of semi-evergreen forest interspersed with deciduous forest and further towards the periphery, regenerating *jhum* land consisting of sympodial bamboo and woody regeneration of various ages. A large proportion of the latter areas were acquired from community-owned *jhum* land. The plateau, mostly grassland scattered with stunted trees, is an important grazing ground for wild ungulates during the wet season, and the grassland habitat is maintained through periodic burning by the FD. The area appears to be a safe island for other large mammals as well, such as the Himalayan Black Bear *Selenarctos thibetanus* (seen once near Narong Chring). A number of settlements are located at the park's periphery, and most of the surrounding area is covered with plantations and recent *jhum* fallows[1].

Conservation scenario: The value of this NP hardly needs to be stated in a highly fragmented landscape where much of the forests are outside PAs (Kumar, 1998; Kumar et al., *in press*). Though the forest in the park is relatively inaccessible, that it still remains intact, can mainly be attributed to its sacredness for the Garos. However, these very communities are heavily dependent on forest resources in the form of NTFP as well as *jhuming*, and the NP will come under increasing pressure as the local population increases and traditional values and beliefs erode. The NP's accessibility makes it vulnerable to pressure from the adjoining plains of Bangladesh as well. At present, the inner parts of the sanctuary at least, appear to be relatively undisturbed. During our survey, we did not encounter any trespassers, though on one occasion tell-tale signs of recent NTFP collection were seen on the plateau path. Resources such as palm and cane must be scarce in the surrounding areas, and illegal extraction of these appears to be a problem that may escalate seriously in the future (Rohmin Thiek, DFO, *pers. comm.*). In these circumstances, the park's accessibility means that mere protection measures will not be sufficient to secure its future. There is a proposal for addition of about 140 km^2 of abandoned *jhum* land and mature forest acquired from local people. If notified, this will be a crucial supplement to the primary park habitat, and a possible buffer as well. Other problems aside, we were struck by the limited scientific information available on the area's fauna, which is a serious problem in itself. For instance, this was the first formal survey of amphibians and reptiles in the park (see below), and resources definitely need to be allocated for further surveys and studies of the area's fauna.

[1] For further details on the NP attributes, (Kumar and Rao, 1985; see Thiek, 2000)

Notes on surveyed fauna:

	No. of species seen during this survey	*Total No. of species reported from the area*	*Forest species included in the analysis*
Amphibians	8	23	-
Frogs	8	22	16
Reptiles	12	33	-
Lizards	12	15	10
Birds	82	199	117

Amphibians– Apart from records of the ZSI from nearby localities in the Garo hills, there has not been any survey of amphibians in *Balphakram NP* prior to this work. Our survey effort was made at a relatively dry period, and the results were strongly influenced by the effectiveness with which non-breeding frogs were located. Notable records (see Appendix II) during the survey include the Red-eyed Shortleg *Leptobrachium smithi* and the Brown-backed Oriental Streamfrog *Rana leptoglossa.*

Among other things, it would be worth examining if the unique physiographic and climatic features of this area combined with its extreme western location in the region, imparts to it an amphibian diversity and composition very different from the other Hill states here. Such a pattern has been reported for other biota, and by virtue of its relative isolation and perhaps its unique geo-tectonic history itself, one might expect a high level of uniqueness of amphibians here. For instance, the Garo Hills Caecilian *Ichthyophis garoensis*, recently described from Tura, is believed to be endemic to these hills. In a broader perspective, the amphibian fauna here appears most similar to that of the allied NE Indian hill ranges such as the Barail and Lushai hills. These conjectures will be better founded when more information is gathered on this area's amphibians.

Reptiles– Notable records (see Appendix II) from *Balphakram NP* include the Indo-Myanmarese Bent-toed Gecko *Cyrtodactylus khasiensis* and Blue-throated Forest Lizard *Ptyctolaemus gularis.* South of the Brahmaputra, this is the westernmost record for these two species. In addition, our examination of the collection at the museum of the PA revealed a number of interesting snake records, including that of a recently discovered species of Wolf Snake *Lycodon zawi* that is new to science (see account for *Ngengpui WLS* below). Another notable record is of a Coral Snake *Maticora cf. intestinalis*, that was examined at the museum of the Tura Government College, which is very likely to be a species new to science. Though the specimens were collected from Tura, the species is very likely to be found in *Balphakram NP*.

It is difficult to comment on the reptile fauna of this area at present as the species list is far from complete.

Birds– The most common species encountered in primary forest were Pale-chinned Flycatcher, Long-tailed Broadbills, Nepal Fulvetta, White-bellied Yuhina, Striped-tit Babbler, Black-naped Monarch and the Greater and Lesser Laughingthrushes. The Asian Paradise-flycatcher was seen thrice, once in association with Asian Fairy Bluebird, White-browed Scimitar Babbler, and Orange-headed Thrush. The Kalij and Peacock Pheasants were seen and heard frequently. A striking feature was the diversity of the family Nectariniidae; six species of sunbirds, Little Spiderhunter, and Scarlet-backed Flowerpecker were seen during the survey. Other notable species seen include the Great Hornbill, White-collared Blackbird, White-browed Shortwing, and Yellow-vented Warbler.

Contrary to the other areas we have visited, the area has quite a few number of species associated with the Indian mainland (e.g. Purple-rumped Sunbird, Purple Sunbird, Brown-headed Barbet, Eurasian Golden Oriole, Brahminy Starling). This is mainly because the Garo Hills are very 'exposed', rising next to the Bangladesh plains, in contrast, the other hill tracts in the region are more 'concealed'. Overall, the forest avifauna of the area appeared to be noticeably depauperate compared to the other areas we visited in NE India. This could partly be because the survey was carried out in summer, when most altitudinal migrants have left for higher altitudes. However, there is a strong possibility that the highly fragmented landscape has broken dispersal, as well as local migratory routes from the Khasi Hills and from the south, through the Bangladesh hills. Detailed studies on the area's avifauna promises to yield interesting patterns.

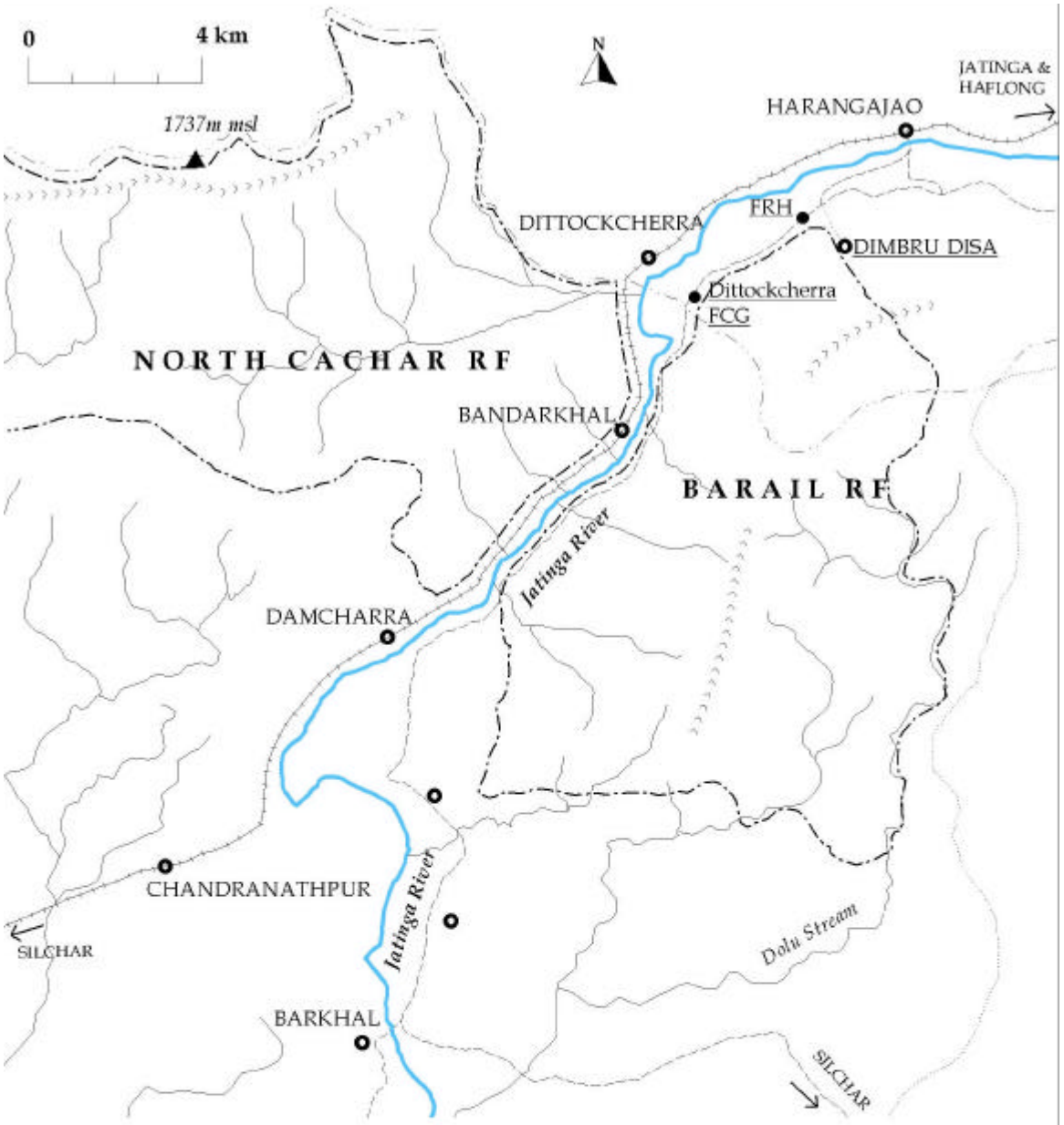
Previous Studies/Surveys: *(Choudhury, 1997; Williams and Johnsingh, 1996)*

BARAIL RESERVE FOREST

Landscape: The RF lies in the Barail Range which covers the Cachar and North Cachar Hills (see Fig. 9). This is the highest range in Assam, and lies between the Brahmaputra and Barak river plains rising above 1900 m msl in places. The range is a south westerly extension of the Patkai ranges of Nagaland and Manipur, which also continue into the Lushai Hills of Mizoram. These ranges are a catchment of the Barak River, the second largest river system in NE India. The terrain ranges from flat and undulating in the river valleys (e.g. Jatinga River) and the main Barak valley plain, to mountainous and often steep along the ranges in the north (highest 1953m msl; Mahadeo Peak). The climate is tropical to subtropical at the upper reaches. Precipitation is high, with a brief but predictable rainless period, and the vegetation at low and mid elevations is tropical semi-evergreen to evergreen forest, tending towards more broadleaved subtropical elements at higher reaches. The *Barail RF* lies in a landscape that is considerably fragmented. To the south, the undulating foothills and the plains beyond have been extensively converted to tea gardens and settled cultivation, while a secondary habitat mosaic at least partially isolates the area from primary forest tracts further north in Assam, southern Nagaland, north-western Manipur, and the Jaintia hills of Meghalaya (Forest Survey of India, 1999). The main secondary landscape elements are cultivated flatland, extensive brakes of monopodial bamboo (*Melocanna sp.*) and clusters of sympodial bamboo (*Dendrocalamus* sp.), tree plantations (teak, sal, gomari), secondary and disturbed forest (e.g. betel vine plantations), and village gardens, including Areca nut palm (*Areca catechu*) plantations. The area is quite densely populated and very cosmopolitan, as people of different ethnic origins have settled in these areas from the adjoining plains, as well as from the hills of neighbouring states. Hence, the forests on these hills have been exploited much more (see introduction) compared to the other hill ranges in the region.

Area-specific notes: The RF lies at the southwestern end of the Barail Range, adjoining the well known Jatinga Valley. Most of the RF is in the Cachar District of Assam, while a small northern portion lies in the North Cachar District. This end of Barail Range, though not as lofty as the main range, is steep in places and forms the catchment of the Jatinga river, which joins the Barak River in the south. The area is drained by a number of small streams which flow through small ravines and valleys, and join the Jatinga River on the western boundary of the reserve. The primary vegetation is tropical semi-evergreen to moist evergreen forest corresponding to Cachar Tropical Evergreen Forest 1B/C3 and Cachar Tropical Semi-evergreen Forest 2B/C2 (Champion and Seth, 1968). The moist forest lies along steep ravines of hill streams, and the undisturbed riparian patches are rich in palms and canes. Large patches of wild banana occur in openings of moist forest, and along waterways. Although degraded along the western and northern fringes that we have seen, the forest on the inner hills of the reserve appear more contiguous and relatively undisturbed, probably continuing thus towards the interior. Most undulating and flat portions in the area have been brought under paddy cultivation, and teak or sal plantations along foothills. On hill slopes, *jhuming*, tree felling, and conversion to betel-vine plantations is prevalent. Such plantations, created by planting the vines after clearing the middle layer (small trees) and understorey in mature forest, is practiced by the *Khasi* settlers in the area. Sometimes banana plants are also cultivated in these plantations. The forest understorey is cleared to the hilltop in some places. Most of the accessible forest has been subjected to heavy cane and palm extraction.

Figure 9: Map of Barail Reserve Forest



Area: *~100 km²*
Location: *24°58′– 25°50′N & 92°50′–92°52′E*
Altitude : *~200-1000m msl*
Annual Rainfall: *3107mm (Haflong-Silchar)*

River & Stream
Hill Orientation
Peak
PA Boundary
District Boundary
Metalled/Jeepable Road
Footpath
Village/Settlement
Locality

Dittokcherra Forest Check Gate area (280-600m msl): Heavily degraded habitat around; disturbed forest patches uphill, (behind the checkpost) continuing into stretches of more contiguous and less disturbed ridge forest.
Forest RH – Dimbru Disa village (250–300m msl): Mosaic of paddy fields, small forest patches, plantations, patches of sympodial bamboo, *jhum* fields, and fallows overgrown with *Lantana* in places.
Dimbru Disa Village – interior (270–800m msl): Teak plantations, sympodial bamboo clusters, monopodial bamboo brakes, *jhum* fields and fallows along the streams and lower reaches, giving way to heavily disturbed forest selectively felled and lopped for betel vine plantation, and more contiguous and relatively undisturbed forests along upper ridges and hill tops.

Conservation scenario: *Barail RF* is one of the few remaining tropical forests in southern Assam. Moreover, the Barail Range in which this small RF lies, is a biologically important area (Choudhury, 1993also see notes on surveyed fauna below). It is a dispersal route for fauna from the higher ranges to the east and northeast, and is an important bridge between the Jainta / Khasi and Manipur Hills. However, this area also has one of the highest population densities among the NE hills, and is degraded. The RF itself is surrounded by settlements, and the area along its periphery is being *jhumed*. Along the northern and western border lies the Diphu–Badarpur-Silchar railway line, which makes the area more accessible and prone to disturbance. This is the only track connecting the southern NE States, to Guwahati and hence, the rest of India. Moreover, a broad gauge track is now being laid along the Jatinga River, and this will put the area under more pressure in the future. Although there is a proposal to declare the RF area as a sanctuary, the possibility of including areas in the relatively undisturbed eastern side of the RF needs to be explored as well. It is obvious that there is a need to draw more scientific and conservation attention to the area.

Notes on surveyed fauna:

	No. of species seen during this survey	*Total No. of species reported from the area*	*Forest species included in the analysis*
Amphibians	15	19	-
Frogs	15	19	15
Reptiles	10	13	-
Lizards	9	12	10
Birds	67	242	193

***Amphibians*-** This is another area for which no amphibian list has yet been published. This effort, undertaken just before the onset of the wet period, yielded very interesting results, including some very crucial records that fill gaps in our knowledge of amphibian distribution in NE India. Notable records (see Appendix II) include two species that are perhaps new to science: *Occidozyga cf. tenasserimensis* (a trickle frog) and *Rhacophorus* sp. (a tree frog). In addition, the Red-eyed Shortleg *Leptobrachium smithi*, Brown-backed Oriental Streamfrog *Rana leptoglossa*, Greater Green-backed Oriental Streamfrog *Rana livida* and the Broad-headed Philautus *Philautus parvulus* are worth special mention.

The frog diversity here appears to be strongly Indo-Malayan in its affinities. However, the Barail hill range is allied to and contiguous with the more lofty tracts in Manipur and adjoining Chin Hills of Myanmar, and it would be interesting to see if the area has amphibian species that have dispersed from the Indo-Chinese sub-region across these higher ranges. Further surveys will definitely reveal many new species and records, including taxa hitherto reported from the hills of neighbouring areas, including Myanmar.

Reptiles- Our survey was the first inventory of reptiles for this area. Interesting records include the forest restricted Flat-backed Japalura *Japalura planidorsata* (see Appendix II). A typical forest assemblage of the area would consist of species like the Flat-tailed and Tockay Gecko, Spiny headed Calotes, Flat-backed Japalura, and forest Skinks.

At present, the reptile inventory is inadequate to make too many conjectures about the diversity and composition of the area's reptile fauna. However, in a biogeographical

context, most of the observations we have made with reference to amphibians (above) would be worth examining.

Birds– Apart from the publications in the 19th and early 20th century (op. cit. Ali and Ripley, 1987), Choudhury's *"Birds of Assam"* (2000) is the only published work which covers the Barail Range. In recent years, this region has attracted some bird watchers because of the intriguing Jatinga Valley phenomenon (see Choudhury, 2000), and their reports are the only bird lists for from the area. Although this range is a well known hot spot for the family Slyviidae (especially laughingthrushes), the scarcity of information is apparent. A total of 18 laughingthrushes are known to be distributed here, of which 7 are distributed 'only' along the Barail and the Patkai Range. The same 7 species also happen to be cited as "*Current Status Unknown*" by Grimmett *et al.* (1999).

Our survey was too short to make too many conjectures on the species composition of the area. However it was superficially very similar to that of Himalayan foothill evergreen forests, especially *Namdapha TR* (see Part IV). The three most common pheasants of the foothill forests of NE India, viz., Red Jungle Fowl, Peacock Pheasant, and Kalij Pheasant were heard and sighted frequently. The area had a noticeably high number of woodpecker species. We sighted eight species including Great Slaty Woodpecker and Pale-headed Woodpecker. The former was seen in a disturbed open forest patch, while the latter was exclusively in bamboo. Only two species of pigeons, Mountain Imperial Pigeon and Ashy Wood Pigeon, were seen in the area. Current status of the latter species in unknown (Grimmett et al., 1999). Frequently detected species in the forest included the Pale-chinned Flycatcher, White-throated Bulbul, and the Greater and Lesser Necklaced Laughingthrushes. Mixed foraging flocks of small insectivores were encountered occasionally, typically including Black-naped Monarch, White-bellied Yuhina, and Nepal Fulvetta. The range-restricted Yellow-vented Warbler was seen once in such a mixed flock. Other birds commonly seen were barbets, leafbirds, orioles, minivets, and drongos. A notable sighting was that of the globally threatened Brown Hornbill, a pair of which was seen in degraded forest (see Appendix II).

Previous Studies/Surveys: *(Choudhury, 1993)*

NGENGPUI WILDLIFE SANCTUARY & PALAK LAKE AREA

Landscape profile: These two areas are situated in the 'ridge and valley' province of Southwestern Mizoram (Pachuau, 1994). To the west are the Chittagong Hills of Bangladesh, and in the east lie the Chin Hills (see Fig. 10). This area is comparatively less mountainous (highest peak, 2157m msl; Phawngpui) than the tracts further east and northeast, which connect the Rakhine Yoma mountain arc to the Patkai Hills in the north. The largest river in the landscape is the Chhimtuipui (Kolodyne). The terrain is undulating to hilly, with a series of parallel north-south ridges (*Mizo* vern. = *tlang*), well drained by numerous rocky as well as silted drainages (*Mizo* vern.= *lui*). The climate is tropical, to subtropical /sub-temperate at the northeastern higher reaches. Rainfall is fairly high (see facing map), with distinct and predictable periods without rain. However, due to the relatively low-lying position of the area and high moisture retention capacity of the soil, conditions remain humid even in the rainless periods between November-December and April (see Pawar, 1999). The forest ranges from tropical semi-evergreen/evergreen to subtropical at the higher reaches. This area is probably the most forested region of Mizoram (see, Forest Survey of India, 1999; Sonali Ghosh, pers. comm.; Sonali Ghosh, pers. comm.). The major secondary landscape elements are fallow *jhum* fields, small to extensive brakes of the monopodial bamboo *Melocanna cf. baccifera* (a result of arrested succession by repeated short-cycle *jhuming*), plantations (mainly *Tectona grandis*, followed by indigenous trees like *Gmelina arborea*), and village gardens/groves. Most villages in this area are along roads.

Area-specific notes: *Ngengpui WLS* lies in the valley of the Ngengpui River, which flows through the heart of the WLS, joining the Kolodyne in the south. The *Palak Lake area* is situated ~20 km (straight distance) southeast of Ngengpui river valley. The lake, ca. 200 m long and 150 m wide, is surrounded by undulating, moderately steep hills, and the general topography and microclimate is similar to that of the Ngengpui River valley. Both areas have dipterocarp (*Dipterocarpus* spp.) dominated Tropical semi-evergreen to moist evergreen forest, corresponding to the Chittagong Tropical Evergreen (Puri et al., 1989; 1B/C4; Wikramanayake et al., 1998) and Cachar Tropical Evergreen forest (1B/C3), along with Cachar tropical semi-evergreen forest (2B/C2; Champion and Seth, 1968). The forest is rich in palms, canes and rattans, and dense cane brakes are often encountered on flats. Narrow strips of tall grassland exist along larger rivers. Most of *Ngengpui WLS* itself is primary forest, bordered by a mosaic of forest fragments, bamboo brakes, plantations and *jhum* fallows of varying ages. Contiguous forest inside the reserve is punctuated by small, low-lying, forest bound marshes (formed by the stalling of silty streams), tree fall gaps and bamboo clusters. A number of villages are situated near *Ngengpui WLS* most along a metalled road that skirts it[1].

The *Palak Lake* area is more fragmented and degraded. A belt of disturbed primary forest encircles the lake, while many of the nearby hills (especially on the western side) are covered by *jhums* and bamboo brakes. The eastern lake shore and at least the first hill chain behind are forested. The forest follows the source (*Mara* vern. = *Adidao*) of the Palak stream which originates from the eastern side of the lake, down to where the gorge opens in the shallow valley where Phura is situated. There are three main villages in the vicinity of *Palak Lake* area, of which Phura (ca. 6 km from *Palak Lake*), with 150+ houses, is the largest.

[1] For more area-specific details, refer to (Pawar, 1999).

Figure 10: Map of Ngengpui Wildlife Sanctuary and Palak Lake

Ngengpui WLS

Ngengpui–Khawmawi Village & FRH (170-200m msl): Mosaic of open forest, primary forest fragments, bamboo brakes, plantations, and *jhum* fallows.

Khangpui–Pawizawh *lui* (~250m msl): Mosaic of primary forest, bamboo brakes, and *jhum* fallows; forest contiguous in sanctuary area across the river.

Kawrang – Zawhlet Tlang (~250-550m msl): Almost entirely primary forest, disturbed around Kawrang *tlang*.

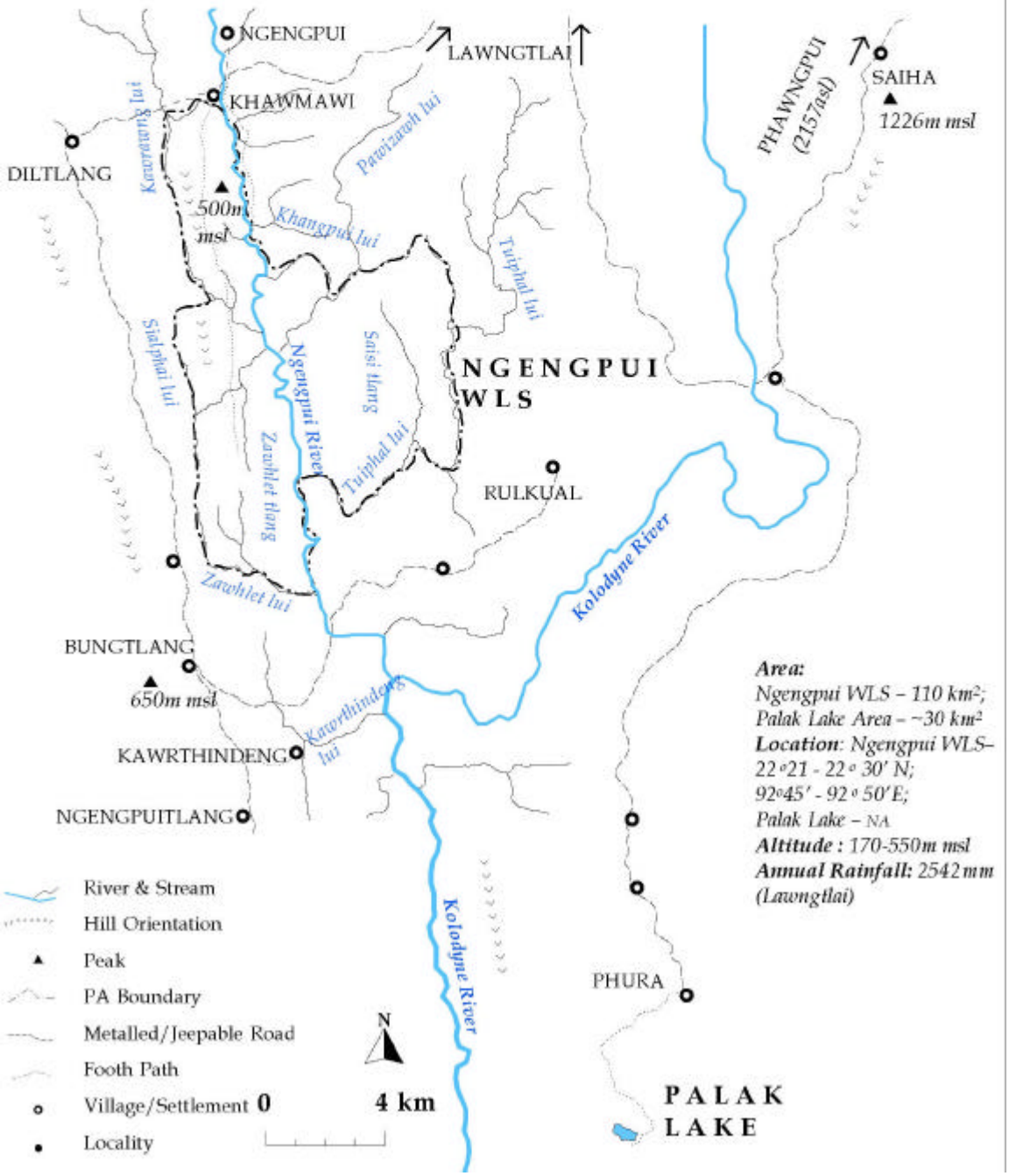
Bungtlang–Ngengpuitlang Village (~280-650m msl): Bamboo brakes, teak plantations, and *jhum* fallows with remnant forest fragments.

Kawrthindeng village to Kolodyne River (~220-340m msl)**:** Mosaic of small to medium primary forest patches, bamboo brakes and *jhum* fallows.

Palak Lake Area (*Mara vern. Pala Tipo*)**:**

Phura (~240m msl): Mosaic of paddy fields, *jhum* fallows, bamboo brakes, and remnant forest patches; giving way to larger bamboo brakes and forest patches towards the lake.

Palak Lake Area: Undisturbed and disturbed primary forest with bamboo brakes and *jhum* fields on the fringes.



Conservation scenario: Significant forest cover still exists outside *Ngengpui WLS* and *Palak Lake* area. This needs to be viewed in light of the fact that though Mizoram is relatively sparsely populated, the extent of primary habitat loss and fragmentation is considerable, especially in comparison with places like Arunachal Pradesh. Both these areas are biologically rich and unique (e.g. *see* notes on surveyed fauna below), and more attention needs to be drawn to their conservation importance. During a 6-month study in the WLS, SP recorded a number of interesting mammals as well (see Appendix IV), including Slow Loris *Nycticebus coucang*, Hoolock Gibbon *Hylobates hoolock*, Oriental Small-clawed Otter *Aonyx cinerea*, and Hairy-footed Flying Squirrel *Trogopterus pearsoni*.

The actual reserve forest around *Palak Lake* is very small (~10.5 km^2), and the inter-village trail that almost encircles it makes it very vulnerable to disturbance. Apart from habitat degradation by *jhuming*, cane extraction, occasional tree felling and hunting of larger vertebrates and birds are constant threats that the area faces. Though attempts are on to declare it a sanctuary, the future is uncertain. The area is not as inaccessible as one might think, and in addition to pressure from local people, changes wrought by external influences are visible as well. For instance, an African Cichlid fish *Tilapia sp.* was released into the lake in the 1980's, and though the lake yields a steady supply of the fish now, most of its indigenous ichthyofauna has probably become extinct. We were also told of "development" schemes that have been considered for the lake, including clearing of forest surrounding the lake and converting it into a boating resort! However, local people seem aware of the ecological repercussions (siltation, among others) of such actions. In general, this area is very vulnerable, and attention needs to be drawn to its conservation value.

The pattern of habitat degradation around *Ngengpui WLS* is similar to that in *Palak Lake* area. The PA status of the WLS affords it more protection than the latter area, but the forests surrounding it continue to deteriorate, and the sanctuary is increasingly becoming an insular patch of primary forest. This, the southernmost of the PAs in NE India, is relatively remote and monitoring it is not easy. In addition, there are many villages close by and not surprisingly, the fringes of the sanctuary itself are under pressure as well. There has been a long standing scheme to relocate Khawmawi village, which presently lies on the sanctuary boundary. Various reasons have prevented its execution, and over the years the situation has become increasingly intractable.

At the present rate, human pressure will continue to undermine the primary habitat contiguity of the landscape, and in the future may threaten the very existence of these two protected areas. Perhaps a feasible initiative in both these areas would be a conservation program in collaboration with local people, which may be very workable considering the fact that *at present* there are still tracts of for make, and may appear casual at the outset. However, we state it with conviction for this area in particular (in contrast to the other areas surveyed; *see* other area accounts) because of SP's previous experience here, and insights gained from local people as well as FD officials.

Notes on surveyed fauna:

	No. of species seen during this survey	*Total No. of species reported from the area*	*Forest species included in the analysis*
Amphibians	24	24	-
Frogs	23	23	18
Reptiles	47	47	-
Lizards	20	20	15
Birds	119	148	118

Amphibians– No previous information was available about the amphibians of this area, and this survey yielded a number of fresh range records (including many Myanmarese species) and a few taxa new to science as well (*see* Appendix II). Notable among these are a new species of Trickle Frog *Occidozyga* cf. *tenasserimensis* (also recorded from *Barail RF* and *Dampa TR*) and *Philautus* sp. (a bush frog). Other interesting records are Daniel's Oriental Stream Frog *Rana danieli* (see account for *Nameri NP / Pakhui TR* above), Greater Greenbacked Oriental Streamfrog *Rana livida*, the Plain Tree Toad *Pedostibes kempi (Bufoides meghalayanus)* and the Golden lined Reedfrog *Chirixalus vittatus*.

Existing information strongly suggests that the area's amphibian fauna is typical of lowland to evergreen / semi-evergreen forest of the Indo-Malayan biogeographic region. Finer conclusions can only be made with a more complete species list and comparisons with other areas in this region.

Reptiles– This area is extremely rich in reptiles and at present appears to be one of the richest in terms of lizards. Notable records (see Appendix II) include the Southeast Asian Softshell Turtle *Amyda cartilaginea*, an unidentified Calotes *Calotes* cf. *alticristatus*, Smooth-backed Parachute Gecko *Ptychozoon lionotum*, Indo-Myanmarese Pygmy Forest Skink *Sphenomorphus courcyanum*, Two-banded Water Skink *Tropidophorus assamensis*, a new species of Wolf Snake *Lycodon zawi*, and the keelback snake *Amphiesma xenura*. The last three species are being recorded after a gap of almost a century.

There is no doubt that further surveys will reveal many more new and exciting finds from *Ngengpui WLS* and *Palak Lake* area. The reptile diversity of this area seems to correspond strongly with that of the moist dipterocarp forests of Myanmar and Thailand.

Birds– In general, the species list of both areas is very similar. The Chestnut-winged Cuckoo, White-rumped Shama, Red-headed Trogon, Long-tailed and Silver-breasted Broadbills, White-throated Bulbuls, White-crested Laughingthrush, Greater and Lesser Necklaced Laughingthrushes, and Forest Wagtail were seen frequently in the forests around *Palak Lake*. The three most common pheasants of the lowland forests Red Jungle Fowl, Grey Peacock Pheasants, and Kalij Pheasant were also common. The area appeared depauperate in small insectivores, and the most common species in the forests were Striped Tit Babbler, Nepal Fulvetta, and White-Bellied Yuhina. Among forest species, probably the most notable species were the Spot-breasted Scimitar Babbler and Hooded Pitta. The former was seen only once while the latter were apparently common (see Appendix II). Other notable species include the largely coastal species Black-capped Kingfisher and the globally threatened Oriental Darter.

Notable records from *Ngengpui WLS* include White-cheeked Partridge, Great Hornbill, Malayan Night Heron, Spot-breasted Scimitar Babbler, Oriental Dwarf Kingfisher,

White-crested Laughingthrush, Great-eared Nightjar, Nepal Babbler, Red-headed Trogon, Black-backed Forktail, Vernal Hanging Parrot, and Great Slaty Woodpecker (see Appendix II). The Oriental Pied Hornbill appeared to be particularly common in both areas, especially around forest edges and in disturbed and secondary forest.

The area has a high proportion of typical low elevation evergreen / semi-evergreen forest birds. As a dipterocarp dominated area, it would be interesting to compare its bird fauna with similar areas in nearby Myanmar and also, other dipterocarp forests further north, such as *Namdapha TR* area. However, on the whole, this area seems poorer in forest avifauna in comparison with some of the low altitude areas we have been to. It appears that much of this disparity is accounted for by the apparent paucity of higher altitude species (which are an important part of the bird assemblage in *Nameri NP–Pakhui WLS*, for instance). Superficial examination shows a high species turnover between this lowland area at the southern end of Mizoram and the nearby higher altitudes around Phawngpui NP (ca. 30 km straight line distance) (Robertson, 1995). It is possible that forest loss *between* these areas, which were formerly the part of an altitudinal continuum of habitats, have restricted local migration and dispersal, resulting in very different and apparently depauperate avifauna in either area. However, there have been few bird surveys in these areas, and further information and more detailed analyses (see Part IV) are likely to yield better insights into these intriguing patterns of bird distribution.

Previous Studies/Surveys: *(Pawar, 1999; Pawar and Choudhury, 2000; Robertson, 1995)*

DAMPA TIGER RESERVE

Landscape profile: This, the largest of the protected areas in Mizoram, is situated at the western limit of the state (see Fig. 11). The area lies in the Lushai hills, a series of parallel, north-south oriented ranges allied to the Rakhine Yoma arc. To the west are the Chittagong hill tracts of Bangladesh. The hills to the eastern limit of this landscape are much higher, continuing further east to the Chin hills of Myanmar. The terrain is mountainous, (highest peaks ca. 1300-1500 m msl), and well dissected by numerous drainages. Within the PA itself, Chawrpialtlang, (~1100 m msl) is the highest locality. The main drainage system consisting of the Teirei, Tut, and Tlawng Rivers, is directed northwards, flowing into the Dhaleshwari River of the Cachar district of Assam. Rainfall is fairly high, but with predictable rainless months. The climate is tropical, but with a distinct cold season more pronounced at higher altitudes. The vegetation ranges from evergreen to semi evergreen tropical forest, tending towards subtropical characteristics at the higher reaches of the higher hills to the east. This area has one of the last remaining natural low- to mid-elevation forests in western Mizoram (see, Forest Survey of India, 1999). There are large tracts of secondary habitat in the landscape, dominated by monopodial bamboo brakes, and regenerating *jhum* fallows. Other secondary elements are plantations (chiefly *Gmelina arborea, Michelia champaca* and *Tectona grandis*), and village gardens. There is very little woody forest contiguity across the landscape, and the forest within the reserve is practically an island surrounded by extensive bamboo tracts (see Forest Survey of India, 1999; Raman, 1995). Towards the east, within a radius of 20-30 km, there are a few more fragmented patches of forest. There are some forest tracts in the adjoining Chittagong Hills of Bangladesh as well (see UNEP, 2001)), but we are unable to comment on their quality and extent. Most human habitation is concentrated along metalled roads in this area.

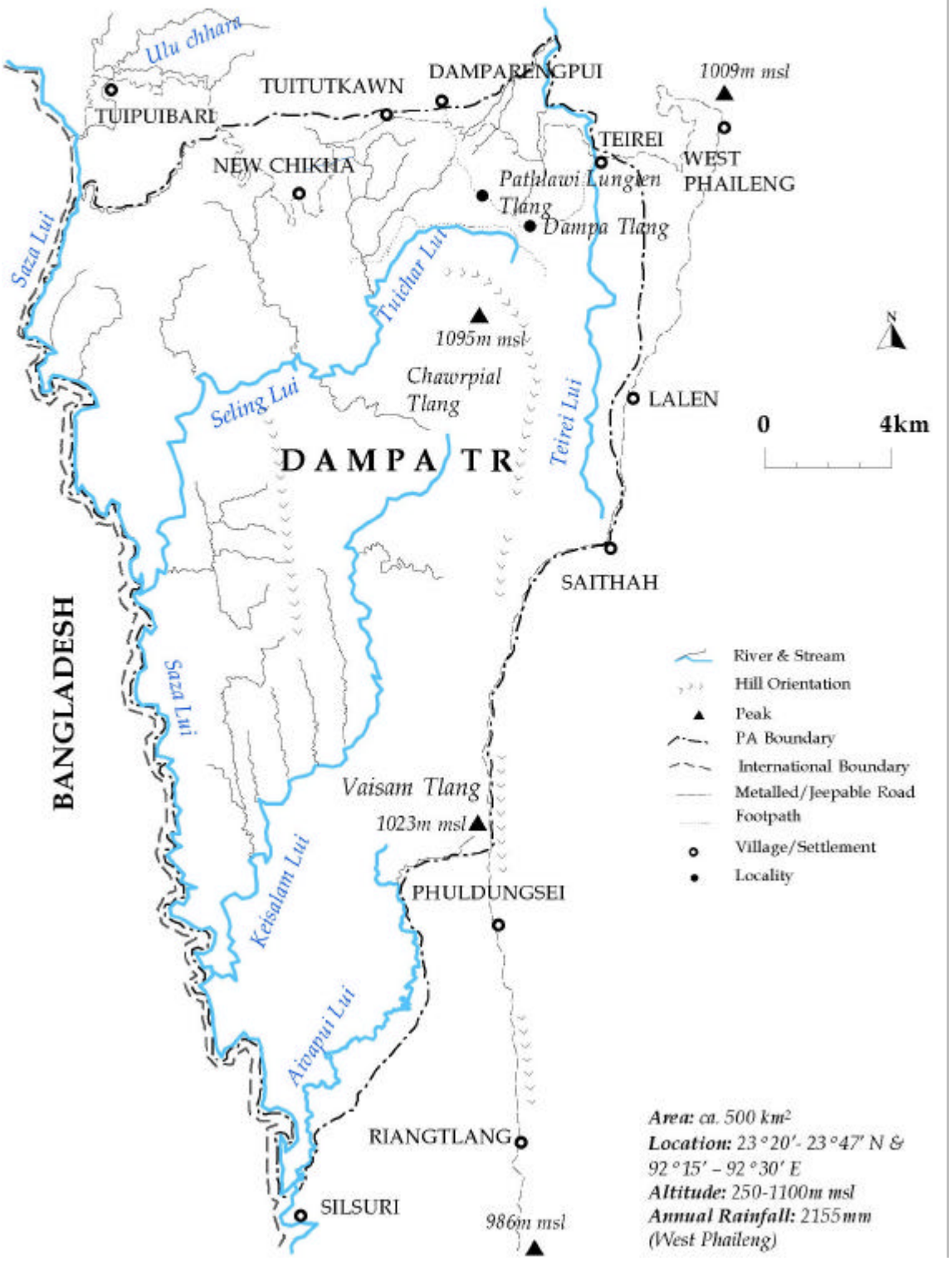
Area-specific notes: The natural vegetation in the reserve is tropical evergreen to semi-evergreen, corresponding to the Cachar Tropical Evergreen 1B/C3 and semi-evergreen 2B/C2 forest (Champion and Seth, 1968). The forest in the moist valleys is lofty and evergreen, while the steeper slopes on the west aspect have more deciduous elements, often with sympodial bamboos in the understorey. There is stunted, open forest on exposed aspects. Tree fall gaps and edges have dense successional vegetation. The extensive bamboo forests are dominated by the monopodial *Melocanna cf. baccifera* with patches of the sympodial *Dendrocalamus* cf. *longispathus*. Strips of tall grassland flank the lower reaches of the river Teirei wherever the forest does not abut the river bank. Raman (1995) mentions that part of the mature forest along the Dampa *tlang* to Pathlawi Lunglen *tlang* stretch has naturally regenerated on an area that was *jhummed* between 1895-1900. There a number of villages at the periphery of the reserve, almost all of them situated along the metal road along its northern and eastern borders[1].

Conservation scenario: The PA status of *Dampa TR* affords it considerably stringent protection. No trespassers were seen within the reserve during our visit, and it appears that the forest patch covering Dampa *tlang* and Chawrpial *tlang* areas is well buffered by their relative inaccessibility and the surrounding bamboo tracts. However, we were not able to visit the other parts of the park, where patches of forest also exist around Lalen village (T.R.S. Raman, *pers. comm.*). Given enough time, the extensive bamboo tracts in the reserve will ultimately give way to woody forest (Raman et al., 1998), and the area will remain an important habitat pool in the future if it remains well protected.

[1] *For more area-specific details, refer to (Raman et al., 1998; Raman, 2001).*

Figure 11: Map of Dampa Tiger Reserve

Teirei Village–River path (300-350m msl): Mainly monopodial bamboo, riparian tall grass, *Michelia* plantation, and shrubby, dense regenerating patches.
Teirei–Dampa Tlang: Monotonous monopodial bamboo interrupted by forest patches, giving way to primary forest as the track ascends towards the *tlang*.
Dampa Tlang-Pathlawi Lunglen Tlang (~900m msl): Mature, undisturbed ridge forest, stunted on exposed faces. Dense clumps of sympodial bamboo towards Pathlawi lunglen tlang, followed by a clearing overgrown with herbaceous climbers on the *tlang*.
Dampa Tlang- Tuichar Puk Kai: Undisturbed primary forest, with patches of stunted, regenerating, and shrubby vegetation on steep slopes along the way.
Tuichar Lui (400-450m msl): Primary forest upstream, giving way to mosaic of forest and monopodial



Particular attention needs to be given to the bamboo tracts in the stream and river valleys as is they are not only the fastest regenerating, but are also biologically rich and very vulnerable to *jhuming* impact (though of lesser concern in areas where villages are situated on *tlangs*). The monoculture plantations in the area make are not ideal habitat for wild animals (especially teak), and the FD needs to decide upon a policy which would allow such monocultures to be replaced by natural forest (through regeneration). Also, we came upon a clearing on Pathlawi-lunglen Tlang, which was created by cutting a bamboo patch, ostensibly to create a grazing site for wild herbivores. This has not worked very well, and the site is now overgrown with weeds, and will probably give way slowly to bamboo again. In our opinion, attempts at making such clearings in wet forest areas are unnecessary, and bamboo forest should not be converted in this manner under any circumstances. The biggest threat that we perceive is from burgeoning populations in the settlements surrounding the reserve, and measures to integrate the needs of the local communities with those of the PA should be initiated soon.

Notes on surveyed fauna:

	no. of species seen during this survey	*Total no. of species reported from the area*	*Forest species included in the analysis*
Amphibians	18	22	-
Frogs	18	22	17
Reptiles	41	43	-
Lizards	16	16	12
Birds	58	229	163

Amphibians– Our amphibian survey in *Dampa TR* was very productive, more so because this area was visited at the onset of the wet period. Apart from important records (*see* Appendix II) such as the trickle frog *Occidozyga* cf. *tenasserimensis*, Plain Tree Toad *Pedostibes kempi (Bufoides meghalayanus*; see Appendix III*)*, Greater Greenbacked Oriental Streamfrog *Rana livida*, and the Broad-headed Philautus *Philautus parvulus*, important information on breeding habits and larvae (tadpoles) was also collected. These species make up the typical forest amphibian assemblage here as well.

This was the first survey of amphibians here, and it would be inappropriate to make too many conjectures on the diversity, composition, and affinities of amphibians here.

Reptiles– The survey in *Dampa TR* was quite productive in terms of reptiles as the season was ideal for a survey of this group. Interesting records (see Appendix II) include the Keeled Box Turtle *Pyxedia mouhoti*, Flat-backed Japalura *Japalura planidorsata* and an unidentified Flying Lizard *Draco* sp. and the Blue Throated Forest Lizard *Ptyctolaemus gularis*.

The lizard assemblage of the area appears in many respects similar to what would be expected in the Montane tracts of Myanmar west of the Ayeyarawaddy River basin (Joseph Slowinski, pers. comm.)

Birds– *Dampa TR* is the only area in the NE Hills where there has been an ecological study on bird communities (Raman et al., 1998; Raman, 2001). The total number of species reported from the area is 237, of which 148 are forest birds. During this survey, 59 species were sighted. Notable among these are the Great Hornbill, Wreathed Hornbill, Malayan Night Heron, and Scarlet-backed Flowerpecker. Raman's (2001) findings give a

good idea of the occurrence and composition of forest and non-forest birds in the area. The forest bird community is represented by species such as Great and Wreathed Hornbills, Grey Peacock Pheasant, Red-headed Trogon, Mountain Imperial Pigeon, Long-tailed Broadbill, White-rumped Shama, Striped Tit Babbler, White-bellied Yuhina, Nepal Fulvetta, Black-naped Monarch, and Velvet-fronted Nuthatch. Interestingly, the Oriental Pied Hornbill, though seen mainly along riparian and secondary forest habitats in other areas, are apparently more forest restricted here. Although the dominant cover is bamboo in these hills and in most of the other NE Hills (more compared to E. Himlayas, or elsewhere), very few species are specialists of this habitat. Only Yellow-bellied Warbler, Rufous-capped Babbler, Puff-throated Babbler, and Brown-cheeked Fulvetta were seen in bamboo. Interestingly, the Pale-chinned Flycatcher, frequent in primary forests in *Balphakram NP* and *Barail RF*, was seen mostly in bamboo patches here. Similarly, the White-browed Piculet, though seen exclusively in bamboo here, was often seen in disturbed forest in the other two areas.

This area, though more of a primary habitat island in comparison to the *Ngengpui WLS–Palak WLS* area, appears to have a proportionally higher number of forest species of higher altitude affinities. This is perhaps because the forest here has been preserved across a wider altitudinal range, which allows more species to remain in the landscape.

Previous Studies/Surveys in the Area: *(Mishra et al., 1998; Raman, 1995; Raman et al., 1995a; Raman et al., 1995b; Raman et al., 1998; Raman, 2001)*

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APPENDICES

I. CHECKLISTS OF SURVEYED FAUNA

Scientific nomenclature and taxonomic order upto genus is after Frost (2001) for *amphibians* and Uetz (2001) for *reptiles*, except in cases where we consider it more appropriate to apply our taxonomic judgment. Where identification is uncertain, "cf." (*confer*; compare) is inserted between the generic and specific epithet. This indicates that the taxon is comparable with or very similar, but cannot be confidently assigned to the species given. Wherever the comparable species is uncertain, "?" is attached before the scientific name, and no specific epithet is given where we have not been able to determine a comparable taxon. To support identifications and ratify distributions, information from various museums has also been used in addition to literature, with particular reference to records from neighbouring regions[1]. Common names are drawn from various sources, including Frank & Ramus (1995). Whenever published common names are inconsistent with existing knowledge of the natural history, behaviour, morphology and regional distribution of a taxon, we have attempted to coin new names. However, considering our present knowledge, deriving common names is often not possible. Such cases are marked it with "**NA**" (not available / applicable).

For *birds*, nomenclature is after Sibley and Monroe (1990), and common names are after Grimmett et al. (1999).

The following symbols are used in the species lists:

- ✓ Species recorded during this survey.
- ✓***** Not recorded during this survey, but by others; sourced from literature. Records from specimens found in field museums of PAs and private collections are included.
- ✓**?** Not seen in the area *per se*, but probably present based upon a confirmed record nearby, or dependable secondary information.
- **†** Species included in analyses (see Part III)
- **(!)** See "Notes on selected species" in the next section.

Throughout the report and in the following checklists, we use the following habitat classification to describe habitat states:

1. Primary / mature[2] forest
- A. Undisturbed to mildly disturbed (largely untouched, occasionally disturbed by hunting or NTFP collection)
- B. Disturbed (regular cane / palm extraction, heavy NTFP collection, selective logging for local consumption)
- C. Heavily disturbed (selectively logged for commercial extraction, betel vine plantation, etc.)

2. Secondary forest (Regenerating jhums/abandoned terraced paddy fields)
- A. Woody regeneration with closed canopy (>15yrs)
- B. Woody regeneration (5-15yrs)
- C. Mixed stands with bamboo and trees (generally >20yrs)
- D. Bamboo (generally monopodial) stands (5-20 yrs)

3. Open habitats

[1] (CAS, 2000b; CAS, 2000a; FMNH, 2001; MCZ, 2001a; MCZ, 2001b)

[2] It is often difficult to determine the age of 'primary' forest, especially in an area with a poorly known history of land use and recovery (Finegan, 1996); much of the forest that is considered primary may often be mature forest that was cut more than 100 years ago (Raman, 1995)

A. Heavily felled / logged (open habitat, often maintained by heavy grazing)
B. Recent *jhums*, abandoned terraced paddy fields (bushy vegetation, <5-10yrs)
C. Current to recently abandoned *jhum* fallows (<2 yrs)
D. Current agricultural lands
E. Human habitation and village gardens
F. Riparian grassland (short or tall grassland, often with scattered trees)

4. Plantations (timber as well as non-timber)

5. Other (Includes aquatic habitats, birds seen in flight, etc.)

AREA CODES:

NP: Nameri NP and Pakhui WLS
NA: Namdapha TR
MO: Mouling NP
BL: Balphakram NP
BR: Barail RF
PA: Palak lake
NG: Ngengpui WLS
DA: Dampa TR

AMPHIBIANS		Habitat class	NP	Na	Mo	Bl	Br	Pl	Ng	Da
Limbless Amphibians (Order Gymnophiona)										
Ichthyophiidae – Caecilians										
-na-	*Ichithyophis garoensis*	-				✓*				
-na-	*?Ichithyophis cf. Kohtaoensis*	1							✓	
Frogs, Toads (Order Anura)										
Megophryidae – Megophryids										
Red-eyed Shortleg (!)	*Leptobrachium smithi* †	1, 2				✓	✓		✓	✓
Boettger's Xenophrys (!)	*Xenophrys. cf. boettgeri* †	1, 2			✓	✓*				
White-lipped Xenophrys	*X. lateralis* †	2	✓							
Indo-Myanmarese Xenophrys	*X. parva* †	1, 2, 4	✓*			✓*	✓		✓	✓
Large Xenophrys	*X. robusta* †	1		✓	✓					
Bufonidae – True toads										
-na- (!)	*?Bufo cf. cryptotympanum/burmanus* †	1		✓						
Himalayan Toad	*Bufo himalayanus*		✓?	✓*	✓*					
Large-eared Toad	*B. macrotis* †		✓*	✓*						
Common Oriental Toad	*B. melanostictus*	1, 2, 3, 4	✓	✓*	✓	✓	✓	✓	✓	✓
Plain Tree Toad (!)	*Pedostibes kempiae* (including *Bufoides meghalayanus)* †	1, 2							✓	✓
Microhylidae – Narrowmouths										
Painted Kaloula	*Kaloula pulchra* †	1, 2					✓?	✓	✓	✓
Berdmore's Asian Narrowmouth	*Microhyla berdmorei* †	1, 2	✓?	✓*		✓?		✓	✓	✓?
Ornate Narrowmouth	*M. ornata*	2, 3	✓			✓?		✓	✓	✓
Ranidae – True Frogs										
Long-fingered Amolops	*Amolops cf. formosus* (including *himalayanus)* †	1	✓?		✓					
-na-	*A. gerbillus* †	1	✓?	✓	✓*					
Common Amolops	*A. marmoratus* †	1, 2		✓*	✓*	✓	✓	✓		✓
Green-spotted Amolops (!)	*A. cf. viridimaculatus* †	1			✓					
Asian Skitterer	*Euphlyctis cyanophlyctis*	3	✓	✓	✓	✓	✓	✓	✓	✓
South Asian Bullfrog	*Hoplobatrachus tigerinus*	2, 3, 4	✓				✓		✓	✓
Corrugated Bullfrog	*H. crassus*	3	✓							
-na-	*Limnonectes sp.*	2							✓	
Asian Cricket Frog	*L. limnocharis* †	1, 2, 3, 4	✓	✓	✓	✓	✓	✓	✓	✓
Asian Broad head	*L. laticeps* †	1	✓?			✓	✓?		✓	✓
Smooth Asian Broadhead	*L. kuhli* †	1		✓						
North-western Trickle Frog (!)	*Occodozyga (Phrynoglossus) borealis* †	1, 2	✓		✓*					

AMPHIBIANS		HABITAT CLASS	NP	NA	MO	BL	BR	PL	NG	DA
-NA-	*O. (P.) cf. tenasserimensis* †	1, 2					✓	✓	✓	✓
-NA-	*Paa liebigii* †		✓?		✓?					
-NA-	*Rana (Ingerana) cf. tasanae* †	1		✓						
PLAIN ORIENTAL STREAMFROG	*R. alticola* †	1, 2	✓?			✓?			✓	
DANIEL'S ORIENTAL STREAMFROG (!)	*R. danieli* † *(including Pterorana khare)*	2, 3,5	✓	✓		✓?			✓	✓
-NA-	*R. garoensis*					✓?				
BROWN-BACKED ORIENTAL STREAMFROG	*R. leptoglossa*†	1, 2, 3				✓	✓	✓	✓	✓
GREATER GREEN-BACKED ORIENTAL STREAMFROG (!)	*R. livida* †	1					✓		✓	✓
SILVER-LINED PADDYFROG	*R. erythraea*		✓*							✓?
YELLOW-LINED PADDYFROG	*R. taiphensis*	3	✓			✓?				
RHACOPHORIDAE – OLD WORLD TREE FROGS										
LINEATED POLYPEDATES	*Polypedates leucomystax cf. sexvirgatus* †	2, 3, 4	✓	✓*		✓?	✓		✓	✓
-NA-	*P. l. cf. himalayanus* †	3	✓*	✓*	✓					
-NA- (!)	*Rhacophorus sp.* †	1					✓			
LARGE GREEN RHACOPHORUS	*R. maximus* †	1, 2	✓*	✓	✓	✓	✓		✓	✓
TWIN-SPOTTED RHACOPHORUS	*R. bipunctatus (including reinwardtii)* †	1		✓*	✓*					✓?
NAMDAPHA RHACOPHORUS	*R. namdaphaensis* †			✓*						
-NA- (!)	*R. naso*†	1			✓					
-NA- (!)	*Rhacophorus cf. jerdoni*†	1			✓					
-NA-	*R. tuberculatus*				✓*					
PIED THELODERMA (!)	*Theloderma asperum* †	1	✓	✓	✓					
-NA-	*T. (Nyctixalus) moloch* †				✓*					
-NA-	*P.* sp[1]	1		✓	✓					
-NA-	*P. sp*[2] †	1, 2					✓	✓	✓	✓
-NA-	*Philautus cf. annandalii*†		✓*	✓*	✓*					
TUBERCULATE PHILAUTUS	*P. andersoni*†	1	✓	✓	✓*					
BROAD-HEADED PHILAUTUS (!)	*P. parvulus* †	1, 2, 3		✓			✓	✓	✓	✓
-NA-	*P. garo*†					✓?				
-NA-	*P. kempiae* †					✓?				
NAMDAPHA PHILAUTUS (!)	*P. namdaphaensis* †	1		✓*					✓	
GOLDEN-LINED REEDFROG (!)	*Chirixalus vittatus* †	1, 4	✓*						✓	
-NA-	*C. simus* †		✓*							
LINEATED REEDFROG (!)	*C. doriae* †	1		✓						

REFERENCES: op. cit. Dutta (1999) / ***Nameri NP & Pakhui WLS***: Datta and Goyal (1997) / ***Namdapha TR***: Sarkar and Sanyal (1985), Singh et al. (2000a) / ***Mouling NP***: Annandale (1912a) / ***Balphakram NP***: Pillai and Chanda (1981) / ***Barail RF***: NA / ***Ngengpui WLS***: Pawar (1999) ***Palak Lake***: NA ***/Dampa TR***: NA

REPTILES		HABITAT CLASS	NP	NA	MO	BL	BR	PL	NG	DA
LIZARDS (SUBORDER SAURIA)										
AGAMIDAE – OLD WORLD ROUGH SCALED LIZARDS										
HORNED TREE LIZARD (!)	*Acanthosaura cf. crucigera*†	1		✓						
-NA-	*C. cf. alticristatus*†	2						✓		
SPINY-HEADED FOREST CALOTES	*C. emma*†	1, 2				✓*	✓	✓	✓	✓
MONTANE GREEN CALOTES	*C. jerdoni*†	1, 2	✓*	✓	✓					
MOUSTACHED CALOTES (!)	*C. mystaceus*†			✓						
COMMON CALOTES	*Calotes versicolor*	2, 3, 4	✓	✓		✓	✓	✓	✓	✓
SPOTTED DRACO	*Draco maculatus*†	1		✓*	✓*	✓*	✓?	✓	✓	✓
-NA-	*Draco sp. (cf. blanfordi-norvilli?)* †	1								✓
-NA-	*Japalura cf. andersoniana*†		✓?		✓*					
FLAT-BACKED JAPALURA (!)	*J. planidorsata*†	1				✓*	✓			✓
-NA-	*Oriocalots paulus*†				✓*					
BLUE-THROATED FOREST LIZARD	*Ptyctolaemus gularis* †	1, 2	✓	✓*	✓*	✓	✓*		✓	✓
GEKKONIDAE – GECKOES										
INDO-MYANMARESE BENT-TOED GECKO	*Cyrtodactylus khasiensis* †	1		✓	✓*	✓				
SPINY-TAILED HOUSE GECKO	*Hemidactylus frenatus*	3	✓		✓	✓	✓	✓	✓	✓
GARNOT'S GECKO	*H. garnoti*†	1						✓	✓	
BROOK'S HOUSE GECKO	*H. brooki*	3	✓	✓?		✓				
ASIAN FLAT-TAILED GECKO	*Cosymbotus platyurus*†	1, 2	✓	✓	✓?	✓	✓	✓	✓	✓
TOCKAY	*Gekko gecko*†	1, 2, 3	✓	✓		✓	✓	✓	✓	✓
SMOOTH-BACKED PARACHUTE GECKO (!)	*Ptychozoon lionotum* †	1							✓	
LACERTIDAE – LACERTIDS OR SLENDER GRASS LIZARDS										
ASIAN LONG-TAILED GRASS LIZARD	*Takydromus sexlineatus cf sexlineatus* †	2, 3, 4	✓	✓?		✓	✓	✓	✓	✓
SCINCIDAE – SKINKS										
STREAMSIDE FOREST SKINK	*Sphenomorphus maculatus*†	1, 2, 3, 4	✓	✓	✓	✓	✓	✓	✓	✓
INDO-MYANMARESE PIGMY FOREST SKINK (!)	*S. courcyanum*†	1			✓*				✓	
LARGE FOREST SKINK	*S. indicum*†	1	✓*	✓	✓*		✓*	✓	✓	
TWO-BANDED WATER SKINK (!)	*Tropidophorus assamensis* †	1, 2							✓	✓
ASIAN SUNSKINK	*Mabuya multifasciata*	2, 3, 4	✓	✓*		✓		✓	✓	✓
STRIPED OLIVE SUNSKINK	*M. dissimilis*	3	✓							
SPECKLED LITTLE SUNSKINK	*Mabuya macularia macularia*	2, 3, 4	✓	✓	✓	✓	✓	✓	✓	✓
-NA-	*Mabuya.* sp.†	2						✓	✓	✓

REPTILES		**HABITAT CLASS**	NP	**NA**	**MO**	**BL**	**BR**	**PL**	**NG**	**DA**
VARANIDAE – MONITOR LIZARDS										
COMMON ASIAN MONITOR	*Varanus bengalensis*	*1, 2, 3, 4, 5*	✓*	✓*	✓*	✓		✓	✓	✓
WATER MONITOR	*V. salvator*								✓	
SNAKES (SUBORDER OPHIDIA)										
TYPHLOPIDAE – BLIND SNAKES										
COMMON BLIND SNAKE	*Ramphotyphlops braminus*	1, 2, 3	✓	✓*					✓	
DIARD'S BLIND SNAKE	*Typhlops diardi*			✓*						
BOIDAE – PYTHONS AND BOAS										
MYANMARESE PYTHON	*P. molurus bivittatus*	3	✓							
REGAL PYTHON (!)	*Python reticulatus*	5	✓*						✓	
COLUBRIDAE – COLUBRIDS										
ORIENTAL VINE / WHIP SNAKE	*Ahaetulla prasina*	2, 3	✓*	✓*	✓	✓*			✓	
LONG-NOSED WHIP SNAKE	*A. nasuta*					✓?				
-NA-	*Amphiesma platyceps*				✓*					
-NA-	*A. khasiensis/modesta*			✓*	✓*					
-NA- (!)	*A. xenura*	1						✓		✓?
STRIPED KEELBACK	*A. stolata*		✓*	✓*						
-NA-	*Pseudoxenodon macrops*			✓*	✓*					
RED-NECKED KEELBACK	*Rhabdophis subminiatus*	1, 2, 3, 4	✓*	✓*		✓*		✓	✓	✓?
COLLARED KEELBACK	*R. himalayanus*	1	✓	✓*	✓*					
-NA-	*Xenochrophis sp.*	5	✓							
CHECKERED KEELBACK	*X. piscator*	5	✓	✓*	✓?		✓		✓	✓
COLLARED BLACK-HEADED SNAKE	*Sibynophis collaris*	2			✓?			✓		
COMMON MOCK VIPER	*Psammodynastes pulverulentus*	2, 3	✓	✓*	✓*	✓*			✓	
-NA-	*Blythia reticulata*				✓*					
INDO-CHINESE RAT SNAKE	*Ptyas korros*	1, 2, 3, 4		✓*	✓				✓	✓
COMMON RAT SNAKE	*P. mucosus*	3			✓?				✓	
LESSER GREEN RACER	*E. frenata*			✓*						
GREATER GREEN RACER	*Elaphe prasina*	1		✓*					✓?	
RED MOUNTAIN RACER	*E. porphyracea*			✓*	✓?					
STRIPE-TAILED RACER	*E. taeniura*			✓*	✓*					
COPPERHEAD RACER	*E. radiata*	1, 2, 3		✓*				✓	✓	
MANDARIN RACER	*E. mandarina*				✓*					
GOLDEN TREE SNAKE	*Chrysopelea ornata*	1, 2	✓*						✓	
PAINTED BRONZEBACK	*Dendrelaphis cf. pictus*	2, 3						✓	✓	✓

REPTILES		**HABITAT CLASS**	NP	**NA**	**MO**	**BL**	**BR**	**PL**	**NG**	**DA**
GREEN BRONZEBACK	*D. cyanochloris*			✓*						
INDO-CHINESE BRONZEBACK	*D. gorei*				✓?					
ORIENTAL STRIPENECK	*Liopeltis frenatus*			✓*	✓*					
COMMON WOLFSNAKE	*Lycodon aulicus*					✓*				
BROAD-BANDED WOLFSNAKE	*L. laoensis*			✓*						
SPECKLED WOLFSNAKE	*L. jara*				✓*					
ZAW'S WOLFSNAKE (!)	*Lycodon zawi*	1, 2?				✓*			✓	✓?
YELLOW-BELLIED FOREST SNAKE	*Rhabdops bicolor*			✓*		✓?				
-NA-	*Trachischium monticola*				✓*					
BANDED KUKRI	*Oligodon albocinctus*	1, 2, 4		✓*	✓*	✓*				
-NA-	*O. cf. cyclurus*	2				✓*			✓	
-NA-	*O. cf. cinereus*	1		✓*					✓?	
-NA-	*O. melanozonatus*				✓*					
MONTANE SNAIL EATER	*Pareas monticola*				✓*					
TAWNY CATSNAKE	*Boiga cf. ochracea*					✓*				
LARGE-SPOTTED CATSNAKE	*B. multomaculata*			✓*						
-NA-	*B. gokool*					✓*				
ELAPIDAE – COBRAS, KRAITS, CORAL SNAKES										
GREATER BLACK KRAIT (!)	*Bungarus niger*	1	✓	✓*		✓*				
LESSER BLACK KRAIT (!)	*B. livida*	1	✓							
BANDED KRAIT	*B. fasciatus*	1							✓	
MCCLELLAND'S CORAL SNAKE	*Calliophis macclellandi*		✓*	✓*	✓*	✓*				
-NA- (!)	*?Maticora cf. intestinalis*					✓*				
MONOCELLATE COBRA	*Naja kaouthia*	1, 2, 3	✓*	✓*	✓*				✓	
KING COBRA (!)	*Ophiophagus hannah*	1	✓*			✓*			✓	
VIPERIDAE – VIPERS										
-NA-	*Trimeresurus cf. erythrurus*		✓?			✓*				
MEDO PIT VIPER	*T. medoensis*			✓*						
STEJNEGER'S GREEN PIT VIPER	*Trimeresurus cf. stejnegeri*	1							✓	✓
JERDON'S MONTANE PIT VIPER	*Trimeresurus jerdoni*			✓*						
MONTANE PIT VIPER	*Ovophis monticola*			✓*	✓*					
TURTLES AND TORTOISES (ORDER TESTUDINES)										
EMYDIDAE – POND TURTLES/BOX AND WATER TURTLES										
KEELED BOX TURTLE (!)	*Pyxedia mouhoti*	2	✓							✓
SOUTHEAST ASIAN LEAF TURTLE	*Cyclemys oldhami*	1, 2, 5	✓*						✓	✓
ASSAM ROOFED TURTLE	*Kachuga sylhetensis*	5	✓						✓	

REPTILES		**HABITAT CLASS**	NP	**NA**	**MO**	**BL**	**BR**	**PL**	**NG**	**DA**
BLACK TURTLE (!)	*Melanochelys trijuga*	5	✓		✓*				✓	✓
TESTUDINIDAE –TORTOISES										
YELLOW TORTOISE (!)	*Indotestudo elongata*	1, 2						✓*	✓	✓
SOUTHEAST ASIAN GIANT TORTOISE (!)	*Manouria emys*	1, 2						✓*	✓	
TRIONYCHIDAE – SOFTSHELL TURTLES										
SOUTHEAST ASIAN SOFTSHELL (!)	*Amyda cartilaginea*	5						✓	✓	
-NA- (!)	*?Nilssonia cf. formosa*			✓*						

REFERENCES: ***Nameri NP & Pakhui WLS:*** *Datta and Goyal (1997)* ***/Namdapha TR:*** *Singh et al. (2000a), Athreya et al. (1997), Captain and Bhatt (2000)* ***/Mouling NP:*** *Annandale (1912b)* ***/Balphakram NP:*** NA ***/Barail RF:*** NA ***/Ngengpui WLS:*** *Pawar (1999), Pawar and Choudhury (2000; Testudines)* ***/Palak Lake:*** NA ***/Dampa TR:*** *Choudhury (2001; Testudines)*

BIRDS		HABITAT CLASS	NP	NA	MO	BL	BR	PA	NG	DA
PHASIANIDAE – PARTRIDGES, FRANCOLINS, SNOWCOCKS, QUAILS AND PHEASANTS										
HILL PARTRIDGE	*Arborophila torqueola*	-		✓*	✓*					
RUFOUS-THROATED PARTRIDGE †	*A. rufogularis*	1A, 2A		✓*	✓					
CHESTNUT-BREASTED PARTRIDGE †	*A. mandelii*	-			✓*					
WHITE-CHEEKED PARTRIDGE † (!)	*A. atrogularis*	1A	✓*	✓			✓*		✓	✓*
MOUNTAIN BAMBOO PARTRIDGE	*Bambusicola fytchii*	-					✓*			✓*
BLYTH'S TRAGOPAN	*Tragopan blythii*	-			✓*					
RED JUNGLEFOWL †	*Gallus gallus*	1B, 1C, 2A, 2B, 2D, 3B, 4	✓	✓*	✓	✓	✓		✓	✓*
KALIJ PHEASANT †	*Lophura leucomelanos*	1A, 1B, 1C, 2A, 2B, 4	✓	✓*		✓	✓	✓	✓	✓
GREY PEACOCK PHEASANT †	*Polyplectron bicalcaratum*	1A, 1B, 2A, 2B, 3A	✓*	✓		✓	✓	✓	✓	✓
DENDROCYGNIDAE – WHISTLING-DUCKS										
LESSER WHISTLING-DUCK	*Dendrocygna javanica*	5		✓*		✓*			✓	
ANATIDAE – SWANS, GEESE AND DUCKS										
RUDY SHELDUCK	*Tadorna ferruginea*	-		✓*	✓*					
WHITE-WINGED DUCK † (!)	*Cairina scutulata*	1C, 5	✓	✓*						
TUFTED DUCK	*Aythya fuligula*	-			✓*					
NORTHERN PINTAIL	*Anas acuta*	-					✓*			
COMMON TEAL	*A. crecca*	-				✓*				
COMMON MERGANSER	*Mergus merganser*	5	✓	✓	✓*	✓*				
TURNICIDAE – BUTTONQUAILS										
BARRED BUTTONQUAIL	*Turnix suscitator*	-			✓*					
PICIDAE – PICULETS AND WOODPECKERS										
SPECKLED PICULET †	*Picumnus innominatus*	1A, 2D, 3B, 3F	✓*	✓*	✓*	✓*			✓	✓
WHITE-BROWED PICULET †	*Sasia ochracea*	1B, 2A, 2D, 3A	✓*	✓*	✓	✓	✓	✓		✓
GREY-CAPPED PYGMY WOODPECKER †	*Dendrocopos canicapillus*	1C	✓	✓*		✓*				✓*
FULVOUS-BREASTED WOODPECKER †	*D. macei*	2A, 2B, 3A	✓	✓*	✓	✓				
CRIMSON-BREASTED WOODPECKER	*D. cathpharius*	-			✓*					
RUFOUS WOODPECKER †	*Celeus brachyurus*	1B, 4	✓*	✓*	✓*	✓*	✓	✓		✓*
PALE-HEADED WOODPECKER †	*Gecinulus grantia*	2D		✓*			✓			✓*
BAY WOODPECKER †	*Blythipicus pyrrhotis*	1A, 1B, 1C, 2A, 2B, 4	✓	✓	✓	✓	✓	✓		✓
HEART-SPOTTED WOODPECKER †	*Hemicircus canente*	-								✓*
GREAT SLATY WOODPECKER †	*Mulleripicus pulverulentus*	1B	✓*	✓			✓		✓	✓*
LESSER YELLOWNAPE †	*Picus chlorolophus*	1B, 1C, 2A, 3A	✓	✓*	✓	✓*	✓		✓	✓*
GREATER YELLOWNAPE †	*P. flavinucha*	1A, 1B, 1C, 3A	✓	✓	✓	✓	✓	✓	✓	✓

BIRDS		HABITAT CLASS	NP	NA	MO	BL	BR	PA	NG	DA
GREY-HEADED WOODPECKER †	*P. canus*	1A, 1C, 2B, 2D, 4	✓	✓	✓*	✓	✓			✓*
HIMALAYAN FLAMEBACK †	*Dinopium shorii*	-				✓*				
BLACK-RUMPED FLAMEBACK	*D. benghalense*	-	✓*							
GREATER FLAMEBACK †	*Chrysocolaptes lucidus*	1B, 1C, 2B, 3A, 3D	✓	✓		✓		✓	✓	✓
MEGALAIMIDAE – ASIAN BARBETS										
GREAT BARBET †	*Megalaima virens*	1A, 1B, 1C, 2A, 2B	✓	✓	✓	✓	✓	✓	✓	✓
BROWN-HEADED BARBET	*M. zeylanica*	-				✓*				
LINEATED BARBET †	*M. lineata*	1C, 2A, 2B, 3A	✓	✓*		✓	✓		✓	✓*
GOLDEN-THROATED BARBET †	*M. franklinii*	-	✓*	✓*	✓*		✓*			
BLUE-THROATED BARBET †	*M. asiatica*	1A, 1B, 1C, 2A, 2B, 3A	✓	✓	✓	✓	✓	✓	✓	✓
BLUE-EARED BARBET †	*M. australis*	-	✓*		✓*	✓*				✓*
COPPERSMITH BARBET	*M. haemacephala*	3A, 3E	✓			✓*	✓			✓*
BUCEROTIDAE – HORNBILLS										
ORIENTAL PIED HORNBILL †	*Anthracoceros albirostris*	1A, 1B, 1C, 2B, 2C, 3A	✓	✓		✓	✓	✓	✓	✓
GREAT HORNBILL † (!)	*Buceros bicornis*	1A, 1B, 1C, 2A, 3A	✓	✓		✓	✓		✓	✓
BROWN HORNBILL † (!)	*Anorrhinus tickelli*	1C, 3D		✓*			✓			
RUFOUS-NECKED HORNBILL † (!)	*Aceros nipalensis*	1A, 1B	✓*	✓			✓*			
WREATHED HORNBILL † (!)	*A. undulatus*	1A, 1B, 1C	✓	✓			✓*		✓	✓
UPUPIDAE – HOOPOES										
COMMON HOOPOE	*Upupa epops*	2B, 3A	✓	✓*	✓*	✓				✓*
TROGONIDAE – TROGONS										
RED-HEADED TROGON †	*Harpactes erythrocephalus*	1A, 1B, 1C	✓*	✓	✓	✓	✓	✓	✓	✓
CORACIIDAE – ROLLERS										
INDIAN ROLLER	*Coracias benghalensis*	3A, 3D	✓	✓*		✓*		✓	✓	✓*
DOLLARBIRD †	*Eurystomus orientalis*	3A, 3D	✓	✓*				✓	✓	✓*
ALCEDINIDAE – SMALL KINGFISHERS										
BLYTH'S KINGFISHER † (!)	*Alcedo hercules*	1A		✓		✓*				
COMMON KINGFISHER	*A. atthis*	-	✓*	✓*		✓*				✓*
BLUE-EARED KINGFISHER †	*A. meninting*	-	✓*							
ORIENTAL DWARF KINGFISHER † (!)	*Ceyx erithacus*	1A, 1B, 2C		✓*	✓*		✓*		✓	✓*
HALCYONIDAE – LARGE KINGFISHERS										
STORK-BILLED KINGFISHER	*Halycon capensis*	-		✓*						✓*
RUDDY KINGFISHER †	*H. coromanda*	-	✓*	✓*	✓*		✓*			
WHITE-THROATED KINGFISHER	*H. smyrnensis*	3A, 3D	✓	✓*	✓*	✓*		✓	✓	✓*
BLACK-CAPPED KINGFISHER (!)	*H. pileata*	3D						✓		

BIRDS		HABITAT CLASS	NP	NA	MO	BL	BR	PA	NG	DA
CERYLIDAE – PIED KINGFISHER										
CRESTED KINGFISHER	*Megaceryle lugubris*	5	✓	✓	✓*	✓*				
PIED KINGFISHER	*Ceryle rudis*	-	✓*	✓*						
MEROPIDAE – BEE-EATERS										
BLUE-BEARDED BEE-EATER †	*Nyctyornis athertoni*	1B, 1C, 3A	✓	✓		✓*		✓	✓	✓*
GREEN BEE-EATER	*M. orientalis*	-				✓*				
BLUE-TAILED BEE-EATER	*M. philippinus*	-	✓*				✓*			✓*
CHESTNUT-HEADED BEE-EATER †	*M. leschenaulti*	3A	✓			✓*				
CUCULIDAE – OLD WORLD CUCKOOS										
PIED CUCKOO	*Clamator jacobinus*	-				✓*				
CHESTNUT-WINGED CUCKOO	*C. coromandus*	1B		✓*				✓		
LARGE HAWK CUCKOO	*Hierococcyx sparverioides*	-		✓*	✓*		✓*			
COMMON HAWK CUCKOO	*H. varius*	-		✓*		✓*				✓*
EURASIAN CUCKOO (!)	*Cuculus canorus*	1C					✓			✓*
INDIAN CUCKOO †	*C. micropterus*	1B, 2C	✓*			✓*	✓*	✓	✓	✓
LESSER CUCKOO	*C. poliocephalus*	-	✓*							
PLAINTIVE CUCKOO	*Cacomantis merulinus*	-	✓*	✓*						✓*
VIOLET CUCKOO	*Chrysococcyx xanthorhynchus*	1B						✓		✓*
ASIAN EMERALD CUCKOO	*C. maculatus*	-				✓*				
DRONGO CUCKOO	*Surniculus lugubris*	1B, 1C, 3A	✓	✓		✓*		✓	✓	✓*
ASIAN KOEL	*Eudynamys scolopacea*	-		✓*			✓*			
GREEN-BILLED MALKOHA †	*Phaenicophaeus tristis*	1B, 1C, 2B, 3A	✓	✓		✓	✓*	✓	✓	✓*
CENTROPODIDAE – COUCALS										
LESSER COUCAL	*Centropus bengalensis*	-	✓*	✓*		✓*				✓*
GREATER COUCAL	*C. sinensis*	3F		✓*		✓*	✓*		✓	✓*
PSITTACIDAE – PARROTS										
VERNAL HANGING PARROT †	*Loriculus vernalis*	1A, 1C	✓			✓*			✓	✓*
ALEXANDRINE PARAKEET	*Psittacula eupatria*	-	✓*	✓*						
ROSE-RINGED PARAKEET	*P. krameri*	-		✓*						
GREY-HEADED PARAKEET †	*P. finschii*	-			✓*					
BLOSSOM-HEADED PARAKEET †	*P. roseata*	-		✓*						
RED-BREASTED PARAKEET	*P. alexandri*	3A	✓			✓*				
APODIDAE – SWIFTS										
HIMALAYAN SWIFLET †	*Collocalia brevirostris*	5	✓*	✓*	✓	✓*				✓*
SILVER-BACKED NEEDLETAIL †	*Hirundapus cochinchinensis*	-	✓*							✓*
BROWN-BACKED NEEDLETAIL †	*H. giganteus*	-					✓*			✓*

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
ASIAN PALM SWIFT	*Cypsiurus balasiensis*	-	✓*	✓*		✓*				✓*
FORK-TAILED SWIFT	*Apus pacificus*	-	✓*							✓*
HOUSE SWIFT	*A. affinis*	-	✓*							✓*
TYTONIDAE – BARN OWLS AND GRASS OWLS										
ORIENTAL BAY OWL †	*Phodilus badius*	-	✓*	✓*						
STRIGIDAE – OWLS										
MOUNTAIN SCOPS OWL † (!)	*Otus spilocephalus*	2A	✓*	✓*	✓				✓	✓*
ORIENTAL SCOPS OWL †	*O. sunia*	-	✓*	✓*						✓*
COLLARED SCOPS OWL †	*O. bakkamoena*	-	✓*	✓*						✓*
SPOT-BELLIED EAGLE OWL †	*Bubo nipalensis*	-	✓*				✓*			
BROWN FISH OWL †	*Ketupa zeylonensis*	-								✓*
TAWNY OWL	*Strix aluco*	-		✓*	✓*					
COLLARED OWLET †	*G. brodiei*	1A, 1B, 2A	✓*	✓	✓			✓	✓	✓*
ASIAN BARRED OWLET †	*G. cuculoides*	1A, 1B, 1C, 2A, 2C, 3E	✓	✓	✓	✓	✓	✓	✓	✓
JUNGLE OWLET †	*G. radiatum*	-		✓*						✓*
SPOTTED OWLET	*Athene brama*	-	✓*		✓*					
BROWN HAWK OWL †	*Ninox scutulata*	-	✓*	✓*						✓*
EUROSTOPODIDAE – EARED NIGHTJARS										
GREAT EARED NIGHTJAR †	*Eurostopodus macrotis*	1B, 2C		✓*				✓	✓	✓*
CAPRIMULGIDAE – NIGHTJARS										
GREY NIGHTJAR	*Caprimulgus indicus*	-		✓*						✓*
LARGE-TAILED NIGHTJAR †	*C. macrurus*	1A, 1B, 2B	✓*		✓*	✓		✓	✓	✓*
COLUMBIDAE – PIGEONS AND DOVES										
ROCK PIGEON	*Columba livia*	-		✓*						
SPECKLED WOOD PIGEON	*C. hodgsonii*	-			✓*					
ASHY WOOD PIGEON † (!)	*C. pulchricollis*	1A, 3A		✓			✓			
GREEN IMPERIAL PIGEON †	*Ducula aenea*	3A	✓							
MOUNTAIN IMPERIAL PIGEON †	*D. badia*	1A, 1B, 1C, 3A	✓	✓	✓*		✓	✓	✓	✓
ORIENTAL TURTLE DOVE	*Streptopelia orientalis*	1C, 2B, 3A, 3F	✓	✓*	✓	✓	✓*			✓*
RED COLARED DOVE	*S. tranquebarica*	-				✓*				
SPOTTED DOVE	*S. chinensis*	3A, 3D, 3E	✓	✓		✓*	✓*	✓	✓	✓*
BARRED CUCKOO DOVE †	*Macropygia unchall*	-	✓*	✓*						✓*
EMERALD DOVE †	*Chalcophaps indica*	1B, 1C, 2B, 3A, 3B	✓	✓*		✓	✓	✓	✓	✓
PAMPADOUR GREEN PIGEON †	*Treron pompadora*	1C, 3A	✓	✓*	✓		✓*	✓		✓*
THICK-BILLED GREEN PIGEON †	*T. curvirostra*	1C, 3A	✓*			✓*	✓*			✓*
PIN-TAILED GREEN PIGEON †	*T. apicauda*	1A, 1B, 1C, 2B, 3A	✓	✓	✓	✓	✓*		✓	✓*

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
WEDGE-TAILED GREEN PIGEON †	*T. sphenura*	2B	✓*	✓*	✓*	✓	✓*			✓*
RALLIDAE – RAILS, GALLINULES AND COOTS										
RED-LEGGED CRAKE †	*Rallina fasciata*	-					✓*			
SLATY-BREASTED RAIL	*Gallirallus striatus*	-					✓*			
PURPLE SWAMPHEN	*Porphyrio porphyrio*	-	✓*							
WATERCOCK	*G. cinerea*	-					✓*			
COMMON MOORHEN	*G. chloropus*	5		✓*				✓		✓*
WHITE-BREASTED WATERHEN	*Amaurornis phoenicurus*	-	✓*			✓*	✓*			✓*
BLACK-TAILED CRAKE	*Porzana bicolor*	-	✓*							
SCOLOPACIDAE – WOODCOCKS AND SNIPES										
EURASIAN WOODCOCK	*Scolopax rusticola*	-					✓*			
PINTAIL SNIPE	*Gallinago stenura*	-		✓*						
COMMON SNIPE	*G. gallinago*	-		✓*						
BLACK-TAILED GODWIT	*Limosa limosa*	-	✓*							
COMMON GREENSHANK	*Tringa nebularia*	-	✓*	✓*						
GREEN SANDPIPER	*T. ochropus*	-	✓*	✓*						
COMMON SANDPIPER	*Actitis hypoleucos*	-	✓*	✓*						
TEMMINCK'S STINT	*Calidris temminckii*	-		✓*						
ROSTRATULIDAE - PAINTED-SNIPES										
GREATER PAINTED-SNIPE	*Rostratula benghalensis*	-		✓*						
BURHINIDAE - THICK-KNEES										
EURASIAN THICK-KNEE	*Burhinus oedicnemus*	-	✓*							
CHARADRIIDAE- OYSTERCATCHERS, AVOCETS AND STILTS										
IBISBILL	*Ibidoryhncha struthersii*	-	✓*	✓*						
PACIFIC GOLDEN PLOVER	*Pluvialis apricaria*	-		✓*						
LITTLE RINGED PLOVER	*Charadrius dubius*	-	✓*	✓*						
NORTHERN LAPWING	*Vanellus vanellus*	-		✓*	✓*					
RIVER LAPWING	*V. duvaucelii*	5	✓*	✓						
RED-WATTLED LAPWING	*V. indicus*	5	✓	✓*						
GLAREOLIDAE – PRANTICOLES AND COURSERS										
SMALL PRANTICOLE	*Glareola lactea*	-	✓*	✓*						
LARIDAE – SKUAS, JAEGERS, SKIMMERS, GULLS AND TERNS										
PALLAS'S GULL	*Larus ichthyaetus*	-		✓*	✓*					
BROWN HEADED GULL	*L. brunnicephalus*	-	✓*							
LITTLE GULL	*L. minutus*	-			✓*					
RIVER TERN	*Sterna aurantia*	-	✓*							

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
ACCIPITRIDAE – OSPREY, HAWKS, EAGLES, HARRIERS AND VULTURES										
OSPREY	*Pandion haliaetus*	-	✓*	✓*						
JERDON'S BAZA †	*Aviceda jerdoni*	-	✓*				✓*			✓*
BLACK BAZA †	*A. leuphotes*	1B, 2B, 5		✓		✓	✓*		✓	✓*
BLACK-SHOULDERED KITE	*Elanus caeruleus*	-		✓*		✓*				
PALLAS'S FISH EAGLE (!)	*Haliaeetus leucoryphus*	5	✓							
WHITE-TAILED EAGLE	*H. albicilla*	5		✓*						
LESSER FISH EAGLE	*Ichthyophaga humilis*	-		✓*						
WHITE-RUMPED VULTURE	*Gyps bengalensis*	-	✓*							
SHORT-TOED SNAKE EAGLE	*Circaetus gallicus*	-	✓*	✓*		✓*				
CRESTED SERPENT EAGLE †	*Spilornis cheela*	2A, 2B, 2C, 3D, 3F, 5	✓	✓	✓	✓	✓	✓	✓	✓
BLACK EAGLE †	*Ictinaetus malayensis*	1A, 2A, 3A, 5	✓*	✓*	✓	✓*	✓*		✓	
EURASIAN MARSH HARRIER	*Circus aeruginosus*	-		✓*						
PIED HARRIER	*C. melanoleucos*	-	✓*	✓*	✓*					
HEN HARRIER	*Circuc cyaneus*	5	✓*			✓				
CRESTED GOSHAWK †	*Accipiter trivirgatus*	-		✓*						
SHIKRA	*A. badius*	-	✓*	✓*	✓*					✓*
EURASIAN SPARROWHAWK	*A. nisus*	-	✓*	✓*	✓*	✓*				
BESRA †	*A. virgatus*	-		✓*						✓*
NORTHERN GOSHAWK	*A. gentilis*	-		✓*						
ORIENTAL HONEY BUZZARD †	*Pernis ptiloryhncus*	-	✓*		✓*					✓*
WHITE-EYED BUZZARD	*Butastur teesa*	-		✓*						
COMMON BUZZARD	*Buteo buteo*	-			✓*					
LONG-LEGGED BUZZARD	*B. rufinus*	-		✓*						
BONELLI'S EAGLE	*Hieraaetus fasciatus*	-		✓*		✓*				
BOOTED EAGLE	*H. pennatus*	-		✓*						
RUFOUS-BELLIED EAGLE †	*H. kienerii*	-		✓*						✓*
CHANGEABLE HAWK EAGLE †	*Spizaetus cirrhatus*	-	✓	✓		✓*				
MOUNTAIN HAWK EAGLE †	*S. nipalensis*	-	✓*	✓*	✓*					
FALCONIDAE – FALCONS										
PIED FALCONET †	*Microhierax melanoleucos*	3A, 3B, 4	✓	✓*	✓*		✓		✓	✓*
LESSER KESTREL	*Falco naumanni*	-				✓*				
COMMON KESTREL	*F. tinnunculus*	3A, 3D, 5	✓	✓*	✓*	✓	✓			✓*
AMUR FALCON (!)	*F. amurensis*	5	✓	✓*						
EURASIAN HOBBY	*F. subbuteo*	-		✓*						
ORIENTAL HOBBY	*F. severus*	-		✓*		✓*	✓*			✓*
PEREGRINE FALCON	*F. peregrinus*	-		✓*						✓*

BIRDS		HABITAT CLASS	NP	NA	MO	BL	BR	PA	NG	DA
ANHINGIDAE – ANHINGAS										
DARTER	*Anhinga melanogaster*	**5**	✓*			✓*		✓		
PHALACROCORACIDAE – CORMORANTS										
GREAT CORMORANT (!)	*Phalacrocorax carbo*	5	✓	✓	✓*					
ARDEIDAE – HERONS AND BITTERNS										
LITTLE EGRET	*Egretta garzetta*	-	✓*	✓*		✓*		✓		
INDIAN POND HERON	*Ardeola grayii*	-	✓*	✓*		✓*	✓*			
CHINESE POND HERON	*A. bacchus*	-					✓*			
WHITE-BELLIED HERON	*Ardea insignis*	-		✓*						
LITTLE HERON	*Butorides striatus*	5	✓*	✓						✓*
MALAYAN NIGHT HERON † (!)	*Gorsachius melanolophus*	1A, 1B, 2C							✓	✓
CINNAMON BITTERN	*Ixobrychus cinnamomeus*	-					✓*			
THRESKIORNITHIDAE – IBISES AND SPOONBILLS										
BLACK-HEADED IBIS	*Threskiornis melanocehpalus*	-	✓*							
CICONIIDAE- STORKS										
BLACK STORK (!)	*Ciconia nigra*	3F	✓*	✓						
LESSER ADJUTANT (!)	*Leptoptilos javanicus*	3A, 3F, 5	✓							
PITTIDAE – PITTAS										
BLUE-NAPED PITTA † (!)	*Pitta nipalensis*	1A	✓*	✓*					✓	
BLUE PITTA †	*P. cyanea*	-								✓*
HOODED PITTA † (!)	*P. sordida*	1A, 1B	✓*				✓*	✓		
EURYLAIMIDAE – BROADBILLS										
SILVER-BREASTED BROADBILL †	*Serilophus lunatus*	1A, 1B, 1C, 2A	✓	✓	✓			✓	✓	✓*
LONG-TAILED BROADBILL †	*Psarisomus dalhousiae*	1A, 1B, 2A, 2C, 3A	✓	✓	✓	✓	✓	✓	✓	✓
IRENIDAE – FAIRY BLUEBIRDS AND LEAFBIRDS										
ASIAN FAIRY BLUEBIRD †	*Irena puella*	1A, 1B, 1C, 3A	✓	✓*	✓*	✓		✓	✓	✓
BLUE-WINGED LEAFBIRD †	*Chloropsis cochinchinensis*	1A, 1C, 2C, 2D, 4	✓	✓*		✓	✓		✓	✓
GOLDEN-FRONTED LEAFBIRD †	*C. aurifrons*	1A, 1C, 2B, 3A, 3D	✓	✓		✓	✓	✓	✓	✓
ORANGE-BELLIED LEAFBIRD †	*C. hardwickii*	1A, 1B, 2A, 2D, 3A	✓*	✓	✓	✓*	✓*	✓		✓
LANIIDAE – SHRIKES										
BROWN SHRIKE	*Lanius cristatus*	-	✓*	✓*	✓*	✓*				✓*
LONG-TAILED SHRIKE	*L. schach*	3	✓*	✓*		✓*			✓	
GREY-BACKED SHRIKE	*L. tephoronotus*	3A	✓	✓*	✓*	✓*	✓*	✓		✓*
CORVIDAE										
RED-BILLED BLUE MAGPIE †	*Urocissa flavirostris*	-			✓*					
COMMON GREEN MAGPIE †	*Cissa chinensis*	1A, 1B, 2B, 3A	✓*	✓	✓	✓			✓	✓*

BIRDS		HABITAT CLASS	NP	NA	MO	BL	BR	PA	NG	DA
RUFOUS TREEPIE	*Dendrocitta vagabunda*	1C	✓			✓*				
GREY TREEPIE †	*D. formosae*	1A, 1B, 1C, 2A	✓	✓	✓	✓*	✓*			✓*
COLLARED TREEPIE †	*D. frontalis*	1B, 3A	✓*	✓						
LARGE-BILLED CROW	*Corvus macrorhynchos*	3	✓*	✓*	✓	✓			✓	✓*
GOLDEN ORIOLE	*Oriolus oriolus*	-				✓*				
BLACK-NAPED ORIOLE	*O. chinensis*	-				✓*				
SLENDER-BILLED ORIOLE	*O. tenuirostris*	-					✓*			
BLACK-HOODED ORIOLE	*O. xanthornus*	3A, 3B, 3C	✓	✓		✓*	✓	✓	✓	✓*
MAROON ORIOLE †	*O. traillii*	1A, 1B, 1C, 2A, 2B, 3A	✓	✓	✓	✓	✓*		✓	✓
LARGE CUCKOOSHRIKE	*Coracina macei*	2B, 3A	✓	✓*	✓*	✓	✓*			✓*
BLACK-WINGED CUCKOOSHRIKE †	*C. melaschistos*	1B, 1C, 3A	✓	✓		✓*	✓*			✓*
ROSY MINIVET †	*Pericrocotus roseus*	2B				✓				
SMALL MINIVET †	*P. cinnamomeus*	-				✓*				
GREY-CHINNED MINIVET †	*P. solaris*	1A, 1B, 2A	✓*	✓	✓					
LONG-TAILED MINIVET †	*P. ethologus*	1B, 1C, 2A, 3A	✓		✓	✓*			✓	
SHORT-BILLED MINIVET †	*P. brevirostris*	1B, 1C, 2A, 2B	✓	✓	✓	✓	✓*			✓*
SCARLET MINIVET †	*P. flammeus*	1A, 1B, 1C, 2A, 2D, 3D, 4	✓	✓	✓	✓*	✓	✓	✓	✓
BAR-WINGED FLYCATCHER-SHRIKE †	*Hemipus picatus*	2A, 2B, 3A		✓*	✓	✓		✓	✓	✓*
YELLOW-BELLIED FANTAIL †	*Rhipidura hypoxantha*	1A, 1B, 2A, 3A	✓	✓	✓					✓*
WHITE-THROATED FANTAIL †	*R. albicollis*	1A, 1B, 1C, 2A, 3A	✓	✓	✓	✓*	✓*		✓	✓*
BLACK DRONGO	*Dicrurus macrocercus*	2A, 3A	✓	✓	✓	✓*		✓	✓	
ASHY DRONGO †	*D. leucophaeus*	1A, 1C, 2B, 2D	✓	✓*	✓	✓	✓			✓*
CROW-BILLED DRONGO †	*D. annectans*	1B							✓	✓*
BRONZED DRONGO †	*D. aeneus*	1A, 1B, 1C	✓	✓	✓*	✓*	✓*		✓	✓*
LESSER RACKET-TAILED DRONGO †	*D. remifer*	1A, 1B, 1C, 2A, 2D, 3A	✓	✓	✓	✓	✓		✓	✓*
SPANGLED DRONGO †	*D. hottentottus*	1B, 1C, 2B, 2D, 3A	✓	✓*	✓*	✓	✓	✓	✓	✓*
GREATER RACKET-TAILED DRONGO †	*D. paradiseus*	1A, 1B, 1C, 2B, 3A, 4	✓	✓		✓	✓*	✓	✓	✓
BLACK-NAPED MONARCH †	*Hypothymis azurea*	1A, 1C, 2B, 2D, 3A	✓*			✓	✓	✓		✓
ASIAN PARADISE-FLYCATHER †	*Terpsiphone paradisi*	1A, 1B, 2D	✓*	✓*	✓*	✓	✓*	✓	✓*	✓
COMMON IORA †	*Aegithina tiphia*	1C, 2B, 3A	✓	✓*	✓*	✓				✓*
COMMON WOODSHRIKE	*Tephorodornis pondicerianus*	-	✓*	✓*						
LARGE WOODSHRIKE †	*T. gularis*	1A, 1B, 1C, 2A	✓	✓	✓*	✓				✓*
CINCLIDAE – DIPPERS										
BROWN DIPPER	*Cinclus pallasii*	5	✓*	✓	✓					
MUSCICAPIDAE – THRUSHES, SHORTWINGS, OLD WORLD FLYCATCHERS AND CHATS										
BLUE-CAPPED ROCK THRUSH	*Monticola cinclorhynchus*	-			✓*					
CHESTNUT-BELLIED ROCK THRUSH	*M. rufiventris*	2A, 3A		✓*	✓		✓*			

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
BLUE ROCK THRUSH	*M. solitarius*	-	✓*	✓*		✓*				✓*
BLUE WHISTLING THRUSH †	*Myoiphonus caeruleus*	1A, 1B, 1C, 3E	✓	✓	✓*	✓	✓		✓	✓
ORANGE-HEADED THRUSH †	*Zoothera citrina*	1A	✓*		✓*	✓	✓*			✓*
PLAIN-BACKED THRUSH †	*Z. molissima*	-		✓*						
LONG-TAILED THRUSH † (!)	*Z. dixoni*	1A		✓*	✓		✓*			
SCALY THRUSH †	*Z. dauma*	-		✓*			✓*			✓*
LONG-BILLED THRUSH †	*Z. monticola*	-				✓*	✓*			
DARK-SIDED THRUSH †	*Z. marginata*	-		✓*						✓*
BLACK-BREASTED THRUSH †	*Turdus dissimilis*	-		✓*			✓*			
WHITE-COLLARED BLACKBIRD †	*T. albocinctus*	1A				✓				
EURASIAN BLACKBIRD	*T. merula*	-					✓*			
GREY-WINGED BLACKBIRD †	*T. boulboul*	-	✓*	✓*						
EYEBROWED THRUSH	*T. obscurus*	-					✓*			
CHESTNUT THRUSH	*T. rubrocanus*	-		✓*						✓*
DARK-THROATED THRUSH	*T. ruficollis*	-		✓*						
GOULD'S SHORTWING † (!)	*Brachypteryx stellata*	2B			✓					
RUSTY-BELLIED SHORTWING †	*B. hyperythra*	-		✓*			✓*			
LESSER SHORTWING †	*B. leucophrys*	-	✓*	✓*						
WHITE-BROWED SHORTWING † (!)	*B. montana*	1A	✓*	✓*		✓	✓*			
DARK-SIDED FLYCATCHER	*Muscicapa sibirica*	-			✓*					
ASIAN BROWN FLYCATCHER (!)	*M. dauurica*	3A	✓*				✓			
BROWN-BREASTED FLYCATCHER †	*M. muttui*	-								✓*
FERRUGINOUS FLYCATCHER	*M. ferruginea*	-	✓*							
RUFOUS-GORGETED FLYCATCHER †	*Ficedula strophiata*	1A, 1B, 2A	✓*	✓	✓		✓*			✓*
RED-THROATED FLYCATCHER	*F. parva*	3A, 3E, 4	✓	✓*		✓*	✓		✓	✓*
WHITE-GORGETED FLYCATCHER	*F. monileger*	-					✓*			
SNOWY-BROWED FLYCATCHER †	*F. hyperythra*	1B, 1C	✓	✓*	✓*		✓*			✓*
LITTLE PIED FLYCATCHER †	*F. westermanni*	1C	✓	✓*	✓*	✓*				✓*
ULTRAMARINE FLYCATCHER	*F. superciliaris*	-		✓*						
SLATY-BLUE FLYCATCHER	*F. tricolor*	-	✓*	✓*						
SAPPHIRE FLYCATCHER †	*F. sapphira*	-		✓*			✓*			
VERDITER FLYCATCHER	*Eumyias thalassina*	2B	✓*		✓*	✓				✓*
LARGE NILTAVA †	*Niltava grandis*	-	✓*	✓*	✓*		✓*			
SMALL NILTAVA †	*N. macgrigoriae*	1B	✓*	✓	✓*		✓*			
RUFOUS-BELLIED NILTAVA †	*N. sundara*	1A, 1B, 1C	✓	✓			✓			✓*
WHITE-TAILED FLYCATCHER †	*Cyornis concretus*	-					✓*			✓*
PALE-CHINNED FLYCATCHER †	*C. poliogenys*	2A, 2B, 2D	✓*			✓	✓	✓		✓

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
PALE BLUE FLYCATCHER †	*C. unicolor*	1C	✓	✓*						
BLUE-THROATED FLYCATCHER	*C. rubeculoides*	1A, 2D				✓*				✓
HILL BLUE FLYCATCHER	*C. banyumas*	-			✓*					
TICKELL'S BLUE FLYCATCHER	*C. tickelliae*	-	✓*	✓*						
PYGMY BLUE FLYCATCHER †	*Muscicapella hodgsoni*	1B, 1C, 2A	✓	✓	✓	✓*	✓*			
GREY-HEADED CANARY FLYCATCHER †	*Culicicapa ceylonensis*	1B, 1C, 2A1A, 1B, 1C, 2A, 2C, 3A	✓	✓	✓*	✓*	✓		✓	✓
SIBERIAN RUBYTHROAT	*L. calliope*	-								✓*
WHITE-TAILED RUBYTHROAT	*L. pectoralis*	-	✓*	✓*	✓*		✓*			
INDIAN BLUE ROBIN †	*L. brunnea*	1A								✓*
ORANGE-FLANKED BUSH ROBIN †	*Tarsiger cyanurus*	-	✓*	✓*			✓*			
RUFOUS-BREASTED BUSH ROBIN	*T. hyperythrus*	-	✓*	✓*						
ORIENTAL MAGPIE ROBIN	*Copsychus saularis*	2B, 3A	✓	✓*	✓*	✓	✓*		✓	✓*
WHITE-RUMPED SHAMA †	*C. malabaricus*	1B, 1C, 2C	✓			✓*		✓		✓
BLACK REDSTART	*Phoenicurus ochruros*	-	✓*		✓*	✓*				✓*
HODGSON'S REDSTART	*P. hodgsoni*	-	✓*	✓*						
DAURIAN REDSTART	*P. auroreus*	3A, 3E	✓	✓*	✓					✓*
BLUE-FRONTED REDSTART	*P. frontalis*	-	✓*							
WHITE-WINGED REDSTART	*P. erythrogaster*	-	✓*							
WHITE-CAPPED WATER REDSTART	*Chaimarrornis leucocephalus*	5	✓	✓	✓	✓	✓		✓	✓*
PLUMBEOUS WATER REDSTART	*Rhyacornis fuliginosus*	5	✓	✓	✓	✓*				✓*
WHITE-TAILED ROBIN †	*Myiomela leucura*	-	✓*	✓*						✓*
BLUE-FRONTED ROBIN †	*Cinclidium frontale*	-		✓*						
LITTLE FORKTAIL †	*Enicurus scouleri*	1B	✓*	✓	✓*	✓*				
BLACK-BACKED FORKTAIL †	*E. immaculatus*	1A, 1B, 1C, 2C, 3D	✓	✓*		✓	✓	✓	✓	✓*
SLATY-BACKED FORKTAIL †	*E. schistaceus*	1B, 1C, 2A, 2C, 3E	✓	✓	✓		✓			✓
WHITE-CROWNED FORKTAIL †	*E. leschenaulti*	1A, 1B	✓*	✓		✓*			✓	✓*
SPOTTED FORKTAIL †	*E. maculatus*	1A, 1B		✓	✓		✓*			✓
PURPLE COCHOA † (!)	*Cochoa purpurea*	1A		✓			✓*			
GREEN COCHOA †	*C. viridis*	-	✓*	✓*			✓*			
COMMON STONECHAT	*Saxicola torquata*	3F	✓	✓*	✓*	✓*				✓*
JERDON'S BUSHCHAT	*S. jerdoni*	-		✓*						
GREY BUSHCHAT	*S. ferrea*	4	✓*	✓*	✓	✓*	✓*			✓*
ISABELLINE WHEATEAR	*Oenanthe isabellina*	-			✓*					
STURNIDAE – STARLINGS AND MYNAS										
CHESTNUT-TAILED STARLING	*Sturnus malabaricus*	3A, 3E	✓	✓*		✓*	✓		✓	✓*
BRAHMINY STARLING	*S. pagodarum*	-				✓*				
ASIAN PIED STARLING	*S .contra*	-	✓*			✓*				

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
COMMON MYNA	*Acridotheres tristis*	3E	✓*	✓*		✓*	✓			
JUNGLE MYNA	*A. fuscus*	-	✓*	✓*		✓*				
HILL MYNA †	*Gracula religiosa*	1A, 1B, 1C, 2B, 3A, 3E	✓	✓	✓*	✓	✓	✓	✓	✓*
SITTIDAE – NUTHATCHES AND WALLCREEPER										
CHESTNUT-BELLIED NUTHATCH †	*Sitta castanea*	1B, 1C, 2C	✓	✓	✓					✓
VELVET-FRONTED NUTHATCH †	*S. frontalis*	1C, 2C, 3A	✓	✓*		✓*				✓
BEAUTIFUL NUTHATCH† (!)	*S. formosa*	1A		✓*	✓		✓*			
CERTHIIDAE – NORTHERN CREEPERS AND WRENS										
WINTER WREN	*Troglodytes troglodytes*	-			✓*					
PARIDAE – PENDULINE TITS AND TITS										
GREY-CRESTED TIT	*Parus dichorous*	-			✓*					
GREAT TIT	*P. major*	3A	✓*	✓*	✓					
GREEN-BACKED TIT †	*P. monticolus*	1A, 2A		✓*	✓					
YELLOW-CHEEKED TIT	*P. spilonotus*	2A, 3A	✓*	✓*	✓					
YELLOW-BROWED TIT	*Sylviparus modestus*	1A		✓*	✓					
SULTAN TIT †	*Melanochlora sultanea*	1A, 1B, 1C, 2A, 3A	✓	✓	✓	✓*	✓		✓	✓*
AEGITHALIDAE – LONG-TAILED TITS										
BLACK-THROATED TIT	*Aegithalos concinnus*	1A, 2A	✓*		✓					
HIRUNDINIDAE – SWALLOWS AND MARTINS										
PLAIN MARTIN	*Riparia paludicola*	-		✓*	✓*					
BARN SWALLOW	*Hirundo rustica*	5	✓*	✓*		✓	✓*			
RED-RUMPED SWALLOW	*H. daurica*	-		✓*			✓*			✓*
STRAITED SWALLOW	*H. striolata*	-					✓*			
ASIAN HOUSE MARTIN	*Delichon dasypus*	5	✓*		✓*					✓*
NEPAL HOUSE MARTIN	*D. nipalensis*	5		✓*	✓					
PYCNONOTIDAE – BULBULS										
CRESTED FINCHBILL	*Spizixos canifrons*	-				✓*				
STRIATED BULBUL †	*Pycnonotus striatus*	-		✓*	✓*		✓*			
BLACK-CRESTED BULBUL †	*P. melanicterus*	1C, 2A, 2C, 2D, 3A	✓	✓*		✓	✓		✓	✓
RED-WHISKERED BULBUL	*P. jocosus*	2B, 3	✓	✓	✓	✓			✓	✓*
HIMALAYAN BULBUL	*P. leucogenys*	-	✓*		✓*					
RED-VENTED BULBUL	*P. cafer*	3	✓	✓	✓	✓	✓*		✓	
WHITE-THROATED BULBUL †	*Alophoixus flaveolus*	1A, 1B, 1C, 2A, 2B, 2C	✓	✓	✓	✓	✓	✓	✓	✓
OLIVE BULBUL †	*Iole virescens*	-				✓*				✓*
ASHY BULBUL †	*Hemixos flavala*	1A, 1B, 1C, 2B	✓*	✓	✓	✓	✓			✓
MOUNTAIN BULBUL †	*Hypsipetes mcclellandii*	2A	✓*	✓*	✓	✓*	✓*			

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
BLACK BULBUL †	*H. leucocephalus*	1A, 1B, 2A, 2B	✓*	✓*	✓	✓*	✓*			✓
CISTICOLIDAE – AFRICAN WARBLERS										
HILL PRINIA	*Prinia atrogularis*	-		✓*	✓*					
RUFESCENT PRINIA	*P. rufescens*	3B, 3E			✓		✓*			✓*
GREY-BREASTED PRINIA	*P. hodgsonii*	3B, 3E			✓	✓*				✓*
YELLOW-BELLIED PRINIA	*P. flaviventris*	-		✓*	✓*					✓*
ASHY PRINIA	*P. socialis*	-				✓*				
PLAIN PRINIA	*P. inornata*	-				✓*				
ZOSTEROPIDAE – WHITE-EYES										
ORIENTAL WHITE-EYE †	*Zosterops palpebrosus*	1C	✓		✓*		✓*		✓	✓*
SYLVIIDAE – WARBLERS, GRASSBIRDS, LAUGHINGTHRUSHES AND BABBLERS										
CHESTNUT-HEADED TESIA †	*Tesia castaneocoronata*	1A, 1B, 2A	✓*	✓	✓					
SLATY-BELLIED TESIA †	*T. olivea*	1A, 1B, 1C, 2A, 2C	✓	✓	✓	✓	✓*		✓	✓
GREY-BELLIED TESIA †	*T. cyaniventer*	1A, 1B, 1C, 2A		✓	✓		✓*			✓*
JAPANESE BUSH WARBLER	*Cettia diphone*	-			✓*					
BROWNISH-FLANKED BUSH WARBLER	*C. fortipes*	3B, 3E			✓					
BROWN BUSH WARBLER	*Bradypterus luteoventris*	-			✓*					
RUSSET BUSH WARBLER	*B. seebohmi*	-			✓*					
BLYTH'S REED WARBLER	*Acrocephalus dumetorum*	-				✓*				✓*
THICK-BILLED WARBLER	*A. aedon*	-			✓*					
STRIATED GRASSBIRD	*Megalurus palustris*	-		✓*						
MOUNTAIN TAILORBIRD †	*Orthotomus cuculatus*	-		✓*	✓*		✓*			
COMMON TAILORBIRD	*O. sutorius*	2D, 3A, 3E, 4	✓*	✓*	✓		✓	✓		✓*
DARK-NECKED TAILORBIRD †	*O. atrogularis*	-				✓*	✓*			✓*
DUSKY WARBLER	*Phylloscopus fuscatus*	-			✓*					
TICKELL'S LEAF WARBLER	*P. affinis*	-	✓*							
BUFF-BARRED WARBLER †	*P. pulcher*	-					✓*			
ASHY-THROATED WARBLER †	*P. maculipennis*	1A, 1B, 2A, 2B		✓	✓		✓*			
LEMON-RUMPED WARBLER †	*P. chloronotus*	1B, 1C, 2A		✓*	✓					
YELLOW-BROWED WARBLER	*P. inornatus*	-	✓*	✓*		✓*	✓*			✓*
GREENISH WARBLER	*P. trochiloides*	-	✓*			✓*				✓*
LARGE-BILLED LEAF WARBLER	*P. magnirostris*	-		✓*		✓*				
EASTERN CROWNED WARBLER	*P. coronatus*	-				✓*				✓*
BLYTH'S LEAF WARBLER †	*P. reguloides*	-	✓*	✓*			✓*			✓*
YELLOW-VENTED WARBLER † (!)	*P. cantator*	1A, 1B, 1C, 2A	✓	✓	✓*	✓	✓		✓*	✓*
GOLDEN-SPECTACLED WARBLER †	*Seicercus burkii*	1C, 2B, 2D	✓	✓*	✓*	✓	✓*			✓*
GREY-HOODED WARBLER †	*S. xanthoschistos*	1A, 1B, 2A, 2B	✓*	✓	✓	✓*	✓*			

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
WHITE-SPECTACLED WARBLER †	*S. affinis*	1A, 1B, 1C, 2A	✓	✓	✓	✓*	✓*			
GREY-CHEEKED WARBLER †	*S. poliogenys*	1B, 1C, 2A	✓	✓	✓		✓*			
CHESTNUT-CROWNED WARBLER †	*S. castaniceps*	1A, 1C, 2A	✓	✓	✓		✓*			
BROAD-BILLED WARBLER †	*Tickellia hodgsoni*	-	✓*	✓*						
RUFOUS-FACED WARBLER †	*Abroscopus albogularis*	1A, 1B, 2C		✓	✓		✓*			✓*
BLACK-FACED WARBLER †	*A. schisticeps*	1A			✓					✓*
YELLOW-BELLIED WARBLER †	*A. superciliaris*	2C, 2D	✓*	✓*			✓	✓	✓	✓
WHITE-CRESTED LAUGHINGTHRUSH †	*Garrulax leucolophus*	1A, 1B, 2A, 2B	✓*	✓	✓	✓*	✓*	✓	✓	✓
LESSER NECKLACED LAUGHINGTHRUSH †	*G. monileger*	1A, 1B, 1C, 2A, 2B, 3A	✓	✓	✓	✓	✓	✓	✓	✓*
GREATER NECKLACED LAUGHINGTHRUSH †	*G. pectoralis*	1A, 1B, 1C, 2A, 2B, 2C, 3A	✓	✓	✓	✓	✓		✓	✓
RUFOUS- NECKED LAUGHINGTHRUSH	*G. ruficollis*	2A, 3A		✓	✓					
RUFOUS-VENTED LAUGHINGTHRUSH †	*G. gularis*	-		✓*			✓*			
STRIATED LAUGHINGTHRUSH †	*G. striatus*	1A	✓*		✓					
YELLOW-THROATED LAUGHINGTHRUSH	*G. galbanus*	-		✓*						
RUFOUS-CHINNED LAUGHINGTHRUSH †	*G. rufogularis*	-		✓*			✓*			
SPOT-BREASTED LAUGHINGTHRUSH †	*G. merulinus*	-					✓*			
GREY-SIDED LAUGHINGTHRUSH	*G. caerulatus*	-							✓*	
BLUE-WINGED LAUGHINGTHRUSH †	*G.squamatus*	2A		✓*	✓					
RED-FACED LIOCICHLA †	*Liocichla phoenicea*	-	✓*	✓*	✓*		✓*			
ABBOTT'S BABBLER †	*Malacocincla abbotti*	1B, 1C, 3C	✓			✓		✓	✓	
BUFF-BREASTED BABBLER †	*Pellorneum tickelli*	-	✓*	✓*						✓*
SPOT-THROATED BABBLER	*P. albiventre*	1B, 1C	✓					✓		
MARSH BABBLER	*P. palustre*	-	✓*							
PUFF-THROATED BABBLER †	*P. ruficeps*	1C, 2D, 3B	✓	✓*		✓*	✓	✓		✓
LARGE SCIMITAR BABBLER † (!)	*Pomatorhinus hypoleucos*	2C		✓*	✓*				✓	✓*
SPOT-BREASTED SCIMITAR BABBLER † (!)	*P. erythrocnemis*	1A, 1B, 1C						✓	✓	
WHITE-BROWED SCIMITAR BABBLER †	*P. schisticeps*	1A, 2A		✓*	✓	✓				✓*
STREAK-BREASTED SCIMITAR BABBLER †	*P. ruficollis*	2D	✓*				✓			
RED-BILLED SCIMITAR BABBLER †	*P. ochraceiceps*	1B		✓	✓*		✓*			
CORAL-BILLED SCIMITAR BABBLER †	*P. ferruginosus*	1B		✓	✓*		✓*			
SLENDER-BILLED SCIMITAR BABBLER †	*Xiphirhynchus superciliaris*	-		✓*			✓*			
LONG-BILLED WREN BABBLER	*Rimator malacoptilus*	-					✓*			
STREAKED WREN BABBLER †	*Napothera brevicaudata*	-		✓*	✓*		✓*			✓*
EYEBROWED WREN BABBLER †	*N. epilepidota*	-		✓*						✓*
SCALY-BREASTED WREN BABBLER †	*Pnoepyga albiventer*	1C, 2A	✓*		✓					✓*
PYGMY WREN BABBLER †	*P. pusilla*	1A, 1B, 2A	✓*	✓	✓					✓*
RUFOUS-THROATED WREN BABBLER	*Spelaeornis caudatus*	-			✓*					

BIRDS		HABITAT CLASS	NP	NA	MO	BL	BR	PA	NG	DA
BAR-WINGED WREN BABBLER	*S. troglodytoides*	-		✓*						
SPOTTED WREN BABBLER † (!)	*S. formosus*	1A		✓			✓*			
WEDGE-BILLED WREN BABBLER †	*S. humei*	-		✓*	✓*		✓*			
RUFOUS-FRONTED BABBLER	*Stachyris rufifrons*	2D	✓*	✓*		✓*		✓		✓*
RUFOUS-CAPPED BABBLER †	*S. ruficeps*	1C, 2D	✓							✓
GOLDEN BABBLER †	*S. chrysaea*	1C, 2A	✓	✓*	✓		✓*			
GREY-THROATED BABBLER †	*Stachyris nigriceps*	1B, 1C, 2A, 2B, 2C, 3A	✓*	✓*	✓		✓	✓		✓
SNOWY-THROATED BABBLER †	*S. oglei*	-		✓*						
STRIPED TIT BABBLER †	*Macronous gularis*	1B, 1C, 2B, 2C, 2D, 3A	✓	✓		✓	✓	✓		✓
STRIATED BABBLER	*Turdoides earlei*	-		✓*						
JUNGLE BABBLER	*T. striatus*	-				✓*				
CHESTNUT-CAPPED BABBLER	*Timalia pileata*	3F				✓*			✓	
SILVER-EARED MESIA †	*Leiothrix argentauris*	1A, 1B, 2A, 2B, 3A	✓	✓	✓		✓*			
RED-BILLED LEIOTHRIX †	*L. lutea*	1A		✓						
CUTIA †	*Cutia nipalensis*	2A			✓					
WHITE-BROWED SHRIKE BABBLER †	*Pteruthius flaviscapis*	1A, 2A		✓*	✓		✓*			
GREEN SHRIKE BABBLER	*P. xanthochlorus*	-		✓*						
BLACK-EARED SHRIKE BABBLER †	*P. melanotis*	1A, 1B		✓	✓		✓*			
WHITE-HOODED BABBLER †	*Gampsorhynchus rufulus*	1A, 1B, 2C, 2D	✓*	✓	✓		✓		✓	✓
RUSTY-FRONTED BARWING †	*Actinodura egertoni*	-	✓*	✓*	✓*		✓*			
STREAK-THROATED BARWING	*A. waldeni*	-			✓*					
BLUE-WINGED MINLA †	*Minla cyanouroptera*	-	✓*	✓*			✓*			
RED-TAILED MINLA †	*M. ignotincta*	1B, 1C	✓*	✓	✓					
YELLOW-THROATED FULVETTA †	*Alcippe cinerea*	1A, 2A		✓*	✓		✓*			
RUFOUS-WINGED FULVETTA †	*A. castaneceps*	-		✓*	✓*		✓*			
RUFOUS-THROATED FULVETTA †	*A. rufogularis*	1A		✓			✓*			
BROWN-CHEEKED FULVETTA †	*A. poioicephala*	2C					✓*			✓
NEPAL FULVETTA †	*A. nipalensis*	1A, 1B, 1C, 2A, 2B, 2C, 2D	✓*	✓	✓	✓	✓	✓		✓
STRIATED YUHINA †	*Yuhina castaniceps*	1B, 1C, 2A		✓	✓		✓*			✓
WHITE-NAPED YUHINA † (!)	*Y. bakeri*	2A	✓*	✓*	✓					
WHISKERED YUHINA †	*Y. flavicollis*	2A	✓*	✓*	✓		✓*			✓*
RUFOUS-VENTED YUHINA	*Y. occipitalis*	2A			✓					
BLACK-CHINNED YUHINA †	*Y. nigrimenta*	1A, 1B, 2A	✓*	✓	✓		✓*			
WHITE-BELLIED YUHINA †	*Y. zantholeuca*	1A, 1B, 1C, 2C, 2D, 4	✓	✓	✓	✓	✓	✓	✓	✓
RUFOUS-BACKED SIBIA †	*Heterophasia annectans*	1A, 2A		✓	✓	✓*	✓*			
RUFOUS SIBIA	*H. capistrata*	-		✓*		✓*				
GREY SIBIA †	*H. gracilis*	-					✓*			

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
BEAUTIFUL SIBIA † (!)	*H. pulchella*	1A		✓*	✓					
LONG-TAILED SIBIA †	*H. picaoides*	1A, 1B	✓*	✓	✓					
GREY HEADED PARROTBILL †	*Paradoxornis gularis*	1B, 2A	✓*	✓*			✓*			
BLACK-THROATED PARROTBILL †	*P. nipalensis*	-		✓*	✓*					
LESSER RUFOUS-HEADED PARROTBILL	*P. atrosuperciliaris*	-		✓*	✓*		✓*			
GREATER RUFOUS-HEADED PARROTBILL †	*P. ruficeps*	1C		✓*	✓					✓*
ALAUDIDAE – LARKS										
RUFOUS-WINGED BUSHLARK	*Mirafra assamica*	-	✓*	✓*						
SAND LARK	*Calandrella raytal*	-		✓*						
ORIENTAL SKYLARK	*Alauda gulgula*	-	✓*	✓*						
NECTARINIIDAE – FLOWERPECKERS, SUNBIRDS AND SPIDERHUNTERS										
YELLOW-VENTED FLOWERPECKER	*Dicaeum chrysorrheum*	-	✓*							✓*
YELLOW-BELIED FLOWERPECKER	*D. melanozanthum*	-		✓*						
PLAIN FLOWERPECKER †	*D. concolor*	3D	✓*				✓			✓*
FIRE-BREASTED FLOWERPECKER †	*D. ignipectus*	1B, 2A	✓*	✓	✓		✓*			
SCARLET-BACKED FLOWERPECKER † (!)	*D. cruentatum*	2B, 2C	✓*			✓				✓
RUBY-CHEEKED SUNBIRD	*Anthreptes singalensis*	2B	✓*			✓	✓*		✓*	✓*
PURPLE-RUMPED SUNBIRD †	*Nectarinia zeylonica*	1A				✓				
PURPLE-THROATED SUNBIRD †	*N. sperata*	1C, 2A				✓				
PURPLE SUNBIRD	*N. asiatica*	2B, 3E				✓				
GREEN-TAILED SUNBIRD †	*Aethopyga nipalensis*	1A	✓*		✓	✓*	✓*			
BLACK-THROATED SUNBIRD †	*A. saturate*	1A, 1B, 1C, 2B	✓	✓	✓	✓	✓			✓*
CRIMSON SUNBIRD †	*A. siparaja*	1B, 1C, 2B	✓	✓*	✓*	✓		✓		✓*
LITTLE SPIDERHUNTER †	*Arachnothera longirostra*	1B, 2B, 3A	✓*	✓*	✓*	✓	✓	✓	✓	✓
STREAKED SPIDERHUNTER †	*A. magna*	1B, 1C, 2C	✓	✓	✓*	✓*	✓*		✓	✓
PASSERIDAE										
RUSSET SPARROW	*Passer rutilans*	-			✓*					
EURASIAN TREE SPARROW	*P. montanus*	-	✓*	✓*	✓*	✓*				✓*
FOREST WAGTAIL †	*Dendronanthus indicus*	1B			✓*	✓*	✓*	✓		✓*
WHITE WAGTAIL	*Motacilla alba*	3F	✓	✓*	✓*	✓*	✓*			✓*
WHITE-BROWED WAGTAIL	*M. maderaspatensis*	-			✓*					
YELLOW WAGTAIL	*M. flava*	3			✓*				✓	
GREY WAGTAIL	*M. cinerea*	-	✓*	✓*	✓*					✓*
PADDYFIELD PIPIT	*Anthus rufulus*	3F	✓	✓*						
OLIVE-BACKED PIPIT †	*A. hodgsoni*	1B, 1C, 2B	✓	✓*	✓*	✓	✓*	✓		✓*
ROSY PIPIT	*A. roseatus*	-		✓*	✓*					
MAROON-BACKED ACCENTOR	*Prunella immaculata*	-			✓*					

BIRDS		**HABITAT CLASS**	**NP**	**NA**	**MO**	**BL**	**BR**	**PA**	**NG**	**DA**
WHITE-RUMPED MUNIA	*Lonchura striata*	2B, 2D, 3B, 3C	✓*	✓*	✓	✓	✓*		✓	✓*
SCALY-BREASTED MUNIA	*L. punctulata*	-			✓*	✓*				
BLACK-HEADED MUNIA	*L. malacca*	-			✓*					
FRINGILLIDAE										
RED CROSSBILL (!)	*Loxia curvirostra*	3B			✓					
DARK-BREASTED ROSEFINCH	*Carpodacus nipalensis*	-		✓*	✓*					
COMMON ROSEFINCH	*C. erythrinus*	-					✓*			✓*
CRIMSON-BROWED FINCH	*Propyrrhula subhimachala*	-		✓*						
SCARLET FINCH	*Haematospiza sipahi*	3B	✓*	✓*	✓		✓*			
CRESTED BUNTING	*Melophus lathami*	3B	✓*		✓	✓*				
LITTLE BUNTING	*Emberiza pusilla*	3D	✓*	✓*	✓		✓*			
BLACK-FACED BUNTING	*E. spodocephala*	-			✓*					

REFERENCES:

NP: ***Nameri NP & Pakhui WLS***: Athreya and Karthikeyan (1995), Datta et al. (1998), Fleming (1997), Singh (1994), Singh (1999a)

NA: ***Namdapha TR***: Alstrom (1994b), Athreya et al. (1997), Athreya (1996), Choudhury (1996), Hornbuckle (1998), Ripley et al. (1991), Samant et al. (1995), Singh (1994), Singh (1999a)

MO: ***Mouling NP***: Sen and Mukhopadhyay (1999), Singh (1994), Singh (1999a)

BL: ***Balphakram NP***: *Kumar et al.(in press)*

BR: ***Barail RF***: Alstrom (1994a), Choudhury (2000), Kumar (2001), Prasad (2001), Robson (2000)

NG: ***Ngengpui WLS & Palak Lake***: Robertson (1995)

DA: ***Dampa TR:*** Raman (1995), Raman et al.(1998), Raman (2001).

II. NOTES ON SELECTED SPECIES

In the following annotations "**Region**", refers to Northeast India and allied hills of Myanmar and China, unless stated otherwise. All remarks in a 'regional' context (e.g. "**Regionally rare"** and "**Regionally threatened**") are based upon our observations, supported by published information, if available. "**New species**" means a taxon apparently never described, and which we consider to be *probably* new to science (pending further taxonomic investigation). A species is considered "**Rediscovered**" in this work if it has been found after a gap of more than 50 years or so. We have glossed over taxonomic details, as it is beyond the scope of this report to detail taxonomic information. "**Globally threatened**" birds are the ones cited in *Threatened Birds of the World* (Birdlife International, 2000). Species cited by Grimmett *et al.* (1999) as *current status unknown, poorly known, no recent records* or *very few recent records* are clubbed here as "**Status unknown**". "**Range restricted**" birds are those with a known global distribution of less than 50,000 km^2 (ICBP, 1992). Species that are reported to occur infrequently are considered "**Rare**" if supported by our observations and in literature.

AMPHIBIANS

RED-EYED SHORTLEG *Leptobrachium smithi*

Distributed up to Thailand, this ostensibly forest-restricted species has been sporadically reported from the NE Hill states (Sengupta et al., 2001), and was seen in *Balphakram NP, Barail RF, Ngengpui WLS,* and *Dampa TR* during this survey. The upper half to the eye of this beautiful species is scarlet. It breeds in forest streams in the wet season, and takes refuge among moist forest litter during periods of inactivity. Its size belies the loudness of its breeding call, and males can be heard from far off. They generally call from secluded places, often a few meters away from the stream. The call has a ventriloquistic quality, and calling males can be difficult to trace. As its short, thin legs indicate, this frog is not a good jumper, and often prefers to walk rather than jump. It also has the ability to move unobtrusively backwards into leaf litter, a ploy it often uses to escape notice when disturbed.

Rediscovery for NE India

BOETTGER'S XENOPHRYS *Xenophrys. cf. boettgeri*

This small frog, last reported from NE India more than 90 years ago as *X. kempi* (Annandale, 1912a), was found during this survey near *Mouling NP*. Boettger's Xenophrys is distributed up to Southeastern China, and it is yet to be determined whether the population from the Eastern Himalayas is taxonomically distinct from the Chinese ones. Males were found calling in winter during this survey; this species probably breeds during wet periods throughout the year. Males start calling by early evening, from secluded places along small to medium sized streams, often perched on small stones or low vegetation. Though frequently heard from streams in secondary habitats, this species is apparently dependent upon consistently moist environments, and may be restricted to the relatively wetter locations of the eastern Himalayas. *Xenophrys* species' have distinctive tadpoles with a funnel shaped apparatus at the mouth, a few of which were found in *Mouling NP* and *Namdapha TR* during this survey. This frog has also been found recently from Tura and Cherrapunjee in Meghalaya (tentative identification; Md. Firoz Ahmed *pers. comm.*) by Md. Firoz Ahmed, and Nagaland by Sabitry Bordoloi (*pers. comm.*).

First record/ New species?

?Bufo cf. Cryptotympanum/burmanus (Unidentified toad)

A small toad with an indistinct mid-dorsal line, indistinct tympanum, and a reddish head, found under a stone in a dry stream near Hornbill camp, *Namdapha TR*. Though its taxonomic identity is far from certain, the closest relatives of this species appear to be a group of toads that includes the Myanmar toad *B. burmanus*. The latter is distributed in the neighbouring mountains of upper Myanmar and Southwestern China. SP found a similar specimen from Phawngpui NP, South Mizoram, in 1999. These specimens either represent a range record, or perhaps a species new to science.

Endemic to NE Indian Hills

PLAIN TREE TOAD *Pedostibes kempi*

Found in *Ngengpui WLS* and *Dampa TR* during this survey. The Plain Tree Toad was originally described from Meghalaya (Boulenger, 1919), based on a single specimen. We consider this species to be same as *Bufoides meghalayana*, which was described much later (Pillai and Yazadani, 1973; Yazadani and Chanda, 1971). If this is established, the original *Pedostibes kempi* (pending taxonomic revision) will be the true scientific name for the plain tree toad (ITZN, 1985). This toad is apparently not uncommon in the forested tracts of the NE hills. A good climber, individuals are often found hiding above ground in crevices and holes in trees and sheaths of wild banana plants. It reportedly breeds in water tanks collected in screw pine (*Pandanus* sp.*)* sheaths and rocky hollows. A male and gravid female were found in *Ngengpui WLS* during March-April 1999, and single males were found along forest streams in *Dampa TR*, during May-June of the present survey. It has also been found from Tura in Meghalaya by Md. Firoz Ahmed (*pers. comm.*).

First record/ New species?

GREEN-SPOTTED AMOLOPS *Amolops cf. Viridimaculatus*

Found during this survey near *Mouling NP*. A large torrent dwelling frog with adhesive discs on tips of fingers and toes, slender fingers, and distinctive large green spots. It appears to be very similar to the Green Spotted Amolops *A. viridimaculatus* of Southern China. However, further investigation is needed to determine the precise identity of this Amolops.

Endemic to E. Himalayas, rediscovered

NORTH-WESTERN TRICKLE FROG *Occidozyga (Phrynoglossus) borealis*

This tiny frog, the adults of which are hardly bigger than a couple of centimetres, was described in 1912 from close to *Mouling NP* (Annandale, 1912a), after which it went unreported for nine decades. Found during this survey in Pakhui and *Nameri NP*. Trickle frogs are an interesting group of small frogs that live among litter and rubble in trickling and seeping streams in and around forests. NE India appears to be the Northwestern limit of the distribution of trickle frogs; its relatives (including allied genera) are found up to equatorial Southeast Asia. Like other relatives, this species is probably restricted to relatively lower latitudes in hilly tracts due to its dependence on seeping water bodies. The males appear to be territorial, and can be heard advertising from streams during day as well as at night with characteristic short bursts of rapid but low pitched "*chek-chek-chek*" calls. This frog has recently been found in Tura, Meghalaya, and Itanagar and Rutung, Arunachal Pradesh by Md. Firoz Ahmed (*pers. comm.*).

New species?

Occidozyga (Phrynoglossus) cf. tenasserimensis (Unidentified Trickle Frog)

This trickle frog, apparently restricted to NE hill forests, was seen during this work in *Barail RF, Dampa TR, Ngengpui WLS*, and around Palak lake. This tiny frog is apparently a close relative of the Myanmar trickle frog *O. tenasserimensis*. These frogs are largely restricted to the vicinity of trickling streams in tree and bamboo forest during summer, where males can be heard advertising in a manner similar to the Northwestern trickle frog, but with a more rapid and higher pitched *"ki-ki-ki-ki*" call. During the wet season, these frogs are often heard from calling from forest litter far away from streams. This frog has also been recently found elsewhere in Mizoram by Md. Firoz Ahmed (*pers. comm.*).

First record/New species

Rana (Ingerana) cf. Tasanae (Unidentified Trickle Frog)

These small, stocky and wrinkled frogs were found in *Namdapha TR*, from situations similar to the two trickle frogs described above. This is a trickle frog, though ostensibly more distantly related to the two previous species. The identity of this species will require more investigation, but it is definitely a new record for NE India, and is very likely to be new to science as well. Its closest relative appears to the Tasan wrinkled frog *Ingerana tasanae*, which is found in Southern Thailand.

Endemic to NE India

DANIEL'S ORIENTAL STREAMFROG *Rana danieli*

During this survey the species was found in *Pakhui WLS*, *Namdapha TR*, *Ngengpui WLS*, and *Dampa TR*. We consider this frog originally described from Meghalaya (Pillai and Chanda, 1977) to be the same as *Pterorana khare*, which was described from Nagaland (Kiyasetuo and Khare, 1986). The generic epithet *Pterorana*, which literally means "winged frog" was derived from apparent flaps on the sides of the body and limbs, which the authors assumed helped these frogs 'glide' (see Kiyasetuo and Khare, 1986). However, information collected during this survey suggests that this generic name is a misnomer, as the 'flaps' are actually loose skin that develops on the groin and the hind legs of males during the breeding season. Our field observations show that this extraordinary frog shows a remarkable level of parental care hitherto not reported for any frog from this region. The loose skin augments respiratory efficiency of the males, who sit under water for long periods to tend spawn and early stage tadpoles. The looseness of the skin may also partly be due to the fact that the frogs apparently feed little, if at all during this period. This lays to rest the theory about the 'gliding' ability that was attributed to *P. khare*. Apparently the females and non-breeding males of this species do not have any loose skin, and such individuals were previously described as Daniel's Streamfrog *R. danieli*. If this is true, the earlier name *R. danieli* will also include all frogs described and identified as *P. khare* (ITZN, 1985). This species has also recently been reported from the Chin hills of adjoining Myanmar (CAS, 2000a), and from *Pakhui WLS* area by Saibal Sengupta (*pers. comm.*) We hope to collect fresh information soon, which will hopefully resolve the status of this enigmatic frog which is endemic to this region.

BROWN-BACKED ORIENTAL STREAMFROG *Rana leptoglossa*

This is the westernmost record of this species, which is distributed eastwards up to southern Thailand and Annam (Vietnam). It was reported during this survey from *Balphakram NP*, *Barail RF*, *Ngengpui WLS* and Dampa TR. Due to its superficial resemblance to the Plain Streamfrog *Rana alticola*, it has not been reported since 1912 (Annandale, 1912a; p. 9, as Hylorana granulosa) although it is common in the lower hills of the NE hills zone. It has large tadpoles (easily identified by a black spot on the tail) which are eaten by local people all along its distribution range in NE India. The male's advertisement is a distinctive "*pak-pak-pak*" bleating call. This species is not found north of the Brahmaputra River.

GREATER GREEN-BACKED ORIENTAL STREAMFROG *Rana livida*

This beautiful large green frog, recorded from *Dampa TR* and *Palak Lake Area* during the present survey, has previously been recorded periodically from the hill tracts of NE India. The natural history of this extremely shy frog is poorly known. They are generally found in the vicinity of shady forest streams, and can be very difficult to catch, as they are quick to escape with long leaps into swift water, or by inserting themselves in cracks and crevices. When in stress, they often secrete a substance from the skin that smells like crushed peas, and can cause mild skin irritation. Males call from secluded places along swift flowing streams. The call is a remarkably bird-like high-pitched *"chick"*. During the breeding season, sporadic bouts of "*chick*" can be heard towards evening, interspersed with long periods of silence. The spawn is attached under boulders and stones in relatively slow flowing sectors of the stream, and the tadpoles are black in colour.

New species?

Rhacophorus sp. (Unidentified Treefrog)

A peculiar looking tree frog with a very elongated and slender body, reddish brown back and orange-red webs between the finger s and toes. A single individual was found sitting on a stone in a stream in *Barail RF*, during daytime. At present, its taxonomic affinities are uncertain; no species in this or neighbouring regions appears very similar, and this may be a taxon new to science.

Endemic to E. Himalayas (?), rediscovered

LONG-NOSED TREEFROG *Rhacophorus naso*

Described from a locality not far from *Mouling NP* (Annandale, 1912a), this species was recorded after a gap of about 90 years during the present work, from the same locality and also from *Namdapha TR*. The latter record is based upon macro photographs (Ashok Captain, *pers. comm.*). This small tree frog is identifiable by its tuberculated skin, inconspicuous colour pattern, a row of blisters fringing the tibia up to the heel, and a small dermal appendage at the tip of its snout. Two male *R. naso* were found during this survey from the filled sheaths of a wild banana plant. Nothing is known about the biology of this species, and its status vis-à-vis related species from neighbouring regions (*R. appendiculatus* and *R. bisacculus*) needs further examination. This frog has also recently been found in Cherrapunjee and Tura in Meghalaya, by Md. Firoz Ahmed (*pers. comm.*).

Endemic species to Eastern Himalayas, rediscovered

Rhacophorus cf. jerdoni (Tree frog; identification tentative)

Recorded from *Mouling NP* during this work; there has been no confirmed record of this frog since its description from Darjeeling (Gunther, 1875), and this appears to be a rediscovery after 125 years. This is a small tree frog with a short, blunt snout, tuberculated, dull green back with darker symmetric markings, orange-yellow pattern on the sides of the groin, and large eyes. Most individuals were found in banana sheaths along streams, while one large male was in a broken bamboo culm. Nothing is known about the biology of this species.

Rediscovery for NE India

PIED THELODERMA *Theloderma asperum*

Distributed throughout tropical Southeast Asia, the Pied Theloderma was last reported from NE India in 1912 from a locality near what is now *Mouling NP* (Annandale, 1912a). It was found during this survey from approximately the same area, and also from *Namdapha TR* and *Pakhui WLS*. The latter record is based upon an individual found by a colleague (Aparajita Datta, *pers. comm.*). This small tree frog, with its distinct black and white colour pattern, rough body and reddish eyes is easy to identify in the field. All Pied Thelodermas during this survey were found in water tanks in *Colocasia* sheaths. When distressed, this frog shows remarkable behaviour; it closes its eyes, draws its limbs close to the body, and slightly clenches its toes and fingers, refusing to respond to any stimulus thereafter. This behaviour was observed in all the individuals found in this survey, and may be interpreted as death feigning. In addition, the black and white dorsal colour-pattern gives a quietly sitting Theloderma an extraordinary resemblance to bird dropping, especially if the frog is on a flat surface. This 'death feigning' behaviour may then also help amplify the impression that that the frog is an inanimate object.

First record for NE India

BROAD-HEADED PHILAUTUS *Philautus parvulus*

This member of the group of the small tree frogs called *Philautus*, bush frogs, or bubble nest frogs, has never been reported from NE India, though it is found in neighbouring Myanmar, and is common in many localities there (Joseph Slowinski, *pers. comm.*). During this survey, the Broad Headed Philautus was found in *Namdapha TR*, *Barail RF*, *Ngengpui WLS*, *Pala Lake Area*, and *Dampa TR*. This species is very distinct in its rather broad head, hidden tympanum, beige to brown colour phases, chromosome mark on its back, orange and black marking on outer groin / inner thighs and the large vocal sac of the male, which when fully distended, is much larger than the frog itself. The call of males is a loud "*tak-tak-tak*" which resounds in the forest understorey, from where they call perched on branches, lianas and saplings. Like other Philautus, this species is apparently not bound to water bodies for reproduction, and probably undergoes direct development without a free-swimming tadpole stage.

GOLDEN-LINED REEDFROG *Chirixalus vittatus*

Close relatives of larger tree frogs, reedfrogs are differentiated by their small size, elongated body, and modified fingers wherein the two outer fingers are opposable to the two inner ones. Most south-Asian species breed in marshes, and the latter modification probably aids in gripping vertical stalks of grass and reeds. The Golden-lined Reedfrog is a conspicuously marked species with two dorso-lateral bright yellow lines from snout to vent. It has hitherto been reported only thrice from NE India {Romer 1949 1416 / id / ft "; Saibal Sengupta and Md. Firoz Ahmed, *pers. comm.*"). During this work, these frogs were found in *Ngengpui WLS* in June 1999. The call of the males is a continuous, pleasant "*tik-tik-tik*". The species breeds in tall grass-dominated marshes, but takes refuge in moist places in wild banana sheaths and tree holes in forest during the dry season.

Rediscovery for NE India

LINEATED REEDFROG *Chirixalus doriae*

This species is characterised by two light dorsolateral lines from eye to vent, between are a few longitudinal dark lines. Though the lineated reedfrog has not been reported from NE India since 1912, there have been occasional reports from neighbouring Myanmar. During this survey, dozens of these frogs were found resting in sheaths of wild banana and *Colocasia* in Moti *jheel, Namdapha TR.* The area is a forest marsh surrounded by forest; both adults and juveniles of various stages were seen, suggesting that the reedfrogs breed there.

REPTILES

SMOOTHBACKED PARACHUTE GECKO *Ptychozoon lionotum*

Parachute geckos have flaps on the sides of their body and on the limbs, which ostensibly serve the dual function of adding air resistance when the lizard takes to the air, while at the same time helping camouflage the animal on tree trunks or other such surfaces. No parachute gecko has hitherto been reported from NE India. Two individuals of the smooth backed parachute gecko were reported from *Ngengpui WLS* in 1999 (Pawar and Biswas, 2001). This strongly arboreal gecko is apparently restricted to forest. It is extremely agile, and its cryptic colouration renders it difficult to spot on trees. It is perhaps not found in the upper NE Indian hills or the Eastern Himalayas.

Endemic to NE India, rediscovered

INDO-MYANMAR PYGMY FOREST SKINK *Sphenomorphus courcyanum*

This diminutive skink is barely 7-8 cm in total length, and all evidence suggests that it is largely restricted to forest, where it isfound in leaf litter. Originally described in 1912 from Rutung in the vicinity of *Mouling NP*, there has been no record of this species since 1935. During this work, a few individuals were found in *Ngengpui WLS*. Further surveys will probably reveal that this species is found in other forested tracts of NE India as well.

Endemic to NE India – Bangladesh Hills, rediscovered

TWO-BANDED WATER SKINK *Tropidophorus assamensis*

This species was found after a gap of 90 years during this work from *Ngengpui WLS* (Annandale, 1912b). Nothing is known about the biology of this species. The two banded water skink can be identified by its strongly keeled dorsal surface, dark brown to black colour and the presence of two yellow bands on its back. This species represents the westernmost distribution of this interesting group of semi-aquatic skinks that live in and around forest streams in Southeast Asia.

First record for NE India

HORNED TREE LIZARD *Acanthosaura cf. crucigera*

This is a large tree lizard with two conspicuous spines on either side of its head, hitherto known to be distributed further eastwards in Southeast Asia. The first record of this species from NE India, based upon specimens examined by us in the field museums at Deban and Miao, *Namdapha TR*. An important addition to the lizard fauna of NE India, and records from adjoining of Myanmar and China need to be investigated to have abetter understanding of its likely dispersal route into this region. Also, The taxonomic status of the Namdapha population may be worth investigating.

First record for NE India

MOUSTACHED CALOTES *Calotes mystaceus*

This is first record of this species from NE India, based upon a specimen examined by us in the field museum at Deban, *Namdapha TR*, and information communicated by a colleague (Aparajita Datta, *pers. comm.*). Both sexes of the moustached calotes have a beautiful blue upper forebody during the breeding season, and a white stripe along the upper lip to the side of the head. This specimen had been found in 1945 in Manipur, with vouchers for seven specimens in ZSI, but these records apparently went unpublished. It has recently been found in northeast Mizoram as well (Aparajita Datta, *pers. comm.*). This report is not surprising, considering that it is known from the Chin hills, which lie adjacent to the NE Indian Hills. It has also been recently found in Mizoram by Md. Firoz Ahmed (*pers. comm.*).

Endemic to region

FLAT-BACKED JAPALURA *Japalura planidorsata*

Found in *Barail RF* and *Dampa TR* during this survey. A beautiful little forest lizard that is almost entirely terrestrial in its habits, living among leaf litter in the forests of the NE hills. Though previously recorded often from NE India - Myanmar, there is little published information on its biology. All males have yellow lips and throat, while some have a striking yellow back as well. The females are relatively plain in colour, and slightly larger than the males. When threatened, Flat-backed Japaluras often resort to hopping which allows them to move more rapidly over leaf litter. They apparently breed in the wet season; gravid females were found in May-June in *Dampa TR*.

Locally threatened?

RETICULATED PYTHON *Python reticulatus*

Recorded from *Ngengpui WLS* during this work. The skin moult of a large individual was retrieved from Ngengpui river in 1999. The python though common over much of its range in Southeast Asia, appears to be rare in NE India. The reason for this may be because NE India is the northwestern limit of the distribution of this snake, perhaps coupled with the fact that it is probably hunted throughout its range in NE India.

Endemic to region, rediscovered

Amphiesma xenura (Keelback; common name uncertain)

Recorded from *Pala Lake Area* area and Aizawl during this survey. A species that had not been reported since 1911, till a spate of recent records (Assam, Saibal Sengupta, *pers. comm.*; Myanmar, Joseph Slowinski, *pers. comm.*), including those during this survey, reaffirmed the presence of this forest keelback in NE India - Myanmar. It is an attractive forest keelback, with complete scales under the tail, a character that no other keelback in this region is known to have. A small individual was found in a dry forest stream near Palak lake. Another individual was found in secondary habitat at the outskirts of Aizawl city.

ZAW'S WOLF SNAKE *Lycodon zawi*

A species recently described (Slowinski et al., 2001), initially found in *Ngengpui WLS* by SP, and subsequently reported during this survey from *Balphakram NP*, and other localities in the NE Indian hills (Md. Firoz Ahmed, Saibal Sengupta, *pers. comm.*) and Myanmar. This apparently forest-restricted wolfsnake has a distinctive pattern of narrow white bands on a brown-black to black body, and lacks a collar band that is found in many of its congeners. It has not yet been reported from the E. Himalayas.

First record/new species for NE India

?Maticora cf. intestinalis (Undescribed Coral Snake)

A coral snake mentioned here on the basis of two specimens collected from forest floor on Tura peak, north west of *Balphakram NP* (Parimal Das, *pers. comm.*) and preserved in the Museum of the Department of Zoology, Tura Government College. This species appears to be most closely related to the coral snake *Maticora intestinalis* from Southeast Asia, and preliminary evidence strongly suggests that it is new to science.

Threatened?

KEELED BOX TURTLE *Pyxedia mouhotii*

A forest turtle with strongly terrestrial habits, sometimes encountered on the forest floor or in moist forest *nullahs*. Reported from *Pakhui WLS* and *Dampa TR* during this survey. Like other medium and large turtles and tortoises of this region, this species is locally hunted for meat (e.g., Pawar and Choudhury, 2000).

Threatened

SOUTHEAST ASIAN SOFTSHELL *Amyda cartilaginea*

This species was reported for the first time in NE India by SP (Pawar and Choudhury, 2000), from *Ngengpui WLS*. During this survey, the skull of a large turtle caught in *Palak Lake* was obtained from Phura village, which appears to be of the southeast Asian softshell. This softshell is hunted and locally traded for meat in the vicinity of *Ngengpui WLS*, and this may also be the case in *Palak Lake* area.

First record for NE India?

?Nilssonia cf. formosa (Unconfirmed)

A softshell turtle shell examined in Miao museum appears to be that of the Burmese peacock softshell *Nilssonia formosa*, a species closely related to the Southeast Asian softshell. However, this needs to be confirmed with more material, and closer examination of the museum specimen. If confirmed, this will be the second species that has been added to the turtle fauna of NE India in the last two years. The nearest previous record of the Burmese peacock softshell is less than 150 km (straight distance; from Upper Myanmar), from *Namdapha TR*.

BIRDS

Globally Threatened

WHITE-CHEEKED PARTRIDGE *Arborophila atrogularis*

Probably locally common in NE India (Grimmett et al., 1999). Two individuals were heard calling in duet from forest floor in primary forest (Hornbill camp, *Namdapha TR;* 14th Jan, 2001; early morning 565m). The same evening, another call was heard nearby. Also the call was heard in moderately disturbed primary forest patch near Kawrthindeng village (*Ngengpui WLS;* 9th May, 2001; morning; 230 m msl).

Globally Threatened

WHITE-WINGED DUCK *Cairina scutulata*

Formerly common and widespread in NE, now restricted to fragmented populations in Assam and Arunachal Pradesh. A pair was seen in an old river bed north of Potasoli forest camp (*Nameri NP;* 27th Oct, 2000; ~0530 hrs; at ~100 m msl). They flew towards a nearby forest patch, circled back into the open grassland, and later disappeared into forest towards the north. Another pair was flushed from a shady stream surrounded by disturbed forest (Balipung Nala; *Nameri NP*; 30th Oct, 2000; ~1000 hrs; ~100 m msl). Additionally, a stuffed specimen was seen on display at the Museum of the *Namdapha TR*, Miao.

Globally Threatened

GREAT HORNBILL *Buceros bicornis*

Seen often in *Nameri NP, Pakhui WLS* and *Namdapha TR* (Nov-Jan; mostly in pairs). Appears to be locally common in these areas and rare elsewhere; three single sightings in *Balphakram NP*, (16th - 23rd March, 2001); one heard in a moderately disturbed primary forest patch in *Barail RF* (8th April, 2001; at ~600 m msl); one individual seen flying over a mosaic of bamboo patches and fragmented forests near Bungtlang village (*Ngengpui WLS*; 7th May, 2001; at ~600 m msl); five single sightings in *Dampa TR*, seen flying over undisturbed primary forest (27th –30th May, 2001; at 400 m msl). Additionally, a few sightings by SP in *Ngengpui WLS* (Dec-April, 1999). Singles seen after March, which is the breeding period, could be males tending to females and brood.

Globally Threatened

BROWN HORNBILL *Anorrhinus tickelli*

The species is reported from eastern Assam, *Namdapha TR*, and Barail Range (Choudhury, 2000; Singh, 1994). Appears to be rare in these areas. One pair was sighted~4-5 km from Dimbru Disa village (*Barail RF*; 13th Apr, 2001; ~1030 hrs, at ~300 m msl), at the edge of a small forest patch surrounded by abandoned *jhum* fields. The male flew from a treetop at the edge of the forest patch to a tree in the open, and back again. It later flew to a tree further away in a middle of large *jhum* field. Meanwhile, the second one, probably a female, remained on the tree, concealed by thick foliage, reluctant to follow the male into the open. It flew towards the interior of the forest patch instead.

Globally Threatened

RUFOUS-NECKED HORNBILL *Aceros nipalensis*

All sightings during this survey are from *Namdapha TR*. The species seems to be locally common there, but rare elsewhere in NE India. Four pairs were sighted, and calls heard on two different occasions, within 4 days along the Haldibari-Hornbill-Bulbulia track (13th–16th Jan, 2001; at 450 m msl-650 m msl). Another pair was seen foraging on the fruits of a *Canarium* sp. along with a Malayan Giant Squirrel *Ratufa bicolor* (08th Jan, 2001; ~0800 hrs; at 410 m msl; 22nd Mile).

Regionally Threatened

WREATHED HORNBILL *Aceros undulatus*

The species was seen often in *Nameri NP* and *Pakhui WLS*, mostly in threes and fours. A major roosting site exists near Seijusa, where both the Great and Wreathed Hornbills roost in large congregations on scattered trees in riparian grassland. On one occasion, 82 Wreathed Hornbills were seen roosting there (*Pakhui WLS*; 9th Nov, 2000; at ~100 m msl; Sejusa). Wreathed Hornbills were seen and heard frequently in most places in *Namdapha TR*. Appears rare in most other areas of NE India; call was heard only once in undisturbed primary forest in *Dampa TR* (28th May, 2001; at ~450 m msl; Tuichar Lui). Skulls and bills seen in villages near *Ngengpui WLS* indicate that this hornbill is found there, or at least was in the past.

Globally Threatened

BLYTH'S KINGFISHER *Alcedo hercules*

Generally rare, but probably locally common in *Namdapha TR* (Athreya et al., 1997). A pair, well concealed in a bush overhanging a stream, was heard calling (*Namdapha TR*; 21st Jan, 2001; ~7000 hrs; at ~300 m msl; Laungka Nala). One of them flew to a big boulder in the stream briefly, and then flew away along the stream. The second one remained concealed in the bush and continued to call. It flew out and followed the first one when approached. Later, along the same stream, another individual was seen. Apart from being noticeably bigger than Common and Blue-eared Kingfishers, this species is predominantly darker mossy green (vs. blue in the other two species).

ORIENTAL DWARF KINGFISHER *Ceyx erithacus*

Seen in *Ngengpui WLS* by SP (Jan-March, 1999) along forest bound streams. Perhaps locally common along the forest tract in that area. Mostly seen flying past swiftly or heard calling along the stream. The call is a moderately high-pitched, piping whistle consisting of single notes repeated continuously. Sometimes these little kingfishers were seen perching on low vegetation next to the water, often quite close to the observer. A specimen was seen on display at the Museum of the *Namdapha TR*, Miao.

BLACK-CAPPED KINGFISHER *Halcyon pileata*

A coastal species, known to move farther inland along large rivers (Ali and Ripley, 1987). One individual was sighted on a tree in the middle of paddy fields, near Phura village (*Palak Lake*; 29th Apr, 2001; ~0540 hrs; at 240 m msl). Interesting sighting because the locality is ca. 120 km (straight distance) inland from the coast, with no large rivers in the vicinity, except a small stream.

Regionally Rare

EURASIAN CUCKOO *Cuculus canorus*

Summer visitor probably breeding in the region (Ali and Ripley, 1987). A single female was sighted on an upper branch of a tall tree in *Barail RF* (12th Apr, 2001; 490 m msl) in moderately disturbed primary forest. It stayed there for about 10 min, after which it made a short foray, and returned with a caterpillar which was promptly eaten. After making a couple of similar forays, it finally flew away.

MOUNTAIN SCOPS OWL *Otus spilocephalus*

This owl was heard almost every night at Ramsing (*Mouling NP*; February, 2001; at 650 m msl) from the region of a mosaic of old and recent woody *jhum* regeneration. Occasionally, more than one individual was heard at the same time. Calls usually started after dark, sometimes continuing through the night. Calls were also heard near *Ngengpui WLS* (13th May, 2001; ~200 m msl) from a mosaic of mature forest fragments and *jhum* fallows of varying ages. SP heard the species often in and around *Ngengpui WLS*, during February – April 1999, from disturbed as well as undisturbed primary forest.

Status Uncertain

ASHY WOOD PIGEON *Columba pulchricollis*

Apparently rare. About 20 or more were seen on a small track in undisturbed forest between Hornbill and Bulbulia in *Namdapha TR* (14th January, 2001; at ~650 m msl). The flock was perched among the branches of a mid-canopy tree, well concealed by the foliage, and was located by feathers scattered on the forest floor underneath. They flushed in small groups, flying in different directions. A number of feathers were also found on a forest track near Chidiya pung. Three individuals were seen in *Barail RF* (8th April, 2001; at ~280 m msl; Ditekchorra Forest Check Gate). They flew from a tree next to a metalled road running through a heavily to moderately disturbed forest patch.

Globally Threatened

PALLAS'S FISH EAGLE *Haliaeetus leucoryphus*

Apparently rare in NE India. One adult was seen circling over the Bhareli River near Potasoli camp (*Nameri NP*; 31st Oct, 2000; noon). Later, a pair (1st Nov, 2001) and a juvenile (3rd Nov, 2000) were seen circling at the same place.

Rare

AMUR FALCON *Falco amurensis*

Rare passage migrant, perhaps breeding in southern Assam (Ali and Ripley, 1987). More than 25 of them were seen circling above the Range Office in *Nameri NP* (24th Oct, 2000). This is believed to be along its main migratory route (Choudhury, 2000).

GREAT CORMORANT *Phalacrocorax carbo*

More than 50 individuals were seen in Noa Dehing on a misty morning (*Namdapha TR*; 18th January, 2001; 0700-0730 hrs; junction of Noa Dehing and Namdapha rivers). The group, following a single 'leader', flew swiftly upstream. A couple of minutes later, another group of 10-12 followed the first one. Since this species is generally seen in small groups in the non-breeding period, this may have been a breeding congregation flying from a common roosting site.

MALAYAN NIGHT HERON *Gorsachius melanolophus*
Considered resident in the region (Ali and Ripley, 1987). Call was heard before dawn from a forested tract near Kawrthingdeng village (*Ngengpui WLS*; 9th May, 2001; ~ 0400 hrs, 220 m msl). During Dec-April 1999, SP saw it thrice in the forest streams in the forest, and once in a stream running through a bamboo brake. One individual was also seen in *Dampa TR* (24th May, 2001; at ~500 m msl; on the way to Dampa tlang). The bird flushed from a big boulder next to a small stream flowing through an old secondary forest, surrounded with patches of bamboo brakes. Additionally, according to local people near *Ngengpui WLS*, this heron breeds in trees along forest streams.

BLACK STORK *Ciconia nigra*
Winter visitor. Three individuals were seen flying away from a stream in *Namdapha TR* (21st Jan, 2001; ~7000 hrs; at ~300 m msl; Laungka Nala)

Globally Threatened

LESSER ADJUTANT *Leptoptilos javanicus*
Probably locally common in areas in and around the Brahmaputra plains, as suggested by our sightings in *Nameri NP*. One individual was seen perched on a bare tree near the old river bed north of Potasoli camp (30th Oct, 2000; at ~100 m msl). Later, a pair was seen circling over the same place (3rd Nov, 2000). Another individual was seen in an open patch, foraging in water puddles created by elephant tracks (14th Nov, 2000; at ~100 m msl).

Status Uncertain

BLUE-NAPED PITTA *Pitta nipalensis*
Seen in *Ngengpui WLS* and surrounding areas during Dec-April 1999. Not uncommon in the forest areas there, but not sighted easily due to its secretive understorey habits. One specimen was seen with a local hunter. On another occasion, a female with chicks was encountered in primary forest in the 3rd week of March, 1999. The female fled and presumably hid nearby, after making a short series of alarm calls. The chicks which were still covered with down, immediately crouched among leaf litter.

Status Uncertain

HOODED PITTA *Pitta sordida*
Either resident or summer visitor (Grimmett et al., 1999). Apparently quite common in the forest around *Palak Lake*; 3 different individuals were seen in one day, a total of 6 sightings in 5 days (29th Apr – 3rd May, 2001; at 300 m msl). Calls were also heard a few times during the day. Mostly seen on the forest litter. Reluctant to fly, unless approached very close, upon which the birds made short flights and perched on low branches and lianas (=0.5m) above the ground. When approached further, they usually flew to another branch nearby and then flew away.

Rare

LONG-TAILED THRUSH *Zoothera dixoni*
One individual was sighted near the Runyo Ridge (*Mouling NP*; 17th Feb, 2001; at 1480 m msl; Ogiyong Gobu camp). It was foraging noisily among leaf litter for a long time without realizing our presence. Upon detecting our presence, it flew to a horizontal liana near the forest floor and perched motionless for a while. Further on the same path (at 1555 m msl) and on the way back, the species was seen three more times. These sightings could be of the same individual.

Rare

GOULD'S SHORTWING *Brachypteryx stellata* (Unconfirmed)

A shortwing was observed for about 10 mins on the ground in dense understorey of a secondary roadside forest patch near a small cascading stream (*Mouling NP*, 4th Feb, 2001; at ~750 m msl; Sirinyuk trail). It had uniform grey underparts with indistinguishable pattern on the flanks in the form of spots or streaks. The wings were bright chestnut. The iris colour was yellowish. The crown, mantle and tail appeared grey (vs. chestnut for Gould's Shortwing), and we identify this as Gould's Shortwing with uncertainty. The locality is also at a lower altitude than usually known for that species, although one specimen had been collected at 540 m msl in Sikkim (Ali and Ripley, 1987). It flew parallel to the road through the undergrowth for short distances, but always returning to the same point, frequently preening and fluffing its feathers all the while. The call was series of high-pitched notes terminating in a piercing 'seeet'.

WHITE-BROWED SHORTWING *Brachypteryx montana*

An immature male was seen by SP in a dry stream in primary forest at Kundulgop (*Balphakram NP*, 21st Mar, 2001; at ~350 m msl). The same bird was seen a few times in a period of an hour or so. SP made only casual observations, as he was looking for amphibians and reptiles. While walking up the stream, the bird appeared nearby a few times, perching on shrubs and low treelets in or near the stream bed, either staying still or cocking its tail slowly a few times. It appeared to be foraging along the stream.

Regionally Rare

ASIAN BROWN FLYCATCHER *Muscicapa dauurica*

One individual was seen in sparse understorey of an open riparian patch surrounded by *jhum* fallows and bamboo clumps (*Barail RF*; 13th Apr, 2001; at ~300 m msl). It flew around the lower understorey for a couple of minutes and finally disappeared.

Rare

PURPLE COCHOA *Cochoa purpurea* (Unconfirmed)

A bird was seen on a tree in undisturbed primary forest in *Namdapha TR* (14th Jan, 2001; ~noon; at ~650 m msl). It was sitting in a upright position on a branch ca. 10m above the ground, on a tree about 5m away. It remained thus for 7-10 minutes, though it saw us close by. We were only able to see it from a ventrally oblique angle. It was dark-brown to maroon, with no visible marks on throat and belly. The wings which two white lines were a shade darker than the body, while the outer tail feathers were lighter. It had a plain face with an indistinctly darker mask. The beak was black in color, pointed, and appeared moderately acute from below. Meanwhile, we noticed a second individual, 12-15m directly above our head perched in thick foliage in a manner similar to the first one. The belly, which was the only part visible appeared pale brown. Both birds were reluctant to fly. After we made some sounds, the first bird stretched its neck forward, and appeared to be ready to fly. It flew away a few moments later, followed by the second one. The colour-pattern and the behaviour of these birds strongly suggest that they were a pair of Purple Cochoas. However, we are unable to confirm this, as we were not able to see the diagnostic lilac crown because of the sighting angle. Though not reported previously, the species is likely to be present in the area as it is distributed further east up to Yunnan and northern Vietnam (Ali and Ripley, 1987).

Globally Threatened

BEAUTIFUL NUTHATCH *Sitta formosa*

Atleast four individuals were seen foraging on a bare tree near the Ogiyong Gabu camp (*Mouling NP*; 18th Feb, 2001; at ~1400 m msl). They appeared to be foraging with a mixed foraging flock, including Sultan Tits, Orange-bellied Leafbirds, Grey-chinned Minivets, Long-tailed Sibias and White-browed Shrike-Babblers.

Range Restricted

YELLOW-VENTED WARBLER *Phylloscopus cantator*

Though restricted to this region, appears to be common locally. The species was always seen in mixed foraging flocks of small insectivores; three sightings in *Nameri NP/Pakhui WLS* (8th – 24th Nov, 2001; 100 m msl-200 m msl; Sejusa and Tipi) and one each in *Namdapha TR* (24th Jan, 2001; at ~400 m msl; on the way to Moti Jheel), *Balphakram NP* (26th Mar, 2001; at ~350 m msl; Narong Chiring), and *Barail RF* (12th Apr, 2001; at 665 m msl).

Status Uncertain

LARGE SCIMITAR BABBLER *Pomatorhinus hypoleucos*

Two sightings by SP in *Ngengpui WLS* (near Kawrthindeng village, February 1999). The first is an unconfirmed sighting of a single individual seen briefly in the upper understorey of a stand of bamboo (*Melocanna baccifera*, *Bambusa tulda* and *Dendrocalamus cf. longispathus*) mixed with woody vegetation. On the other occasion, an adult was seen with a local hunter who had shot it in a mature bamboo stand in the same area.

Status Uncertain

SPOT-BREASTED SCIMITAR BABBLER *Pomatorhinus erythrocnemis*

The species was seen with Necklaced Laughingthrushes in disturbed primary forest next to *Palak Lake* (2nd May, 2001; at 300 m msl). About 12-15 individuals in the flock crossed the road very close to the ground, and they immediately crossed back and disappeared upon sighting us. Another flock of ca. 10 individuals, again with Necklaced Laughingthrushes, was seen near Kawrthindeng village (*Ngengpui WLS*; 9th May 2001; at 230 m msl) in moderately disturbed primary forest. These records are probably the lowest altitudinal records for the species.

Rare

SPOTTED WREN BABBLER *Spelaeornis formosus* (Unconfirmed)

A wren babbler was seen on a rainy day in boulder strewn forest understorey in *Namdapha* TR (24th Jan, 2001; at ~500 m msl, Moti Jheel trail). It was located bby its striking, spluttering (alarm?) call. The bird was observed for a few minutes in steady rain, during which it preened and shook itself, until it was startled by a clap of thunder after which it disappeared in the understorey. It had whitish spots on the mantle and the nape (appeared more heavily spotted than Pygmy Wren Babbler). The call is similar to that described for Spotted Wren Babbler (Grimmett et al., 1999). The same call was heard previously on the same trail, but the birds were not sighted. On another occasion, a pair was heard and fleetingly glimpsed in thick understorey (12th Jan, 2001; at ~490 m msl; Haldibari camp; around dusk). The apparent rarity of this bird could be partly due to difficulty in sighting it; at least in *Namdapha* TR, it is probably more common than believed (only two previous records; Athreya, 1997).

Range Restricted

WHITE-NAPED YUHINA *Yuhina bakeri*

This range-restricted species was sighted only in *Mouling NP*, where it appeared to be the most common of all the yuhinas (Feb 2001; 800 m msl-1470 m msl). Seen mostly in single species flocks ca. 20 individuals, or occasionally, in flocks with Whiskered Yuhinas and Nepal Fulvettas.

Range Restricted

BEAUTIFUL SIBIA *Heterophasia pulchella*

A flock with ~10-15 individuals was seen in Ogiyong Gobu camp (*Mouling NP*; 17th Feb, 2001; at 1215 m msl). The flock was foraging silently among foliage just below the canopy of a stunted riparian patch next to the Eggong stream. The following day, a flock, perhaps the same one, was seen close by.

Status Uncertain

SCARLET-BACKED FLOWERPECKER *Dicaeum cruentatum*

Apparently not uncommon in *Balphakram* NP (15th - 16th Mar, 2001; at ~300 m msl). Two males were sighted chasing each other in regenerating forest. Another male was seen foraging among bamboos along with a Crimson Sunbird on the same trail. On another occasion, a single male was seen in an open forest patch. Only other record for this species is from *Dampa* TR, a single male was seen next to a stream in undisturbed primary forest (30th May, 2001; at 400m msl; Tuichar Lui).

First record?

RED CROSSBILL *Loxia curvirostra* (Unconfirmed)

A flock of Scarlet Finches was seen foraging in bushy secondary growth near *Mouling NP* (13th Feb, 2001; 0830 hrs; at 650 m msl; Ramsing). In this group of 12-15 birds (2-3 male and 5-6 female Scarlet Finches), two females with crossed beaks were seen. The crossed beaks were very pronounced, even without binoculars. Also, two females were seen with a duller appearance and without a bright rump like Scarlet Finch females. Not accustomed to identification of finches, we failed to note if these duller individuals had crossed bills. In addition, a dull scaly red individual was seen, which could be a Red Crossbill male. A couple of hours later, a Scarlet Finch group was seen in the same area, which could be the same group. However, we could not see any Crossbills among them. A combination of factors, including the species' altitudinal range (lowest record at 1500 m msl in Sikkim during winter; Ali and Ripley, 1987) leaves room for doubt and prevents us from confirming this sighting. However, *Mouling NP* is within the known range of the species (Bhutan through northeast Burma to China and higher altitudes in Southeast Asia). In addition, there is a strong possibility that the species can descend to lower altitudes (in this case, in the company of Scarlet Finches). Though Crossbills are found primarily in association with conifer forests, they are known to wander over vast areas in a search for ripe cones. *Mouling NP* has a wide altitudinal range, and it is likely that conifers are present relatively closeby.

III. CHECKLIST OF MAMMALS ENCOUNTERED

M S		NP	NA	MO	BL	BR	PL	NG	DA
MANIDAE									
CHINESE PANGOLIN	*Manis pentadactyla*							✓	
TUPAIIDAE									
NORTHERN TREESHREW	*Tupaia belangeri*							✓	
LORISIDAE									
SLOW LORIS	*Nycticebus coucang*							✓	
CERCOPITHECIDAE									
ASSAMESE MACAQUE	*Macaca assamensis*	✓						✓	✓
BEAR / STUMP-TAILED MACAQUE	*M. arctoides*							✓?	
PHAYRE'S LEAF MONKEY	*Semnopithecus phayrei*							✓?	
CAPPED LEAF MONKEY	*S. pileatus*		✓					✓	
HYLOBATIDAE									
HOOLOCK GIBBON	*Hylobates hoolock*		✓		✓	✓		✓	
CANIDAE									
DHOLE / INDIAN WILD DOG	*Cuon alpinus*							✓	
URSIDAE									
ASIATIC / HIMALAYAN BLACK BEAR	*Ursus thibetanus*				✓			?	
MUSTELIDAE									
YELLOW-THROATED MARTEN	*Martes flavigula*		✓			✓			
HOG BADGER	*Arctonyx collaris*							✓	
ORIENTAL SMALL-CLAWED OTTER	*Aonyx cinerea*							✓	
VIVERRIDAE									
LARGE INDIAN CIVET	*Viverra zibetha*							✓	
SMALL INDIAN CIVET	*Viverricula indica*							✓?	
HIMALAYAN PALM CIVET	*Paguma larvata*							✓	
BINTURONG	*Arctictis binturong*	✓						✓	
HERPESTIIDAE									
CRAB-EATING MONGOOSE	*Herpestes urva*							✓	
FELIDAE									
LEOPARD CAT	*Prionailurus bengalensis*							✓	
LEOPARD	*Panthera pardus*							✓?	
TIGER	*P. tigris*	✓							
ELEPHANTIDAE									
ASIAN ELEPHANT	*Elephas maximus*	✓			✓	✓?	✓	✓	
SUIDAE									
WILD PIG	*Sus scrofa*			✓?				✓	
CERVIDAE									
SAMBAR	*Cervus uncolor*							✓	
BARKING DEER	*Muntiacus muntjak*	✓	✓					✓	
HOG DEER	*Axis porcinus*		✓?						
BOVIDAE									
GAUR	*Bos gaurus*	✓						✓	
SOUTHERN SEROW	*Naemorhedus sumatraensis*							✓	
SCUIRDAE									
BLACK GIANT SQUIRREL	*Ratufa bicolor*	✓	✓		✓			✓	

MAMMALS		NP	NA	MO	BL	BR	PL	NG	DA
ORANGE-BELLIED HIMALAYAN SQUIRREL	*Dremomys lokriah*								
PALLAS' / RED-BELLIED SQUIRREL	*Callosciurus erythraeus*							✓	
HOARY-BELLIED SQUIRREL	*C. pygerythrus*							✓	
HIMALAYAN STRIPED SQUIRREL	*Tamiops mcclellandii*	✓						✓	
PTEROMYIDAE									
RED FLYING SQUIRREL	*Petaurista petaurista*							✓	
HAIRY-FOOTED FLYING SQUIRREL	*Trogopterus pearsoni*							✓	
HYSTRICIDAE									
MALASIAN PORCUPINE	*Hystrix brachyura*							✓?	
ASIATIC BRUSH-TAILED PORCUPINE	*Atherurus macrourus*							✓	

AREA CODES:

NP: Nameri NP and Pakhui WLS
NA: Namdapha TR
MO: Mouling NP
BL: Balphakram NP
BR: Barail RF
PA: Palak lake
NG: Ngengpui WLS
DA: Dampa TR

IV. METHODS FOR PRESERVATION OF AMPHIBIANS AND REPTILES

It is always difficult to make a decision regarding specimen collection; often a lot of thought has to be put into arguing for and against collection of biological specimens. It is seldom possible to identify amphibians and reptiles by superficial examination, and voucher specimens are essential for reference and comparisons. NE India has a poor record of amphibian and reptile inventorying, and voucher samples do not exist for most areas. Though Bombay Natural History Museum (BNHM) and Zoological Survey of India (ZSI) are important repositories of specimens from this region (ZSI has 289 name-bearing types, including some from neighboring regions (Das et al., 1998), these collections are old. Local repositories are very important, at the very least, in aiding documentation and identification for generating area-specific species lists.

In general, however, we believe that collection should be minimised, especially if there is a duplication of effort where a lot of unnecessary collection can take place. The decision often needs to be made separately for each taxon. For instance, in case of snakes, one must remember that a lot of killing already takes place due to the number of misconceptions and superstitions associated with this poorly studied group. Often, a number of valuable specimens can be obtained by preserving *road killed animals* as well.

The following guidelines are in compliance with well established methods (Etheridge, 1958; Heyer et al., 1994; cf. Smith, 1931; Smith, 1935), but with some modifications, keeping in mind the availability of preservation materials in Indian situations.

IMPORTANT: Euthanasia should be done in a humane manner, and in a way that will leave the specimens undamaged and in a relaxed, natural position. Avoid using formalin for this purpose, not only because it results in a painful death of the animal, but also contorts and deforms the specimen. *Prolonged exposure to formalin solution, and formaldehyde gas should be avoided; plastic/rubber gloves are recommended while handling the chemical.*

1. **Euthanising–** The simplest method for *amphibians* is to immerse specimens into water in which 'Chloretone' (hydrous Chlorobutanol) has been dissolved (1/4th tsp to 1 lt water) *or* expose them to fumes of chloroform in an air-tight glass jar.
2. **Fixation**[1]**–** Ideally, specimens should be 'fixed' in 'formalin'[2] diluted by mixing 1 part : to 5 parts of water, before transferring to the permanent preservative. As the fixative may not penetrate to the inner tissues and organs, it should be injected and/or some slits be made without damaging the specimen (definitely recommended for large specimens). In the case of very large snakes (for instance, a 3-4 ft python), may be skinned (remove all tissue and bone up to the neck and anus; leave skin, head, and tail intact), dipped in fixative, and rolled up before storing in preservative. Specimens should be spread out as naturally as possible before they harden in the fixative. They should be retained in the fixative for a while (between few hours to a maximum of 2-3 days), before transferring to preservative (see below).
3. **Preservation–**The formalin solution for preservation should be weaker than that used for fixation (1 part formalin: 9 parts water). A stronger solution makes specimens hard and brittle, especially in the case of reptiles. Tadpoles, which have

[1] Though not recommended, this step can be skipped if resources or time do not permit.

[2] Popular name for a solution of formaldehyde gas (CH20) in water, generally sold as 35% to 38% formalin by most chemical suppliers.

high water content, should be retained permanently in the fixative concentration. As formalin tends to decompose into acid over time (generally a few years), which causes irreversible damage to specimens, this can be avoided by making fresh solutions periodically, or by buffering the diluted formalin with a combination of anhydrous/monobasic (Na_2HPO_4) and hydrous/dibasic (NaH_2PO_4) Sodium Phosphate (~3.4 gm: 6.3 gm/lt, respectively). Another preservative is 70% ethyl alcohol, easily prepared by mixing 1 part of water to 3 parts of 95-100% ethyl alcohol[1]. A stronger concentration of alcohol will dehydrate specimens excessively, and irreversibly, rendering them useless for any meaningful taxonomic work. Though easier to handle, and a superior preservative in many ways, the main disadvantage of ethyl alcohol is its volatility; the specimen jar should be airtight, and alcohol content monitored and topped up periodically. Weak alcohol concentration (<60-70%) will result in a gradual decomposition of the specimens.

4. **Labelling and storage –** Each specimen should be tagged or labeled (aluminum, plastic, or waterproof paper tags), with numbers corresponding to certain data (collection date, precise locality, and collector's name,) is a must, colour, habitat or other description if possible), either attached directly or entered in a notebook or preferably, logged in a permanent register. If not for the purposes of display, many specimens can be stored in a single, air-tight jar (larger the better), but without over packing.
5. **Emergency preservation and transportation:** As an emergency measure in the field, specimens can be temporarily kept in salt (not recommended for amphibians) and any kind of alcoholic liquid (including after-shave lotion and rum). After they have hardened sufficiently (at least a few days in preservative), specimens can be wrapped in cloth/cotton and transported (or stored as such for a few months at a stretch) in sealed plastic bags. Damage can further be avoided by putting specimen bags in shielding containers (such as plastic jars or boxes).

[1] Available with most chemical suppliers, but heavily taxed in some Indian states.

V. GETTING THERE...

NAMERI NP & PAKHUI TR

Getting There

The Divisional Forest Office (DFO) of Nameri NP is located at Tezpur. Tezpur – Guwahati is 182 km (5-6 hrs by bus). Most buses leave from Paltan Bazaar at Guwahati. To get to Bhalukpong, there are buses from Tezpur or Balipara (takes about 2 hrs by bus from Balipara). There are taxis available from Bhalukpong to Tipi (7 km; ~ Rs 15 per head; booking entire taxi costs ~ Rs 80) To get to Potasoli, where the Range Office is, get down at at Hati Gate along the same route to Balakpong. Hati Gate is about 2 km from the office.

The DFO and RO of Pakhui TR are located at Sejusa. To get to Seijusa, there are buses from Tezpur (or Balipara), which takes about 3 hrs. Or, Guwahati-Tezpur buses pass through a town called Soibari, which you can take a taxi, or a Sumo to get to Seijusa.

Addresses

Nameri NP

Divisional Forest Officer
Western Assam Wildlife Division
Dolabari, Tezpur 784001
Ph: (03712) 20854(O), 20803 (R), 21619 (F)

Range Officer
P.O. Gamani, 784 103, Nameri NP

Pakhui TR

Divisional Forest Officer
Pakhui Wildlife Division
P.O. Seijusa 790 103
East Kameng District, Arunachal Pradesh

NAMDAPHA TIGER RESERVE

Getting There

The Project Tiger Director is located at Miao in Tirap District. There are frequent buses from Guwahati up to Dibrugarh and Tinsukia (We travelled from Tezpur to Tinsukia by a night bus, which took about 10 hrs). There is only one daily from from Tinsukia to Miao, otherwise one of the frequent buses can be taken up to the last town, Jagun in Assam, a few km before the Arunachal Pradesh border. There are taxis available from Jagun to Miao (~30 km). The Forest RH is located at Deban, which is 18 km from Miao. The only way to get there is by taxi (Rs 400-500).

Addresses

Namdapha Tiger Reserve
Mioa, Dist. Changlang
Arunachal Pradesh 792 112
Ph: 03807-22249

MOULING NP

Getting There

The DFO of the NP is at Jengging in Upper Siang district. There are daily buses to Jengging leaving Pashighat at around 1600 hrs and reaching at 0300 hrs. The best place to stay is the Circuit House. There is a Forest RH as well. It is difficult to access the protected area from Jengging, however the road towards Sirinyuk Nala is an excellent place for bird watching as there are still primary forest remnants on the way.

The RO of the park is ~4 km away from Ramsing village. There is also a forest RH at Ramsing. There is a bus up to a place called Moying, ~45 km away from Jengging. From Moying, you have trek on the main road using all the possible short cuts to a bifurcation to the rest house about 1 km before the village.

To get to Pashighat via Dibrugarh: two ferries to cross Brahmaputra. First option is to go to Sonari Ghat takes about 1-2 hrs and take a jeep or bus to Pasighat, which takes about 6 hrs. Second option is to take a ferry up to teen (3) mile, which takes about 8 hrs. From there there is bus which leaves around 1800 hrs to Pashighat, taking about 1½ hrs. If the famous Hotel Siang is little dirty for your liking, try Hotel Donyi Polo.

Addresses

DFO Mouling Wildlife Division
Jengging, Upper Siang, 791 002
Ph: 03777-22592 (O), 62592 (R)

BALPHAKRAM NP

Getting there

There is a single bus every day from Guwahati to Tura, leaving from a place called Machkhowa. Leaving Guwahati at 2030 hrs, the bus reaches Tura at 0400 hrs. There is also a Sumo service which leaves at 1400 hrs, and takes about 5 hrs. The DFO of Balphakram NP is at Baghmara. There is a bus from Tura to Baghmara at 0530 hrs (heavy rush for the bus) reaching at 1230 hrs. Next bus is at 0630 hrs. However private buses or sumos are strongly recommended! There is one bus for the 60 km road from Baghmara to Balphakram, leaving Baghmara at 1230 hrs, and reaching at 1630 hrs. The main gate of the NP is about 6 km before Mahadeo Village. There is a VIP Rest House close to the Main gate (Rs 200/night/head). The bus from Balphakram to Baghmara-Tura leaves around 0700 hrs. The bus from Tura to Guwahati is from the bazaar at around 2000 hrs.

Address

Divisional Forest Officer
Balphakram National Park, Wildlife Division
Baghmara, Dist. South Garo Hills
Meghalaya
Ph: 03639-22220 (O)

BARAIL RF

Getting there

The RF falls in two districts, and can be accessed from one of the villages between

Harangajao and Bandarkhal Villages. The DFO is located at Halflong. There is a bus to Halflong leaving Guwahati at 2030 hrs, and reaching at 0830 hrs. The other alternative is a narrow gauge train from Lumding. There are trains from Halflong to Harangajao (Deputy RO is at Harangajao) at 1150, 1530, and 0145 hrs. The CCF of Cachar District is at Silchar. Silchar can be reached from Guwahati by bus or train (via Haflong and Harangajao).

Address
Divisional Forest Officer
NC Hills Division
Haflong 788819
Assam
Ph: 36356(O), 36271(R)

NGENGPUI WLS & PALAK LAKE

Getting there
Aizawl to Lawngtlai is ~300 km, and takes 15 hrs by bus. The bus (Lai Night Super) leaves Aizawl at 1445 hrs and reaches at 0600-0800 hrs. The DFO is located at Lawngtlai. There is a RO office and RH at Ngengpui-Khawmawi village. The Mizoram State Transport (MST) bus from Lawngtlai to Bungtlang via Ngengpui-Kawmawi leaves at 0600 hrs, taking 4-5 hrs for the 81 km distance (~2 hrs to Ngengpui village; 38 km). There is also an Armada service.

Palak Lake: All concerned FD officials (Mara Autonomous District Council FD) are at Saiha (Siaha). There is a daily bus from Lawngtlai to Saiha (~80 km; 3.5 hrs), leaving at 0600 hrs. There is a RO offce and FRH at Phura (~7 km from the Lake). There is a Sumo service from Saiha to Phura 3 days a week, leaving in the morning, returning the same day.

Address
Ngengpui WLS
Divisional Forest Officer
Chhimtuipui Forest Division
P.O. Lawngtlai
Mizoram
Ph: 03885-32323 (O), 322733 (R)

DAMPA TR

Getting there
The Project Tiger Director is located at West Phaileng (~110 km from Aizawl). It takes 4½ hrs by Sumo (leaves at 1300 hrs from Aizawl). There are also several buses throughout the day. The FRH is at Terei (~14 km from W. Phaileng).

Address
Project Tiger Director
P.O. West Phaileng, Dist. Mamit
796 431 Mizoram
Ph: 0389-329339 (R), 322733 (O).