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Diversity and distribution of gekkonids of the Andaman & Nicobar Islands:

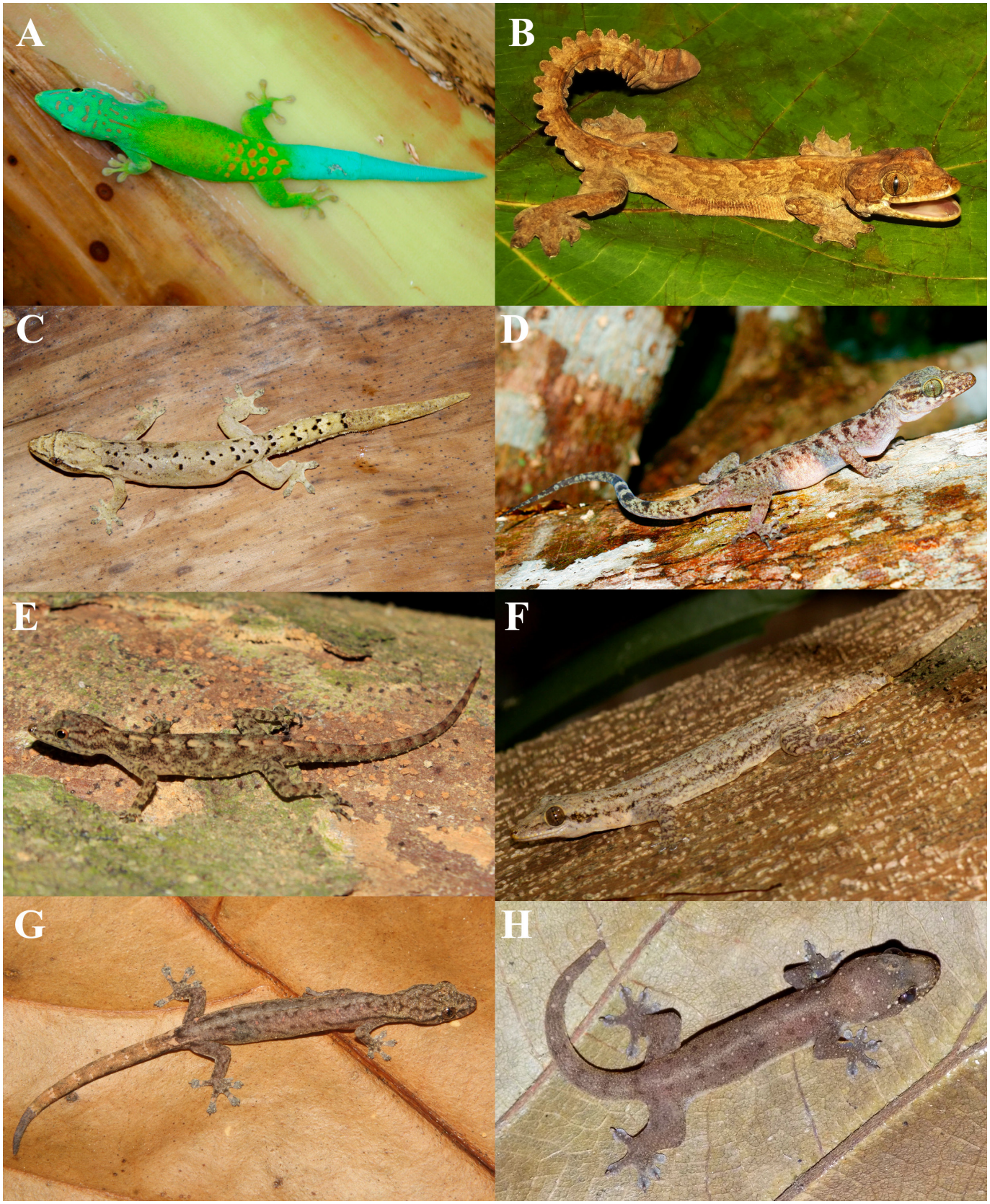
An overview of past studies to the present scenario, with an updated checklist and future prospects

Gekkonids are one among the most diverse and relatively ancient group of reptiles and currently comprise about 1,472 species worldwide (Uetz et al. 2021). Southeastern Asia is one of the global hotspots of gekkonid diversity and is home to several major regional radiations such as *Cyrtodactylus*, *Cnemaspis*, *Gekko*, *Hemiphyllodactylus* etc. (Uetz et al. 2021).

Within the southeastern Asian region, the Andaman & Nicobar Islands situated to the south of the Burmese Peninsula and to the north of the Sundaic Island of Sumatra span across the extremities of two global biodiversity hotspots namely Indo-Burma (Andamans) and the Sundaland (Nicobars). Together, their land area totals to about 8250 km^2. Habitats in these islands range from mangrove creeks along the coast through littoral, dry evergreen, tropical wet evergreen up to stunted montane forests on hilltops, thus providing a fairly vast array for the species to occupy.

Studies on Gekkonidae in the Andaman & Nicobar Islands date back to the discovery of two new species *Puellula rubida* (now *Cyrtodactylus rubidus*) and *Phelsuma andamanense* (now *Phelsuma andamanensis*) described in the report of the erstwhile curator of the Asiatic Society of Bengal (Blyth 1861). Three years later, Tytler (1865) described the large bodied species *Gekko verreauxi* from the Andaman Islands. Steindachner (1867) reported *Ptychozoon homalocephalum* (now *Gekko nicobarensis*) from the Nicobars. This was followed by that of Stoliczka (1873), who described the dwarf gecko *Gymnodactylus wicksi* (now *Cnemaspis*) from Preparis Island (a part of the Andaman chain) that is currently within the political boundary of Myanmar.

Subsequently, Annandale (1905) described *Gonatodes andersonii* (now *Cnemaspis*) from the isolated eastwardly island of Narcondam, in the Andaman archipelago. He reported some additional species such as *Hemidactylus frenatus*, *Gehyra mutilata*, *Gekko stentor*, *G. verticillatus*, and *Lepidodactylus lugubris* in addition to those known previously.



Representative gekkonids from various genera occurring in the Andaman & Nicobar Islands: A—*Phelsuma andamanensis* | B—*Gekko nicobarensis* | C—*Lepidodactylus* cf. *lugubris* | D—*Cyrtodactylus rudidus* | E—*Cnemaspis andersonii* | F—*Hemidactylus* cf. *platyurus* | G—*Hemiphyllodactylus* cf. *typus* | H—*Gehyra* cf. *mutilata*.

Smith (1935) in his monograph on lizards of British India and the adjacent regions listed nine species of gekkonids from the Andaman & Nicobar Islands. He also synonymized the two *Cnemaspis* species, *andersonii* and *wicksi* under the Ceylonese taxon *Cnemaspis kandiana* (see Smith 1940). Decades later, Biswas & Sanyal (1977) reported four species of gekkonids from Great Nicobar Island, which included two more additional species, namely—*Hemiphyllodactylus typus typus* (now *H. typus*) and *Platyurus platyurus* (now *Hemidactylus platyurus*)—bringing the total number of geckos in these archipelagos to 11. Within a short while, Biswas & Sanyal (1980) listed and retained the same 11 species of gekkonids from the Andaman & Nicobar Islands. Ota et al. (1991) revalidated *Gekko verreauxii* from the synonymy of *Gekko smithii*. Ratnam (1992) studied the distribution and behavior of *Phelauma andamanensis*.

The subsequent list of Geckos from the Andaman & Nicobar Islands by Das (1994) included 10 species, and lacked the mention of *Hemidactylus platyurus* while still retaining *Gekko gekko*. Later, Das (1997) added another new gekkonid *Cyrtodactylus adleri* from the Nicobar Islands. Subsequently, Das (1999) listed eight species each from the Andaman & Nicobar archipelagos respectively, with four species being shared between the two, totaling to 12 species in the Andaman & Nicobar archipelago in total.

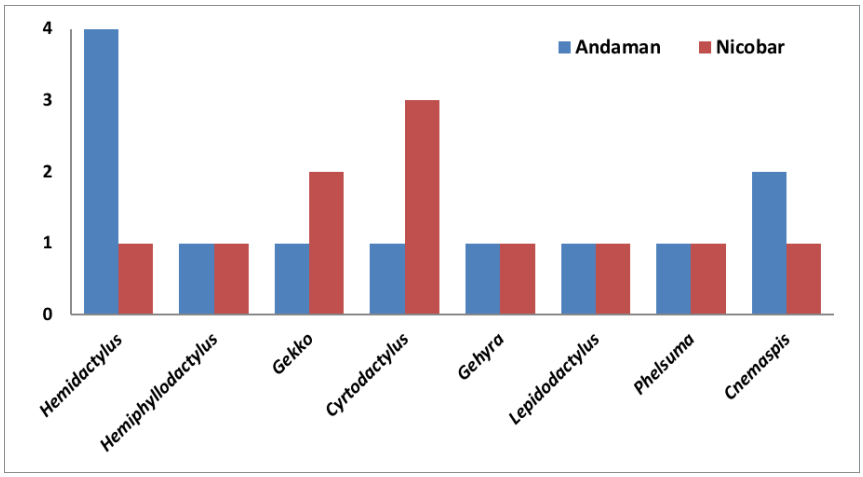
The next list of Gekkonids by Vijayakumar (2005) included nine species from the Nicobar Islands including a doubtful record of *Hemidactylus garnotii* and a purported new species of *Cyrtodactylus*. Also, he considered the *Cnemaspis* cf. *kandiana* to represent a potentially new species. However, no attempt was made to resolve any of these uncertainties. Manamendra-Arachchi et al. (2007) revalidated *Cnemaspis andersonii* and *C. wicksi* as distinct species from the Sri Lankan endemic *C. kandiana*. Later, Das & Vijayakumar (2009) described a new species *Ptychozoon nicobarensis* from the Nicobar archipelago, which has been transferred to the genus *Gekko* recently (Wood et al. 2020).

The next list of geckos of the Andaman & Nicobar Islands by Harikrishnan et al. (2010) included 13 species and excluded one of the purported new *Cyrtodactylus* sp. listed by Vijayakumar (2005). Chandramouli et al. (2012) reported *Hemiphyllodactylus typus* from the Andaman Archipelago for the first time. Later, Chandramouli (2015) reported *Hemidactylus* aff. *brookii* (now *H.* cf. *murrayi* fide Mahony 2011; Lajmi et al. 2016) from Port Blair. Subsequently, the till then Andaman endemic *Phelsuma andamanensis* was reported for the first time from the Nicobar archipelago (Chandramouli 2017). This was followed by the first report of a predominantly south Asian gekkonid *Hemidactylus leschenaultii* from the Andaman Islands by Gokulakrishnan et al. (2019). Further observations on courtship and breeding behaviour of *Phelsuma andamanensis* were reported by Chandramouli (2020a).

Very recently, three new gekkonids namely *Cnemaspis nicobaricus*, *Cyrtodactylus nicobaricus*, and *Cyrtodactylus camortensis* have been described from the Nicobar

Islands, bringing the total species of geckos to 18 in the Andaman & Nicobar archipelago (Chandramouli 2020b,c). Mohan (2020) provided an update on island-wise occurrence records of gekkonids in the Andaman & Nicobar Islands, albeit overlooking the previously published record of *Cnemaspis nicobaricus* from Little Nicobar (Chandramouli 2020b) and the description of two new *Cyrtodactylus* species from the Nicobar Islands (Chandramouli 2020c). Lastly, the systematic status of the Nicobar population of *Gekko smithii* was reassessed by Chandramouli et al. (2021), who described it as a distinct species, *Gekko stoliczkai* endemic to the southern Nicobar Islands.

Trend-line showing the rate of addition of gekkonids to the Andaman & Nicobar Islands.



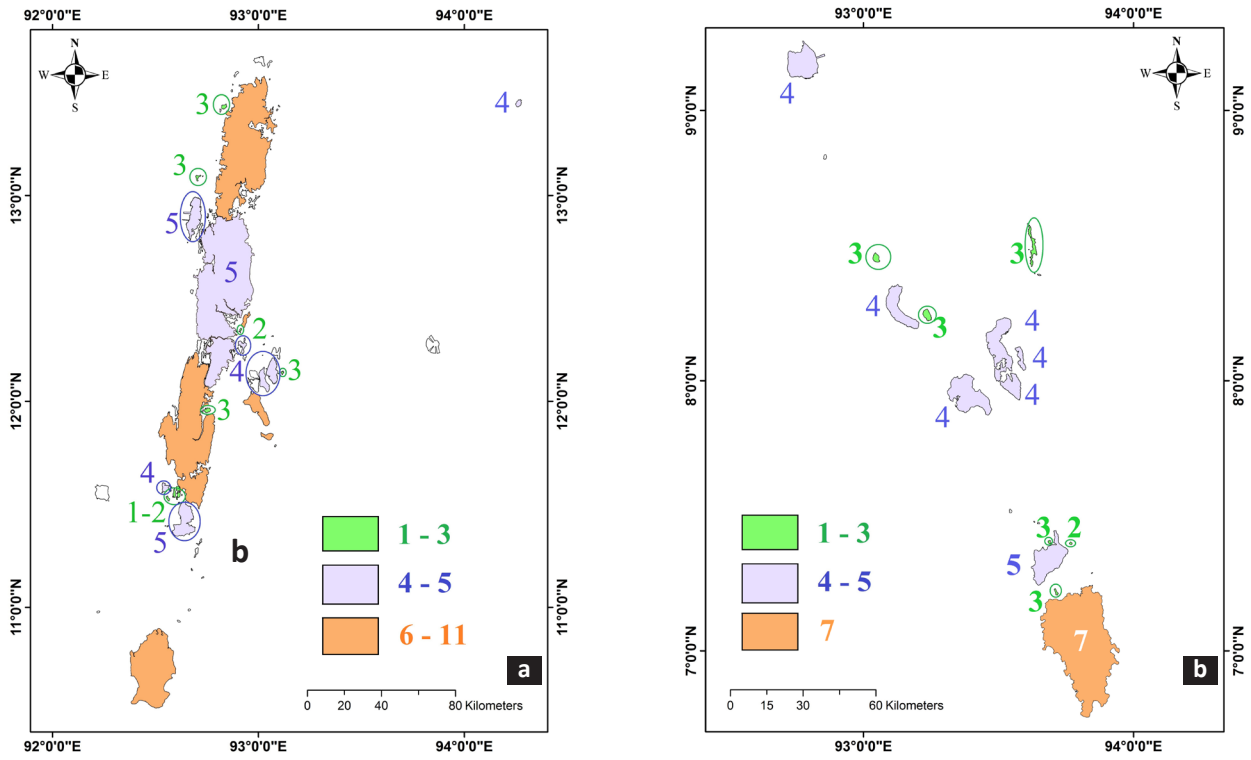
Taxonomic composition of the gekkonid fauna of the Andaman & Nicobar Islands.

The current diversity of gekkonids in the Andaman & Nicobar archipelago is dominated by the genera *Hemidactylus* and *Cyrtodactylus* with four species each, of which, the former constitutes the more cosmopolitan species while the latter comprises of regional endemics (Chandramouli 2020c; Uetz et al. 2021). They are closely followed by the genera *Cnemaspis* and *Gekko*, which are represented by three species each. The largely Melanesian genera *Gehyra* and *Lepidodactylus* as well as the genus *Hemiphyllodactylus* constitute one species each along with another unique representative from the predominantly Malagasy genus *Phelsuma*. The generic diversity between the Andaman and the Nicobar archipelagos is nearly similar with eight genera (*Cnemaspis*, *Cyrtodactylus*, *Gehyra*, *Gekko*, *Phelsuma*, *Hemidactylus*, *Lepidodactylus*, and *Hemiphyllodactylus*) being common between the two island groups. At the species level, 12 species are known from the Andaman Islands

while 11 species have been reported from the Nicobar Islands. Five species namely *Hemidactylus frenatus*, *Hemiphyllodactylus* cf. *typus*, *Phelsuma andamanensis*, *Lepidodactylus* cf. *lugubris*, and *Gehyra* cf. *mutilata* are shared between the Andaman & Nicobar group of Islands. The presence of *H.* cf. *platyurus* in the Nicobars reported by Tiwari & Biswas (1973) needs further confirmation. Hence, its presence in the Nicobar Islands is not regarded authentic herein until further confirmation.

The proportion of endemism is 41% (5/12) for the Andaman Islands while it is higher, at 64% (7/11) for the Nicobar Islands, owing to the addition of four newly described endemic species (Chandramouli 2020b,c; Chandramouli et al. 2021).

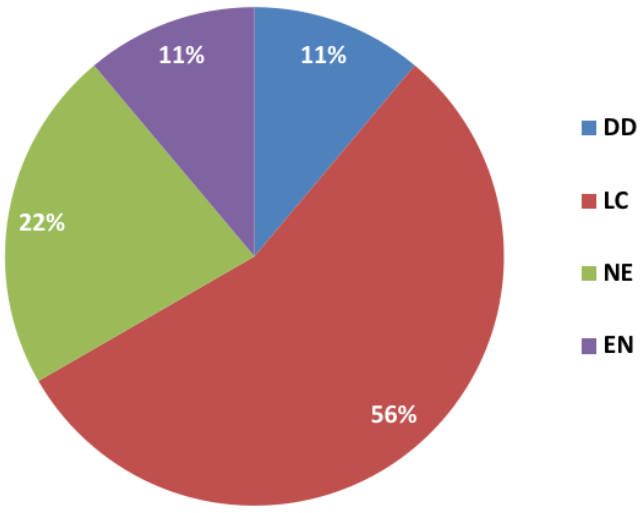
A map of species richness patterns of gekkonids of the Andaman & Nicobar Islands shows that it varies from 1–11 in the Andaman archipelago. North, South, Little Andaman Havelock, Neil, and Long Island among the sampled ones had 6–11 species, while Middle Andaman, Interview, Baratang, Rutland, Tarmugli, John Lawrance, and Henry Lawrance Islands had 4–5 species of geckos. Kyd, Inglis, North Reef, Paget, other islands of the Labyrinth archipelago and Guitar Island had 1–2 species of geckos. In the Nicobar archipelago, the island-wise species richness ranged from 2–7, with the majority of the islands having 4–5 species of gekkonids, with just six islands having 2–3 species.



Map of the Andaman (a) & Nicobar Islands (b) showing gekkonid species richness.

Table 1. Checklist of geckos of the Andaman & Nicobar Islands with their respective distribution ranges within the Islands.

Species	Distribution in A&N Islands	IUCN Red List status
Cnemaspis andersonii (Annandale, 1905)	Andaman Islands	DD
Cnemaspis nicobaricus Chandramouli, 2020	Great and Little Nicobar Islands	NE
Cnemaspis wicksi (Stoliczka, 1873)	Preparis Island, Andaman (now in Myanmar)	DD
Cyrtodactylus adleri Das, 1997	Southern Nicobar Islands	EN
Cyrtodactylus camortensis Chandramouli, 2020	Central Nicobar Islands	NE
Cyrtodactylus nicobaricus Chandramouli, 2020	Car Nicobar	NE
Cyrtodactylus rubidus (Blyth, 1861)	Andaman Islands	LC
Gehyra cf. *mutilata* (Weigmann, 1834)	Andaman & Nicobar Islands	LC
Gekko nicobarensis (Das & Vijayakumar, 2009)	Northern & central Nicobar Islands	EN
Gekko stoliczkai Chandramouli et al., 2021	Southern Nicobar Islands	NE
Gekko verreauxi Tytler, 1864	Andaman Islands	LC
Hemidactylus frenatus Dumeril & Bibron, 1836	Andaman & Nicobar Islands	LC
Hemidactylus leschenaultii Dumeril & Bibron, 1836	South Andaman	LC
Hemidactylus cf. *platyurus* (Schneider, 1792)	Andaman Islands	LC
Hemidactylus cf. *murrayi* Gleadow, 1887	Andaman Islands	LC
Hemiphyllodactylus cf. *typus* Bleeker, 1860	Andaman Islands & Great Nicobar	LC
Lepidodactylus cf. *lugubris* (Dumeril & Bibron, 1836)	Andaman Islands & Great Nicobar	LC
Phelsuma andamanensis Blyth, 1861	Andaman Islands & Car Nicobar	LC



Conservation status of gekkonids as per the IUCN Red List.

An analysis of the conservation status of gecko fauna of the Andaman & Nicobar Islands reveals that a fairly high proportion (56%) are of 'Least Concern', followed by those that still remain yet to be assessed formally (22%), 11% still remain in the 'Data Deficient' category while 11% are under the 'Endangered' category. Taxonomic status of five species—*Gehyra* cf. *mutilata*, *Hemidactylus* cf. *platyurus*, *Hemidactylus* cf. *murrayi*, *Hemiphyllodactylus* cf. *typus*, and *Lepidodactylus* cf. *lugubris*—are currently uncertain and are in need of further rigorous

assessment based on various criteria (pers. obs.). It is speculated that future studies on some of these species could possibly prove some of them to be specifically distinct from the nominate forms, thereby increasing the uniqueness of the gekkonid fauna of the Andaman & Nicobar Islands further.

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