Local Endemism Within the Western Ghats–Sri Lanka Biodiversity Hotspot

Franky Bossuyt,[1,2*†] Madhava Meegaskumbura,[3,4*] Natalie Beenaerts,[1*] David J. Gower,[5] Rohan Pethiyagoda,[4] Kim Roelants,[1] An Mannaert,[1] Mark Wilkinson,[5] Mohomed M. Bahir,[4] Kelum Manamendra-Arachchi,[4] Peter K. L. Ng,[6] Christopher J. Schneider,[3] Oommen V. Oommen,[7] Michel C. Milinkovitch[2]

The apparent biotic affinities between the mainland and the island in the Western Ghats–Sri Lanka biodiversity hotspot have been interpreted as the result of frequent migrations during recent periods of low sea level. We show, using molecular phylogenies of two invertebrate and four vertebrate groups, that biotic interchange between these areas has been much more limited than hitherto assumed. Despite several extended periods of land connection during the past 500,000 years, Sri Lanka has maintained a fauna that is largely distinct from that of the Indian mainland. Future conservation programs for the subcontinent should take into account such patterns of local endemism at the finest scale at which they may occur.

Island biota typically are closely related to the source of colonists when both areas have been in regular contact (*1–3*). The level of endemism on continental islands is therefore expected to reflect the number and duration of ocean-level lowstands that allowed exchange with the mainland (*4*). Sri Lanka is a relatively large island (~66,000 km^2) in the Indian Ocean and is part of the same shallow continental shelf as India (*5*). During the Pleistocene ice ages, Sri Lanka was intermittently connected to mainland India (*6*), until sea level rise created the present disruption ~10,000 years ago (*7*) (Fig. 1). Classical comparisons of faunal elements from both sides of the Palk Strait indicate a high degree of morphological similarity in several groups, suggesting abundant, recent biotic interchange with southern India (*8–12*). Similar observations prompted Wallace (*13*) more than a century ago to recognize a Ceylonese (or Lankan) biogeographic region, associating Sri Lanka with the southernmost part of the Western Ghats, a hill range along the west coast of India (Fig. 1A). Today, both areas are united in the Western Ghats–Sri Lanka biodiversity hotspot, because they are construed as forming "a community of species that fits together as a biogeographic unit" (*14*).

Here we explore the evolutionary relationships between the subcontinent's island and mainland fauna in two invertebrate and four vertebrate groups. The selected taxa are freshwater crabs (Parathelphusidae and Gecarcinucidae), freshwater shrimps (*Caridina*, Atyidae), tree frogs (*Philautus*, Rhacophorinae, Ranidae), caecilian amphibians (Ichthyophiidae and Uraeotyphlidae), shieldtail snakes (Uropeltidae), and freshwater fishes (*Puntius*, Cyprinidae). These animals occupy a diverse range of habitats (terrestrial, subterranean, semiaquatic, and strictly aquatic) (Table 1) and are thus a sample of a broad range of ecologies and life histories. To get unbiased partitions of genetic diversity, individuals were sampled randomly from 125 and 70 different locations (table S1) in Sri Lanka and the Western Ghats of southern India, respectively. We sequenced fragments of mitochondrial DNA for each specimen and then selected one individual per unique haplotype per geographic region for further phylogenetic analysis (*15*).

Our analyses indicate that the Sri Lankan fauna is derived from an evolutionarily diverse faunal stock on the Indian mainland (*16*). However, the inferred phylogenetic trees also demonstrate that the overall limited biotic interchange has left both areas with an unexpectedly large number of endemics. For example, the Sri Lankan *Philautus* tree frogs (Fig. 2A) are the result of an extensive radiation on the island (*17*), and a small clade of deeply nested Indian tree frogs provides evidence for back

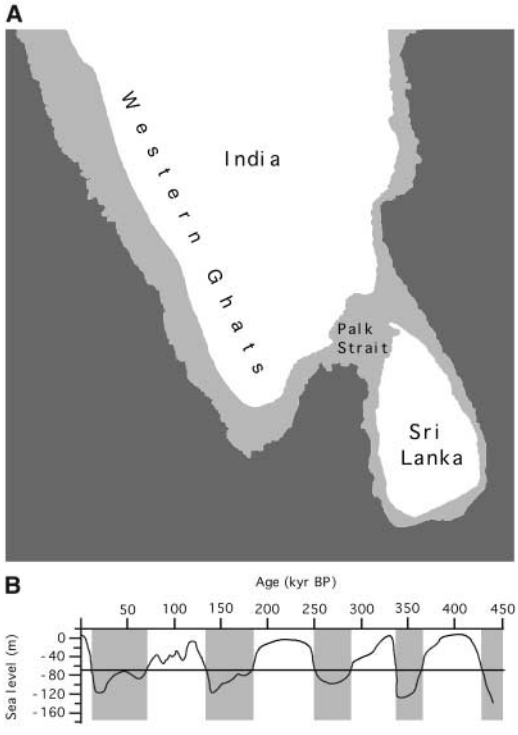

Fig. 1. (**A**) India and Sri Lanka (current outline in white) are part of the same continental shelf (light gray), which does not exceed 70 m (light gray/dark gray border) in depth. (**B**) During the past 500,000 years, sea level variations (*6*) dropping below –70 m (the horizontal line) caused Sri Lanka to be connected to India on several occasions (shaded columns) by a >100-km-broad land bridge. kyr BP, thousands of years before present.

[1]Biology Department, Unit of Ecology and Systematics, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium. [2]Laboratory of Evolutionary Genetics, Université Libre de Bruxelles, Code Postal, 300, Institute for Molecular Biology and Medicine, Rue Jeener and Brachet 12, B-6041 Gosselies, Belgium. [3]Department of Biology, Boston University, 5 Cummington Street, Boston, MA 02215, USA. [4]Wildlife Heritage Trust, 95 Cotta Road, Colombo 8, Sri Lanka. [5]Department of Zoology, The Natural History Museum, London SW7 5BD, UK. [6]Department of Biological Sciences, National University of Singapore, Kent Ridge, Singapore 119260, Republic of Singapore. [7]Department of Zoology, University of Kerala, Kariavattom 695581, Thiruvananthapuram, Kerala, India.

*These authors contributed equally to this work.
†To whom correspondence should be addressed. E-mail: fbossuyt@vub.ac.be

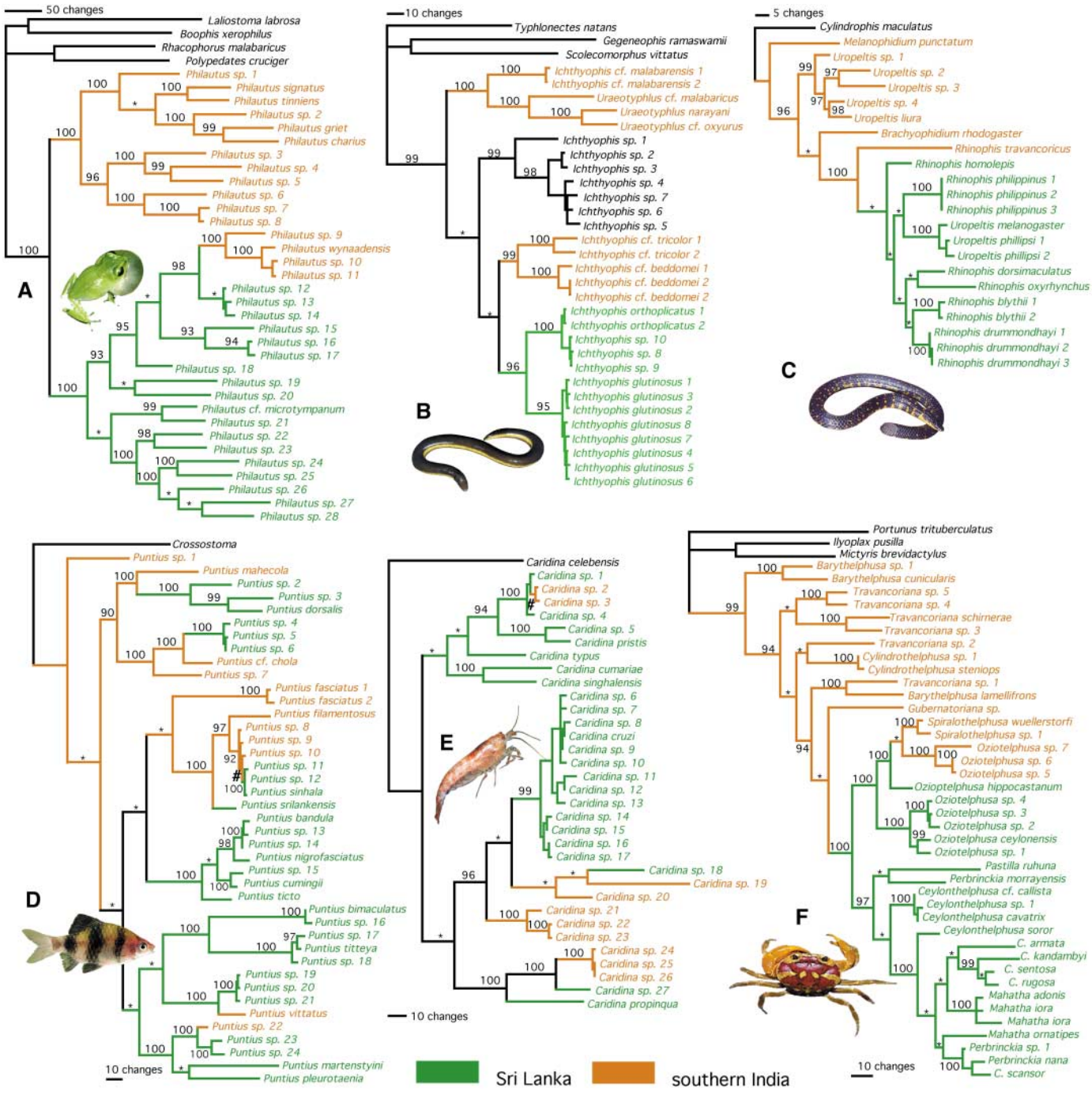

Fig. 2. Phylogenetic relationships among Indian (orange) and Sri Lankan (green) species as revealed by one of the most parsimonious trees for (**A**) tree frogs, (**B**) caecilians, (**C**) uropeltid snakes, (**D**) freshwater fishes, (**E**) freshwater shrimps, and (**F**) freshwater crabs. The strict consensus of equally parsimonious trees for each of these is shown in fig. S1. Black names represent outgroup species, except for *Ichthyophis*, which represents Southeast Asian taxa. Numbers on branches and asterisks indicate metapopulation Genetic Algorithm metaGa branch support values of ≥90% and <90%, respectively. Parsimony bootstrap values and Bayesian posterior probabilities are given in figs. S1 and S2, respectively. Numerical designations of operational taxonomic units indicate different haplotypes for mitochondrial DNA, not necessarily different species. Splits indicated with # represent recent exchanges between the mainland and the island.

dispersal of a single lineage to southern India. Similarly, our freshwater crab phylogeny revealed a radiation into several endemic genera of parathelphusids on Sri Lanka, followed by limited dispersal to India in the lowland-associated clade (*Oziotelphusa* and *Spiralothelphusa*) (Fig. 2F). In accord with morphological studies (*18*, *19*), no gecarcinucids sensu stricto were found on Sri Lanka, leaving no evidence for successful colonization of the island. The uniqueness of both sides of the Palk Strait is most noticeably illustrated by caecilians and shieldtail snakes: In both cases, all sampled island species represent endemic monophyletic groups (Fig. 2, B and C). Finally, although the pattern of limited biotic exchange is less apparent in strictly aquatic groups (Table 1), part of Sri Lanka's fish and shrimp species nevertheless form distinct clades (Fig. 2, D and E). These observations jointly indicate

Table 1. Taxa included in this study.

Taxon	Total number of specimens	Unique haplotypes	Habitat
Tree frogs	44	34	Terrestrial (including arboreal)
Caecilians	35	28	Subterranean
Uropeltid snakes	33	22	Subterranean
Freshwater fishes	51	41	Strictly aquatic
Freshwater crabs	77	40	Semiaquatic
Freshwater shrimps	44	33	Strictly aquatic

that exchange between the mainland southern Indian and insular Sri Lankan faunas has been severely restricted, despite the recurrent existence of a broad (>100-km) land bridge (*5*) during several episodes of sea level lowstands (Fig. 1B).

We used the sequence data to estimate the age of biotic exchange events (fig. S2, purple numbers) in each of the six groups. Our calculations (table S4) preclude a late Pleistocene origin for all but two splits and indicate that the corresponding events occurred before the multiple sea level lowstands of the past 500,000 years. These results are reinforced by the fact that our field surveys and phylogenetic analyses did not reveal conspecific populations in India and Sri Lanka in the four terrestrial, subterranean, and semiaquatic groups (Table 1). This was unexpected because, throughout their taxonomic history, there have been many instances in which populations on both sides of the oceanic barrier have been regarded as conspecific (*8–10*, *12*).

Our analyses show that numerous rainforest species form endemic clades, clearly identifying the Western Ghats and Sri Lanka's wet zone as distinct units. There are two possible reasons why biologists may have overlooked the differentiation between Indian and Sri Lankan faunas. First, incorrect systematic affiliations of specimens is understandable a posteriori, because our phylogenies identify homoplasy in coloration and general morphology in all groups. Second, the Sri Lankan fauna comprises a widely distributed, dry lowcountry element and a more diverse but restricted rainforest component (*20*). Because the former contains several species common to the dry zones of northern Sri Lanka and southern India that are likely Pleistocene dispersers, it has been assumed that this pattern could be generalized across the whole region.

Exact causes for the restricted dispersal between India and Sri Lanka remain speculative, but our findings highlight the importance of less conspicuous factors as important barriers to terrestrial dispersal. The faunal insularity between the wet zone of Sri Lanka and the moist forests of the Western Ghats likely results from the inability of rainforest organisms to disperse across the intervening dry lowlands. Although the climatic history of South Asia remains poorly understood, our results and the current climatic correlation between the plains of southern India and northern Sri Lanka (*21*) are possibly indicative of similar conditions during the late Pleistocene, contrary to the idea that rainforest spread onto the land bridge during periods of low sea level (*22*). Hence, montane areas and their associated climate and vegetation, rather than the present-day coastal outline, may constitute isolated islands in which the rainforest-adapted fauna has been trapped for long periods (*23*, *24*). We therefore expect that similar patterns of restricted dispersal exist elsewhere on the subcontinent, such as between opposite sides of the Palghat gap, a broad valley that traverses the southern Western Ghats. The high degree of endemicity in some species of the subcontinent is compatible with this prospect; tree frogs, uropeltids, and freshwater crabs, for example, include point endemics with distributions of often just a few square kilometers (*25–27*). Thus, treating the Western Ghats and Sri Lanka as a single hotspot carries with it the danger of overlooking strong biogeographic structure within this region (*28*, *29*). Conservation management of the Indian subcontinent will benefit from further characterization of the heterogeneity of biodiversity down to more local scales.

References and Notes

1. G. G. Gillespie, G. K. Roderick, *Annu. Rev. Entomol.* **47**, 595 (2002).
2. R. H. MacArthur, E. O. Wilson, *The Theory of Island Biogeography* (Princeton Univ. Press, Princeton, NJ, 1967).
3. P. J. Darlington, *Zoogeography: The Geographical Distribution of Animals* (Wiley, New York, 1957).
4. C. D. Schubart, R. Diesel, S. B. Hedges, *Nature* **393**, 363 (1998).
5. T. Somasekaram, Ed., *Atlas of Sri Lanka* (Arjuna Consulting, Dehiwela, Sri Lanka, 1997).
6. E. J. Rohling *et al.*, *Nature* **394**, 162 (1998).
7. G. G. Vaz, *Curr. Sci.* **79**, 228 (2000).
8. P. Kirtisinghe, *The Amphibian Fauna of Ceylon* (self-published, Colombo, Sri Lanka, 1957).
9. R. F. Inger, H. B. Shaffer, M. Koshy, R. Bakde, *J. Bombay Nat. Hist. Soc.* **81**, 551 (1984).
10. M. A. Smith, *Serpentes* (*Fauna of British India, Reptilia and Amphibia*, Taylor & Francis, London, 1943), vol. 3.
11. R. Pethiyagoda, *Freshwater Fishes of Sri Lanka* [Wildlife Heritage Trust (WHT), Colombo, Sri Lanka, 1991].
12. R. Bott, *Abh. Senckenb. Naturforsch. Ges.* **526**, 1 (1970).
13. A. R. Wallace, *The Geographical Distribution of Animals* (Macmillan, London, 1876).
14. N. Myers, R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca, J. Kent, *Nature* **403**, 853 (2000).
15. Materials and methods are available as supporting material on *Science* Online.
16. The geographic origin and/or direction of dispersal of a clade can only be established if sufficient sampling is available from the whole distribution area. As such, a single mainland origin of Sri Lankan lineages is currently indicated in three of the six examined groups because of their nested position with respect to Indian and/or Asian lineages: caecilians and uropeltid snakes (both indicated by our analyses) and *Philautus* tree frogs [not evident from our tree, but shown in (*17*)]. A mainland origin for Sri Lankan clades is not contradicted in the three other groups, but will only be unambiguously confirmed when more inclusive phylogenies are available for these groups.
17. M. Meegaskumbura *et al.*, *Science* **298**, 379 (2002).
18. P. K. L. Ng, F. W. M. Tay, *Zeylanica* **6**, 113 (2001).
19. R. Bott, *Ark. Zool.* **22**, 627 (1970).
20. F. R. Senanayayake, M. Soulé, J. W. Senner, *Nature* **265**, 351 (1977).
21. G. B. Pan, K. Rupa Kumar, *Climates of South Asia* (Wiley, New York, 1997).
22. W. Erdelen, C. Preu, in *Vegetation and Erosion*, J. B. Thornes, Ed. (Wiley, Chichester, UK, 1990), pp. 491–504.
23. J. E. Cadle, H. C. Dessauer, C. Gans, D. F. Gartside, *Biol. J. Linn. Soc.* **40**, 293 (1990).
24. C. Moritz, L. Joseph, M. Cunningham, C. J. Schneider, in *Tropical Rainforest Remnants: Ecology, Management, and Conservation of Fragmented Communities*, W. F. Laurance, R. O. Bierregaard, Eds. (Univ. of Chicago Press, Chicago, 1997), pp. 442–465.
25. R. J. R. Daniels, *Curr. Sci.* **81**, 240 (2001).
26. R. Pethiyagoda, K. Manamendra-Arachchi, *Occas. Pap. Wildl. Heritage Trust* **2**, 1 (1998).
27. P. K. L. Ng, *J. S. Asian Nat. Hist.* **1**, 129 (1995).
28. J. R. Prendergast, R. M. Quinn, J. H. Lawton, B. C. Eversham, D. W. Gibbons, *Nature* **365**, 335 (1993).
29. A. S. L. Rodrigues *et al.*, *Nature* **428**, 640 (2004).

30. We thank the Forest Department and the Department of Wildlife Conservation, Sri Lanka, for research permission; J. Spinks, S. Loader, and S. Meegaskumbura for lab work; the Louisiana State University Museum of Natural Science's Collection of Genetic Resources for tissues; D. Raheem, Y. Mapatuna, F. Naggs (U.K. Darwin Initiative grant no. 162/08/214), S. Kankanam-Gamage, K. Wewelwala, S. Batuwita, and R. Wickramatilleke for fieldwork; and A. Captain, S. Thakur, and C. Luckhaup for photographs. Sequences have been deposited at GenBank under accession nos. AY700937 to AY700990 (caecilians); AY700999 to AY701021 and AY701030 to AY701052 (snakes); AY706108 to AY706131 and AY708128 to AY708196 (frogs); AY708197 to AY708278 (fishes); AY708052 to AY708091 (crabs); and AY708092 to AY708127 (shrimps). F.B. is a postdoctoral researcher and K.R. an aspirant at the Fonds voor Wetenschappelijk Onderzoek (FWO)–Vlaanderen. Supported by FWO–Vlaanderen grant nos. G.0056.03 and 1.5.039.03 (F.B.), Vrije Universiteit Brussel–Onderzoekrsaad (F.B. and K.R.); Fonds National de la Recherche Scientifique, the "Communauté Française de Belgique" (Action de Recherches Concertées no. 11649/20022770); the Walloon Region (BioRobot-Initiative no. 114840) (M.C.M.); Boston Univ. and NSF grant no. DEB9977072 (C.J.S. and M.M.); Leverhulme Trust grant no. F/00696/F (D.J.G and M.W.); and WHT Sri Lanka (R.P., M.M., M.M.B., and K.M-A).

Supporting Online Material

www.sciencemag.org/cgi/content/full/306/5695/479/DC1
Materials and Methods
Figs. S1 and S2
Tables S1 to S4
References and Notes

11 May 2004; accepted 1 September 2004

Local Endemism within the Western Ghats-Sri Lanka Biodiversity Hotspot

Bossuyt, F. *et al.*

Supporting Online Material

Materials and Methods

1. Sampling

Specimens of the six groups were sampled from 125 and 70 locations in Sri Lanka and southern India, respectively (Table S1). For each group, a wide variety of both morphologically similar and divergent specimens from both sides of the oceanic barrier were randomly selected.

Table S1. List of specimens sampled.

Hapl.	*Genus*	*Species*	Locality	Country
Treefrogs				
H1	*Philautus*	*sp. 1*	Chikmalagur-Bhadra Reservoir Road	India
H1	*Philautus*	*sp. 1*	Madikeri, Karnataka	India
H2	*Philautus*	*signatus*	Ooty, Tamil Nadu	India
H2	*Philautus*	*signatus*	Sims Park, Coonoor, Tamil Nadu	India
H2	*Philautus*	*signatus*	Ooty, Tamil Nadu	India
H3	*Philautus*	*tinniens*	Ooty, Tamil Nadu	India
H4	*Philautus*	*sp. 2*	Coonoor, Tamil Nadu	India
H5	*Philautus*	*griet*	Munnar, Kerala	India
H5	*Philautus*	*griet*	Munnar, Kerala	India
H6	*Philautus*	*charius*	Chikmalagur-Bhadra Reservoir Road	India
H6	*Philautus*	*charius*	Madikeri, Karnataka	India
H7	*Philautus*	*sp. 3*	Munnar, Kerala	India
H8	*Philautus*	*sp. 4*	Trivandrum - Ponmudi Road, Kerala	India
H9	*Philautus*	*sp. 5*	Madikeri, Karnataka	India
H10	*Philautus*	*sp. 6*	Madikeri, Karnataka	India
H11	*Philautus*	*sp. 7*	Sultans Battery, Kerala	India
H12	*Philautus*	*sp. 8*	Ponmudi, Kerala	India
H13	*Philautus*	*sp. 9*	Neyyar Dam, Kerala	India
H13	*Philautus*	*sp. 9*	Ponmudi, Kerala	India
H13	*Philautus*	*sp. 9*	Neyyar Dam, Kerala	India
H13	*Philautus*	*sp. 9*	Ponmudi, Kerala	India
H14	*Philautus*	*wynaadensis*	Sultans Battery, Kerala	India
H15	*Philautus*	*sp.12*	around Kandy, Central Province	Sri Lanka
H16	*Philautus*	*sp. 13*	Unawatuna, Southern Province	Sri Lanka
H17	*Philautus*	*sp.14*	Kitulgala, Sabaragamuwa Province	Sri Lanka
H18	*Philautus*	*sp.15*	Unknown	Sri Lanka
H19	*Philautus*	*sp. 16*	Kitulgala, Sabaragamuwa Province	Sri Lanka
H20	*Philautus*	*sp. 17*	Unawatuna, Southern Province	Sri Lanka
H21	*Philautus*	*sp.18*	Kitulgala, Sabaragamuwa Province	Sri Lanka
H22	*Philautus*	*sp.19*	Kottawa, Southern Province	Sri Lanka
H22	*Philautus*	*sp.19*	Kottawa, Southern Province	Sri Lanka
H23	*Philautus*	*sp.20*	Unknown	Sri Lanka
H24	*Philautus*	*microtympanum*	Nuwara Eliya, Central Province	Sri Lanka
H25	*Philautus*	*sp.21*	Unknown	Sri Lanka
H26	*Philautus*	*sp.22*	Unknown	Sri Lanka
H27	*Philautus*	*sp.23*	Unknown	Sri Lanka
H28	*Philautus*	*sp. 24*	Nuwara Eliya, Central Province	Sri Lanka
h28	*Philautus*	*sp. 24*	Nuwara Eliya, Central Province	Sri Lanka
H29	*Philautus*	*sp.25*	Unknown	Sri Lanka
H30	*Philautus*	*sp 26*	Nuwara Eliya, Central Province	Sri Lanka
H31	*Philautus*	*sp. 27*	Knuckles, Central Province	Sri Lanka
H32	*Philautus*	*sp.28*	Unknown	Sri Lanka
H33	*Philautus*	*sp. 10*	Kumarakum, Kerala	India
H34	*Philautus*	*sp. 11*	Thekkady, Kerala	India
Out	*Laliostoma*	*labrosa*	unknown	Madagascar
Out	*Boophis*	*xerophilus*	unknown	Madagascar
Out	*Rhacophorus*	*malabaricus*	Ponmudi, Kerala	India
Out	*Polypedates*	*cruciger*	unknown	Sri Lanka

Hapl.	*Genus*	*Species*	Locality	Country
Fishes				
H1	*Puntius*	*bandula*	Galapitamada	Sri Lanka
H2	*Puntius*	*bimaculatus*	Galle, Southern Province	Sri Lanka
H3	*Puntius*	*sp 16*	Mineriya	Sri Lanka
H4	*Puntius*	*sp 4*	Galle, Southern Province	Sri Lanka
H4	*Puntius*	*sp 4*	Galle, Southern Province	Sri Lanka
H4	*Puntius*	*sp 4*	Galle, Southern Province	Sri Lanka
H5	*Puntius*	*sp 5*	Mineriya	Sri Lanka
H6	*Puntius*	*sp 6*	Anuradhapura	Sri Lanka
H6	*Puntius*	*sp 6*	Anuradhapura	Sri Lanka
H7	*Puntius*	*chola*	Kottayam, Kerala	India
H7	*Puntius*	*chola*	Kottayam, Kerala	India
H7	*Puntius*	*chola*	Kottayam, Kerala	India
H8	*Puntius*	*sp 7*	Madras, Tamil Nadu	India
H9	*Puntius*	*sp 15*	Kelani	Sri Lanka
H10	*Puntius*	*cumingii*	Galle, Southern Province	Sri Lanka
H11	*Puntius*	*sp 2*	Homadola	Sri Lanka
H12	*Puntius*	*sp 3*	Menik	Sri Lanka
H13	*Puntius*	*dorsalis*	Galle, Southern Province	Sri Lanka
H14	*Puntius*	*fasciatus1*	Chenganur	India
H15	*Puntius*	*fasciatus2*	Kerala	India
H16	*Puntius*	*sp 9*	Neyyettinkara, near Trivandrum, Kerala	India
H17	*Puntius*	*sp 8*	Neyyettinkara, near Trivandrum, Kerala	India
H18	*Puntius*	*sp 10*	Chalakkudy, Kerala	India
H19	*Puntius*	*filamentosus*	Trivandrum, Kerala	India
H20	*Puntius*	*sp 1*	Coonoor, Tamil Nadu	India
H21	*Puntius*	*martenstyini*	Rattota, Central Province	Sri Lanka
H22	*Puntius*	*mahecola*	Kottayam, Kerala	India
H22	*Puntius*	*mahecola*	Kottayam, Kerala	India
H22	*Puntius*	*mahecola*	Kottayam, Kerala	India
H23	*Puntius*	*sp 14*	Kuruwita	Sri lanka
H24	*Puntius*	*sp 13*	Bentota	Sri lanka
H25	*Puntius*	*nigrofasciatus*	Galle, Southern Province	Sri lanka
H26	*Puntius*	*pleurotaenia*	Galle, Southern Province	Sri lanka
H27	*Puntius*	*sp 23*	Kuruwita, Sabaragamuva Province	Sri lanka
H28	*Puntius*	*sp 24*	Hambantota	Sri lanka
H29	*Puntius*	*sp 22*	Kottayam, Kerala	India
H30	*Puntius*	*sp 11*	Kelaniya	Sri lanka
H31	*Puntius*	*sinhala*	Galle, Southern Province	Sri lanka
H31	*Puntius*	*sinhala*	Galle, Southern Province	Sri lanka
H31	*Puntius*	*sinhala*	Galle, Southern Province	Sri lanka
H31	*Puntius*	*sinhala*	Galle, Southern Province	Sri lanka
H32	*Puntius*	*sp 12*	Kandalama	Sri lanka
H33	*Puntius*	*srilankensis*	Rattota, Central Province	Sri lanka
H34	*Puntius*	*ticto*	Kandalama	Sri lanka
H35	*Puntius*	*sp 17*	Galle, Southern Province	Sri lanka
H36	*Puntius*	*sp 18*	Bentota	Sri lanka
H37	*Puntius*	*titteya*	Galle, Southern Province	Sri lanka
H38	*Puntius*	*sp 19*	Kuruwita, Sabaragamuva Province	Sri lanka
H39	*Puntius*	*sp 21*	Galle, Southern Province	Sri lanka
H40	*Puntius*	*sp 20*	Anuradhapura	Sri lanka
H41	*Puntius*	*vittatus*	Neyyettinkara, near Trivandrum, Kerala	India
Out	*Crossostoma*	*lacustre*	-GenBank -	Unknown

Table S1. List of specimens sampled (continued).

Hapl.	*Genus*	*Species*	Locality	Country
Caecilians				
H1	*Uraeotyphlus*	*cf. malabaricus*	near Vandiperiyar, Kerala	India
H2	*Uraeotyphlus*	*cf. oxyurus*	near Payyanur, Kerala	India
H3	*Uraeotyphlus*	*narayani*	Kannam, Kerala	India
H4	*Ichthyophis*	*cf. malabarensis2*	Palod, Kerala	India
H5	*Ichthyophis*	*cf. malabarensis*	near Thodupuzha, Kerala	India
H5	*Ichthyophis*	*cf. malabarensis1*	Thodupuzha, Kerala	India
H6	*Ichthyophis*	*orthoplicatus 2*	near Passara, Uva Province	Sri Lanka
H7	*Ichthyophis*	*orthoplicatus 1*	Bibilegama, Uva Province	Sri Lanka
H8	*Ichthyophis*	*cf. tricolor 1*	near Vandiperiyar, Kerala	India
H9	*Ichthyophis*	*cf. tricolor 2*	near Punalur, Kerala	India
H10	*Ichthyophis*	*cf. beddomei 2*	near Periya, Kerala	India
H10	*Ichthyophis*	*cf. beddomei 2*	near Sulthan Bathery, Kerala	India
H11	*Ichthyophis*	*cf. beddomei 1*	Subramanya, Karnataka	India
H12	*Ichthyophis*	*sp.2*	Ban Tung Tao, Surat Thani Province	Thailand
H13	*Ichthyophis*	*sp.3*	Hat Yai, Songkhla Province	Thailand
H14	*Ichthyophis*	*sp.6*	Ban Na Sabaeng, Ubon Ratchathani Province	Thailand
H15	*Ichthyophis*	*sp.5*	Mae Saivalley, Chiang Mai Province	Thailand
H16	*Ichthyophis*	*sp.7*	Longling, Yunnan Province	China
H17	*Ichthyophis*	*sp.4*	Tam Dao, Vinh Phuv Province	Vietnam
H18	*Ichthyophis*	*sp.1*	Mang Xang	Vietnam
H19	*Ichthyophis*	*glutinosus 1*	Western Province, Kalutara District, nr. Palawatta	Sri Lanka
H19	*Ichthyophis*	*sp. 10*	near Haldummula, Sabaragamuwa Province	Sri Lanka
H20	*Ichthyophis*	*glutinosus 2*	near Nakiyadeniya, Southern Province	Sri Lanka
H20	*Ichthyophis*	*glutinosus 2*	near Galle, Southern Province	Sri Lanka
H21	*Ichthyophis*	*glutinosus 3*	near Opata, Southern Province	Sri Lanka
H21	*Ichthyophis*	*glutinosus 3*	near Opata, Southern Province	Sri Lanka
H21	*Ichthyophis*	*glutinosus 3*	near. Morawaka, Southern Province	Sri Lanka
H22	*Ichthyophis*	*glutinosus 4*	Suudagala, Sabaragamuwa Province	Sri Lanka
H22	*Ichthyophis*	*glutinosus 4*	Pussellawa, Central Province	Sri Lanka
H23	*Ichthyophis*	*glutinosus 5*	near Rattota, Central Province	Sri Lanka
H23	*Ichthyophis*	*glutinosus 5*	Gammaduwa, Central Province	Sri Lanka
H24	*Ichthyophis*	*glutinosus 6*	near Peradeniya, Central Province	Sri Lanka
H25	*Ichthyophis*	*glutinosus 7*	near Rattota, Central Province	Sri Lanka
H26	*Ichthyophis*	*glutinosus 8*	Bibilegama, Uva Province	Sri Lanka
H27	*Ichthyophis*	*sp. 8*	near Haldummula, Sabaragamuwa Province	Sri Lanka
H28	*Ichthyophis*	*sp. 9*	near Haldummula, Sabaragamuwa Province	Sri Lanka
Out	*Typhlonectes*	*natans*	unknown	unknown
Out	*Gegeneophis*	*ramaswamii*	unknown	India
Out	*Scolecomorphus*	*vittatus*	unknown	unknown

Hapl.	*Genus*	*Species*	Locality	Country
Snakes				
H1	*Brachyophidium*	*rhodogaster*	Shembagganur, Tamil Nadu	India
H2	*Melanophidium*	*punctatum*	Valparai, Tamil Nadu	India
H3	*Rhinophis*	*drummondhayi 2*	near Passara, Uva Province	Sri Lanka
H3	*Rhinophis*	*drummondhayi 2*	Talawakella, Central Province	Sri Lanka
H3	*Rhinophis*	*drummondhayi 2*	above Namunkula	Sri Lanka
H4	*Rhinophis*	*drummondhayi 1*	Madulsima, Uva Province	Sri Lanka
H4	*Rhinophis*	*drummondhayi 1*	Madulsima, Uva Province	Sri Lanka
H5	*Rhinophis*	*drummondhayi 3*	Pindarawatta	Sri Lanka
H6	*Uropeltis*	*sp. 2*	Ooruvasal, Kerala	India
H7	*Uropeltis*	*sp. 3*	Munnar, Kerala	India
H8	*Uropeltis*	*sp. 1*	unknown	India
H9	*Uropeltis*	*sp. 4*	Munnar, Kerala	India
H10	*Uropeltis*	*liura*	unknown	India
H10	*Uropeltis*	*liura*	unknown	India
H11	*Rhinophis*	*philippinus 1*	near Rattota, Central Province	Sri Lanka
H11	*Rhinophis*	*philippinus 1*	Kalugaltenna	Sri Lanka
H11	*Rhinophis*	*philippinus 1*	Kalugaltenna	Sri Lanka
H11	*Rhinophis*	*philippinus 1*	near Rattota, Central Province	Sri Lanka
H11	*Rhinophis*	*philippinus 1*	Palatenne	Sri Lanka
H12	*Rhinophis*	*dorsimaculatus*	Marichchikkadi	Sri Lanka
H13	*Rhinophis*	*travancoricus*	Palod, Kerala	India
H14	*Uropeltis*	*melanogaster*	Nicapota, North Western Province,	Sri Lanka
H15	*Uropeltis*	*phillipsi 1*	near Gammaduwa, Central Province	Sri Lanka
H16	*Uropeltis*	*phillipsi 2*	Gammaduwa, Central Province	Sri Lanka
H17	*Rhinophis*	*oxyrhynchus*	unknown	Sri Lanka
H17	*Rhinophis*	*oxyrhynchus*	Polonarywa	Sri Lanka
H18	*Rhinophis*	*homolepis*	near Rakwana, Sabaragamuwa Province	Sri Lanka
H19	*Rhinophis*	*philippinus 2*	Palatenne	Sri Lanka
H20	*Rhinophis*	*philippinus 3*	Palatenne	Sri Lanka
H21	*Rhinophis*	*blythii 1*	Talawakella, Central Province	Sri Lanka
H22	*Rhinophis*	*blythii 2*	Ingestre Estate	Sri Lanka
H22	*Rhinophis*	*blythii 2*	Ingestre Estate	Sri Lanka
H22	*Rhinophis*	*blythii 2*	Ingestre Estate	Sri Lanka
Out	*Cylindrophis*	*maculatus*	near Palawatta, Western Province	Sri Lanka

Table S1. List of specimens sampled (continued).

Hapl.	*Genus*	*Species*	Locality	Country
Crabs				
H1	*Ceylonthelphusa*	*sentosa*	Kanneliya, Southern Province	Sri Lanka
H1	*Ceylonthelphusa*	*sentosa*	Pitadeniya, Uva Province	Sri Lanka
H2	*Oziotelphusa*	*sp. 1*	Puwakpitiya Knuckles, Central Province	Sri Lanka
H2	*Oziotelphusa*	*sp. 1*	Tanamalwila, Uva province	Sri Lanka
H2	*Oziotelphusa*	*sp. 1*	Pathanegalle	Sri Lanka
H3	*Ceylonthelphusa*	*soror*	Bogowantalawa-Balanguda road	Sri Lanka
H3	*Ceylonthelphusa*	*soror*	Bogowantalawa-Balanguda road	Sri Lanka
H3	*Ceylonthelphusa*	*soror*	Bogowantalawa-Balanguda road	Sri Lanka
H4	*Ceylonthelphusa*	*scansor*	Hantane, Sabaragamuva Province	Sri Lanka
H4	*Ceylonthelphusa*	*scansor*	Hantane, Sabaragamuva Province	Sri Lanka
H5	*Oziotelphusa*	*sp. 2*	Tanamalwila, Uva Province	Sri Lanka
H5	*Oziotelphusa*	*sp. 2*	Tanamalwila, Uva Province	Sri Lanka
H5	*Oziotelphusa*	*sp. 2*	Tanamalwila, Uva Province	Sri Lanka
H6	*Perbrinckia*	*nana*	Kanneliya, Southern Province	Sri Lanka
H7	*Mahatha*	*iora*	Kumbalwela, Uva Province	Sri Lanka
H7	*Mahatha*	*iora*	Kumbalwela, Uva Province	Sri Lanka
H8	*Ceylonthelphusa*	*kandambyi*	Udugama, Sabaragamuva Province	Sri Lanka
H9	*Ceylonthelphusa*	*rugosa*	Gannoruwa, Central Province	Sri Lanka
H9	*Ceylonthelphusa*	*rugosa*	Puwakpitiya Knuckles, Central Province	Sri Lanka
H9	*Ceylonthelphusa*	*rugosa*	Darawala	Sri Lanka
H9	*Ceylonthelphusa*	*rugosa*	Hantane, Sabaragamuva Province	Sri Lanka
H10	*Ceylonthelphusa*	*cf. callista*	Knuckles, Central province	Sri Lanka
H11	*Ceylonthelphusa*	*cavatrix*	Pathanegala	Sri Lanka
H11	*Ceylonthelphusa*	*cavatrix*	Pathanegala	Sri Lanka
H11	*Ceylonthelphusa*	*cavatrix*	Pathanegala	Sri Lanka
H11	*Ceylonthelphusa*	*cavatrix*	Pathanegala	Sri Lanka
H11	*Ceylonthelphusa*	*cavatrix*	Pathanegala	Sri Lanka
H12	*Perbrinckia*	*morrayensis*	Tillerie Estate	Sri Lanka
H12	*Perbrinckia*	*morrayensis*	Tillerie Estate	Sri Lanka
H12	*Perbrinckia*	*nn*	Adams Peak, Sabaragamuwa Province	Sri Lanka
H13	*Pastilla*	*ruhuna*	Hirimbura, Southern Province	Sri Lanka
H13	*Pastilla*	*ruhuna*	Hirimbura, Southern Province	Sri Lanka
H13	*Pastilla*	*ruhuna*	unknown	Sri Lanka
H14	*Oziotelphusa*	*sp. 3*	Deniyaya, Southern Province	Sri Lanka
H15	*Mahatha*	*sp.*	Bibilegama, Uva Province	Sri Lanka
H16	*Oziotelphusa*	*sp. 4*	Richmond hill	Sri Lanka
H17	*Oziotelphusa*	*hippocastanum*	unknown	Sri Lanka
H17	*Oziotelphusa*	*hippocastanum*	unknown	Sri Lanka
H18	*Spiralothelphusa*	*wuellerstorfi*	Madras, Tamil Nadu	India
H19	*Gubernatoriana*	*sp.*	Ponmudi, Kerala	India
H19	*Gubernatoriana*	*sp.*	Ponmudi, Kerala	India
H19	*Gubernatoriana*	*sp.*	Ponmudi, Kerala	India
H20	*Oziotelphusa*	*ceylonensis*	Colombo, Western Province	Sri Lanka
H21	*Travancoriana*	*sp. 3*	Ualur-Mangery Road, Tamil Nadu	India
H22	*Oziotelphusa*	*sp. 5*	Kottarakkar-Trivandrum Road, Kerala	India
H22	*Oziotelphusa*	*sp. 5*	Kolaththuppuzha-Tenmalai Road, Kerala	India
H23	*Travancoriana*	*sp. 4*	Munnar-Pollachchi Road, Kerala	India
H24	*Spiralothelphusa*	*sp. 1*	Trisur-Chalakudy Road, Kerala	India
H24	*Oziotelphusa*	*sp. 1*	unknown	India
H24	*Spiralothelphusa*	*sp. 1*	Trissur, Kerala	India
H25	*Barytelphusa*	*cunicularis*	Manjery-Trissur Road, Kerala	India
H25	*Barytelphusa*	*cunicularis*	Manjery-Trissur Road, Kerala	India
H26	*Travancoriana*	*schirnerae*	Mettupalayam-Ooti Road, Tamil Nadu	India
H26	*Travancoriana*	*schirnerae*	Mettupalayam-Ooti Road, Tamilnadu.	India
H27	*Oziotelphusa*	*sp. 6*	Kolaththuppuzha-Tenmalai Road, Kerala	India
H28	*Travancoriana*	*sp. 5*	Kumerli-Munnar Road, Kerala	India
H29	*Oziotelphusa*	*sp. 7*	Angamali-Thoduppusa Road, Kerala	India
H29	*Oziotelphusa*	*sp. 7*	Trissur-Chalakudy Road, Kerala	India
H29	*Oziotelphusa*	*sp. 7*	near Angamali, Kerala	India
H29	*Oziotelphusa*	*sp. 7*	Angamali- Thodoppusa Road, Kerala	India
H30	*Barytelphusa*	*lamellifrons*	Between Ranni-Kumerli, Kerala	India
H30	*Barytelphusa*	*lamellifrons*	unknown	India
H31	*Barytelphusa*	*sp. 1*	Chathankodu, Kerala	India
H31	*Barytelphusa*	*sp. 1*	Chathankodu, Kerala	India
H32	*Travancoriana*	*sp. 1*	Ponmudi, Kerala	India
H32	*Travancoriana*	*sp. 1*	Ponmudi, Kerala	India
H33	*Cylindrotelphusa*	*steniops*	Chathankodu, Kerala	India
H34	*Mahatha*	*iora*	Dunhinda Falls, Uva Province	Sri Lanka
H34	*Mahatha*	*iora*	Duhinda Falls, Uva Province	Sri Lanka
H35	*Cylindrotelphusa*	*sp. 1*	Gammaduwa Knuckles, central Province	India
H36	*Ceylonthelphusa*	*armata*	Kadugannawa, Central Province	Sri Lanka
H37	*Perbrinckia*	*sp. 1*	Batadomba cave, Kuruwita, Sabaragamuva Province	Sri Lanka
H37	*Perbrinckia*	*sp. 1*	Batadomba cave, Kuruwita, Sabaragamuva Province	Sri Lanka
H38	*Ceylonthelphusa*	*cavatrix*	Pathanegala	Sri Lanka
H38	*Ceylonthelphusa*	*sp. 1*	Batambakuruwita	Sri Lanka
H39	*Travancoriana*	*sp. 2*	Ponmudi, Kerala	India
H40	*Mahatha*	*ornatipes*	Navinna, Southern Province	Sri Lanka
Out	*Portunus*	*trituberculatus*	-GenBank -	Unknown
Out	*Ilyoplax*	*pusilla*	-GenBank -	Unknown
Out	*Mictyris*	*brevidactylus*	-GenBank -	Unknown

Table S1. List of specimens sampled (continued).

Hapl.	*Genus*	*Species*	Locality	Country
Shrimps				
H1	*Caridina*	*typus*	Rumassala, Southern Province	Sri Lanka
H2	*Caridina*	*cruzi*	Imaduwa, Southern Province	Sri Lanka
H2	*Caridina*	*cruzi*	Kamburupitiya, Southern Province	Sri Lanka
H2	*Caridina*	*cruzi*	Kosmulla, Southern Province	Sri Lanka
H3	*Caridina*	*cumariae*	Rozella, Central Province	Sri Lanka
H4	*Caridina*	*pristis*	Pussellawa, Central Province	Sri Lanka
H4	*Caridina*	*pristis*	Peradeniya, Central Province	Sri Lanka
H5	*Caridina*	*propinqua*	Ratgama lake, Southern Province	Sri Lanka
H6	*Caridina*	*singhalensis*	Horton Plains, Central Province	Sri Lanka
H6	*Caridina*	*singhalensis*	Galpalama, Central Province	Sri Lanka
H7	*Caridina*	*sp. 1*	Kandy Lake, Central Province	Sri Lanka
H8	*Caridina*	*sp. 10*	Elledola, Southern Province	Sri Lanka
H9	*Caridina*	*sp. 11*	Batakitta, Sabaragamuwa Province	Sri Lanka
H10	*Caridina*	*sp. 12*	Lelkada, Southern Province	Sri Lanka
H10	*Caridina*	*sp. 12*	Thalduwa, Sabaragamuwa Province	Sri Lanka
H10	*Caridina*	*sp. 12*	Battaluoya	Sri Lanka
H10	*Caridina*	*sp. 12*	Babbarugahana ella, Central Province	Sri Lanka
H10	*Caridina*	*sp. 12*	Wellemedan, Southern Province	Sri Lanka
H11	*Caridina*	*sp. 13*	Midigahamulla, Sabaragamuwa Province	Sri Lanka
H12	*Caridina*	*sp. 14*	Kandy Lake, Central Province	Sri Lanka
H13	*Caridina*	*sp. 15*	Wasgomuwa, Northern Central Province	Sri Lanka
H14	*Caridina*	*sp. 16*	Madukotanarawa	Sri Lanka
H15	*Caridina*	*sp. 17*	Moneragala, Uva Province	Sri Lanka
H16	*Caridina*	*sp. 18*	Modera, Western Province	Sri Lanka
H16	*Caridina*	*sp. 18*	Wakwella, Southern Province	Sri Lanka
H17	*Caridina*	*sp. 19*	Vikom, Kerala	India
H18	*Caridina*	*sp. 2*	Porunthanur, Kerala	India
H19	*Caridina*	*sp. 20*	near Sanchipuram, Tamil Nadu	India
H20	*Caridina*	*sp. 22*	Between Kanjirappalli-Palai, Kerala	India
H21	*Caridina*	*sp. 23*	near Thamarahulam, Kerala	India
H22	*Caridina*	*sp. 24*	Kattakada, Kerala	India
H23	*Caridina*	*sp. 25*	Vellikkunnam, Kerala	India
H24	*Caridina*	*sp. 26*	Kumarakom, Kerala	India
H24	*Caridina*	*sp. 26*	Achchankovil River, Kerala	India
H25	*Caridina*	*sp. 21*	unknown	India
H26	*Caridina*	*sp. 27*	Kottawa, Southern Province	Sri Lanka
H27	*Caridina*	*sp. 3*	Vellikkunnam, Kerala	India
H27	*Caridina*	*sp. 3*	Near Kanjirappalli, Kerala	India
H28	*Caridina*	*sp. 4*	Mawanana, Southern Province	Sri Lanka
H29	*Caridina*	*sp. 5*	Parhenegedera dola, Central Province	Sri Lanka
H30	*Caridina*	*sp. 6*	Ekneligoda, Sabaragamuwa Province	Sri Lanka
H31	*Caridina*	*sp. 7*	Mawanana, Southern Province	Sri Lanka
H32	*Caridina*	*sp. 8*	Rumassala, Southern Province	Sri Lanka
H33	*Caridina*	*sp. 9*	Mawanana, Southern Province	Sri Lanka
Out	*Caridina*	*celebensis*	Sg Keliling, Pulau Tioman Island	Maleysia

Table S1. List of specimens sampled (continued).

2. DNA methods and alignment

Mitochondrial DNA fragments were PCR-amplified and sequenced on both strands. Primers used in this study are provided in Table S2. The following fragments were amplified and sequenced:

Treefrogs: (i) a ~580 bp segment of the Cytb gene, (ii) a ~500 bp segment including portion of the ND1 gene, the complete $tRNA^{Ile}$ and $tRNA^{Gln}$ genes, and portion of the $tRNA^{Met}$ gene, (iii) a ~370 bp segment of the 12S rRNA gene.

Caecilians: a ~375 bp segment of the 12S rRNA gene, a ~535 bp segment of the 16S rRNA gene and a ~690 bp segment of the Cytb gene.

Snakes: a ~375 bp segment of the 12S rRNA gene and a ~505 bp segment of the 16S rRNA gene.

Fishes: a ~590 bp segment of the 16S rRNA gene and a ~540 bp segment of the Cytb gene.

Shrimps and *crabs*: a ~1,310 bp segment including portion of the 16S rRNA gene, $tRNA^{Val}$ and portion of the 12S rRNA gene.

Alias	Primer sequence (5' - 3')	Reference
Cytb-A	CCATGAGGACAAATATCATTYTGRGG	Bossuyt & Milinkovitch (2000) *PNAS* **97**: 6585-6590
Cytb-B	CTTCTACTGGTTGTCCTCCGATTCA	Bossuyt & Milinkovitch (2000) *PNAS* **97**: 6585-6590
Cytb-C	CTACTGGTTGTCCTCCGATTCATGT	Bossuyt & Milinkovitch (2000) *PNAS* **97**: 6585-6590
Cytb-D	TATGTTCTACCATGAGGACAAATATC	Simon et al. (1994) *Ann. Entomol. Soc. Am.* **87**: 651-701
Cytb-E	ACCTCTCATCCTTATGAAACTTTGG	this study
12V16-A	ACAAGCGCCAGGGWAYTACGAGC	Bossuyt & Milinkovitch (2000) *PNAS* **97**: 6585-6590
12V16-B	TTCATTGTTATTTAATCTTTCCC	Bossuyt & Milinkovitch (2000) *PNAS* **97**: 6585-6590
12V16-C	AAACTGGGATTAGATACCCCACTAT	Richards & Moore (1996) *Mol. Phylogenet. Evol.* **5**: 522-532.
12V16-D	GAGGGTGACGGGCGGTGTGT	this study
12V16-E	GCTAGACCATKATGCAAAAGGTA	Richards & Moore (1996) *Mol. Phylogenet. Evol.* **5**: 522-532.
16S-A	CGCCTGTTTAYCAAAAACAT	Simon et al. (1994) *Ann. Entomol. Soc. Am.* **87**: 651-701
16S-B	CCGGTYTGAACTCAGATCAYGT	Simon et al. (1994) *Ann. Entomol. Soc. Am.* **87**: 651-701
NDH-A	GCCCCATTTGACCTCACAGAAGG	this study
NDH-D	GGTATGGGCCCAAAAGCTT	this study
MITO1-A	GTACATATCGCCCGTCGCTT	Kitaura et al. (1998) *Mol. Biol. Evol.* **15**: 626-637
MITO1-C	CATGTACATATCGCCCGTCG	this study
MITO1-B	TTGCACGGTCATAATACCGC	this study

Table S2. - Primers used in this study.

The use of mitochondrial DNA. - Biogeographic studies that are based solely on mitochondrial DNA should be interpreted with caution, because patterns in mitochondrial haplotypes can become at least partially decoupled from that in chromosomal DNA (*S1*). However, decoupling of mtDNA and nuDNA loci is a problem that generally occurs at a recent time scale (populations within species). In this study, differential sorting might cause some disagreements between mitochondrial and nuclear trees *within* each Sri Lankan/Indian clade, but it is hard to imagine the process to cause discrepancies between nuclear and mitochondrial loci regarding the existence of these clades.

3. Phylogenetic analyses

Sequences were aligned using ClustalX 1.64 (*S2*) and ambiguous sections were excluded for subsequent analyses. Plots of transitions and transversions against uncorrected and GTR-corrected pairwise distances indicated that none of the fragments showed saturation. The most appropriate likelihood model was determined with Modeltest 3.06 (*S3*). An overview of the results of parsimony and Modeltest 3.06 analyses are provided in table S3.

	Shrimps	Crabs	Snakes	Frogs	Caecilians	Fishes
Number of specimens sequenced	44	77	33	44	35	51
Unique haplotypes	33	40	22	34	28	41
Total data matrix (bp)	1363	1430	910	1489	1659	1153
Unambiguously aligned (bp)	836	764	815	1369	1366	1065
Parsimony informative (bp)	227	247	115	623	414	316
Constant (bp)	524	423	634	654	830	679
Number of MP trees	8	108	1	6	6	6
Length of MP trees (10,000 reps)	833	1126	372	4099	1479	1400
Hierarchical chi-square test	HKY+G+I	GTR+G+I	TrN+G+I	TrN+G+I	GTR+G+I	TrN+G+I
Akaike Information Criterion	TVM+G+I	GTR+G+I	GTR+G+I	HKY+G+I	GTR+G+I	GTR+G+I

Table S3. An overview of the results of parsimony and Modeltest 3.06 analyses

- *Maximum parsimony*

MP analyses were performed using PAUP* 4.0b10 (*S4*). Heuristic maximum parsimony (MP) searches were performed with 10,000 replicates each with a random addition starting tree (all characters unordered and equally weighted). Clade support under MP was calculated using nonparametric bootstrapping (*S5*) in 10,000 replicates (Fig S1).

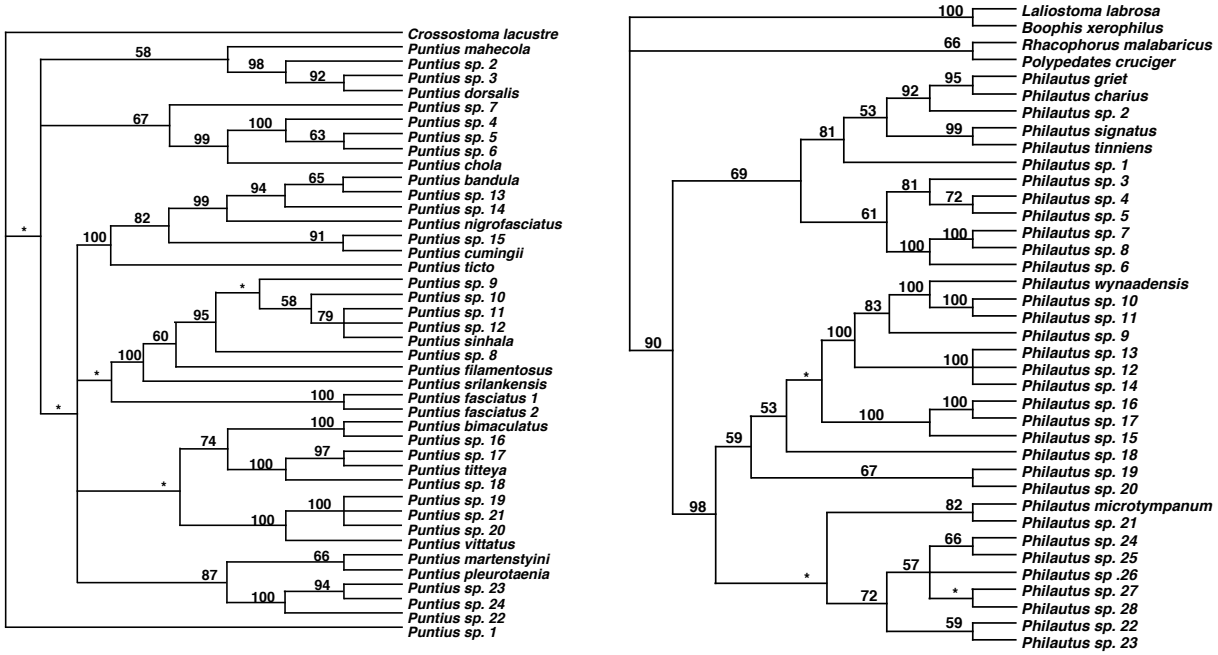

Fig. S1. - Strict consensus of equally parsimonious trees for each of the six groups. The numbers on the branches indicate MP bootstrap values for 10,000 replicates.

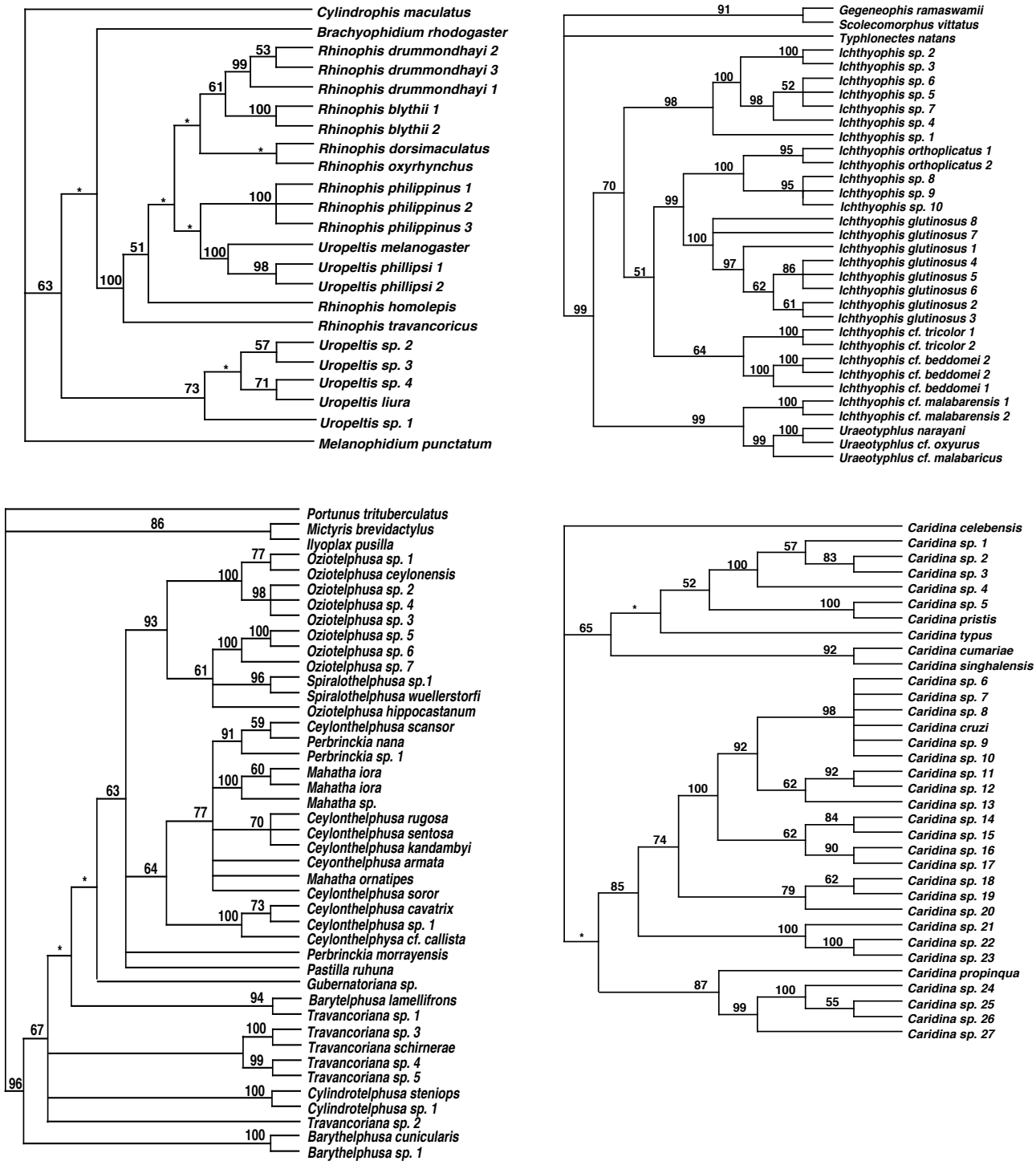

Fig. S1. *(Continued)* - Strict consensus of equally parsimonious trees for each of the six groups.

The numbers on the branches indicate MP bootstrap values for 10,000 replicates.

- Maximum Likelihood

We conducted 250 replicated metaGA searches using MetaPIGA 1.0.2b (*S6*), each with strict consensus pruning among four populations, using the HKY+G+I model (the model in MetaPIGA that best approximates the model proposed by Modeltest under the AIC criterion) with the Ti/Tv ratio optimized every 200 generations. The 1,000 resulting trees were used to compute metaGa branch support values and thus estimate posterior probabilities of branches (Fig. 2).

- Bayesian analyses

Bayesian analyses were performed using MrBayes v.3.0b4 (*S7*) under the models that best approximate the model proposed by Modeltest 3.06 under the AIC criterion. Four chains were run simultaneously for 2,000,000 generations and trees were sampled every 200 cycles. We discarded the first 2,000 trees as the "burn in". Hence Bayesian posterior probabilities were estimated as the 50% majority-rule consensus tree of the 8,000 remaining trees (Fig. S2). Repeated runs confirmed the successful convergence to the posterior parameter distribution.

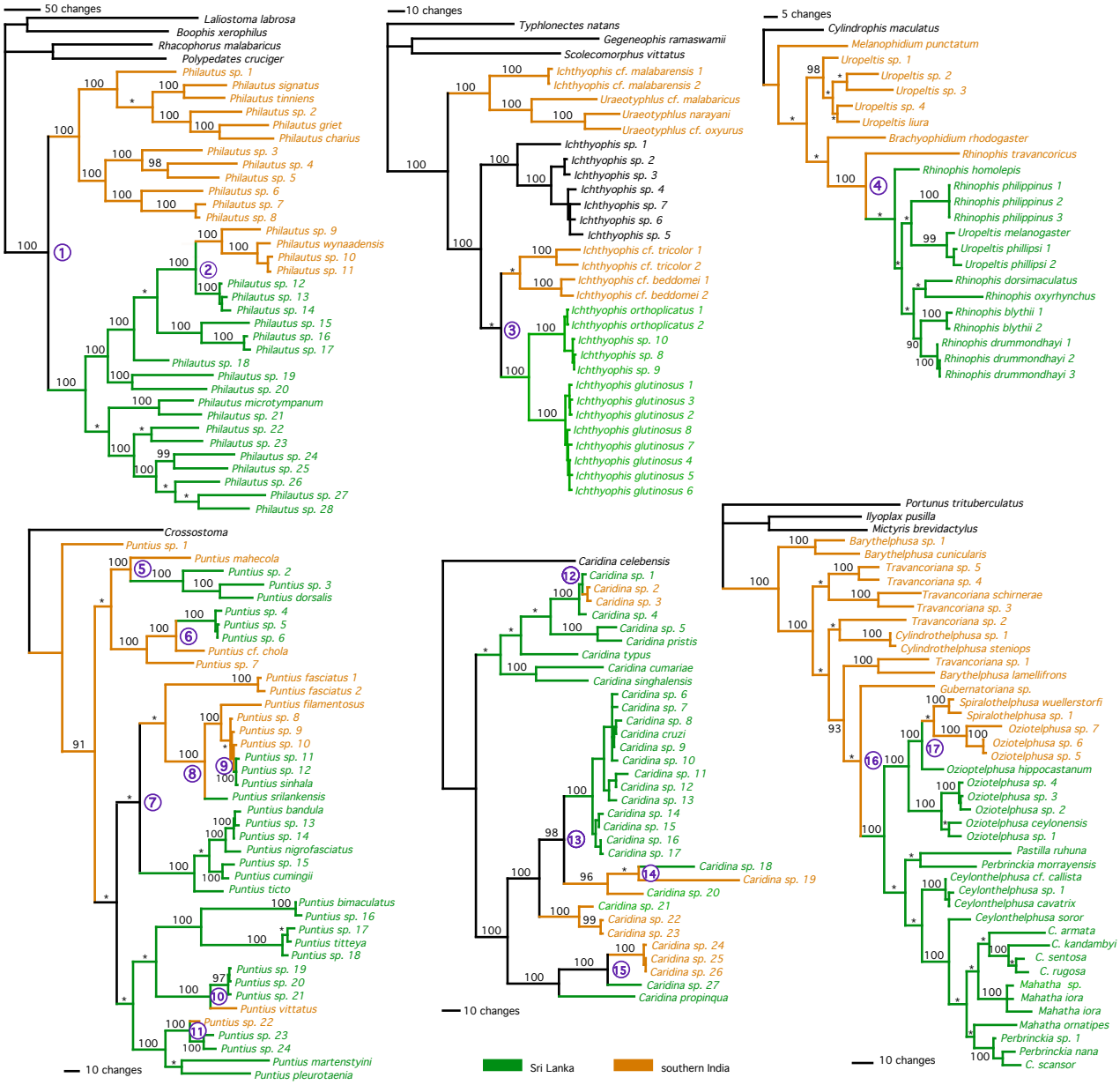

Fig. S2. - Phylogenetic relationships among Indian (orange) and Sri Lankan (green) species. Numbers on branches and asterisks indicate bayesian posterior probability values ≥90% and <90%, respectively. Numbers in purple are biotic exchange events between India and Sri Lanka, cross-referenced in Table S4.

4. Time estimation

To evaluate whether biotic exchange between southern India and Sri Lanka occurred during late Pleistocene sea-level lowstands, we calculated interval estimates for dates of divergence at every node that represents a split between Indian and Sri Lankan lineages (Table S4). As reliable calibration points were not available, we determined the median (and minimum and maximum) of all pairwise divergences between taxa on either side of each corresponding node. Because rates are unknown for most of our specific taxa, we based our divergence time estimates on a range of published mtDNA clock rates in each taxonomic group separately. Brachyuran rates reported for rDNA are fairly comparable, ranging from 0,65-0,88% (*S8*) to 0,9% (*S9*). The same range was used for shrimps (*S10*). We applied a broad range of divergence rates, between 0.65% per Myr (*S11*) and 1,25-1,32% per Myr reported for freshwater fishes of the genus *Barbus* in *cytb* (*S12*), to estimate divergences in *Puntius*. In amphibians, a range of divergence rates has been published: 0,38% per Myr for rDNA and 0,77% per Myr for *cytb* in newts (*S13*), 0,69% per Myr in the ND1-ND2 region of Bufonidae (*S14*) and 1% in 16S rDNA of Ranidae (*S15*). For snakes, we used a rate interval of 0.47 to 1.32% per Myr (*S16*).

Two of the nodes in our trees are backed by published estimates: first, the estimated divergence of 21 - 43 mya between *Philautus charius* and (*P. microtympanum, P. wynaadensis*) in (*S17*) corresponds to node 1 in our Fig. S2. Second, ref. (*S18*) estimated a minimum of 10-15 million years divergence between Sri Lankan and Indian uropeltids, which corresponds to node 4 in Fig. S2.

	Node	Sequence divergence (%) Median	Min.	Max.	Range for mtDNA clock rate [Ref.]	Estimated time (Myr) Calculated	Published	Minimum age (Myr)	Score
Treefrogs	1	0.201	0.177	0.230	0.38 - 1.00 [S13, S14, S15]	20.1 - 52.9	21-43	17.74	**
	2	0.096	0.091	0.122	0.38 - 1.00 [S13, S14, S15]	9.6 - 25.3	-	9.11	**
Caecilians	3	0.099	0.093	0.105	0.38 - 1.00 [S13, S14, S15]	9.9 - 26.0	-	9.25	**
Snakes	4	0.078	0.071	0.086	0.47 - 1.32 [S16]	5.9 - 16.7	10-15	5.42	**
Fishes	5	0.107	0.101	0.108	0.65 - 1.32 [S11, S12]	8.1 - 8.6	-	7.68	**
	6	0.048	0.047	0.050	0.65 - 1.32 [S11, S12]	3.6 - 3.8	-	3.56	*
	7	0.098	0.086	0.126	0.65 - 1.32 [S11, S12]	7.4 - 7.8	-	6.54	**
	8	0.035	0.031	0.058	0.65 - 1.32 [S11, S12]	2.6 - 2.8	-	2.35	*
	9	0.005	0.004	0.005	0.65 - 1.32 [S11, S12]	0.4 - 0.4	-	0.28	#
	10	0.030	0.030	0.032	0.65 - 1.32 [S11, S12]	2.3 - 2.4	-	2.28	*
	11	0.024	0.023	0.024	0.65 - 1.32 [S11, S12]	1.8 - 1.9	-	1.71	*
Shrimps	12	0.008	0.007	0.009	0.65 - 0.90 [S8, S9, S10]	0.9 - 1.2	-	0.81	#
	13	0.094	0.080	0.128	0.65 - 0.90 [S8, S9, S10]	10.4 - 14.4	-	8.88	**
	14	0.113	0.113	0.113	0.65 - 0.90 [S8, S9, S10]	12.5 - 17.3	-	12.51	**
	15	0.052	0.052	0.052	0.65 - 0.90 [S8, S9, S10]	5.8 - 8.0	-	5.78	**
Crabs	16	0.107	0.092	0.120	0.65 - 0.90 [S8, S9, S10]	11.9 - 16.5	-	10.18	**
	17	0.055	0.029	0.066	0.65 - 0.90 [S8, S9, S10]	6.1 - 8.4	-	3.20	*

Table S4. - Percent sequence divergences and time estimates. The range of nodal ages reflects the median divided by the max. and min. % divergence, *resp*., for biotic exchange events indicated by purple numbers in Fig. S2. We also calculated a conservative minimum age (*i.e*., the minimum sequence divergence divided by the maximum rate). Based on the latter calculation, 10 out of the 17 estimated times predate the sea-level lowstands of the past 500,000 years by an order of magnitude (*i.e*., > 10 times, indicated by **), and five more by threefold (indicated by *). Only two exchange events are estimated younger than 1 million year (indicated by #).

We calculated a conservative minimum age of divergence (Table S4) as the minimum sequence divergence for a split in our data divided by the maximum published rate. Our estimates of nodal times corresponding to biotic exchange events pre-date the border of 500,000 years by an order of magnitude (*i.e*., 10-fold) in 10 nodes and by three-fold in 5 nodes. These approximations should be viewed with caution, given that they are likely subject to several problems discussed in the literature (*S19*). Additionally, some calculated splits may not represent the actual biotic exchange event between the mainland and the island Sri Lanka, because we can not rule out closer relationships of Asian taxa with Indian or Sri Lankan taxa in some groups (*cf*. remark 16 in References and Notes).

Nevertheless, our estimates suggest that the late Pleistocene sea-level lowstands had little influence on the dispersal of several of Sri Lanka's prominent faunal groups.

Supporting Reference list

S1. C.H. Cannon, P.S. Manos, *J. Biogeogr.* **30**, 211 (2003).

S2. R. Chenna *et al*., *Nucleic Acids Res.* **31**, 3497 (2003).

S3. D. Possada, K.A. Crandall, *Bioinformatics* **14**, 817 (1998).

S4. D. L. Swofford, *PAUP*, Phylogenetic Analysis Using Parsimony (*and other methods)*, Version 4.0b10 (Sinauer, Sunderland, MA, 2002).

S5. J. Felsenstein, *Evolution* **39**, 783 (1985).

S6. A.R. Lemmon, M.C. Milinkovitch, *Proc. Natl. Acad. Sci. USA* **99**, 10516 (2002).

S7. F. Ronquist, J.P. Huelsenbeck, *Bioinformatics* **19**, 1572 (2003).

S8. C.D. Schubart, J.E. Neigel, D.L. Felder, *Crust. Issues* **12**, 817 (2000).

S9. C. Sturmbauer, J.S. Levinton, J. Christy, *Proc. Natl. Acad. Sci. USA* **93**, 10855 (1996).

S10. L.M. Mathews, C.D. Schubart, J.E. Neigel, D.L. Felder, *Mol. Ecol.* **11**, 1427 (2002).

S11. E. Bermingham, S.S. McCafferty, A.P. Martin, in *Molecular Systematics of Fishes*, T.D. Kocher, C.A. Stepien, Eds. (Academic press, San Diego, 1997), pp. 113-128.

S12. P. Kotlik, N.G. Bogutskaya, F.G. Ekmekçi, *Mol. Ecol.* **13**, 87 (2004).

S13. A. Caccone, M.C. Milinkovitch, V. Sbordoni, J.R. Powell, *Syst. Biol*. **46**, 126 (1997).

S14. J.R. Macey *et al.*, *Mol. Phylogenet. Evol.* **9**, 80 (1998).

S15. J. Kosuch, M. Vences, A. Dubois, A. Ohler, W. Böhme, *Mol. Phylogenet. Evol.* **21**, 398 (2001).

S16. K.R. Zamudio, H.W. Greene, *Biol. J. Linn. Soc.* **62**, 421 (1997).

S17. K. Roelants, J. Jiang, F. Bossuyt, *Mol. Phylogenet. Evol.* **31**, 730 (2004).

S18. J.E. Cadle, H.C. Dessauer, C. Gans, D.F. Gartside, *Biol. J. Linn. Soc.* **40**, 293 (1990).

S19. L. Bromham, D. Penny, *Nat. Rev. Gen.* **4**, 216 (2003).