Australian Systematic Botany, 2021, **34**, 227–251
https://doi.org/10.1071/SB20015_AC

Supplementary material

The impact of multiple molecular and morphological data sets on the phylogenetic reconstruction of subtribe Neurachninae (Poaceae: Panicoideae: Paniceae)

E. J. Thompson[A,B] *and Melodina Fabillo*[A]

[A]Queensland Herbarium, Department of Environment and Science, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, Qld 4066, Australia.

[B]Corresponding author. Email: john.thompson@des.qld.gov.au; jthompso@bigpond.net.au

Table S1. Primers used in the amplification of selected DNA regions in Neurachninae, its allies and outgroup species (Panicoideae)

Locus	Amplification primers (5′ to 3′)	PCR conditions	Reference
ITS	ITS1: TTG CGT TCA AAG ACT CGA TGA ITS2: AAC AAC TCT CAG CAA CGG	94°C, 4 min; 30× (94°C, 1:30 min; 52°C, 0:30 min; 72°C, 1:00 min) 72°C, 10 min	Grass Phylogeny Working Group II (2012); Teerawatananon *et al*. (2011)
*mat*K	*mat*K1412SR: CTG ATA CAT AAG AGT TRT AT *trn*K391F: ATC TGG GTT GCT AAC TCA ATG G	94°C, 3 min; 30× (94°C, 1:00 min; 49°C, 0:30 min; 72°C, 1:00 min) 72°C, 10 min	Christin *et al*. (2012); Soreng *et al*. (2015); Zimmermann *et al*. (2013)
*ndh*F	*ndh*F1311F: ACT GCA GGA TTA ACT GCG TT *ndh*F2091R: GAC CCA CTC CAT TGG TAA TTC	94°C, 4 min; 30× (94°C, 1:30 min; 48°C, 0:30 min; 72°C, 1:00 min) 72°C, 10 min	Christin *et al*. (2012); Grass Phylogeny Working Group II (2012); Morrone *et al*. (2012); Soreng *et al*. (2015); Zimmermann *et al*. (2013)
*rbc*L	*rbc*La_f: ATG TCA CCA CAA ACA GAG ACT AAA GC *rbc*La_r: GTA AAA TCA AGT CCA CCR CG	94°C, 4 min; 30× (94°C, 1:30 min; 55°C, 1:00 min; 72°C, 1:00 min) 72°C, 10 min	Grass Phylogeny Working Group II (2012); Zimmermann *et al*. (2013)
*rpo*C2	*rpo*C2_F: TGT TAA ATT TAG ATA TAG GAC *rpo*C2_R: ATA TGC AGT TCT TGA AGA ATG	94°C, 4 min; 30× (94°C, 1:30 min; 48°C, 0:30 min; 72°C, 1:00 min) 72°C, 10 min	Christin *et al*. (2012); Grass Phylogeny Working Group II (2012)
*rpl*16	*rpl*16_1_F: CTT AGT GTG TGT CTC GTT AG *rpl*16_1_R: GTA ATT CAT AGA CCA TAC AC	94°C, 4 min; 30× (94°C, 1:30 min; 48°C, 0:30 min; 72°C, 1:00 min) 72°C, 10 min	Christin *et al*. (2012)
*trn*L–F	*trn*LF(c): CGA AAT CGG TAG ACG CTA CG *trn*LF (f): ATT TGA ACT GGT GAC ACG AG	94°C, 3 min; 30× (94°C, 1:00 min; 55°C, 1:00 min; 72°C, 1:30 min) 72°C, 6:00 min	Christin *et al*. (2012); Teerawatananon *et al*. (2011)

Table S2. Taxa, details of vouchers, locality and GenBank accession numbers of sequence data

Taxon		Voucher details	Locality	GenBank accession						
				ITS	ndhF	matKF	rbcL	rpoC2	rpl16	trnLF
Ingroup										
Ancistrachne	*Ancistrachne maidenii* (Ham.) Vickery[A]	Thompson EJT936 (BRI)	Australia	MK330914	MK330970	MN702502	MN702529	MN702581	MN702555	MN702606
	Ancistrachne maidenii (Ham.) Vickery	Thompson & Guymer EJT1038 (BRI)	Australia	MK330932	MK330972	MN702520	NA	MN702598	MN702547	MN702624
	Ancistrachne numaeensis (Balansa) S.T.Blake	van Drot 567 (NOU)	New Caledonia	MK330927	MK330980	MN702515	MN702542	MN702593	MN702568	MN702619
	Ancistrachne uncinulata (R.Br.) S.T.Blake	Thompson & Simon EJT849 (BRI)	Australia	MK330920	MK330981	MN702508	MN702535	MN702587	MN702561	MN702612
	Ancistrachne uncinulata (R.Br.) S.T.Blake[A]	Thompson EJT1018 (BRI)	Australia	MK330929	MK330982	MN702517	MN702544	MN702595	MN702570	MN702621
Calyptochloa	*Calyptochloa cylindrosperma* E.J.Thomps. & B.K.Simon	Thompson CHA799 (BRI)	Australia	MK330911	MK330971	MN702499	MN702526	MN702578	MN702552	MN702603
	Calyptochloa gracillima subsp. *gracillima* (C.E.Hubb.) E.J.Thomps. & B.K.Simon[A]	Thompson/EJT830 (BRI)	Australia	MK330919	MK330983	MN702507	MN702534	MN702586	MN702560	MN702611
	Calyptochloa johnsoniana E.J.Thomps. & B.K.Simon	Thompson & Simon EJT928 (BRI)	Australia	MK330924	MK330976	MN702512	MN702539	NA	MN702565	MN702616
Cleistochloa	*Cleistochloa sclerachne* (F.M.Bailey) C.E.Hubb.	McDonald KRM11638 (BRI)	Australia	MK330906	MK330977	MN702494	MN702521	MN702573	MN702547	MN702599
	Cleistochloa sclerachne (F.M.Bailey) C.E.Hubb.	Forster & McDonald PIF32799 (BRI)	Australia	MK330907	MK330975	MN702495	MN702522	MN702574	MN702548	MN702600
	Cleistochloa subjuncea C.E.Hubb. (2)	Thompson & Simon HUG815 (BRI)	Australia	MK330925	MK330978	MN702513	MN702540	MN702591	MN702566	MN702617
	Cleistochloa subjuncea C.E.Hubb.[A]	Thompson EJT1012 (BRI)	Australia	MK330931	MK330974	MN702519	MN702546	MN702597	MN702572	MN702623
	Cleistochloa sp. (Duaringa K.B.Addison 42)	Thompson & Simon EJT934 (BRI)	Australia	MK330915	MK330979	MN702503	MN702530	MN702582	MN702556	MN702607
Dimorphochloa	*Dimorphochloa rigida* S.T.Blake	Thompson & Simon EJT803 (BRI)	Australia	MK330912	MK330973	MN702500	MN702527	MN702579	MN702553	MN702604
	Dimorphochloa rigida S.T.Blake[A]	Thompson & Simon EJT915 (BRI)	Australia	MK330917	MK330990	MN702505	MN702532	MN702584	MN702558	MN702609
	Dimorphochloa sp. (Charters Towers E.J.Thompson + CHA554)[A]	Thompson & Simon HUG792 (BRI)	Australia	MK330908	MK330989	MN702496	MN702523	MN702575	MN702549	MN702601
	Dimorphochloa sp. (Miles E.J.Thompson EJT888)	Thompson & Simon EJT931 (BRI)	Australia	MK330921	MK330985	MN702509	MN702536	MN702588	MN702562	MN702613
Neurachne	*Neurachne munroi* (F.Muell.) F.Muell.[A]	Thompson & Simon MUT553 (BRI)	Australia	MK330926	MK330986	MN702514	MN702541	MN702592	MN702567	MN702618
	Neurachne queenslandica S.T.Blake	Thompson & Simon EJT871 (BRI)	Australia	MK330918	MK330988	MN702506	MN702533	MN702585	MN702559	MN702610
Paraneurachne	*Paraneurachne muelleri* (Hack.) S.T.Blake[A]	Thompson GAL354 (BRI)	Australia	MK330916	MK330987	MN702504	MN702531	MN702583	MN702557	MN702608
Thyridolepis	*Thyridolepis mitchelliana* (Nees) S.T.Blake	Thompson EJT899 (BRI)	Australia	MK330909	MK330996	MN702497	MN702524	MN702576	MN702550	MN702602
	Thyridolepis xerophila (Domin) S.T.Blake[A]	Thompson & Simon EJT909 (BRI)	Australia	MK330913	MK330984	MN702501	MN702528	MN702580	MN702554	MN702605
Outgroup										
Entolasia	*Entolasia marginata* (R.Br.) Hughes[A]	Thompson MOR772 (BRI)	Australia	MK330930	NA	MN702518	MN702545	MN702596	MN702571	MN702622
	Entolasia minutifolia B.K.Simon	Thompson & Simon EJT965 (BRI)	Australia	MK330923	MK330995	MN702511	MN702538	MN702590	MN702564	MN702615
	Entolasia stricta (R.Br.) Hughes	Thompson MOR756 (BRI)	Australia	MK330910	MK330993	MN702498	MN702525	MN702577	MN702551	NA
Panicum	Panicum effusum R.Br.[A]	Thompson EJT916 (BRI)	Australia	MK330928	MK3309NA	MN702516	MN702543	MN702594	MN702569	MN702620
Walwhalleya	*Walwhalleya subxerophila* (Domin) K.E.Wallis & J.J.Bruhl[A]	Thompson EJT962 (BRI)	Australia	MK330922	NA	MN702510	MN702537	MN702589	MN702563	MN702614

[A]Accession used in minimal sample set in the study of Neurachninae.

Table S3. Species × character state matrix for the 104 morphological characters for 22 species used in the study of Neurachninae

Species used by: [1]Hilu and Wright (1982) [did not nominate species], [2]Morrone *et al*. (2012) [[#]used *Neurachne alopecuroides*] and [3]Zuloaga *et al*. (2000) [did not nominate species]. *as *Homopholis belsonii* in some cases

Sample	Character code																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ancistrachne maidenii	3	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	0	0	0	0	0
Ancistrachne numaeensis	2	0	0	0	0	1	1	1	0	1	0	0	0	0	2	0	0	1	2	0	0	0	0	0	0
Ancistrachne uncinulata [1, 2, 3]	2	0	0	0	0	1	1	1	0	1	0	0	0	0	2	0	0	1	2	0	0	0	0	0	0
Calyptochloa cylindrosperma	3	0	1	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	0	0	2
Calyptochloa gracillima [1, 2, 3]	3	0	1	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	0	0	2
Calyptochloa johnsoniana	3	0	1	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	0	0	2
Cleistochloa sp. (Duaringa K.B.Addison 42)	3	0	1	2	0	0	0	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	0	0	2
Cleistochloa sclerachne	2	0	1	3	1	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1
Cleistochloa subjuncea [1, 3]	2	0	1	3	1	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1
Dimorphochloa rigida [2, 3]	2	0	1	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0
Dimorphochloa sp. (Charters Towers E.J.Thompson+ CHA554)	0	0	1	3	1	0	0	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	0	0	0
Dimorphochloa sp. (Miles E.J.Thompson EJT888)	0	0	1	3	1	0	0	0	0	0	0	2	0	0	1	0	0	0	1	1	0	0	0	0	0
Entolasia marginata	2	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	1	0
Entolasia minutifolia	2	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	1	0
Entolasia stricta [1, 2, 3]	2	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	1	0
Neurachne munroi [1, #, 3]	2	0	0	1	1	0	2	0	1	1	0	2	1	0	2	1	0	0	3	1	1	1	0	0	2
Neurachne queenslandica	2	1	0	1	1	0	2	0	0	1	0	2	1	0	2	1	0	0	3	1	1	1	0	0	2
Paraneurachne muelleri [1, 2, 3]	3	0	0	1	1	1	2	0	1	1	0	2	1	0	2	1	0	0	3	1	1	1	0	0	2
Panicum effusum	1	0	0	0	0	1	0	0	0	0	1	0	0	0	2	0	0	0	2	0	0	0	1	0	0
Thyridolepis mitchelliana [1, 2, 3]	1	1	0	1	1	0	3	0	0	1	0	2	1	1	2	1	1	0	4	1	2	1	0	0	2
Thyridolepis xerophila [1, *]	1	1	0	1	1	0	3	0	0	1	0	2	1	1	2	1	1	0	4	1	2	1	0	0	2
Walwhalleya subxerophila	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	1	0	0

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
0	0	2	1	3	1	1	0	0	0	0	0	0	0	0	1	2	1	1	0	0	1	0	1	0	2	1	0	0	0	0	2	0	0	0	0	0	4	1	0	1	1	1	1	2
0	0	2	1	4	0	2	0	0	0	0	1	0	0	0	1	3	0	1	1	1	1	0	1	0	2	1	1	1	2	0	0	3	0	0	1	1	0	0	0	0	0	0	0	0
0	0	2	1	4	0	2	0	0	0	0	1	0	0	0	1	3	1	1	1	0	1	0	1	0	2	1	1	1	2	0	0	3	0	0	1	1	0	0	0	0	0	0	0	0
0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	1	0	2	0	3	2	0	1	2	1	1	3	0	0	2	0	1	1	0	3	1	2	2	2
0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	1	0	2	0	3	2	0	1	2	1	1	3	0	0	2	0	1	1	1	3	1	2	2	2
0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	1	0	2	0	3	2	0	1	2	1	1	3	0	0	2	0	2	1	0	3	1	2	2	2
0	1	1	1	2	2	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	1	0	2	0	3	2	0	1	2	1	1	3	0	0	2	2	4	1	0	1	1	2	2	2
0	0	1	1	1	3	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	3	0	3	0	3	3	0	1	2	0	0	3	0	0	2	0	1	2	0	2	2	1	2	2
0	0	1	1	1	2	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	1	0	2	0	3	2	0	1	2	0	0	3	0	0	2	0	1	2	0	2	2	1	2	2
0	0	1	1	1	2	0	0	2	0	1	0	0	0	0	1	2	0	2	0	0	3	1	2	0	3	2	1	1	2	0	0	3	0	0	2	0	3	2	0	2	2	1	1	1
0	1	1	1	2	2	0	0	0	0	0	0	0	0	0	2	2	1	2	0	0	1	0	2	0	3	2	1	1	1	0	0	3	0	0	2	0	2	1	0	1	1	2	2	2
0	1	1	1	2	2	0	0	0	0	0	0	0	0	0	2	2	1	2	0	0	1	0	2	0	3	2	1	1	1	0	0	3	0	0	2	0	2	1	0	1	1	2	2	2
0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	3	2	1	1	0	1	0	0	1	3	1	0	1	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0
0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	1	1	0	1	0	0	1	3	1	0	1	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0
0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	1	1	0	1	0	1	1	3	1	0	1	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0
0	2	3	2	1	2	0	1	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	1	0	3	0	0	1	1	0	2	0	0	0	2	1	0	0	0	0	0	0	0	0
0	2	3	2	1	3	0	1	0	1	0	1	1	1	1	0	1	0	0	0	1	0	0	3	0	3	0	0	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
0	2	3	2	0	3	0	1	2	1	1	1	1	1	1	0	1	0	0	0	0	2	0	2	0	3	0	0	1	1	1	2	4	0	0	2	1	0	0	0	0	0	0	0	0
0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
1	2	0	2	1	1	0	0	0	0	0	1	0	1	2	0	1	0	0	0	0	1	0	0	0	1	0	0	1	2	2	2	4	0	0	2	2	0	0	0	0	0	0	0	0
1	2	0	2	1	1	0	0	0	0	0	1	0	1	2	0	1	0	0	0	0	1	0	0	0	1	0	0	1	2	2	2	4	0	0	2	2	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	3	0	1	0	0	0	0	0	0	0	0	1	1	2	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0

References

Christin PA, Wallace MJ, Clayton H, Furbank RT, Hattersley PW, Sage RF, Macfarlane TD, Ludwig M (2012) Multiple photosynthetic transitions, polypoidy, and lateral gene transfer in the grass subtribe Neurachninae. *Journal of Experimental Botany* **63**, 6297–6308. doi:10.1093/jxb/ers282

Grass Phylogeny Working Group II (2012) New grass phylogeny resolves deep evolutionary relationships and discovers C4 origins. *New Phytologist* **193**, 304–312. doi:10.1111/j.1469-8137.2011.03972.x

Hilu KW, Wright K (1982) Systematics of Gramineae, a cluster analysis study. *Taxon* **31**, 9–36. doi:10.2307/1220585

Morrone O, Aagesen L, Scataglini MA, Salariato DL, Denham SS, Chemisquy MA, Sede SM, Giussani LM, Kellogg EA, Zuloaga FO (2012) Phylogeny of the Paniceae (Poaceae: Panicoideae): integrating plastid DNA sequences and morphology into a new classification. *Cladistics* **28**(4), 333–356. doi:10.1111/j.1096-0031.2011.00384.x

Soreng RJ, Peterson PM, Romaschenko K, Davidse G, Zuloaga FO, Judziewicz EJ, Filgueiras TS, Davis JI, Morrone O (2015) A worldwide phylogenetic classification of the Poaceae (Gramineae). *Journal of Systematics and Evolution* **53**(2), 117–137. doi:10.1111/jse.12150

Teerawatananon A, Jacobs SWL, Hodkinson TR (2011) Phylogenetics of Panicoideae (Poaceae) based on chloroplast and nuclear DNA sequences. *Telopea* **13**(1–2), 115–142. doi:10.7751/telopea20116009

Zimmermann T, Bocksberger G, Brüggemann W, Berberich T (2013) Phylogenetic relationship and molecular taxonomy of African grasses of the genus *Panicum* from chloroplast DNA-barcodes and nuclear gene sequences. *Journal of Plant Research* **126**, 363–371. doi:10.1007/s10265-012-0538-y

Zuloaga FO, Morrone O, Giussani LM (2000) A cladistic analysis of the Paniceae: a preliminary approach. In 'Grasses: Systematics and Evolution'. (Eds SWL Jacobs, JE Everett) pp. 123–135. (CSIRO Publishing: Melbourne, Vic., Australia)