Systematic Parasitology **52:** 183–191, 2002.

Aptorchis aequalis Nicoll, 1914 (Digenea: Plagiorchiidae) is a senior synonym of *Dingularis anfracticirrus* Jue Sue & Platt, 1999 (Digenea: Plagiorchiidae)

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Accepted for publication 6th November, 2001

Abstract

Examination of the type-specimen of *Aptorchis aequalis* Nicoll, 1914 (Digenea: Plagiorchiidae) revealed anatomical features not included in the original description; most notably the intestinal caeca extend to near the posterior end of the worm instead of terminating just posterior to the ventral sucker. A comparison of the type of *A. aequalis* with specimens identified as *Dingularis anfracticirrus* Jue Sue & Platt, 1999, from the author's collection yielded no differences that would justify the recognition of two genera. Therefore, *Dingularis* Jue Sue & Platt, 1999, is considered a junior subjective synonym of *Aptorchis* Nicoll, 1914. Principal components analysis of specimens of *Aptorchis* collected from three species of freshwater turtles at various localities in Queensland and New South Wales, Australia revealed no differences between these specimens and the type-specimen of *Dingularis anfracticirrus*. Therefore, *D. anfracticirrus* is considered a junior subjective synonym of *A. aequalis*. *Aptorchis* Nicoll, 1914, includes the following species: *A. aequalis* (= *Dingularis anfracticirrus* new synonymy); *A. pearsoni* (Jue Sue & Platt, 1999) n. comb.; and *A. megapharynx* (Jue Sue & Platt, 1999) n. comb.

Introduction

Nicoll (1914) erected and described *Aptorchis aequalis* as a new genus and species of trematode from the Australian freshwater turtle, *Elseya latisternum* Gray, based on a single specimen from northern Queensland, assigning it to the Lepodermatidae (= Plagiorchiidae). Jue Sue & Platt (1999) erected *Dingularis* for three species of digenes from freshwater turtles in southern Queensland, with *D. anfracticirrus* Jue Sue & Platt, 1999 as the type-species.

The collection and examination of specimens tentatively identified as *D. anfracticirrus* from several species of freshwater turtles from various locations in Queensland and New South Wales, Australia during 1993–94 by the senior author led to the re-assessment of the relationship between *Aptorchis* and *Dingularis*.

Materials and methods

The turtles examined for this study were collected at various sites in Queensland and New South Wales, Australia from August, 1993 through to May, 1994 (Table 1). Turtles from Alligator Creek, Queensland, and Smith Creek, Macleay River, New South Wales, were collected by hand while snorkelling. At all other locations, turtles were collected in traps baited with meat scraps. Turtles were maintained in holding tanks and necropsied within 48 h of capture. They were injected with a lethal dose of sodium pentabarbitone. Necropsies were conducted using standard procedures. Worms were killed and fixed with steaming 5% formalin; they were placed in a screw-cap vial with a small amount 0.7% saline, steaming formalin was added to the vial and the vial quickly capped and shaken vigorously for a few seconds. The worms were then stained in Van Cleave's haematoxylin (Pritchard & Kruse, 1982), dehydrated, cleared in methyl salicylate and mounted as whole-mounts in Canada balsam. The type of *Aptorchis aequalis* (QM No. GL 11844) was examined for comparative purposes.

All measurements are in micrometres unless otherwise noted, and are given as the mean followed by the range in parentheses. Representative specimens have

Table 1. Prevalence, intensity and abundance of *Aptorchis aequalis* collected from various freshwater turtles and localities in Queensland, Australia from August, 1993 to May, 1994.

Locality	Turtle species	Prevalence (%)	Mean intensity	Mean abundance
AC[1]	*Elseya latisternum*	18.1 (2/11)	1 (1)	0.18
	Emydura krefftii	100 (2/2)	6 (6)	6.0
RRD[2]	*Emydura krefftii*	52.6 (10/19)	2.8 (1-6)	1.47
JS[3]	*Emydura krefftii*	50.0 (2/4)	7.5 (7-8)	3.75
LD[4]	*Emydura macquarii*	36.4 (4/11)	1.1 (2-4)	0.91
MR[5]	*Emydura macqurii dhara*	63.6 (7/11)	4.0 (1-7)	4.0

[1]Alligator Creek, Queensland (19°23′S, 146°57′E); [2]Ross River Dam, Thuringowa, Queensland (19°25′S, 146°44′E); [3]Jurona Station (19°33′S, 147°16′E); [4]Leslie Dam, Warwick, Queensland (25°01′S, 152°55′E); [5] Macleay River, New South Wales (31°01′S, 152°56′E).

been deposited in the Queensland Museum, Brisbane, Queensland (QM), Australia.

To evaluate patterns of morphological variation in this sample, the quantitative characters recorded for each specimen were subjected to principal components analysis (PCA). To permit exclusive focus on size-related differences, independently of any measure of overall size, total length and three ratio characters were excluded from the analysis, resulting in a 33 OTU (operational taxonomic units, or individual specimens) by 16 character data-matrix. Because the first component of a PCA based on logarithmically transformed morphometric data generally reflects size relationships (see Somers [1989] and references therein), the data were log-transformed and used as input for calculating (i) pair-wise average taxonomic distances among the OTUs and (ii) a character × character variance-covariance (VCOV) matrix. The VCOV matrix was used as input for PCA and the OTUs were projected onto the two-dimensional space defined by the first two principal components. A minimum spanning tree (MST) derived from the OTU × OTU distance matrix was superimposed on this projection. All analyses were conducted using NTSYS-pc, version 1.8 (Rohlf, 1993).

Results

Examination of the type, and only, specimen of *A. aequalis* (Figure 1) revealed several differences from the original description (Nicoll, 1914). The type-specimen was obviously severely flattened, which resulted in the posterior end being much wider than would be expected in a specimen prepared without flattening. Most of the measurements made in the current study correspond quite closely to those provided in the original paper; however, several differences were found. The ventral sucker was smaller (243 × 292 *vs* 310 × 310) and the distance from the anterior end to the ventral sucker was found to be 663 as opposed to 820 in the original. The prepharynx was given as 100 and the original illustration (Nicoll, 1914, figure 7) clearly showed this structure between the oral sucker and pharynx. Our examination (Figure 1) showed significant compression of the anterior end and the length of the prepharynx could not be measured accurately.

Specimens collected from the type-host (*Elseya latisternum*) and type-locality (northern Queensland) shows the same basic morphology (Figures 2, 3) as the type of *A. aequalis*, had the type not been mechanically flattened.

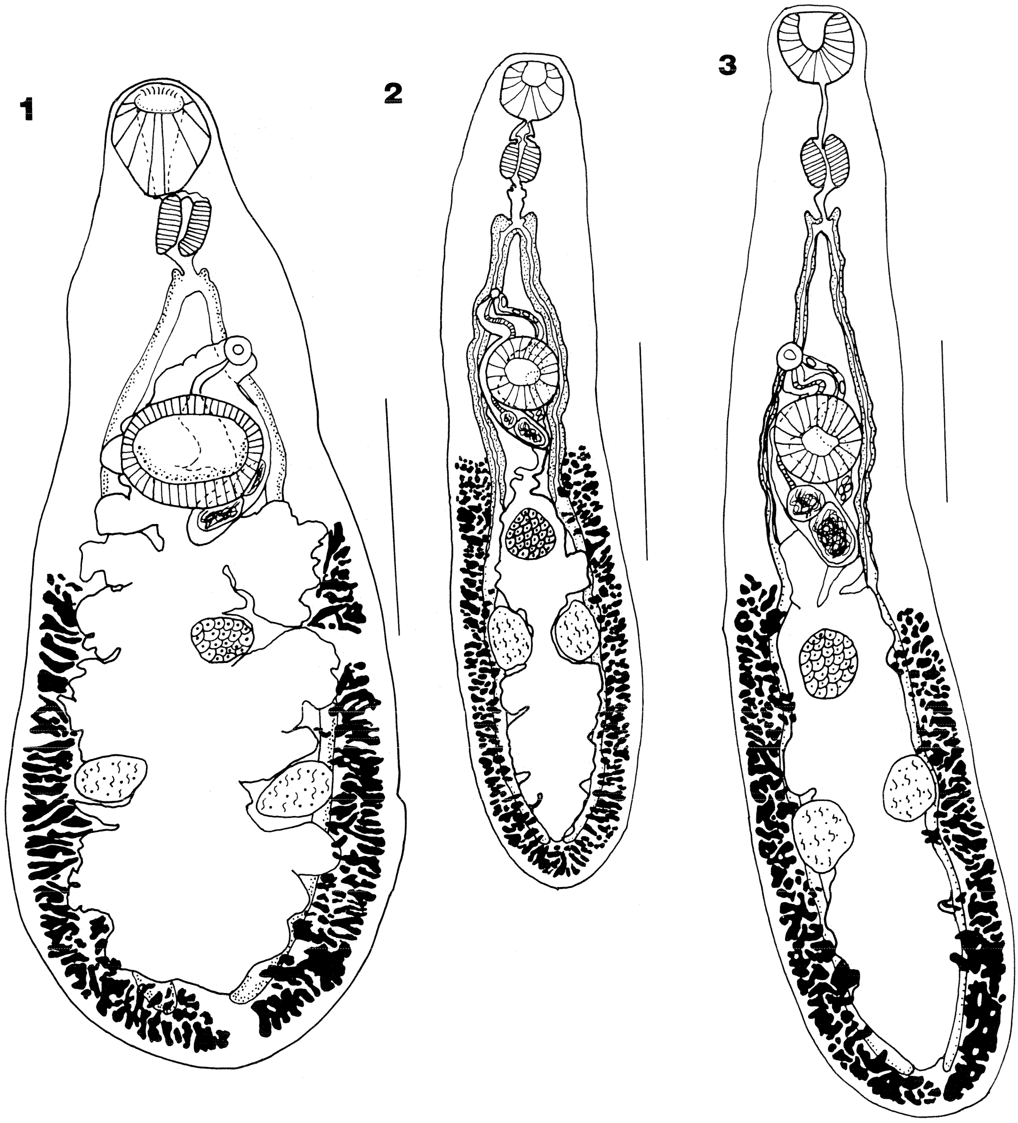
Measurements of the 2 recently collected specimens from the type-host overlap those of the type for most features (Table 2). Additional specimens from various hosts and locations in both northern and southern Queensland, and northern New South Wales, show a wide variation in metrical characters with extensive overlap between samples (Table 2).

Multivariate relationships among the 33 OTUs are summarised in Figure 4 as a projection of the OTUs onto the 2-dimensional space defined by the first 2 components of the PCA. The first component (eigenvalue = 0.152) summarises 72.4% of the variance in the data. All characters have positive loadings of similar magnitude (Table 3) on this component, an indication that it reflects overall size differences among the OTUs. This is further supported by the fact that OTU A2 has the smallest total length, OTU E3 is one of the longer specimens, and the correlation between total length and first component score is 0.877. The second principal component (0.026 and 12.5%) is primarily a contrast between LTL, RTW and LTW on the one hand (having comparatively high negative

Table 2. Measurements of *Aptorchis aequalis/Dingularis anfracticirrus* from various hosts and localities in Queensland, Australia, mean (range), in micrometres.

	*D. anfracticirrus**	*A. aequalis***		*A. aequalis****				
	Em. macquarii	*El. latisternum*	*El. latisternum*	*Em.krefftii*			*Em. macquarii*	*Em. macquarii dhara*
	Holotype	type	Alligator Creek	Alligator Creek	Ross River Dam	Jurona Station	Leslie Dam	Macleay River
N	1	1	2	7	7	4	4	7
Total Length	4430	2081	2719 (1987-3450)	2869 (2315-3152)	4024 (2560-5520)	3493 (2672-5141)	4631 (4250-5125)	2607 (2040-2978)
Maximum Width	840	847	576 (418-734)	486 (350-632)	617 (360-836)	650 (459-816)	770 (673-887)	539 (449-602)
Oral sucker L.	218	225	179 (135-223)	168 (140-223)	182 (115-266)	226 (168-292)	242 (205-261)	178 (150-212)
Oral sucker W.	252	208	210 (158-261)	184 (158-230)	209 (133-287)	247 (180-308)	248 (218-287)	195 (168-215)
Pharynx L.	168	123	128 (100-155)	137 (115-183)	140 (100-165)	168 (135-235)	175 (145-208)	128 (115-138)
Pharynx W.	81	115	122 (93-150)	116 (103-128)	130 (98-145)	163 (138-214)	153 (115-220)	114 (98-143)
Ventral sucker L.	374	243	229 (170-287)	247 (215-287)	296 (180-350)	293 (209-449)	406 (345-491)	262 (225-334)
Ventral sucker W.	386	292	231 (175-287)	245 (205-292)	283 (173-329)	283 (198-444)	383 (334-485)	308 (261-365)
Anterior to caecal bifurcation	744	428	520 (376-663)	602 (490-704)	673 (510-816)	695 (465-867)	839 (745-908)	534 (465-663)
Ovary L.	210	115	153 (105-200)	139 (90-168)	201 (165-245)	184 (165-215)	251 (235-271)	147 (110-175)
Ovary W.	210	150	150 (115-185)	137 (75-170)	179 (133-225)	178 (155-213)	257 (235-292)	138 (105-175)
Right testis L.	294	140	196 (153-238)	166 (125-193)	215 (175-251)	217 (195-261)	322 (261-386)	171 (160-193)
Right testis W.	298	193	148 (105-190)	140 (65-193)	180 (140-214)	167 (163-177)	268 (240-287)	142 (110-175)
Left testis L.	294	123	182 (150-213)	163 (110-190)	221 (175-292)	222 (195-238)	325 (251-365)	184 (148-225)
Left testis W.	294	185	140 (105-175)	147 (75-188)	174 (130-218)	156 (145-163)	275 (261-292)	149 (118-175)
Cirrus-sac L.	1430	547	661 (475-846)	729 (663-820)	1122 (663-1550)	1105 (778-1738)	1373 (1175-1691)	702 (558-838)
Cirrus-sac W.	139	83	101 (63-138)	74 (60-108)	95 (65-120)	94 (78-113)	130 (118-153)	84 (63-100)
Ant. end to genital pore (%)	29.9	27.1	29.3 (27.6-31.0)	35.5 (33.0-39.7)	30.5 (24.5-35.9)	34.1 (26.7-40.8)	30.9 (27.9-36.7)	32.8 (29.7-37.0)
Anterior end to ventral sucker (%)	31.6	31.9	33.8 (32.4-35.2)	38.7 (34.7-42.4)	34.3 (27.3-40.6)	37.8 (29.0-44.3)	34.0 (30.8-41.3)	34.7 (30.4-38.5)
Ratio oral sucker/ventral sucker	0.62	0.81	0.85 (0.84-0.85)	0.72 (0.62-0.87)	0.68 (0.55-0.86)	0.86 (0.67-1.01)	0.63 (0.57-0.69)	0.66 (0.61-0.72)
Queensland Museum Accession No.	G 215048	GL 11844	G 218790-91	G 218809-15	G 218797-804	G 218792-96	G 218805-08	G 218816-22

*Measurements from Jue Sue & Platt (1999).
**Original measurements from type-specimen.
***Specimens from current study.



Figures 1–3. Aptorchis aequalis, adults. 1. Type-specimen, ventral view. 2, 3. Voucher specimens collected from the type-host, ventral. *Scale-bars*: 500 μm.

loadings; Table 3) and OSW, OSL, PL and VSW on the other (these have the highest positive loadings; Table 3). Three OTUs in particular (B1, B2, D3; Figure 4) are conspicuously different on component 2. While the former 3 are the most noticeably different on component 2, OTUs from area C also illustrate considerable variation on both components.

The MST superimposed on Figure 4 reveals some distortions between the among-OTU distances derived from the full set of characters and those implied by the first 2 components; e.g. for the full data-set, B1 is closer to F7 than to F4, C3 is closer to C6 than to F6, and D4 is closer to B3 than to B5. These are, however, minor distortions. The cophenetic correlation between the full distance matrix and that derived from Figure 4 is 0.983, indicating that it is a 'very good' (Rohlf, 1993) depiction of among-OTU relationships.

Discussion

Aptorchis was considered sufficiently different from the specimens that later formed the basis for the erection of *Dingularis*, with *D. anfracticirrus* as the

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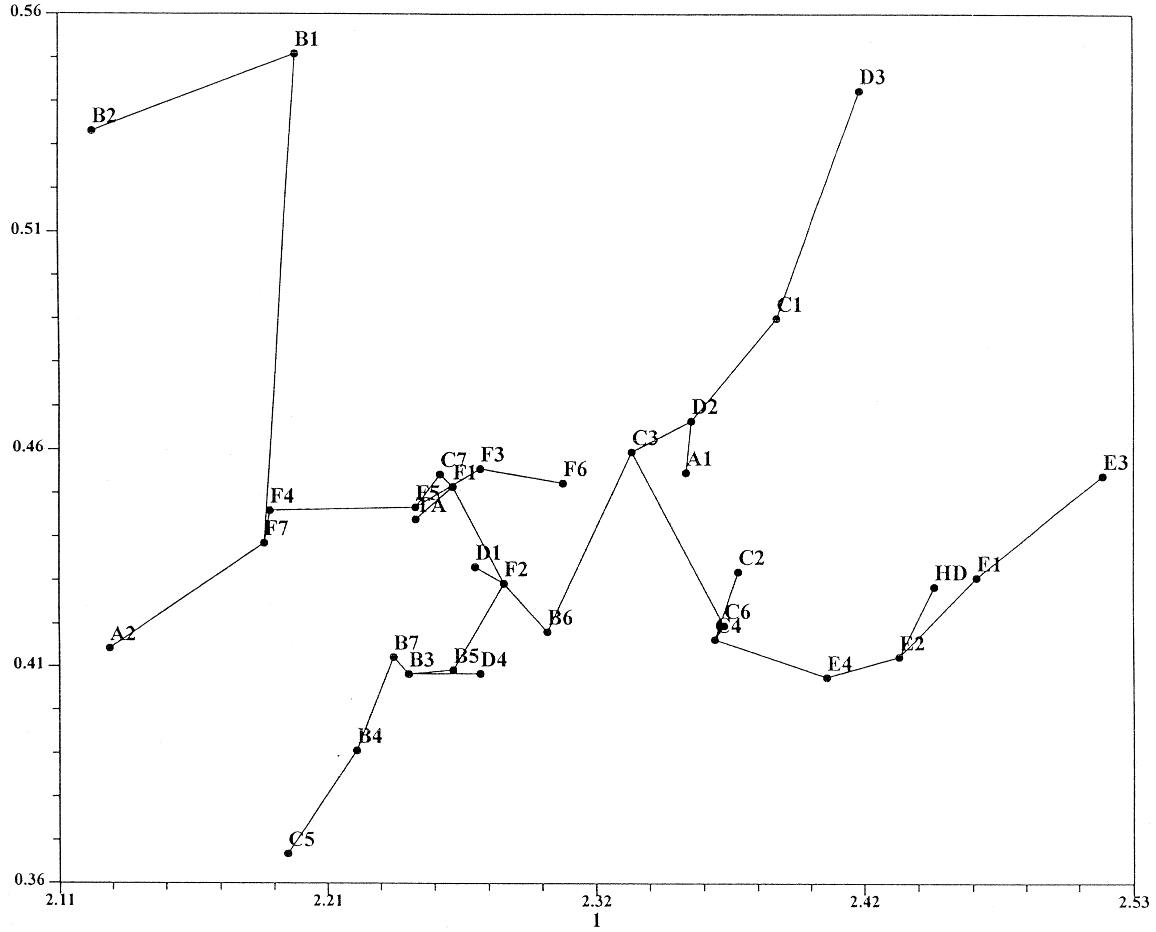

Figure 4. OTUs projected on to principal components one and two with a minimum spanning tree derived from the OTU × OTU distance matrix of *Aptorchis aequalis* and *Dingularis anfracticirrus* from various hosts and localities. *Abbreviations*: A1-2, from *Elseya latisternum*, Alligator Creek, northern Queensland; B1-7, from *Emydura krefftii*, Alligator Creek, northern Queensland; C1-7, from *E. krefftii*, Ross River Dam, Thuringowa, northern Queensland; D1-4, from *E. krefftii*, Jurona Station, northern Queensland; E1-4, from *E. macquarii*, Leslie Dam, Warwick, southern Queensland; F1-7, from *E. macquarii dhara*, Smith Creek, Macleay River, northern New South Wales; TA, type of *A. aequalis* from *Elseya latisternum*, 'northern' Queensland; HD, holotype of *Dingularis anfracticirrus*, from Kholo, Brisbane River, southern Queensland.

type-species, and was not therefore considered further. The specimens were tentatively assigned to *Astiotrema* Looss, 1900; however, differences in several adult characters and the form of the larval excretory system precluded their placement in this genus (Jue Sue & Platt, 1999). Unfortunately, the excretory system of *A. aequalis* is unknown.

In his original description of *A. aequalis*, Nicoll (1914) stated that 'The intestinal diverticula are short. They keep close to the ventral sucker and terminate a short distance behind it, the ends being obscured by the uterus.' The uterus in the posterior part of the body is extensive, obscuring the intestinal caeca, as well as much of the female reproductive system (Figure 1). Based on the collection of additional specimens, Nicoll (1918) revised his original description to include the extension of the caeca to the posterior end of the worm, an observation confirmed in the present study. Yamaguti (1958, 1971) failed to correct the original description and included 'ceca terminating a short distance to the acetabulum' in both the key to the subfamily Aptorchiinae Yamaguti, 1958 and his description of *Aptorchis*. This does not excuse Jue Sue & Platt (1999) from overlooking Nicoll's work. With the elimination of this difference, there are no objective criteria for separating these taxa. On the basis of priority, *Dingularis* must be considered a junior subjective synonym of *Aptorchis*. Therefore, the species

Table 3. Character loadings on principal components one and two. Analysis based on corresponding metrical values for *Dingularis anfracticirrus/Aptorchis aequalis* as presented in Table 2.

Character	PC1	PC2
Maximum width (MW)	0.096	0.020
Oral sucker length (OSL)	0.067	0.058
Oral sucker width (OSW)	0.061	0.051
Pharynx length (PL)	0.060	0.043
Pharynx width (PW)	0.070	0.031
Ventral sucker length (VSL)	0.097	0.034
Ventral sucker width (VSW)	0.081	0.042
Anterior to caecal bifurcation (ACB)	0.075	0.019
Ovary length (OL)	0.110	−0.015
Ovary width (OW)	0.117	−0.028
Right testis length (RTL)	0.101	−0.029
Left testis length (LTL)	0.123	−0.062
Right testis width (RTW)	0.107	−0.041
Left testis width (LTW)	0.116	−0.070
Cirrus-sac length (CSL)	0.136	0.031
Cirrus-sac width (CSW)	0.097	0.020

originally contained in *Dingularis* are transferred to *Aptorchis*. A revised generic diagnosis of *Aptorchis* is given below.

Aptorchis Nicoll, 1914

Syn. *Dingularis* Jue Sue & Platt, 1999

Diagnosis

Plagiorchiida, Plagiorchioidea, Plagiorchiidae. Body elongate, slightly dorso-ventrally flattened. Tegument armed; body-spines in quincunx, extend to testes or posterior end; 3–4 rows of spines present immediately anterior to mouth, continuous or not, with lateral spines; tegument unspined anterior to pre-oral spines. Frontal glands present; ducts dorsal and lateral to oral sucker, open pre-orally in unarmed area. Tegumental glands numerous in forebody. Oral sucker smaller than ventral sucker; prepharynx of variable length. Pharynx larger or smaller than oral sucker. Oesophagus short, joining caeca terminally or medially; anterior caecal diverticula present or absent; caeca extend almost to posterior end. Ventral sucker large, in anterior half of body, spined or not, with 9 papillae in mouth. Entire reproductive system may demonstrate right-handed or left-handed orientation. Testes two, entire, inter-caecal, in posterior third of body, symmetrical, diagonal or tandem. Cirrus-sac large, sinuous or tortuous, extends well posterior to ventral sucker, contains unarmed cirrus, glandular pars prostatica and bipartite seminal vesicle occupying less than half its volume. Genital pore in forebody or at level of anterior margin of ventral sucker, submedian, equidistant from mid-line and lateral margin, sinistral or dextral. Ovary median or submedian, in posterior half of body, between testes and ventral sucker. Seminal receptacle median or submedian, usually postero-dorsal to and smaller than ovary. Mehlis' gland present, surrounds proximal end of uterus. Laurer's canal long, thick-walled, opens onto dorsal surface anterior or posterior to testes. Uterus with single convoluted loop, comprising descending and ascending arms, inter- and post-caecal, extending to posterior extremity. Vitelline follicles large or small, extend in ventro-lateral extra-caecal fields from posterior level of cirrus-sac almost to ends of caeca or to posterior extremity. Excretory pore subterminal; excretory vesicle T-shaped. In gut of Australian freshwater turtles.

Type-species: *A. aequalis* Nicoll, 1914.

Additional species: *A. pearsoni* (Jue Sue & Platt, 1999) n. comb.; *A. megapharynx* (Jue Sue & Platt, 1999) n. comb.

Remarks

The description of *A. aequalis* was based on a single specimen (Nicoll, 1914). Measurements of the type are shown in Table 2. In a later paper, Nicoll (1918) included additional selected measurements, extending the size range of the species to 3.85 mm along with concomitant increases in the oral and ventral sucker diameters and greater distance between the anterior end and the ventral sucker, as well as observations on the presence of a bipartite seminal vesicle.

Recently collected specimens of *A. aequalis* showed a striking difference in the form of the oesophago-intestinal junction in the form of the description of *A. anfracticirrus.* In the latter species, the oesophagus merges smoothly with the caeca, while in *A. aequalis* (Figures 2, 3) the oesophagus enters the caeca medially with the formation of two prominent anterior caecal diverticula. Nicoll (1914) stated that 'at the intestinal bifucation the initial parts of the diverticula are somewhat swollen', although he did not specifically state that anterior diverticula were present, nor did he figure anterior diverticula in his illustration of *A. aequalis.* Examination of the type revealed that very small anterior diverticula are indeed present.

Additional specimens showed significant variation in this structure (Figure 5). Therefore, the presence of anterior caecal diverticula cannot be used to separate *aequalis* and *anfracticirrus*.

Specimens collected and assigned to *Aptorchis* from the type-host and type-locality (Table 2) overlap with the type-specimen of *A. aequalis* in virtually every respect. Metrical characters from all specimens examined varied widely and overlapped in most instances and were impossible to separate from measurements given for *D. anfracticirrus* (see Jue Sue & Platt, 1999).

As there were no consistent qualitative differences between the specimens examined, we decided to conduct a multivariate analysis of the quantitative characters recorded for each specimen. It is well known (e.g. Rohlf & Bookstein, 1987) that a multivariate analysis can be used to detect a general size component in the variation among a set of specimens. If we can identify a general size component, then the residual variation is viewed by some (e.g. Sneath & Sokal, 1973; Somers, 1989; see Bookstein, 1989, for a different view) as a reflection of shape. While both size and shape are taxonomically important aspects of variation, if one specimen is simply a larger version of another, i.e. the difference represents an isometric increase in size, then it is difficult to argue that they are not the same. As noted by Sneath & Sokal (1973), 'Evidently overall size makes in some sense a 'relatively small contribution' toward taxonomic resemblance, while the complexities of shape contribute much more'. The objective of our multivariate analysis is to determine whether there is evidence of either size and/or shape differences among the sampled specimens.

Our multivariate analysis of relationships among these OTUs does not provide support for the hypothesis that *A. aequalis* and *D. anfracticirrus* are two distinct species. Rather, these results indicate that the quantitative difference between the two type-specimens is primarily a general size difference; the type of *A. aequalis* (TA in Figure 4) is simply a smaller specimen than the holotype of *D. anfracticirrus* (HD in Figure 4). The overall difference between HD and TA is even less than that between OTUs C1 and C5, two specimens collected from *Emydura krefftі* at Ross River Dam in northern Queensland. In fact, with respect to the characters that account for the greatest proportion of the residual variation (component two; what Somers, 1989, would refer to as shape) when component one is subtracted from the data, these two OTUs are more like each other than are specimens collected at the same locality, especially for groups B, C and D.

Based on this information *D. anfracticirrus* Jue Sue & Platt, 1999, is considered a junior subjective synonym of *A. aequalis* Nicoll, 1914. A revised description of *A. aequalis* is provided below based on the specimens examined in this study and information from Jue Sue & Platt (1999).

Aptorchis aequalis Nicoll, 1914

Syn. *Dingularis anfracticirrus* Jue Sue & Platt, 1999

Description

Body elongate, 3,591 (1,987–5,570), rounded at both ends, slightly dorso-ventrally flattened, widest at level of testes, 607 (350–887). Tegument thick, armed with projecting recurved spines in quincunx; spines continue to posterior end, decrease in size and number posteriorly, reduced in size and number on medial ventral surface between oral and ventral suckers, sharply demarcated from large ventro-lateral spines; 3 rows of small rounded pre-oral spines anterior to mouth, discontinuous with lateral spines; tegument unarmed anterior to pre-oral spines. Oral sucker spherical to subspherical, 195 (115–292) × 215 (133–304); mouth subterminal, ventral. Prepharynx short, 203 (40–360), usually folded. Pharynx anteriorly 4-lobed, muscular, 149 (100–235) × 134 (93–220); nuclei in posterior half. Oesophagus short, 128 (63–209), thick-walled, lined with finger-like projections into lumen. Caeca equal, thick-walled, narrow, dorso-lateral, extend almost to posterior end; anterior caecal diverticula present or absent. Ventral sucker 294 (170–491) × 284 (173–465), 36.1% (27.3–44.3%) of total body length from anterior end, unspined; single circle of 9 papillae in mouth.

Testes 2, large, equal, spherical or sub-spherical, entire, in posterior 1/3 of body, ventro-lateral to excretory vesicle, diagonal to almost symmetrical, separated by uterus; right testis 218 (125–386) × 178 (65–287), left testis 218 (110–365) ×177 (75–292). Cirrus-sac long, 1,008 (475–1,738) × 95 (60–153), tortuous in both horizontal and sagittal planes, extends posteriorly almost to anterior level of vitellarium, contains seminal vesicle, pars prostatica and cirrus. Seminal vesicle large, lies diagonally across body towards dorsal side, straight, bipartite; posterior part cylindrical, 190 (88–386) × 78 (35–133); anterior part sub-spherical, 81 (35–175) × 74 (40–125). Pars

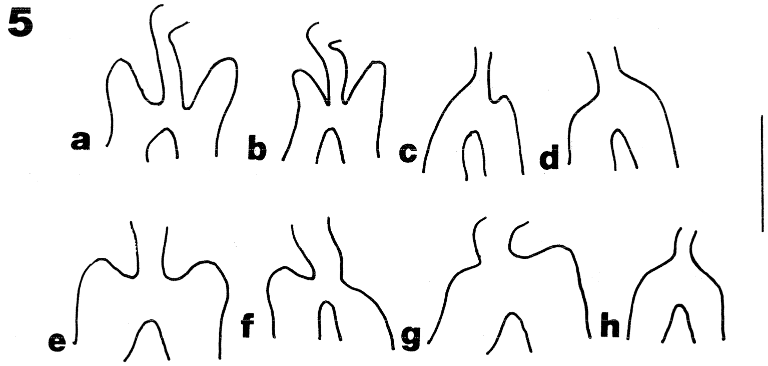

Figure 5. Variation in shape and extent of intestinal diverticula of *Aptorchis aequalis* from various hosts and localities. 5a, from *Elseya latisternum*, Alligator Creek, northern Queensland; 5b–d, from *Emydura krefftii*, Alligator Creek, northern Queensland; 5e–h, from *Emydura macquarii dhara*, Smith Creek, Macleay River, New South Wales.

prostatica long, twisting, glandular, surrounded by gland-cells with granular cytoplasm which project into lumen, overlaps anterior half of ventral sucker dorsally, loops back on itself ventrally at antero-lateral margin of ventral sucker, proceeds diagonally across body. Cirrus muscular, unarmed, eversible, opens into genital atrium postero-dorsal to uterus. Genital pore ventral, in forebody, submedian, equidistant from mid-line and lateral body margin, sinistral or dextral, 32.5% (24.5–40.8%) of total body length from anterior end.

Ovary sub-spherical 184 (90–271) × 177 (75–292), median to submedian, post-equatorial. Seminal receptacle thin-walled, spherical or sub-spherical, median or submedian, on opposite side to and postero-dorsal to ovary. Laurer's canal long, thick-walled, joins oviduct dorsally, ciliated and inflated proximally; remainder uniformly narrow, proceeds posteriorly, opens dorsally through simple median pore anterior to testes. Mehlis' gland postero-ventral to ovary, surrounds proximal end of uterus. Oötype not prominent. Uterus inter- and post-caecal; single convoluted loop, comprising descending and ascending arms, opens into genital atrium antero-ventral to male opening. Vitelline follicles small, compact, irregularly shaped, extend extra-caecally in ventro-lateral fields from near posterior border of cirrus-sac to posterior end; fields usually confluent posteriorly forming 'U'. Common vitelline duct inflated to form vitelline reservoir, joins oviduct dorsally. Vitelline reservoir small, variable in shape, median or submedian, postero-dorsal to seminal receptacle.

Excretory vesicle T-shaped, expanded and notched at anterior end, dorsal to testes, extends to ovary and seminal receptacle. Excretory pore subterminal on dorsal surface in mid-line. Freshly laid eggs (n=30) 32–35 × 19–21, smooth, thick-shelled, lightly tanned, distinctly operculate, embryonated, containing fully-developed miracidium.

Type-host: Elseya latisternum Gray.
Other hosts: Emydura macquarii (Gray), *E. krefftii* (Gray), *E. macquarii dharra* Cann.
Type-locality: Northern Queensland.
Other localities: Kholo, Brisbane River, Queensland, Australia (27°34′S, 152°45′E); Alligator Creek, Queensland (19°23′, 146°57′E); Ross River Dam, Thuringowa, Queensland (19°25′S, 146°44′E); Jurona Station (19°33′S, 147°16′E); Leslie Dam, Warwick, Queensland (25°01′S, 152°55′E); Smith Creek, Macleay River, New South Wales (31°01′S, 152°56′E).

Remarks

Aptorchis aequalis is found exclusively in the large intestine of the host turtle (Jue Sue & Platt, 1999; current study), although Nicoll (1914, 1918) identified the location only as 'intestine.' This species is not apparently found in large numbers in any individual host, as the mean intensity and abundance are typically quite low (Table 1). The original description was based on a single specimen (Nicoll, 1914) and the subsequent redescription was based on six individuals from a single host (Nicoll, 1918). *Emydura krefftii* may be a more important host than the type-host, at least in some localities, considering that, where both *Elseya latisternum* and *Emydura krefftii* were examined, the latter species had a higher mean intensity and abundance.

The sample sizes are, however, too small to draw any firm ecological conclusions.

Acknowledgements

TRP wishes to thank: the Lilly Foundation for their support of a sabbatical leave; Dr David Blair for laboratory support and advice; Drs Tom Cribb and Sylvie Pichelin, University of Queensland, for providing laboratory space and assistance with the collection of turtles; Prof. Klaus Rohde, University of New England, for laboratory space; and Keith Cornish, David Dye and Wayne Higgins, University of New England, for assistance with collecting turtles.

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