



Phylogenetic systematics of day geckos, genus *Phelsuma*, based on molecular and morphological data (Squamata: Gekkonidae)

SARA ROCHA^{1,2,3}, HERBERT RÖSLER⁴, PHILIP-SEBASTIAN GEHRING⁵, FRANK GLAW⁶,
DAVID POSADA³, D. JAMES HARRIS^{1,2}, & MIGUEL VENCES^{5,7}

¹CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal

²Departamento de Biologia, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre FC4, 4169-007 Porto, Portugal

³Departamento de Bioquímica, Genética e Immunología, Facultad de Biología, Universidad de Vigo, Vigo 36310, Spain

⁴Senckenberg Naturhistorische Sammlungen Dresden, Museum für Tierkunde, Sektion Herpetologie, Königsbrücker Landstr. 159, 01109 Dresden, Germany

⁵Technical University of Braunschweig, Zoological Institute, Spielmannstr. 8, 38106 Braunschweig, Germany

⁶Zoologische Staatssammlung München, Münchhausenstr. 21, 81247 München, Germany

⁷Corresponding author. E-mail: m.vences@tu-bs.de

Table of contents

Abstract	2
Introduction	2
Material and methods	3
Results and discussion	4
<i>Phelsuma barbouri</i> group	9
<i>Phelsuma dubia</i> group	11
<i>Phelsuma mutabilis</i> group	13
<i>Phelsuma cepediana</i> group	13
<i>Phelsuma astriata</i> group	14
<i>Phelsuma madagascariensis</i> group	15
<i>Phelsuma lineata</i> group	19
<i>Phelsuma laticauda</i> group	23
<i>Phelsuma klemmeri</i> group	23
<i>Phelsuma andamanense</i> group	24
<i>Phelsuma standingi</i> group	24
Species not assigned to any species group	24
Conclusion	25
Acknowledgements	25
References	26

Abstract

We review the intrageneric systematics of day geckos, genus *Phelsuma* (Squamata: Sauria: Gekkonidae) in the light of a recently published multigene phylogeny, and provide an overview of 19 selected chromatic, morphological and behavioural characters for all currently recognized species and subspecies in the genus. To replace previous attempts of dividing the genus into phenetic species assemblages, we propose the following monophyletic species groups and summarize the morphological characters that partly support this grouping: *Phelsuma barbouri* group (*P. barbouri*, *P. pronki*); *P. dubia* group (*P. berghofi*, *P. dubia*, *P. flavigularis*, *P. hielscheri*, *P. malamakibo*, *P. modesta*, *P. nigristriata*, *P. ravenala*); *P. mutabilis* group (*P. borai*, *P. breviceps*, *P. mutabilis*); *P. cepediana* group (*P. borbonica*, *P. cepediana*, *P. guentheri*, *P. guimbeui*, *P. inexpectata*, *P. ornata*, *P. rosagularis* as well as the extinct species *P. edwardnewtonii* and *P. gigas*); *P. astriata* group (*P. astriata*, *P. sundbergi*); *P. madagascariensis* group (*P. abbotti*, *P. grandis*, *P. guttata*, *P. kochi*, *P. madagascariensis*, *P. parkeri*, *P. seippi* and probably *P. masohoala*); *P. lineata* group (*P. antanosy*, *P. comorensis*, *P. kely*, *P. lineata*, *P. pusilla*, *P. quadriocellata* and probably *P. hoeschi*); *P. laticauda* group (*P. laticauda*, *P. pasteuri*, *P. robertmertensi*, *P. v-nigra*); *P. klemmeri* group (*P. klemmeri*); *P. andamanense* group (*P. andamanense*) and *P. standingi* group (*P. standingi*). Due to their equivocal placements based on different molecular markers, we refrain from assigning *P. serraticauda* and *P. vanheygeni* to any of these species groups at this time. We complement the molecular data with new trees based on partial sequences of the 16S rRNA gene for the *P. madagascariensis*- and *P. lineata* groups and propose to elevate *P. lineata dorsivittata* and *P. quadriocellata parva* to full species rank as *P. dorsivittata* and *P. parva*.

Key words: Squamata: Gekkonidae: *Phelsuma*, *Phelsuma parva*, *Phelsuma dorsivittata*; Andamans; Comoros, Madagascar, Mascarenes, Seychelles, species groups

Introduction

Day geckos, genus *Phelsuma* Gray, are one of the most prominent groups of lizards of the Malagasy region. They are naturally distributed on most islands and in the western Indian Ocean, and have additionally been widely introduced, both in remote locations like Hawaii (Lever 2003), Florida (Krysko *et al.* 2003), and Moorea, French Polynesia (Ota & Ineich 2006) as well as in closer archipelagos like the Mascarenes (Checke & Hume 2008). Most of the circa 44 species of *Phelsuma* occur on Madagascar, but these geckos have also naturally colonized the Comoros, Mascarenes, Seychelles, Andamans, Zanzibar and Pemba, as well as several other small islands and a few localities on the East African mainland. *Phelsuma* are colourful lizards of great morphological homogeneity, with round pupils (except *P. guentheri*) and undivided toe lamellae. A putative synapomorphy of *Phelsuma* might be the contact between the prefrontal and postorbitofrontal bones, a feature otherwise only present among pygopodids (see Daza & Bauer 2010). Besides body size, few morphological characters are known that can be used to distinguish species, or define species groups within *Phelsuma*, and their taxonomy is largely based on colour that ranges from bright green, with red spots and markings in most species, to dull grey or brownish in a few others.

Despite the extensive published works on *Phelsuma* taxonomy, ecology, biogeography and ethology (Loveridge 1941, 1942; Mertens 1954, 1963a, 1963b, 1964, 1966; Cheke 1975, 1981, 1982; Meier 1982; Gardner 1986, 1987; Losos 1986; Radtkey 1996; Meier & Böhme 1991, 1996; Krüger 1996c; Ikeuchi *et al.* 2005; Van Heygen 2004) there are still many uncertainties, even regarding the alpha-taxonomy of these lizards. Many taxa, especially subspecies, have been described only based on chromatic characters, and many are poorly defined. In several cases colour transitions/polymorphisms can be observed and thus some subspecies and even species may represent artificial taxa based on local colour morphs (Glaw and Vences 1994). Loveridge (1942) made the first important attempt to sort out relationships within these day-geckos, in the form of a phenetic key, and Mertens (1962) in a review of *Phelsuma* designated informal species groups within the genus based on the same characters used by Loveridge. This classification has since been revised and updated (Glaw & Vences 1994; Glaw *et al.* 1999; Van Heygen 2004). The latter author defined nine Malagasy species groups, based on phenetic characters: *P. barbouri* group (*P. barbouri*), *P. guttata* group (*P. abbotti*, *P. guttata*, *P. masohoala*, *P. seippi*), *P. madagascariensis* group (*P. madagascariensis* [including *P. grandis* and *P. kochi* as subspecies], *P. standingi*), *P. lineata* group (*P. kely*, *P. lineata*, *P. pusilla*, *P. quadriocellata*), *P. mutabilis* group (*P. breviceps* and *P. mutabilis*), *P. laticauda* group (*P. antanosy*, *P.*