Synopsis

Understanding the patterns and processes generating biodiversity is fundamental to ecology and evolutionary biology, and studying diversification can give us key insights into this process. In my thesis, I investigate diversification patterns of lineage and morphology to understand the underlying climatic processes that have shaped these patterns. Peninsular India provides an exciting historical context to study diversification. The first chapter gives a brief introduction to the framework used to study lineage and morphological diversification, climate and geological history of Peninsular India, and the model system used in this thesis. *Hemidactylus* geckos— commonly called 'house geckos'— are found in a wide range of habitats and climatic zones, and are an excellent model system to address this question. However, given the dearth of studies in the tropics, especially the dry zone of Peninsular India, a large proportion of the diversity is undescribed. Therefore, the first task was to carry out systematic sampling accompanied by species delimitation, before addressing questions regarding diversification in this group.

Molecular data are increasingly being used to resolve cryptic species complexes; however, subsequent formal species description and taxonomic revisions often remain incomplete. Given that most species are described based on morphology-based alpha taxonomy, one cannot resolve nomenclatural issues of species complexes without the aid of morphology. In the second chapter, I aim to resolve the taxonomic status of a long-known human commensal and cryptic species complex— *Hemidactylus brookii*. Based on samples collected opportunistically across India, I analysed molecular as well as morphological data. While the molecular data resulted in identification of genetically distinct clades, morphological data yielded evidence to support clades retrieved by molecular data. Based on morphological data available on synonyms, the nomenclatural issues as well as taxonomic status of these species were resolved. The study also revealed that the *H. brookii* complex in India includes two commensal species, *H. parvimaculatus* and *H. murrayi*.

Furthermore, these two lineages have independently acquired adaptations that could have assisted them in exploiting human habitat.

The third chapter focuses on the larger Indian radiation, and has three broad sections –
1. Species delimitation using multispecies coalescent based approach. 2. Pattern of lineage diversification and 3. Pattern of morphological diversification. I delimit 40 putative species within the Indian radiation which is over 30% increase in diversity in this group. These lineages were then used for further analysis. With regard to the pattern of diversification, I found an early-burst in lineage accumulation. To understand if this radiation exhibits ecomorphs, based on habitat preferences we catagorised these geckos into four groups— terrestrial, rupicolous, arboreal and human commensal geckos. However, morphological data revealed presence of two broad ecomorphs— terrestrial geckos and scansorial geckos (consisting of rupicolous, arboreal and human commensal species). I also found that there was a delayed accumulation of disparity in morphology, which occurred ~15 Million years ago (Ma).

In the fourth chapter, I investigate the possible role of climate in generating these patterns of lineage and morphological diversification. Previous studies suggest that *Hemidactylus* dispersed into India after the Indian plate collided with Asia around 45 Ma. This lineage then underwent rapid radiation between 44 to 31 Ma, which coincides with the Eocene-Oligocene cooling. The Eocene-Oligocene cooling is purported to have led to extinction of several tropical rainforest flora and coincides with the appearance of drier forms. Given that species in the Indian radiation are distributed in the dry as well as wet zone, using ancestral trait reconstruction I demonstrate that the ancestor of this radiation was a dry zone adapted species. Therefore, I propose that this global cooling, which resulted in drier environment, might have provided numerous unoccupied niches for the recently dispersed *Hemidactylus* lineage to exploit. This scenario was supported by the early burst in lineage accumulation seen in this group. Interestingly morphological disparity did

not track the trend in lineage diversification over time, with much of the disparity accumulating after 15 Ma. To understand the drivers of this pattern, ancestral state reconstruction of scansorial and terrestrial geckos was carried out. Results show that the terrestrial geckos have evolved independently at least five times. The earliest diversification began ~ 22–14 Ma, followed by the evolution of other ground dwelling lineages more recently. Most of diversification in the terrestrial lineages coincide with the intensification of monsoon seasonality during late Miocene, which initiated the establishment of open grassland habitats. Thus establishment of grasslands might have facilitated the evolution of the terrestrial lineages.

The fifth chapter summarises the conclusions of each chapter in brief. My findings indicate that climate has been a key factor shaping the lineage as well as morphological diversification in this group. Understanding the broad ancestral climatic niche of *Hemidactylus* also provides an insight into the climatic history of Peninsular India.