

These are electronic appendices to the paper by Nagy *et al.* 2003 Multiple colonizations of Madagascar and Socotra by colubrid snakes: evidence from nuclear and mitochondrial gene phylogenies. *Proc. R. Soc. Lond. B* **270**, 2613–2621. (DOI 10.1098/rspb.2003.2547.)

Electronic appendices are refereed with the text. However, no attempt has been made to impose a uniform editorial style on the electronic appendices.

### **Electronic Appendix A: Discussion of taxon sampling and relationships within the Pseudoxyrhopiinae**

Our study included representatives of most major African colubrid lineages except natricines which showed no affinities to Malagasy taxa in previous analyses (Kraus & Brown 1998; Slowinski & Lawson 2002). Our sampling further included the two Socotran colubrid species, as well as representatives of 15 out of 18 Malagasy genera. Of the remaining three genera from Madagascar, *Pararhadinaea* and *Exallodontophis* are certainly related to *Pseudoxyrhopus* and *Heteroliodon* (Cadle 1999), and *Brygophis* is probably related to *Geodipsas* (Andreone & Raxworthy 1998), which assures us that we have not missed any major Malagasy lineage.

Within the Malagasy clade, several groupings merit to be discussed. The strongly supported lineage of *Langaha*, *Ithycyphus* and *Micropisthodon* contains diurnal arboreal snakes of a similar general habitus. Species of *Langaha* are characterized by sexually dimorphic nasal appendages, and the identification of *Ithycyphus* and *Micropisthodon* as their closest relatives allows for outgroup comparisons in studies on the evolution of this spectacular character. *Compsophis* and *Geodipsas* have been thought to be closely related previously (Glaw & Vences 1994; Ziegler *et al.* 1997). Our data confirm these assumptions. More thorough morphological studies will probably show that these two taxa are synonyms, which would result in the need of transferring all *Geodipsas* species to the genus *Compsophis* which has nomenclatural priority. Of the less well supported groupings of our trees, it is worth emphasizing the clustering of *Alluaudina* with *Geodipsas* and *Compsophis*, which agrees with hemipenal morphology (Ziegler *et al.* 1997).

#### Additional references:

- Andreone, F. & Raxworthy, C. J. 1998 The colubrid snake *Brygophis coulangesi* (Domergue 1988) rediscovered in north-eastern Madagascar. *Trop. Zool.* **11**, 249-257.
- Cadle, J. E. 1999 The dentition, systematics, and phylogeny of *Pseudoxyrhopus* and related genera from Madagascar (Serpentes: Colubridae), with description of a new species and a new genus. *Bull. Mus. Comp. Zool.* **155**, 381-443.
- Ziegler, T., Vences, M., Glaw, F. & Böhme, W. 1997 Genital morphology and systematics of *Geodipsas* Boulenger, 1896 (Reptilia: Serpentes: Colubridae), with description of a new genus. *Revue suisse Zool.* **104**, 95-114.

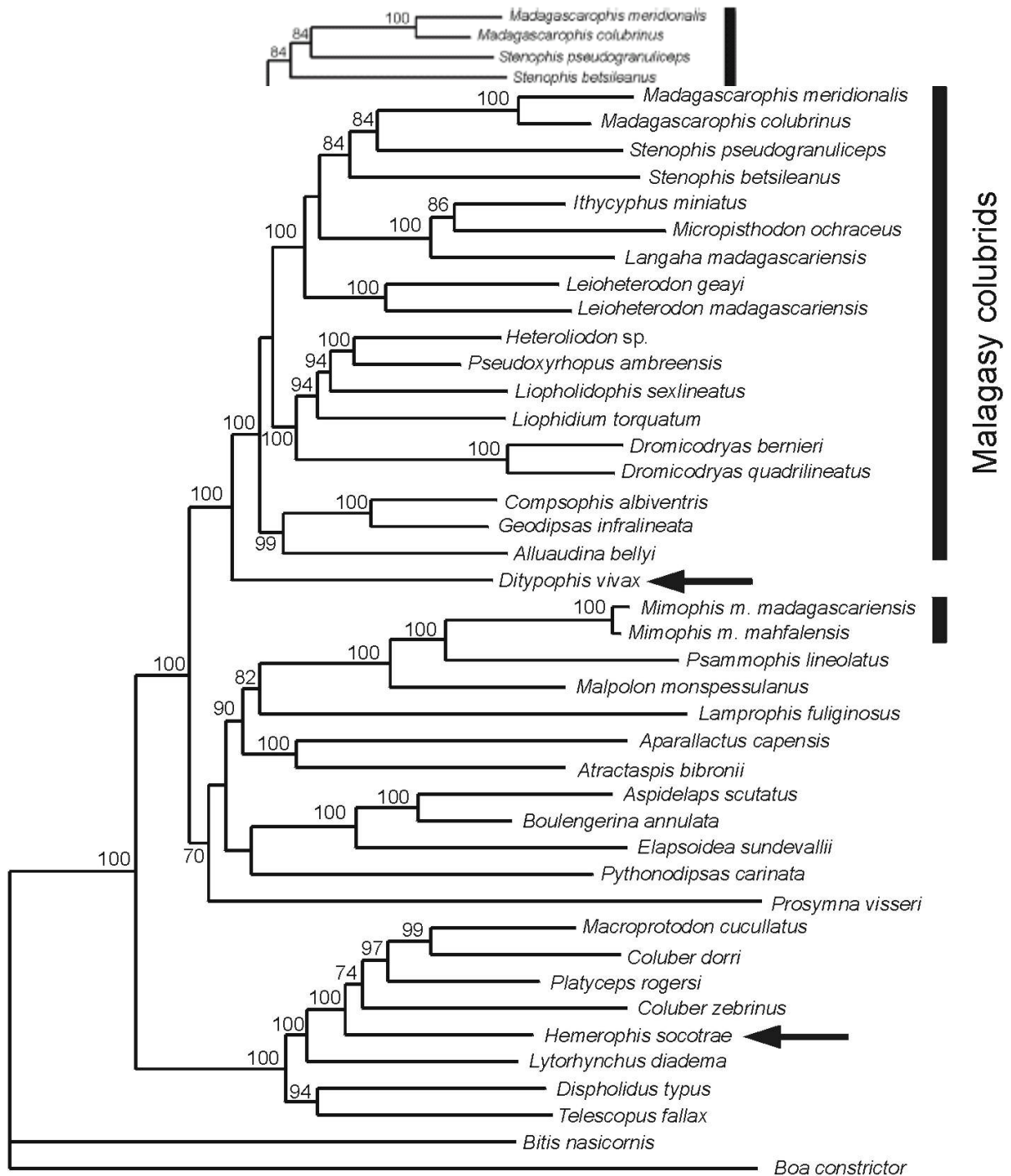
**Electronic Appendix B:** Taxa used for analysis, collection numbers and localities of voucher specimens and GenBank accession numbers for the three gene fragments analyzed. Subfamilial assignment of colubrids is largely given according to Zaher (2000); *Macroprotodon* being transferred to the Colubrinae and *Dromicodryas* to the Pseudoxyrhopiinae based on the molecular evidence herein. Assignment of *Prosymna* to the Colubridae seems uncertain according to our data. Museum acronyms used: CAS, California Academy of Sciences, San Francisco; FAZC, Zoological Collection of Franco Andreone, specimens to be deposited in MRSN; HLMD, Hessisches Landesmuseum Darmstadt (RA codes refer to specimen collection nos., other HLMD codes refer to the reptile tissue collection); NMW, Naturhistorisches Museum Wien (W. Mayer tissue collection no.); MRSN, Museo Regionale di Scienze Naturali, Torino; PEM, Port Elizabeth Museum, Port Elizabeth; UADBA, Université d'Antananarivo, Département de Biologie Animale; ZFMK, Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn; ZSM, Zoologische Staatssammlung München.

Species	Subfamily/Family	Locality	Voucher	Accession c-mos	Accession cyt b	Accession 16S rRNA
<i>Alluaudina bellyi</i>	Pseudoxyrhopiinae	Madagascar, Berara	MRSN FAZC 10622	AY187966	AY188005	AY188044
<i>Compsophis albiventris</i>	Pseudoxyrhopiinae	Madagascar, Mt. d'Ambre	ZSM 497/2000	AY187972	AY188011	AY188050
<i>Ditypophis vivax</i>	Pseudoxyrhopiinae	Socotra	HLMD RA-2972	AY187974	AY188013	AY188052
<i>Dromicodryas bernieri</i>	Pseudoxyrhopiinae	Madagascar, Ifaty	UADBA FG/MV 2000.517	AY187975	AY188014	AY188053
<i>Dromicodryas quadrilineatus</i>	Pseudoxyrhopiinae	Madagascar, Sambava	not collected/ HLMD J66	AY187976	AY188015	AY188054
<i>Geodipsas infralineata</i>	Pseudoxyrhopiinae	Madagascar, Manjakatombo	ZSM 378/2000	AY187978	AY188017	AY188056
<i>Heteroliodon sp.</i>	Pseudoxyrhopiinae	Madagascar, Mt. des Français	ZSM 548/2000	AY187979	AY188018	AY188057
<i>Ithycyphus miniatus</i>	Pseudoxyrhopiinae	Madagascar, Berara	MRSN-FAZC 10680	AY187980	AY188019	AY188058
<i>Langaha madagascariensis</i>	Pseudoxyrhopiinae	Madagascar (pet trade)	ZSM 636/2000	AY187981	AY188020	AY188059
<i>Leioheterodon geayi</i>	Pseudoxyrhopiinae	Madagascar, Toliara	ZSM 630/2000	AY187982	AY188021	AY188060
<i>Leioheterodon madagascariensis</i>	Pseudoxyrhopiinae	Madagascar, Maromandia	MRSN-FAZC 10621	AY187983	AY188022	AY188061
<i>Liophidium torquatum</i>	Pseudoxyrhopiinae	Madagascar, Mt. d'Ambre	not collected/ HLMD J84	AY187984	AY188023	AY188062
<i>Liopholidophis sexlineatus</i>	Pseudoxyrhopiinae	Madagascar, Mandraka	UADBA FG/MV 2000.38	AY187985	AY188024	AY188063

Species	Subfamily/Family	Locality	Voucher	Accession c-mos	Accession cyt b	Accession 16S rRNA
<i>Madagascarophis colubrinus</i>	Pseudoxyrhopiinae	Madagascar, Benavony	ZSM 403/2000	AY187989	AY188028	AY188067
<i>Madagascarophis meridionalis</i>	Pseudoxyrhopiinae	Madagascar, Ifaty	ZSM 629/2000	AY187988	AY188027	AY188066
<i>Micropisthodon ochraceus</i>	Pseudoxyrhopiinae	Madagascar, Ambato	ZFMK 66658	AY187991	AY188030	AY188069
<i>Pseudoxyrhopus ambreensis</i>	Pseudoxyrhopiinae	Madagascar, Mt. d'Ambre	not collected/HLM D J102	AY187996	AY188035	AY188074
<i>Stenophis betsileanus</i>	Pseudoxyrhopiinae	Madagascar, Marojejy	ZFMK 60500	AY187998	AY188037	AY188076
<i>Stenophis pseudogramuliceps</i>	Pseudoxyrhopiinae	Madagascar, Mt. des Francais	ZSM 550/2000	AY187999	AY188038	AY188077
<i>Malpolon monspessulanus</i>	Psammophiinae	Greece, Polidrassi	HLMD RA-2606	AY187990	AY188029	AY188068
<i>Mimophis mahfalensis madagascariensis</i>	Psammophiinae	Madagascar, Mt Ibity	ZSM 397/2000	AY187992	AY188031	AY188070
<i>Mimophis m. mahfalensis</i>	Psammophiinae	Madagascar, Kirindy	not collected/HLM D J68	AY187993	AY188032	AY188071
<i>Psammophis lineolatus</i>	Psammophiinae	Kazakhstan, Charyn Canyon	not collected/HLM D J76	AY187995	AY188034	AY188073
<i>Lamprophis fuliginosus</i>	Boodontinae	Tanzania, Tanga Region	CAS 168909	AF471143	AF471060	AY188079
<i>Pythonodipsas carinata</i>	Boodontinae	Namibia, Kaokoveld	PEM R8234	AY187997	AY188036	AY188075
<i>Coluber dorri</i>	Colubrinae	Senegal, Niokolo-Koba NP	HLMD RA-2906	AY188001	AY188040	AY188081
<i>Coluber zebrinus</i>	Colubrinae	Namibia, N of Warmquelle	CAS 214764	AY188004	AY188043	AY188084
<i>Dispholidus typus</i>	Colubrinae	South Africa, Cape Town	HLMD RA-2974	AY187973	AY188012	AY188051
<i>Hemerophis socotrae</i>	Colubrinae	Socotra	HLMD RA-2973	AY188003	AY188042	AY188083
<i>Lytorhynchus diadema</i>	Colubrinae	Tunisia, Djébil NP	HLMD RA-2333	AY187986	AY188025	AY188064
<i>Macroprotodon cucullatus</i>	Colubrinae	Tunisia, Bou Hedma	HLMD RA-2974	AY187987	AY188026	AY188065
<i>Platyiceps rogersi</i>	Colubrinae	Egypt, Sinai	NMW KCR2	AY188002	AY188041	AY188082
<i>Prosymna visseri</i>	Colubrinae?	Namibia, Sesfontein	CAS 214753	AY187994	AY188033	AY188072

Species	Subfamily/Family	Locality	Voucher	Accession c-mos	Accession cyt b	Accession 16S rRNA
<i>Telescopus fallax</i>	Colubrinae	Jordan, Tasan	not collected/ HLMD S90	AY188000	AY188039	AY188078
<i>Aspidelaps scutatus</i>	Bungarinae, Elapidae	NE Namibia	not collected/ HLMD J128	AY187968	AY188007	AY188046
<i>Boulengerina annulata</i>	Bungarinae Elapidae	Zaire (pet trade)	HLMD RA- 1607	AY187971	AY188010	AY188049
<i>Elapsoidea sundevalli</i>	Bungarinae Elapidae	Namibia, W of Opuwo	HLMD RA- 2211	AY187977	AY188016	AY188055
<i>Aparallactus capensis</i>	Aparallactinae, Atractaspididae	South Africa, Pretoria	not collected/ HLMD J156	AY187967	AY188006	AY188045
<i>Atractaspis bibronii</i>	Atractaspidinae, Atractaspididae	Namibia, W of Opuwo	HLMD RA- 2210	AY187969	AY188008	AY188047
<i>Bitis nasicornis</i>	Viperinae, Viperidae	Zaire, Kivu	HLMD RA- 2898	AY187970	AY188009	AY188048
<i>Boa constrictor</i>	Boinae, Boidae	unknown (pet trade)	not collected	AF471115	AF471036	AY188080

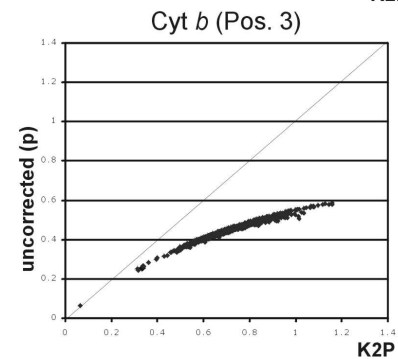
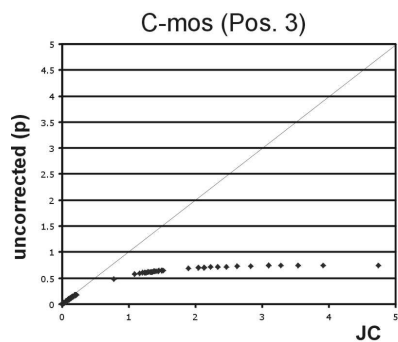
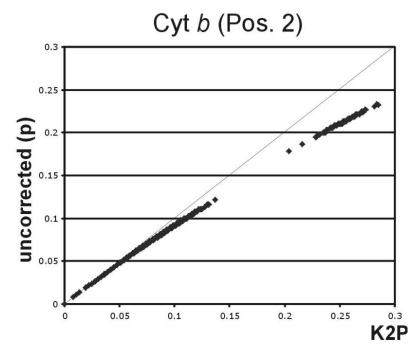
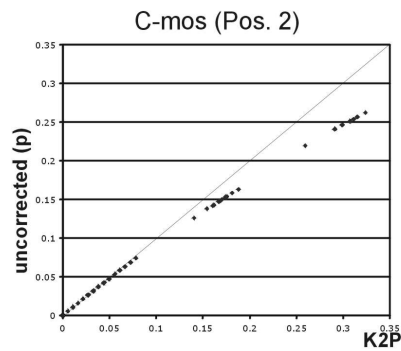
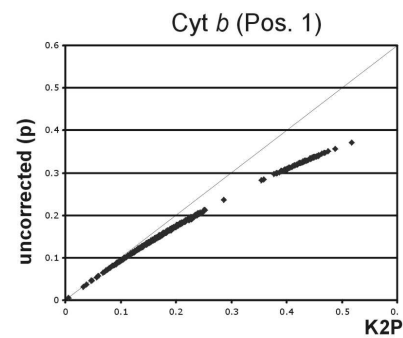
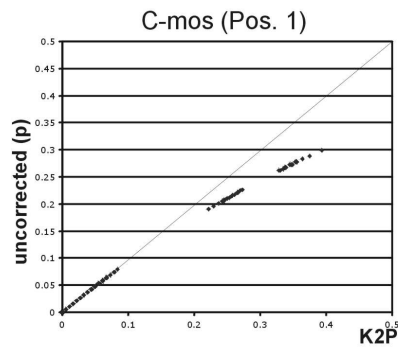
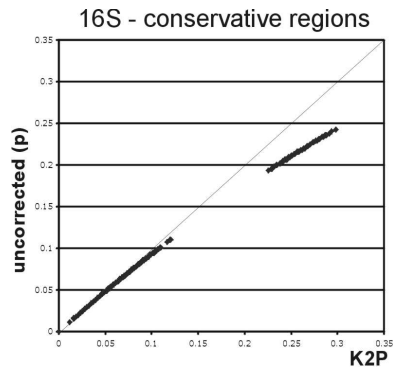
**Electronic Appendix C.** Consensus phylogram of 45,000 trees obtained by Bayesian inference, based on the same data set as the ML analysis in Fig. 1. Numbers are Bayesian posterior probabilities (clade credibility values). *Boa constrictor* was used as the outgroup. Taxa from Madagascar are marked by vertical black bars, taxa from Socotra are indicated by arrows.



0.1 substitutions / site

## Electronic Appendix D: Saturation plots of different data partitions

Uncorrected p-distances were plotted against corrected distances (Kimura 2-parameter; Jukes-Cantor for third positions of *c-mos*). The degree of tapering of the slopes indicates saturation.



## Electronic Appendix E: Estimates of ages of divergence of crucial clades

The table shows the results of analyses after non-parametric rate smoothing (Sanderson 1997) using the r8s program (Sanderson 2002). The values are ages in MYr ago, with 95% confidence intervals (computed using the cross-validation procedure) in parentheses. Because of polytomies and lack of informative sites (in c-mos), calculations were not possible in all cases.

	Combined	Cytochrome <i>b</i> (2nd Pos)	C-mos (2nd Pos)	16S rRNA (conservative regions)
<i>Ditytophis</i> – Malagasy	30.75	31.49	≤ 29.48	46.82
Pseudoxyrhopiinae	(24.32-41.05)	(21.50-49.98)		(26.76-75.85)
Deepest split in	25.59	26.22	≤ 29.48	33.96
Malagasy	(18.97-35.04)	(17.51-43.51)		(17.81-62.46)
Pseudoxyrhopiinae				
<i>Mimophis</i> - <i>Psammophis</i>	12.88	8.24	≤ 29.48	19.56
<i>Hemerophis</i> – sister clade	21.84 (16.19-30.90)	19.52	---	26.71