

# SPECIES PHYLOGENY VERSUS GENE TREES: A CASE STUDY OF AN INCONGRUENT DATA MATRIX BASED ON *PAPHIOPEDILUM* PFITZ. (ORCHIDACEAE)

Marcin Górniak<sup>1\*</sup>, Dariusz L. Szlachetko<sup>2</sup>, Natalia Olędryńska<sup>2</sup>, Aleksandra M. Naczka<sup>1</sup>, Agata Mieszkowska<sup>1</sup>, Lidia Boss<sup>3</sup> and Marek S. Ziętara<sup>1</sup>

<sup>1</sup> Department of Evolutionary Genetics and Biosystematics, University of Gdansk, 80-309 Gdańsk, Poland; marcin.gorniak@ug.edu.pl (M.G.); aleksandra.naczka@ug.edu.pl (A.N.); agata.mieszkowska@ug.edu.pl (A.M.); marek.zietara@ug.edu.pl (M.Z.)

<sup>2</sup> Department of Plant Taxonomy and Nature Conservation, University of Gdańsk, 80-309 Gdańsk, Poland; dariusz.szlachetko@ug.edu.pl (D.S), natalia.oledrzynska@ug.edu.pl

<sup>3</sup> Department of Bacterial Molecular Genetics, University of Gdańsk, 80-309 Gdańsk, Poland; lidia.boss@ug.edu.pl

\* Correspondence: marcin.gorniak@ug.edu.pl

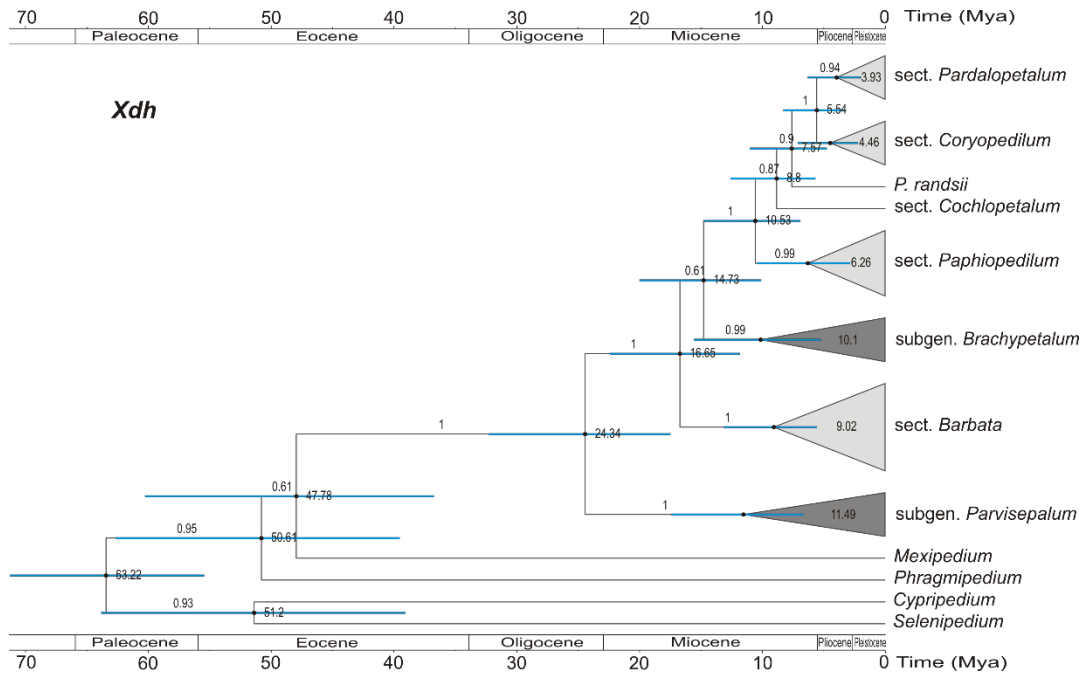
## Supplementary Data

**Table S1** MrModelTest results

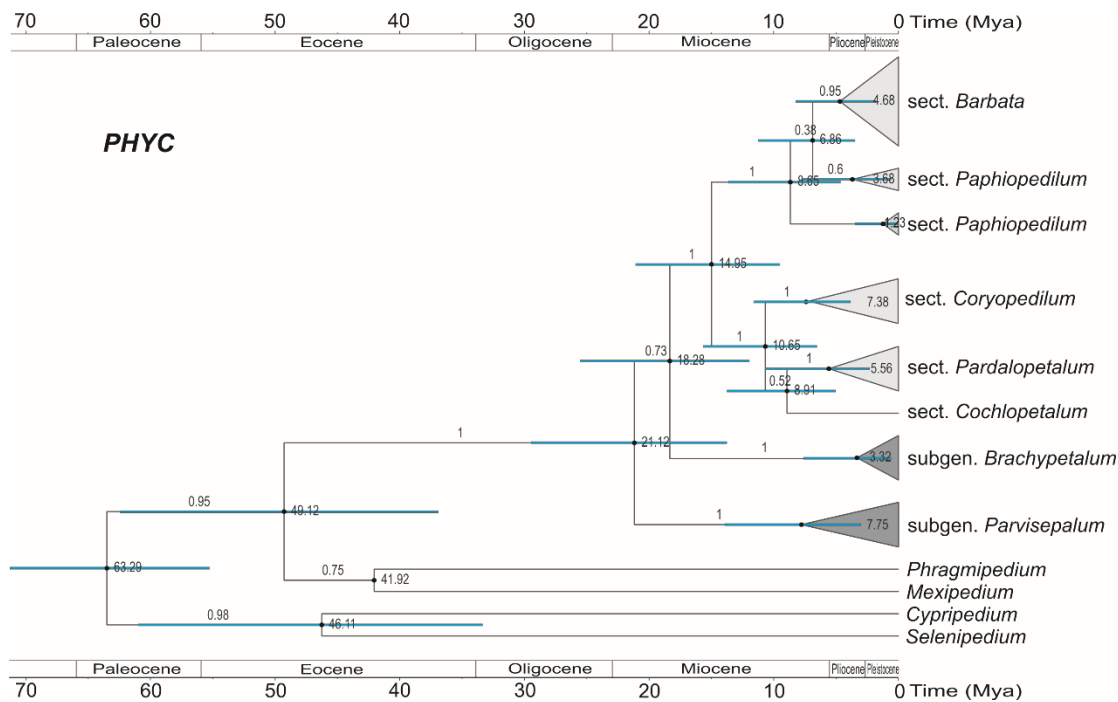
Data matrix	model selected by MrModelTest	Data matrix	model selected by MrModelTest
<i>ACO</i>	SYM+G	<i>matK</i>	GTR+G
<i>DEF4</i>	HKY+I	<i>rbcL</i>	F81
<i>XDH</i>	HKY+G	<i>ycf1</i>	GTR+I+G
<i>LFY</i>	GTR+I+G	<i>atpI-atpH</i>	GTR+I
<i>RAD51</i>	GTR+I	<i>trnS-trnfM</i>	HKY
<i>PHYC</i>	HKY+G	<i>atpF-atpH</i>	GTR+I
<i>XDH_2</i>	HKY+G	<i>rpoC2</i>	GTR+I
<i>LFY_2</i>	GTR+I	<i>accD</i>	GTR+I
<i>RAD51_2</i>	GTR+I		

**Table S2.** Sources of materials and GenBank accession numbers of taxa used in this study

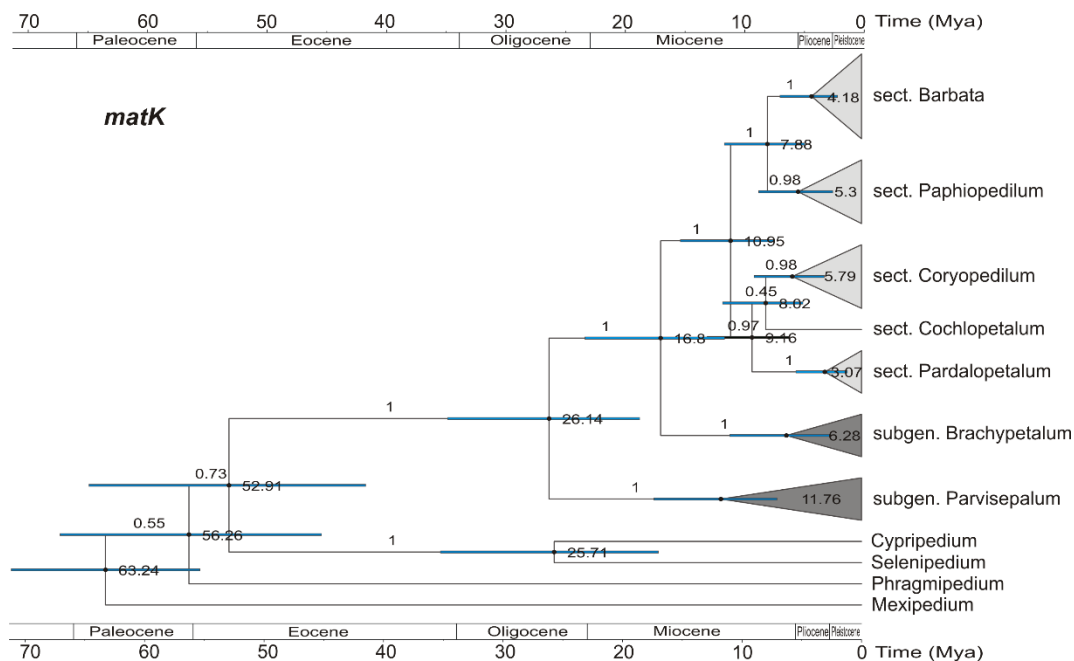
	Taxa	Sources/Vouchers	ycf1	atpI-atpH	trnS-trnM	atpI-atpH	rpoC2	accD	rbcL	ACO	DEF4	LFY	RAD51	Sources/Vouchers	PhyC	Xdh	matK
Subg. <i>Parvissepalum</i>	<i>P. armeniacum</i> S.C. Chen & F.Y. Liu	NOCC, 2471	KP311895	KP312208	KP312321	KP312560	KP311896	KP312095	KP311796	KP312432	KP312873	-	KP312898	08/07P	KX886238*	JQ660950	JQ660908
	<i>P. delavayi</i> G. Gussone	NOCC, 1951	JQ182265	KP312209	KP312322	KP312561	JQ182229	KP312096	JQ182211	KP312433	KP312874	-	KP312900	29/06/S	KX886239*	JQ660949	JQ660905
	<i>P. haughtianum</i> Perner & O. Gruss ( <i>Parvissepalum</i> 1)	NOCC, 2501	KP311899	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>P. micranthum</i> Tang & F.T. Wang ( <i>Parvissepalum</i> 1)	NOCC, 1919	KP311898	KP312212	KP312325	KP312564	KP311899	KP312099	KP311799	-	KP312877	-	KP312903	70/06/P	KX886237*	GU004514	KX886268*
Subg. <i>Brachypetalum</i>	<i>P. vietnamense</i> O. Gruss & Perner ( <i>Parvissepalum</i> 1)	NOCC, 2099	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>P. bellatulum</i> (Rohb.f.) Stein	NOCC	JN181516	KP312217	KP312330	KP312569	JN181499	KP312104	JN181465	JN181401	KP312881	JN181424	KP312910	13/07/P	KX886234*	KX886255*	KX886267*
	<i>P. canaliculatum</i> (Lindl. ex Bateman) Pfitzer in H.G.A. Engler & K.A.L. Pratt (eds.)	NOCC, 2511	KP311704	KP312220	KP312333	KP312572	KP311905	KP312107	KP311805	KP312441	KP312884	KP312788	KP312915	25/07/C	KX886236*	JQ660946	JQ660902
	<i>P. godefroyae</i> (God.-Leb.) Stein ( <i>Brachypetalum</i> 1)	NOCC, 4826	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subg. <i>Paphiopedilum</i>	<i>P. niveum</i> (Rohb.f.) Stein ( <i>Brachypetalum</i> 1)	NOCC, 6326	KP311710	KP312226	KP312339	KP312578	KP311911	KP312113	KP311811	KP312453	KP312692	-	KP312922	78/08/P	KX886235*	JQ660947	JQ660903
	<i>P. glaucodictum</i> (Blume) Stein ( <i>Corycypedium</i> 1)	NOCC, 6182	KP311713	KP312230	KP312343	KP312582	KP311914	KP312117	KP311814	KP312457	KP312697	KP312893	KP312927	-	-	-	-
	<i>P. kotokekingii</i> Foville	NOCC, 6321	KP311714	KP312231	KP312344	KP312583	KP311915	KP312118	KP311815	KP312458	KP312699	KP312904	KP312929	62/06/P (c.96)	KX886226*	KX886253*	KX886265*
	<i>P. ocellatum</i> ( <i>Corycypedium</i> 1)	-	-	-	-	-	-	-	-	-	-	-	-	79/05/P (c.2)	KX886225*	KX886252*	KX886264*
Sect. <i>Corycypedium</i>	<i>P. philippinense</i> (Rohb.f.) Stein ( <i>Corycypedium</i> 2)	NOCC, 2035	KP311715	KP312232	KP312345	KP312584	KP311916	KP312119	KP311816	KP312459	KP312700	KP312895	KP312930	89/06/P (c.62)	KX886232*	KX886254*	KX886266*
	<i>P. randsii</i> ( <i>Corycypedium</i> 2)	-	-	-	-	-	-	-	-	-	-	-	-	93/06 (c.2)	KX886227*	JQ660935	JQ660888
	<i>P. rothschildianum</i> (Rohb.f.) Stein	NOCC, 6071	KP311718	KP312235	KP312348	KP312587	KP311919	KP312122	KP311819	KP312463	KP312703	KP312813	KP312933	-	-	-	-
	<i>P. hayaldatum</i> (Rohb.f.) Stein	NOCC, 2014	KP311724	KP312242	KP312355	KP312594	KP311925	KP312129	KP311825	KP312469	KP312709	KP312821	KP312940	49/06	KX886224*	KX886251*	KX886263*
Sect. <i>Pardalopetalum</i>	<i>P. lowii</i> (Lindl.) Stein	NOCC, 4824	KP311726	KP312244	KP312357	KP312596	KP311927	KP312131	KP311827	-	KP312711	KP312825	KP312942	66/08/P (c.52)	KX886222*	JQ660936	JQ660890
	<i>P. parishii</i> (Rohb.f.) Stein	NOCC, 2628	KP311727	KP312245	KP312358	KP312597	KP311928	KP312132	KP311828	KP312472	KP312712	KP312826	KP312944	82/06/P	KX886223*	JQ660937	JQ660891
	<i>P. chamberlainianum</i> ( <i>Cochlopetalum</i> 1)	-	-	-	-	-	-	-	-	-	-	-	-	20/08/P	KX886221*	JQ660938	JQ660892
	<i>P. victoria-regina</i> (Sander) M.W. Wood ( <i>Cochlopetalum</i> 1)	MBO, 921156-1	KP311733	KP312252	KP312365	KP312604	KP311934	KP312139	KP311834	KP312480	KP312721	KP312833	KP312953	-	-	-	-
Sect. <i>Paphiopedilum</i>	<i>P. druryi</i> (Bedd.) Stein 1	MBO, 913218-1	KP311739	KP312258	KP312371	KP312610	KP311940	KP312145	KP311840	KP312488	KP312727	KP312792	KP312963	32/06/K	KX886220*	JQ660939	JQ660894
	<i>P. gratianum</i> Rolfe 1	NOCC, 3076	KP311743	KP312262	KP312375	KP312614	KP311944	KP312149	KP311844	KP312492	KP312730	KP312843	KP312966	44/03/K	KX886229*	JQ660944	JQ660900
	<i>P. transiensianum</i> O. Gruss & Perner	NOCC	KP311757	KP312277	KP312389	KP312629	KP311957	KP312164	KP311858	KP312514	KP312746	KP312852	KP312969	11/07/P	KX886233*	KX886250*	KX886262*
	<i>P. villosum</i> (Lindl.) Stein	MBO, 913228-1	KP311758	KP312278	KP312390	KP312630	KP311958	KP312165	KP311859	KP312515	KP312748	KP312856	KP312967	11/09/P	KX886216*	JQ660943	JQ660899
Sect. <i>Barbata</i>	<i>P. barbatum</i> (Lindl.) Pfitzer	NOCC, 6320	KP311761	KP312281	KP312393	KP312633	KP311960	KP312168	KP311862	KP312519	KP312750	KP312856	KP312969	11/08/P	KX886215*	JQ660940	JQ660895
	<i>P. callosum</i> (Rohb.f.) Pfitzer	NOCC, 25191	KP311763	KP312283	KP312395	KP312635	KP311962	KP312170	KP311864	KP312523	KP312752	KP312859	KP312969	17/06/P	KX886217*	KX886246*	KX886258*
	<i>P. dayanum</i> (Lindl.) Stein	NOCC, 4629	KP311766	KP312286	KP312396	KP312636	KP311965	KP312173	KP311867	KP312526	KP312755	KP312863	KP312966	28/06/P	KX886219*	KX886245*	KX886257*
	<i>P. virens</i> var. <i>javanicum</i> (Reinw. ex Lindl.) Pfitzer ( <i>Barbata</i> 1)	NOCC, 4629	KP311766	KP312286	KP312396	KP312636	KP311965	KP312173	KP311867	KP312526	KP312755	KP312863	KP312966	12/10/5/P	KX886214*	KX886244*	KX886256*
Sect. <i>Barbata</i>	<i>P. javanicum</i> (Reinw. ex Lindl.) Pfitzer ( <i>Barbata</i> 1)	NOCC, 6318	KP311769	KP312289	KP312400	KP312641	KP311967	KP312176	KP311869	KP312528	KP312756	KP312865	KP312968	88/06/P	KX886218*	KX886247*	KX886259*
	<i>P. purpuratum</i> (Lindl.) Stein	NOCC, 1615	KP311773	KP312293	KP312404	KP312645	KP311971	KP312180	KP311873	KP312533	KP312760	KP312870	KP312969	-	-	-	-
	<i>Phragmipedium besseae</i>	-	-	-	-	-	-	-	-	-	-	-	-	136/08/P	KX886240*	JQ660951	JQ660908
	<i>Cypripedium dicksonianum</i>	-	-	-	-	-	-	-	-	-	-	-	-	Free Miller s.n.	KX886241*	JQ660952	JQ660909
Outgroup	<i>Mexipedium xerophyllum</i>	-	-	-	-	-	-	-	-	-	-	-	-	Popov s.n.	KX886243*	GU004510	JQ660907
	<i>Selenipedium sequinociale</i>	-	-	-	-	-	-	-	-	-	-	-	-	8261 Schachtel	KX886242*	GU004507	EF079360



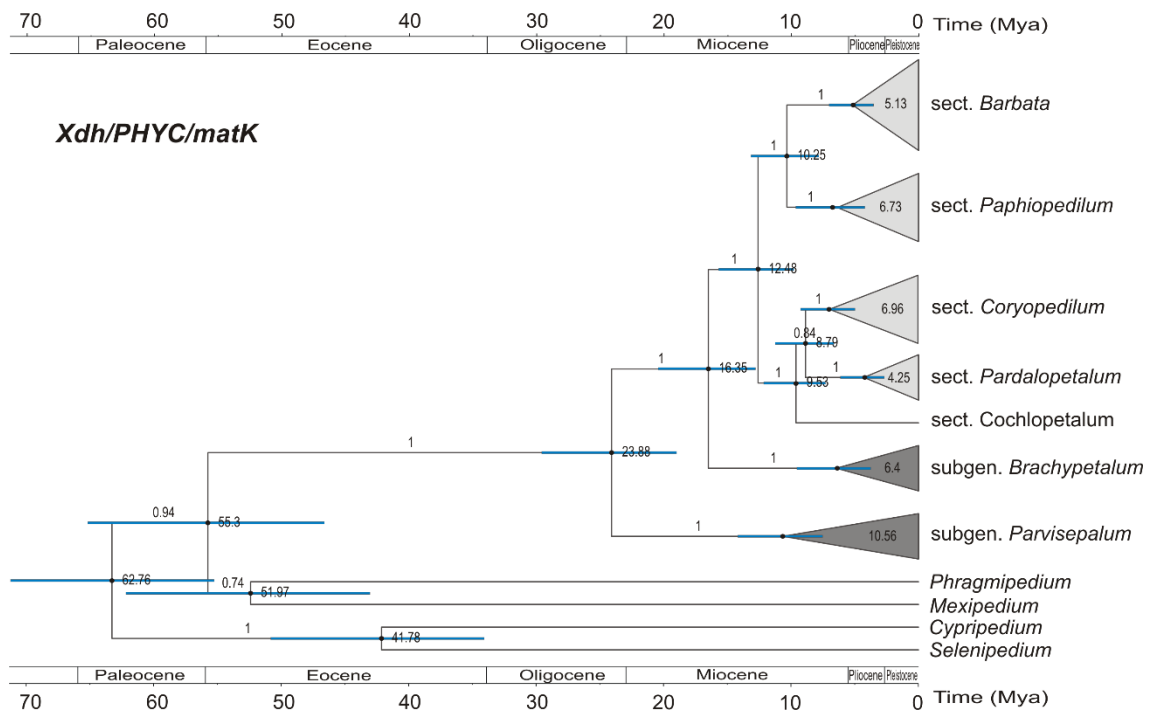
**Figure S1.** Time-calibrated tree of *Paphiopedilum* genus (maximum clade credibility tree) resulting from the BEAST analysis of the nuclear low copy gene *XDH*. Posterior Probability (PP) values are indicate above branches. Numbers at nodes are divergence times based on a strict clock analysis. Bars represent the 95% highest posterior credibility intervals of divergence times. Classification to clades follows Cribb (1998).



**Figure S2.** Time-calibrated tree of *Paphiopedilum* genus (maximum clade credibility tree) resulting from the BEAST analysis of the nuclear low copy gene *PHYC*. Posterior Probability (PP) values are indicate above branches. Numbers at nodes are divergence times based on a strict clock analysis. Bars represent the 95% highest posterior credibility intervals of divergence times. Classification to clades follows Cribb (1998).



**Figure S3.** Time-calibrated tree of *Paphiopedilum* genus (maximum clade credibility tree) resulting from the BEAST analysis of the *matK* gene. Posterior Probability (PP) values are indicate above branches. Numbers at nodes are divergence times based on a strict clock analysis. Bars represent the 95% highest posterior credibility intervals of divergence times. Classification to clades follows Cribb (1998).



**Figure S4.** Time-calibrated tree of *Paphiopedilum* genus (maximum clade credibility tree) resulting from the BEAST analysis of the combined nuclear low copy gene *XDH*, *PHYC* and plastid *matK* gene. Posterior Probability (PP) values are indicate above branches. Numbers at nodes are divergence times based on a strict clock analysis. Bars represent the 95% highest posterior credibility intervals of divergence times. Classification to clades follows Cribb (1998).

## References

Cribb, P.J. *The Genus Paphiopedilum*. 2nd ed.; Natural History Publications (Borneo) in association with Royal Botanic Gardens: Kew, Kota Kinabalu, Sabah, Malaysia, 1998.