

A CHECKLIST OF THE VERTEBRATES OF KERALA STATE, INDIA

P.O. Nameer¹, Praveen J², A. Bijukumar³, Muhamed Jafer Palot⁴, Sandeep Das⁵ & Rajeev Raghavan^{6,7}

¹ Centre for Wildlife Studies, College of Forestry, Kerala Agricultural University, KAU (PO), Thrissur, Kerala 680656, India

² B-303, ShriramSpurthi, ITPL Main Road, Brookefields, Bengaluru, Karnataka 560037, India

³ Department of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram, Kerala 695581, India

⁴ Zoological Survey of India (ZSI), Western Ghat Regional Centre, Jafar Khan Colony, Eraniel, Kozhikode, Kerala 673006, India

⁵ Forest Ecology and Biodiversity Conservation Division, Kerala Forest Research Institute (KFRI), Peechi, Kerala 680653, India

⁶ Center for Taxonomy of Aquatic Animals, Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, Kerala 682506, India

⁷ Laboratory of Systematics, Ecology and Conservation, Zoo Outreach Organization (ZOO), Coimbatore, Tamil Nadu 641035, India

¹ nameer.po@kau.in (corresponding author), ² paintedstork@gmail.com, ³ bijupuzhayoram@gmail.com,

⁴ palot.zsi@gmail.com, ⁵ sandeep.koodu@gmail.com, ⁶ rajeevraq@hotmail.com



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Abstract: Following the first publication on vertebrates of India (Blanford 1888–1890), a huge wealth of information has been compiled on the vertebrate fauna of various biogeographic zones of the country, especially the Western Ghats. The state of Kerala comprising of a land area of 38,863km², 590km coastline, an intricate system of backwaters along the coast, tropical moist forests of the Western Ghats, the highly undulating terrain, and the tropical monsoon is a unique geographical and environmental entity rich in biodiversity. A region-specific checklist that summarises and documents the current status of vertebrate diversity provides benchmark data for documentation and appreciation of biodiversity at regional level. Further, with the current rate of global biodiversity loss and concordant conservation efforts, the taxonomic community has a greater responsibility to make scientific information available to scientists, policy makers, politicians, research students and all relevant stakeholders, an attempt that has been made in the present paper. The State of Kerala has 1847 species of vertebrates in 330 families and 81 orders, of which 386 are endemic to the Western Ghats region (of the Western Ghats - Sri Lanka Hotspot), and 205 species as threatened. Six hundred and eighty species of vertebrates of Kerala have been listed in the various schedules of the Indian Wildlife (Protection) Act, while 148 are listed in the different appendices of CITES.

Keywords: Amphibians, birds, CITES, freshwater fishes, Indian Wildlife (Protection) Act, IUCN conservation status, Malayalam name, mammals, marine fishes, reptiles, vernacular name, Western Ghats.

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For **Author Details** and **Malayalam Abstract** see end of this article.

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INTRODUCTION

With a diversity of 5,411 mammals (Wilson & Mittermeier 2009), 10,027 birds (Dickinson & Remsen 2013; Dickinson & Christidis 2014), 10,178 reptiles (Uetz & Hosek 2014), 7,356 amphibians (Frost 2015), and 33,059 fishes (Eschmeyer & Fong 2014) inhabiting most of the major habitat types, occupying nearly all elevations and depths, and displaying remarkable variations in body size and life histories, vertebrates play vital roles in ecosystems, despite comprising only about 3% of global biodiversity (Hoffman et al. 2010).

The Western Ghats region (part of the Western Ghats - Sri Lanka Biodiversity Hotspot), represents a macrocosm of India's biodiversity. Close to 39% of the vertebrates occurring in this hotspot are endemic (Anon 2009). However, biodiversity of the Western Ghats has been extensively modified for human settlement by forest clearing and resultant habitat fragmentation, unsustainable exploitation of resources, land conversion specifically for monocrop plantations, invasive alien species and climate change (WGEEP 2011). Further, the highly productive coastal ecosystems along the western coast of India are also under severe stress due to increasing developmental activities in the coastal zone, pollution, over harvesting and climate change (KSCSTE 2005). Surprisingly, there are very few datasets available on the status of individual species, and checklists and catalogues presenting updated information on status of biodiversity, even for groups like vertebrates. Conversely, the Strategic Plan for Biodiversity 2011–2020, a 10-year framework of the Convention on Biological Diversity (CBD) demands for action by all countries and stakeholders to save biodiversity and enhance its benefits for people (Anon 2013). This requires concerted efforts by all parties to the CBD to properly document and protect biodiversity.

A checklist of fauna is a basic inventory for management of a biological landscape. Large administrative units handling the ministries of environment, forests, natural resources or wildlife for a country or state/province develop and implement their plans based on such inventories. Habitat and park managers use checklists of flora and fauna, possibly with annotations on conservation priority and threat status, to judiciously manage the habitats understanding the cost-benefits of each conservation action. However, lack on synchrony between the checklists of different classes; over-representation of one class over the other due to emphasis laid due to a particular study, and mismatch in the standards used to assess threat levels can all impact

the management practice. For any park manager, the dream would be to maintain a single inventory of all flora and fauna found in the park, derived from a survey with bare minimum essentials laid out in a uniform fashion and a timely updation of this list maintaining the same principle.

Compared to countries in the Western Hemisphere (Banks et al. 1987; Hanel et al. 2009), there have been very few attempts in India to produce comprehensive and synchronised faunistic checklists. The Zoological Survey of India (ZSI) has published faunal series on the States of Orissa (1987), West Bengal (1992), Meghalaya (1995), Delhi (1997), Gujarat (2000), Sikkim (2003), Manipur (2004), Nagaland (2006), Arunachal Pradesh (2006), Mizoram (2007), Goa (2008), Tamil Nadu (2009), Meghalaya (2012), Andaman & Nicobar Islands (2012), Uttarakhand (2012) and also brought out a series on fauna of conservation areas and fauna of wetland ecosystems (<http://zsi.gov.in/App/content.aspx?link=199>). Johnsingh (2001) published a comprehensive vertebrate checklist of the Kalakkad-Mundanthurai Tiger Reserve in Tamil Nadu, while recently, Nair & Krishna (2013) published a vertebrate checklist for the National Chambal Sanctuary, Madhya Pradesh. The state of Kerala is perhaps the only one in India which has a checklist of forest trees (Sasidharan 2000). In addition there are also some independent checklists for mammals, birds, reptiles, amphibians and fishes from Kerala, and this compilation is a natural extension at integrating all of them.

METHODS, DEFINITIONS AND DATA SOURCES

This checklist covers both terrestrial (including freshwater) and marine vertebrate classes including Pisces (Fishes), Amphibia (Amphibians), Reptilia (Reptiles), Aves (Birds) and Mammalia (Mammals) recorded from the state of Kerala (as on 1 March 2015). Political boundaries of the state of Kerala are as defined by the Government of India. For marine vertebrates, the maritime limits for continental fauna which is typically defined as extending till 200 nautical miles from the coast or a median between two political entities if they are closer than 400 nautical miles has been followed. This matches the definition for the Exclusive Economic Zone (EEZ) of a country and that the biological resources (including their conservation measures) present in this zone belongs to the country. For the sake of the present checklist, the maritime limit is the median between the coast of Kerala and

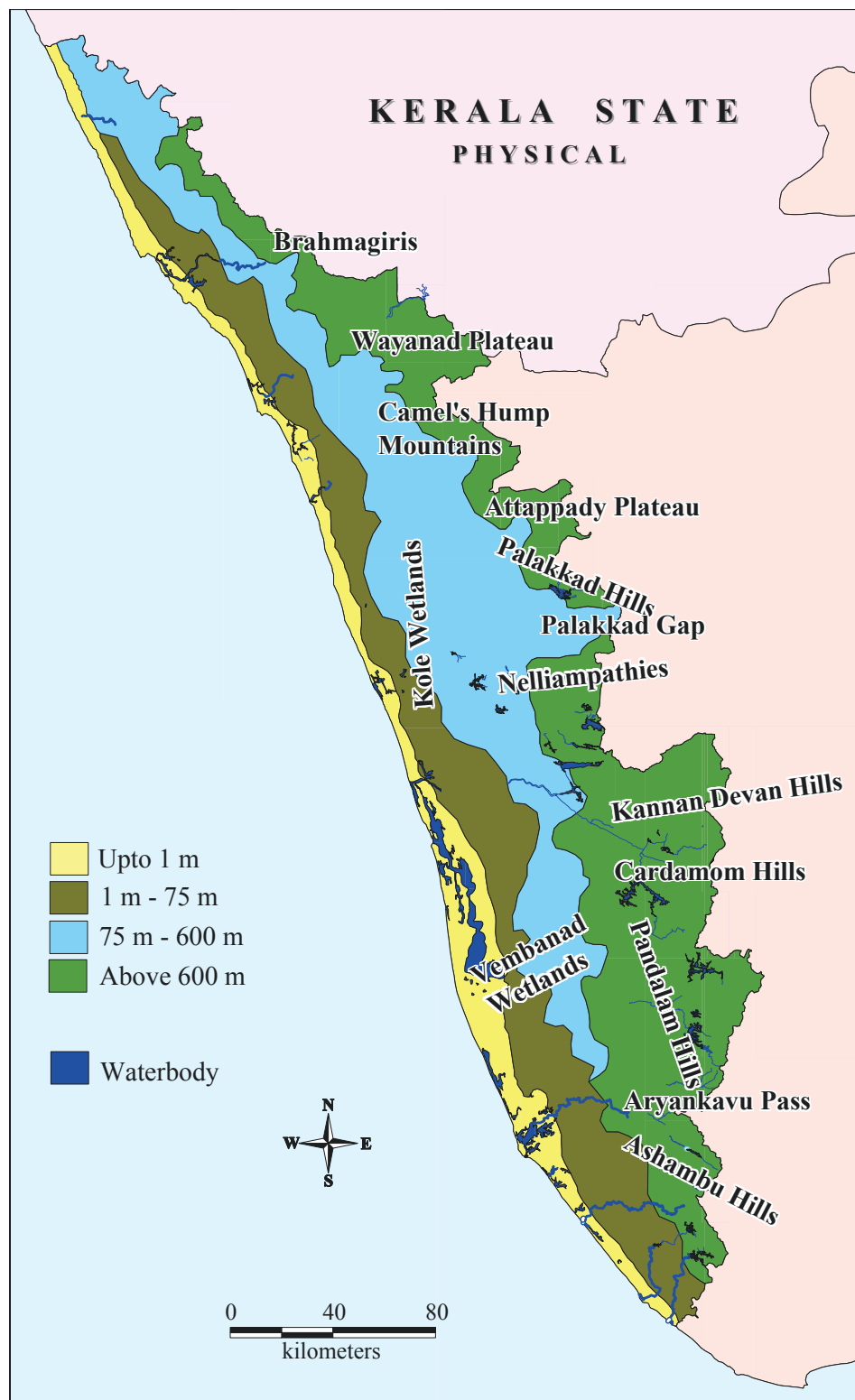


Figure 1. Physical map of Kerala

the islands of Lakshadweep, the nearest political entity across the Arabian Sea (Fig. 1). Care has been taken to ensure that the list is as authentic and up-to-date as

possible and therefore certain species that have been recorded with less remarkable evidence or a subject of a challenge have been excluded (see details in remarks

within each taxonomic section). Species that were once known to occur and are currently 'extirpated' or 'extinct' and species with naturalised population are included with appropriate notes. Escapees of exotic species that do not have a viable breeding population have not been included. No distinction is made between resident and migratory species, or between those that occur regularly and those of casual or accidental occurrence.

Taxonomy and Nomenclature

Taxonomy followed for each group is based on well-accepted primary literature/s (see individual papers). Wherever there was a pressing need to deviate from the standard taxonomy, the same has been stated explicitly in notes. Recent changes in taxonomy and/or contradicting opinions and views are covered as specific footnotes. Though Malayalam (local language of the state of Kerala) names for the mammal and bird species followed standard references (Ali 1969; Prater 1971; Neelakantan 1984; Radhakrishnan 1997; Nameer 2000; Palot & Radhakrishnan 2003; Grimmet et al. 2007; Sashikumar et al. 2011), there was a need to coin new vernacular names for fishes, amphibians and reptiles; as well as several species of mammals and birds not covered in the above references. Additional Malayalam names were also suggested where the existing name was not ideal. Google transliteration was used to complete the phonetic Latin transliteration of the Malayalam names.

IUCN Red List of Threatened Species™

The International Union for Conservation of Nature (IUCN) maintains the Red List of Threatened Species™, an inventory of the extinction risk and conservation status of the world's species. Information on the conservation status of all taxa listed in this checklist was retrieved from the IUCN Red List of Threatened Species (www.iucnredlist.org), whose underlying assessments are based on the IUCN Red List Categories and criteria (version 3.1) (IUCN 2001). Additionally, the results of the recent assessments for some of the groups of mammals (Molur et al. 2003; 2005), reptiles (Srinivasulu et al. 2014), and freshwater fishes (Dahanukar et al. 2011) were also consulted. BirdLife International annually updates the threat status of birds and the 2015 assessment published in October is followed here. For details on the IUCN Red Listing process, refer to Mace et al. (2008), Hoffman et al. (2010) and Collen et al. (2014). *Raorchestes travancoricus* was thought to be extinct (Biju 2004) as on 1 March 2015, the cut off date fixed on the records of the vertebrates from Kerala for this monograph. However, the recent IUCN assessment (2015.3) has elevated the

status of *Raorchestes travancoricus* to Endangered (IUCN SSC Amphibian Specialist Group 2015), which is followed here.

Endemism

Only two levels of endemism are mentioned and discussed in the checklists, viz., Kerala (KL) and the Western Ghats (WG). Other cases of endemism or restricted ranges, wherever applicable, are indicated in the foot notes. While political boundaries of Kerala State are well-defined, it is not so for the Western Ghats region. For the sake of the present paper, we follow the boundaries of the Western Ghats as defined by Gadgil (2011). However, in certain cases, particularly for birds, some of the accepted Western Ghats endemics have got small resident populations in pockets that strictly fall outside this region in the southern Eastern Ghats or Deccan Plateau. However, such anomalies are not considered as a case to drop the endemic status of these species which are otherwise primarily restricted to the Western Ghats.

Schedules of the Indian Wildlife (Protection) Act (WPA)

Indian Wildlife (Protection) Act of 1972 amended up to 2011 forms the legal framework for conservation of flora and fauna in India. Though there was a proposal to revise the different schedules of the Wildlife (Protection) Act 1972 (MOEF 2007), this is yet to be implemented. A draft Wildlife (Protection) Amendment Bill (2013), though placed in the Rajya Sabha is also yet to be approved by the Ministry of Environment, Forests and Climate Change (MoEFCC). One of the major change suggested in the 2013 draft amendment is the inclusion of Schedule VII, which lists the species whose trade is to be regulated using the provisions of the CITES. On 26 March 2015, the MoEFCC constituted an Expert Group to revise the Schedule I of the Wildlife (Protection) Act.

The Act itself is more than 40 years old, and the taxonomy and nomenclature of species have changed since then. This brings in significant challenges in interpreting the schedule and relating to the most recent taxonomy. Our attempt to interpret the WPA schedules in the current checklist should not be considered as a replacement for WPA, or as a document with a legal standing. It can only be treated as a ready reckoner of WPA at species level for the vertebrate fauna of the state of Kerala.

The details on the fauna listed in the different schedules of the Wildlife (Protection) Act, 1972 were retrieved from the website of the MoEFCC (www.moef.nic.in/sites/default/files/wildlife11.pdf), which is

amended up to 2003.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The three Appendices of CITES form the legal framework through which a species in the international trade can be confiscated and action taken on the trader. India has been a party to the CITES since 1976 and has the legal responsibility to abide by it. Information on species that occur in Kerala which are listed in the different appendices of CITES were retrieved from the CITES website (<http://www.cites.org/eng/app/appendices.php>).

RESULTS AND DISCUSSION

a. Vertebrate diversity of Kerala

Vertebrate diversity of Kerala is represented by 1,847 species in 330 families and 81 orders (Table 1 and Fig. 2). Fishes (freshwater and marine) are the most diverse group of vertebrates (905 species), followed by birds (500 species), reptiles (173 species), amphibians (151 species) and mammals (118 species). Reptiles and amphibians are represented with fewer numbers of families and orders when compared to other vertebrate groups (Table 1, Fig. 2).

b. Vertebrates of Kerala in marine versus terrestrial environments

Forty-two percent (779 species) of the vertebrates of Kerala occur in the marine environment (Table 2, Fig. 3). Except amphibians, representatives of all other vertebrate groups occur in marine environments; however, the proportion of marine forms varies between taxonomic groups. Fishes have the greatest representatives (79%) of marine forms, followed by mammals (19%) represented by two orders Cetacea (dolphins, whales and porpoises) and Sirennia (Dugongs or Sea Cows). Among birds, the pelagic forms include members of the families Phaethontidae (tropic birds), Oceanitidae (austral storm-petrels), Hydrobatidae (northern storm-petrels), Procellariidae (petrels and shearwaters), Fregatidae (frigatebirds), Sulidae (boobies), Stercorariidae (skuas and jaegers) and certain Laridae (gulls and terns), accounting for only 6% of the total bird species of Kerala. Among reptiles, the marine forms account for ≤5% and are represented by the families Cheloniidae (sea turtles), Dermochelyidae (Leather-back Turtle) and a few members of Elaphidae (sea snakes).

Table 1. Vertebrate diversity in Kerala State

	Orders	Families	Species
Fishes	41	172	905
Amphibians	2	11	151
Reptiles	3	24	173
Birds	22	88	500
Mammals	13	35	118
All Vertebrates	81	330	1847

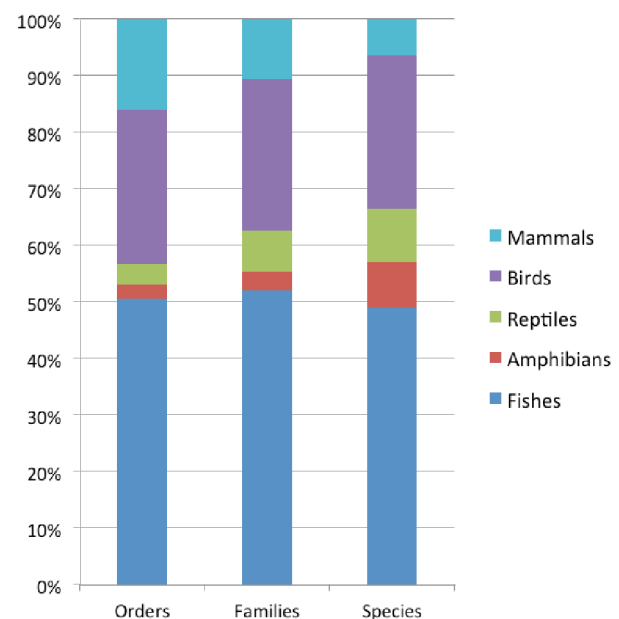


Figure 2. Percentage occurrence of different vertebrate taxa at the species, family and order level in Kerala

c. Endemism within the vertebrates of Kerala

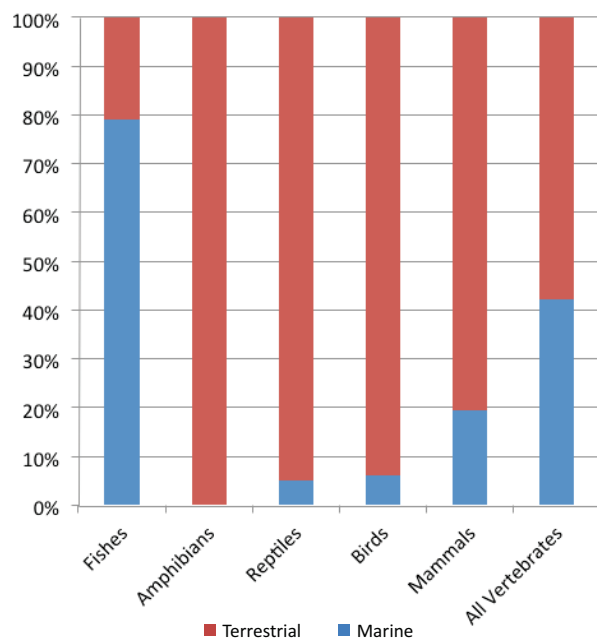
Endemism among vertebrates have been discussed under two sections, i.e., endemism within Western Ghats, and endemism with regard to the political boundaries of Kerala State.

Three-hundred-and-eighty-six species (36%) of vertebrates of Kerala are endemic to the Western Ghats and Kerala, of which 282 species (26%) are endemic to the Western Ghats, while 104 species (10%) are endemic to Kerala (Table 3, Fig. 4).

Endemism is greatest among amphibians with 90% endemic species, of which 66% are endemic to the Western Ghats, while 24% are endemic to the state of Kerala, followed by freshwater fishes (69%), of which 39% are endemic to the Western Ghats and 30% are known only from Kerala. Among the reptiles, 53% are

Table 2. Number of vertebrates of Kerala in marine and terrestrial environments

	Marine	Terrestrial
Fishes	716	189
Amphibians	0	151
Reptiles	9	164
Birds	31	469
Mammals	23	95
All Vertebrates	779	1068

**Figure 3. Marine versus terrestrial vertebrates of Kerala**

endemic to the Western Ghats and 6% endemic to Kerala. Fifteen percent of all mammals of Kerala are endemic either to the Western Ghats (14%) and/or to Kerala (1%). The only mammal that is endemic to Kerala is Ranjini's Rat *Rattus ranjinae*. The level of endemism is the lowest among birds with only 4% endemic to the Western Ghats and no species endemic to Kerala (Fig. 5).

d. Threatened vertebrates of Kerala

Of 1,847 vertebrates of Kerala, 205 (~11%) species are listed as threatened in the IUCN Red List of Threatened Species of which 23 are Critically Endangered, 90 are Endangered and 92 are Vulnerable. About 101 species of vertebrates are Data Deficient (Table 4, Fig. 6), which should be accorded high priority with respect to future research and monitoring as many of them are likely to be eligible for listing under various threatened categories

Table 3. Level of endemism among the vertebrates of Kerala

Vertebrate Class	Endemic to	
	Western Ghats	Kerala
Fishes	131	57
Amphibians	136	36
Reptiles	87	10
Birds	17	0
Mammals	15	1
All Vertebrates	386	104

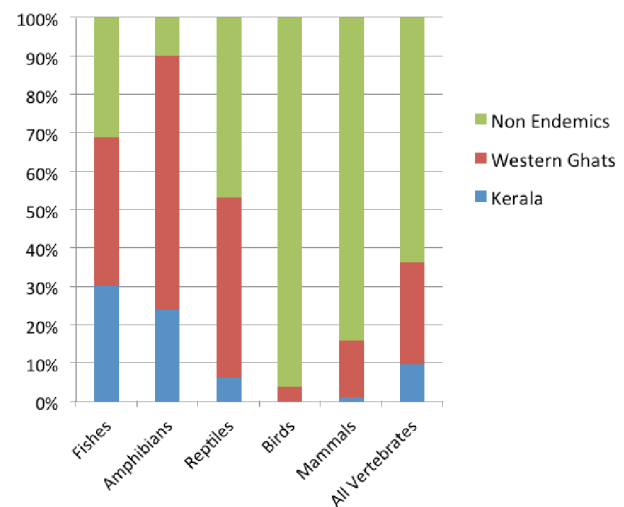
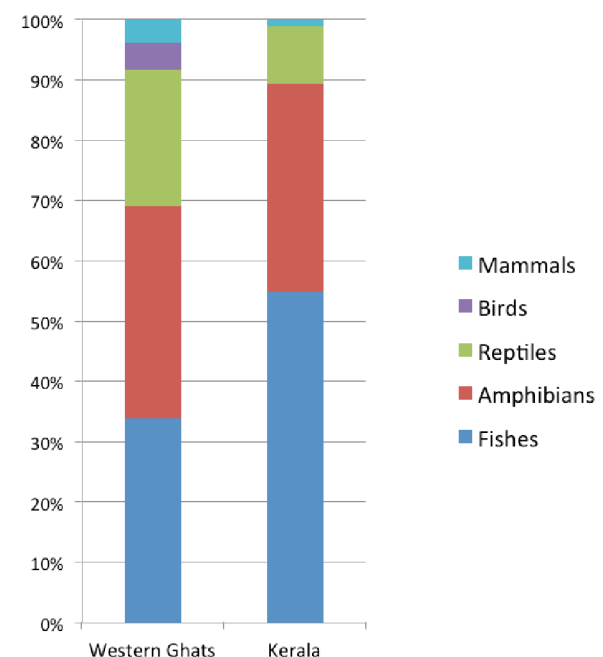
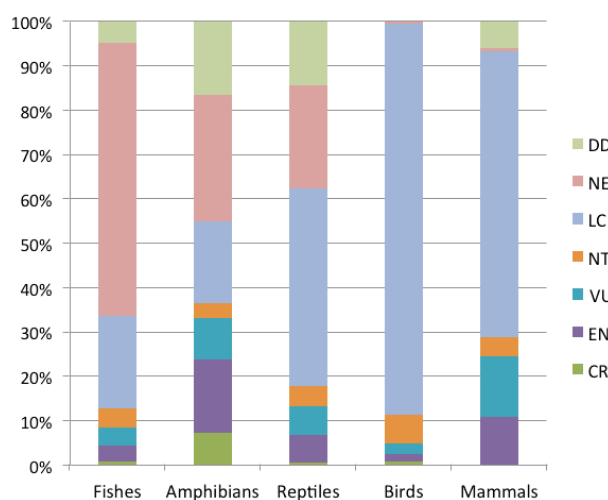
**Figure 4. Level of endemism among the vertebrates of Kerala****Figure 5. Vertebrates endemic to Kerala and endemic to Western Ghats**

Table 4. Vertebrates of Kerala under different IUCN Threat Categories

Vertebrate Class	IUCN Red List categories								
	EX	EW	CR	EN	VU	NT	LC	NE	DD
Fishes	0	0	7	33	38	37	190	556	44
Amphibians	0	0	11	25	14	5	28	43	25
Reptiles	0	0	1	11	11	8	77	40	25
Birds	0	0	4	8	13	32	441	2	0
Mammals	0	0	0	13	16	5	76	1	7
All Vertebrates	0	0	23	90	92	87	812	642	101

EX - Extinct; EW - Extinct in the Wild; CR - Critically Endangered; EN - Endangered; VU - Vulnerable; NT - Near Threatened; LC - Least Concerned; DD - Data Deficient; NE - Not Evaluated

**Figure 6. Threatened status of the vertebrates of Kerala**

once more information becomes available. A total of 642 species of vertebrates have not been assessed for their conservation status (Not Evaluated), majority of which are fishes (556 species, 86.60%), followed by amphibians (43 species) and reptiles (40 species) (Table 4).

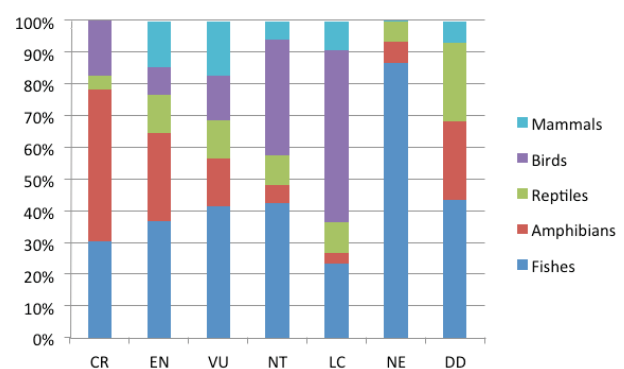
e. Vertebrates of Kerala and the Indian Wildlife (Protection) Act, 1972

Ninety-eight species of vertebrates of Kerala have been included in the Schedule I of the Indian Wildlife (Protection) Act (1972) (WPA). An additional 48 species are included in the Schedule II, four in the Schedule III and 507 in the Schedule IV. Twenty species, i.e., one species of bird (House Crow) and 19 species of mammals of Kerala have been included under the Schedule V of WPA. However, 1,170 species (63%) of vertebrates of Kerala have not been included under any of the Schedules of

Table 5. Vertebrates of Kerala listed under the different Schedules of the Wildlife (Protection) Act, of 1972

Vertebrate class	Schedules of WPA						x
	I	II	III	IV	V	VI	
Fishes	15	0	0	0	0	0	890
Amphibians	0	0	0	19	0	0	132
Reptiles	11	8	0	97	0	0	57
Birds	53	1	0	388	1	0	57
Mammals	19	39	4	3	19	0	34
All Vertebrates	98	48	4	507	20	0	1170

x - No. of species in none of the schedules

**Figure 7. The proportion of the vertebrates of Kerala within the different IUCN Red List categories**

the WPA. Ninety-eight percent of fishes and 87% of the amphibians of Kerala have not been included under any of the Schedules of WPA (Table 5, Fig. 7).

About 50% of the Schedule I animals listed in WPA belong to birds, while those in Schedule II and Schedule III primarily consist of mammals. About 80% of the Schedule IV animals consists of birds, while 99% of the animals listed under the Schedule V, are mammals (Fig. 8).

f. Vertebrates of Kerala and the Convention on International Trade in Endangered species of Flora and Fauna (CITES)

Only 8% of the vertebrates of Kerala have been listed in the various appendices of the Convention on International Trade in Endangered species of Flora and Fauna (CITES). Mammals are well represented in CITES with 39% of them being listed in one of the appendices (between I and III) of CITES, followed by birds and reptiles with about 13% and 12% species respectively. Fishes and amphibians have only negligible representation in CITES (Table 6, Fig. 9).

Table 6. Vertebrates of Kerala listed under the different appendices of CITES

Vertebrate Class	Appendices of CITES			None
	I	II	III	
Fishes	0	7	0	898
Amphibians	0	2	0	149
Reptiles	9	9	4	151
Birds	5	66	0	429
Mammals	14	22	10	72
All Vertebrates	28	106	14	1699

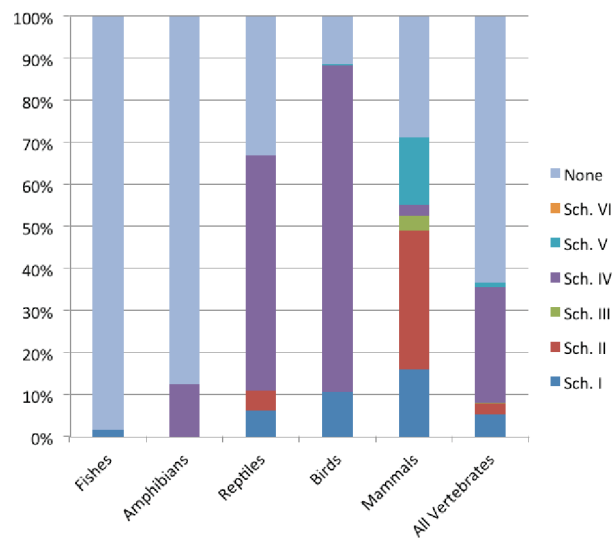
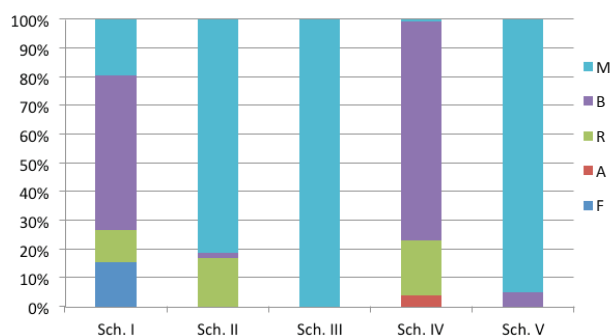
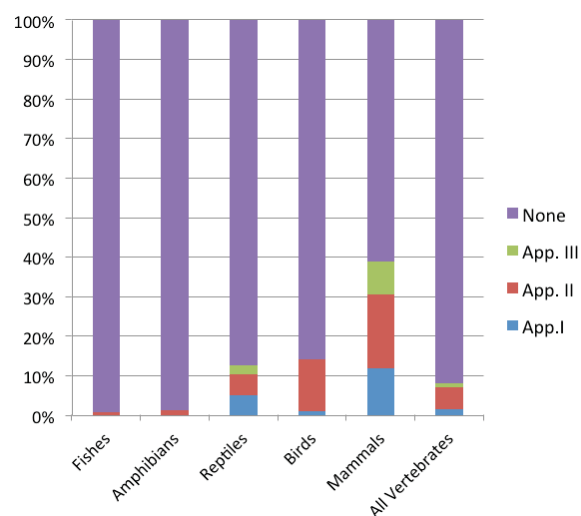
A total of 28 species of vertebrates of Kerala are listed under the Appendix I of the CITES, while 106 species in Appendix II and 14 species in Appendix III. There are no fishes and amphibians of Kerala listed in the Appendix I and III of the CITES (Table 6).

About 50% of the vertebrates of Kerala listed in the Appendix I of CITES are mammals, while reptiles account for about 32% and birds 18%. Appendix II of CITES has representation from all the five vertebrate classes, with birds dominating with about 62%. Appendix III of the CITES, however deals only about mammals and reptiles (Fig. 10).

CONCLUSION

This updated checklist reveals high diversity, endemism and threat levels for the vertebrate fauna of Kerala State. The uniqueness of the vertebrate fauna of Kerala is manifested by the high levels of endemism in lower groups like freshwater fishes, amphibians and reptiles. Close to one-third of amphibians and 10% of fishes of Kerala State are also threatened calling for greater attention and awareness on the conservation requirements for these poorly-known and often ignored groups. There are also huge numbers of marine fishes and recently described freshwater fishes and amphibians which are yet to be assessed for their conservation status. We hope that the key results and observations made in our paper would be a first step in understanding the research and conservation requirements for the various vertebrate groups in the state of Kerala.

While utmost care has been taken to ensure that the contents are accurate and up-to-date, there are possibilities of minor mistakes or omissions taking into account the scale of the work that has been attempted through this paper. We encourage readers to provide their feedbacks if any especially on the vernacular names

**Figure 8. Vertebrates of Kerala listed under the Wildlife (Protection) Act, of 1972****Figure 9. The proportion of the different vertebrates of Kerala in the different schedules of the Wildlife (Protection) Act, of 1972. M - Mammals; B - Birds; R - Reptiles; A - Amphibians; F - Fishes****Figure 10. Vertebrates of Kerala listed in the appendices of CITES**

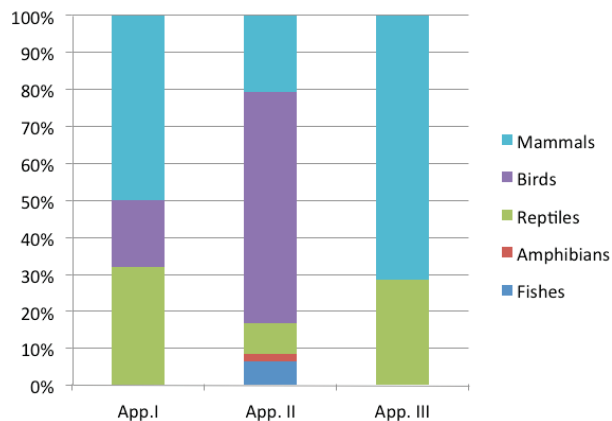


Figure 11. The proportion of the different vertebrates of Kerala in the different appendices of the CITES

(especially for those species for which we proposed new names) and other problems, if any. This compilation represents a first attempt and we hope to update this list at periodic intervals.

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മുഖവുര

കേരളത്തിലെ കശേരുമൃഗങ്ങളുടെ ആദ്യപ്രസിദ്ധീകരണത്തിൽ (ബ്ലാൻഫോർഡ് 1888–90) തുടങ്ങി രാജ്യത്തിന്റെ വിവിധ ജൈവഭൂപ്രകൃതിമേഖലകളിലെ, പ്രത്യേകിച്ചും പശ്ചിമഘട്ടത്തിലെ നട്ടെല്ലുള്ള ജീവികളെപ്പറ്റി വളരെ വിപുലമായ വിവരങ്ങൾ സമാഹരിക്കപ്പെട്ടിട്ടുണ്ട്. 38,863 ചതുരശ്ര കിലോമീറ്റർ ഭൂവിസ്തൃതിയും, 590 കിലോമീറ്റർ കടൽതീരവും തീരപ്രദേശത്തെ സങ്കീർണ്ണമായ കായൽ പരപ്പുകളും, പശ്ചിമഘട്ടത്തിലെ ഉഷ്ണമേഖലാ ആർദ്രവനങ്ങളും, നിർന്നേനതമായ ഭൂപ്രദേശവും, ഉഷ്ണമേഖലാമൺസൂൺ കാലാവസ്ഥയും ഉൾപ്പെടുന്ന കേരള സംസ്ഥാനം ഭൂമിശാസ്ത്രപരമായും പാരിസ്ഥിതികമായും അസ്തിത്വമുള്ള അതിവിശിഷ്ടമായ ഒരു പ്രദേശമാണ്. കശേരുജന്തുക്കളുടെ വൈവിധ്യത്തിന്റെ തത്സ്ഥിതി രേഖപ്പെടുത്തുന്ന പ്രാദേശികാടിസ്ഥാനത്തിലുള്ള ഒരു ഒത്തുനോക്കൽ പട്ടിക ജൈവവൈവിധ്യം സംബന്ധിച്ച അടിസ്ഥാന രേഖകൾ ലഭ്യമാക്കാനും പ്രാദേശിക ജൈവവൈവിധ്യത്തെപ്പറ്റിയുള്ള ഗ്രാഹ്യം വർധിക്കാനും സഹായകമാവും. ആഗോളതലത്തിൽ സംഭവിക്കുന്ന ജൈവവൈവിധ്യനാശത്തിന്റെ തോതും തത്ഫലമായാണുയിരിക്കുന്ന സംരക്ഷണ സംരംഭങ്ങളും ഈ മേഖലയിൽ ലഭ്യമായ ശാസ്ത്രീയമായ അറിവ് ശാസ്ത്രജ്ഞർ, നയരൂപീകരണം നടത്തുന്നവർ, രാഷ്ട്രീയക്കാർ, ഉചിതമായ ഗുണഭോക്താക്കൾ തുടങ്ങിയവരിൽ എത്തിക്കേണ്ട അധിക ഉത്തരവാദിത്വം വർഗീകരണശാസ്ത്രം കൈകാര്യം ചെയ്യുന്ന സമൂഹത്തിന് നൽകുന്നു.

കേരളത്തിൽ കാണപ്പെടുന്ന 1847 കശേരുക ജീവികളെ കുറിച്ച് ഈ ഏകവിഷയക പ്രബന്ധത്തിൽ പ്രതിപാദിച്ചിട്ടുള്ളത്. അതിൽ 905 മൽസ്യങ്ങൾ, 151 ഉഭയജീവികൾ, 173 ഉരഗജീവികൾ, 500 പക്ഷികൾ, 118 സസ്തനികൾ എന്നിവ ഇതിൽ ഉൾപ്പെടുത്തിയിരിക്കുന്നു.

Author Details: P.O. NAMEER is Professor and Head of Centre for Wildlife Studies, KAU. His research interest include the taxonomy, biogeography and ecology of vertebrates except fishes.

PRAVEEN J is a computer engineer by profession and a hobbyist bird-watcher. He involves in citizen science initiatives that monitor and report spatio-temporal aspects of bird distribution by bridging amateur bird-watcher networks with ecologists and wildlife biologists. He is an Associate Editor of Indian BIRDS journal and his interests include threatened and endemic birds of Western Ghats, pelagic birds of Indian seas and Indian bird rarities.

A. BIJUKUMAR is Associate Professor and Head of the Department of Aquatic Biology and Fisheries, University of Kerala, India. His areas of specializations include biodiversity documentation and taxonomy of fish, crustacea and mollusca. Currently engaged in projects on biogeography and phylogeography of marine fauna of India.

MUHAMED JAFER PALOT is Assistant Zoologist with Zoological Survey of India, Western Ghat Regional Centre, Kozhikode, Kerala, India. He works on taxonomy and ecology of butterflies, dragonflies, reptiles and birds.

SANDEEP DAS is presently a PhD scholar in University of Calicut, Kerala working in Kerala Forest Research Institute. His research interests are in the field of amphibian ecology especially in their breeding behaviour.

RAJEEV RAGHAVAN is an Assistant Professor at the Kerala University of Fisheries and Ocean Studies, Kochi, whose research focuses on generating information and developing methods to support conservation decision-making in tropical freshwater ecosystems. He is the South Asia Co-Chair of the IUCN SSC/WI Freshwater Fish Specialist Group, Coordinator of the IUCN SSC Freshwater Fish Red List Authority and the SSC Freshwater Representative on the IUCN Red List Committee.