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A revision of the cestode genus *Joyeuxiella* Fuhrmann, 1935 (Dilepididae: Dipylidiinae)

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Summary

Of 13 species allocated to the genus *Joyeuxiella*, only *J. pasqualei* (Diamare, 1893), *J. fuhrmanni* (Baer, 1924) and *J. echinorhyncoides* (Sonsino, 1889) are considered valid. *J. chyzeri* (Ratz, 1897), *J. pasqualeiformis* (López-Neyra, 1928), *J. rossicum* (Skryabin, 1923), *J. aegyptica* (Meggitt, 1927), *J. fortunatum* (Meggitt, 1927) and *J. guilhoni* Troncy, 1970 are synonymized with *J. pasqualei*. *Joyeuxiella* sp. (Kofend, 1917) and *J. paucitestis* Mettrick & Beverley-Burton, 1961 are considered to be synonyms of *J. fuhrmanni*. *J. gervaisi* (Setti, 1895) and *J. dongolense* (Beddard, 1913) are considered *species inquirendae*. A key to the valid species of the genus is provided.

Introduction

The genus *Joyeuxiella* was first erected under the name of *Joyeuxia* by López-Neyra (1927) for dilepidids previously allocated to *Dipylidium* Leuckart, 1893 with thorn-like hooks, one egg per uterine capsule and the vagina opening posteriorly to the cirrus sac. López-Neyra (1927) designated *D. chyzeri* Ratz, 1897 as type species but wrongly attributed it to Diamare, 1892. He also included in the genus *J. pasqualei* (Diamare, 1893 not 1892 as stated), *J. echinorhyncoides* (Sonsino, 1889), *J. gervaisi* (Setti, 1895), *Joyeuxia* sp. (Kofend, 1917) and *J. fuhrmanni* (Baer, 1924) and later (1928) added *J. dongolense* (Beddard, 1913), *J. aegyptica* Meggitt, 1927, *J. rossica* (Skryabin, 1923) and *J. pasqualeiformis* López-Neyra, 1928 as new combinations. Witenberg (1932) in a revision of the genus concluded that the above species and *Dipylidium fortunatum* Meggitt, 1927 should be assigned to this genus but that only *J. pasqualei* and *J. echinorhyn-*

coides should be considered valid. He synonymized *J. chyzeri*, *J. rossica*, *D. fortunatum*, *J. pasqualeiformis* and *J. fuhrmanni* with *J. pasqualei* which he designated the type species. In so doing he indirectly invalidated the genus, an error perpetuated by Neveu-Lemaire (1936). Fuhrmann (1935) emended the name to *Joyeuxiella* because the original was preoccupied by a sponge, *Joyeuxia* Topsent, 1890. Witenberg's (1932) synonymies were accepted by Neveu-Lemaire (1936) and by Hughes, Baker & Dawson (1941) but they were not adopted by Wardle & McLeod (1952), Ortlepp (1933), Yamaguti (1959), Mettrick & Beverley-Burton (1961) or Troncy (1970). The two last-named authorities added two new species, *J. paucitestis* and *J. guilhoni*, respectively, to the genus. Round (1968) noted the confusion and chose to list all the species accepted by Yamaguti (1959), pending a revision.

The genus has not been revised since Witenberg's work and the present study was therefore undertaken to clarify the situation. Type specimens have

been examined whenever possible but those of some species are lost or otherwise unobtainable. Lists of hosts and localities are given by Witenberg (1932), Wardle & McLeod (1952), Yamaguti (1959) and Round (1968) and are not included here. Measurements are in microns unless otherwise stated.

Only three species of the genus are considered valid and these are described below.

Descriptions

Joyeuxiella fuhrmanni, 1935

Synonym: *Joyeuxia* López-Neyra, 1927

Generic diagnosis: Dilepididae, Dipylidiinae; small to medium cestodes, genitalia double; rostellum retractile, conical or cylindrical, armed with several alternating circles of thorn-shaped hooks decreasing in size at the base of the rostellum; suckers unarmed; genital pore in anterior half of each lateral margin; testes numerous, medullary; cirrus pouch elongated oval to pyriform, crossing excretory stems, opening anteriorly to vagina; ovary lobed, fan-shaped; seminal receptacle present, oval to spindle-shaped, among ovarian lobes; vitelline gland postovarian, compact or slightly lobed, oval to kidney-shaped; uterus breaking down into egg capsules each containing a single egg; adults in mammals.

Genotype: *Joyeuxiella chyzeri* (Ratz, 1897), synonym of *J. pasqualei* (Diamare, 1893)

Joyeuxiella pasqualei (Diamare, 1893)

(Table 1, Figs. 1–4)

Synonyms: *Dipylidium pasqualei* Diamare, 1893; *Joyeuxia pasqualei* (Diamare, 1893) López-Neyra, 1927; *Dipylidium chyzeri* Ratz, 1897; *Dipylidium rossicum* Skryabin, 1923; *Diplopylidium fortunatum* Meggitt, 1927; *Joyeuxia aegyptica* Meggitt, 1927;

Joyeuxia pasqualeiformis López-Neyra, 1928; *Joyeuxiella guilhoni* Troncy, 1970.

Material examined:

J. pasqualei

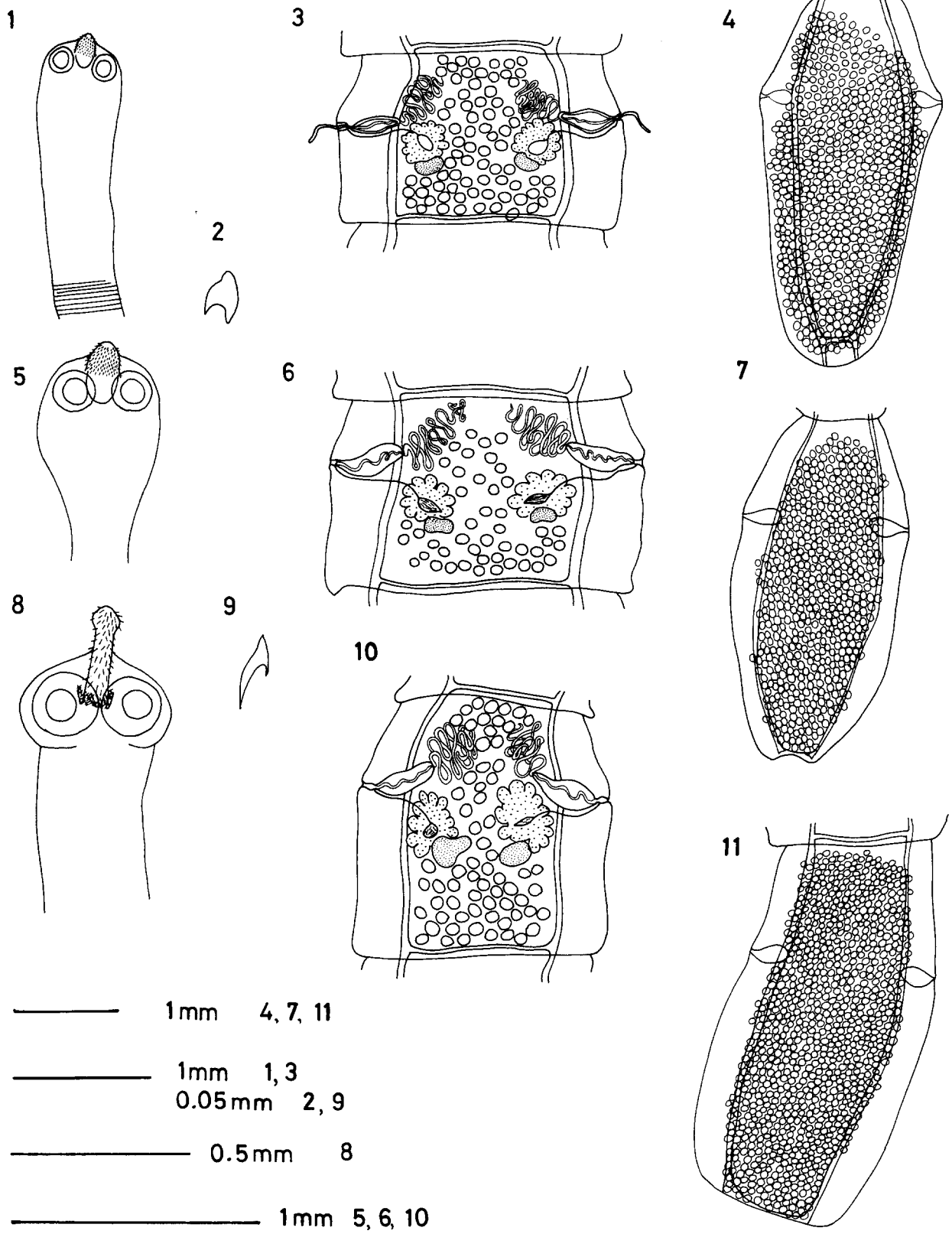
Type specimens not available;

Other material from:

cat	Nigeria	British Museum (Natural History) 1974. 4.4. 7–8.
	Jericho	BM(NH) 1977.10.24. 96–98; Zool. Mus. Humboldt-Univ., Berlin, 6050.
	Iraq	BM(NH) 1980.6.20. 27–30.
<i>Canis aureus</i>	Kenya	Commonwealth Institute of Parasitology, 3714.
<i>Felis lybica</i>	Zambia	C.I.P. 3981.
<i>Felis serval</i>	Zambia	C.I.P. 3982.
		Originally identified as <i>J. chyzeri</i> (Ratz 1897) from:
cat	Federation of Malay States	BM(NH) 1933.6.14. 336–345.
<i>Felis serval</i>	Nigeria	BM(NH) 1977.11.9. 19.
		Originally identified as <i>J. fortunatum</i> (Meggitt, 1927) (determined by Meggitt) from:
cat	Egypt (Gizeh)	BM (NH) cotypes 1934. 6.4. 31–32; Cairo collection 802b, 715. 1968.11.25. 23
		Originally identified as <i>J. aegyptica</i> (Meggitt, 1927) (determined by Meggitt) from:
<i>Felis sylvatica</i>	Egypt	BM (NH) cotypes 1934. 6.4. 53–82
<i>Felis sylvestris</i>	Egypt	BM (NH) 1968.11.26. 48
		Originally identified as <i>J. guilhoni</i> Troncy, 1970 from:



Figs. 1–11. Figs. 1–4. *Joyeuxiella pasqualei*. Fig. 1. Scolex; Fig. 2. Rostellar hook; Fig. 3. Mature proglottis; Fig. 4. Gravid proglottis. Figs. 5–7. *Joyeuxiella fuhrmanni*. Fig. 5. Scolex; Fig. 6. Mature proglottis; Fig. 7. Gravid proglottis. Figs. 8–11. *Joyeuxiella echinorhyncoides*. Fig. 8. Scolex; Fig. 9. Rostellar hook; Fig. 10. Mature proglottis; Fig. 11. Gravid proglottis.



— 1mm 4, 7, 11
— 1mm 1, 3
— 0.05mm 2, 9
— 0.5mm 8
— 1mm 5, 6, 10

Table 1. *Joyeuxiella pasqualei* (Diamare, 1893): comparison of specimens described by various authors

	Diamare (1893)	Witenberg (1932)	present study	López-Neyra (1928)	Troncy (1970)	(= <i>J. guilthoni</i>) (= <i>J. guilthoni</i>)
length	approx. 200 mm	65-500 mm	31-365 mm	190-300 mm	—	30-125 mm
width	—	—	0.4-2.0 mm	1.6-2.0 mm	—	—
no. segments	—	70-359	47-274+	numerous	140-200	166-158
scolex	—	400-500 diam.	141-430 × 234-522	350-400 diam.	135 × 370	188-329 × 216-464
neck	—	—	427-2120	—	90-1100 × 200	807-1900
suckers	—	—	94-183	130-150	105	83-146
rostellum	—	100-160 × 80-120	136-282 × 56-146	150-170 × 50-58	110-170	150-234 × 71-113
no. hook circles	16	14-18	8-18	15-16	12-15	12-18
hook size	7	11-16 → 6-10	12-17 → 4-8	9-10 → 6	12-15	12-17 → 5-7
mature segment	—	—	295-1900 × 290-2000	≈ 1.0 × 0.7 mm	—	304-1142 × 475-1000
cirrus sac	—	180-330 long	85-393 × 47-141	≈ 200 × 90	210 × 65	94-221 × 42-103
cirrus diam.	—	—	17-19	—	20	—
testes no.	—	40-100	68-130	60-100	49-77	41-78
max. diam.	—	40-70	46-113	—	20-30	45-66
ovary max. diam.	—	—	141-435	160-200 × 120-150	60-200	141-282
vit. gl. size	—	—	61-183	100-75	115 × 90	51-103 × 38-85
rec. sem.	—	—	66-190 × 24-85	—	50 × 30	47-103 × 24-47
gravid segment	—	1.5-6.0 × 1.5-2.0 mm	0.9-4.9 × 0.3-2.2 mm	—	2.68 × 1.45	1.5-4.5 × 0.3-1.0 mm
egg capsule	—	53-76	42-94	50-80	50-60	42-71
egg size	—	34-50	30-45	36-40	—	28-40
embryo	—	—	35-40	32	30-35	23-33
hooks	—	—	17-21	14-18	18	14-18

Felis serval Republic of Chad Muséum Nationale d'Histoire Naturelle, Paris, cotypes, C32; 668S.

The complete range for the species is presented below; data by individual workers are compared in Table 1.

Strobila up to 365 mm long (500 when relaxed) by 0.4–2.0 mm wide, with 47 to 359 segments; scolex dorso-ventrally flattened, 135–430 × 234–522; 'neck' 427–2120; suckers round-oval, 83–183 diam.; rostellum usually bluntly conical, occasionally bulb-shaped depending on state of contraction, 106–282 × 50–146, armed with 8–18, usually 10–15, alternating rows of hooks quincunxially arranged, rose-thorn-shaped with length of bases exceeding that of blades; blades 12–17 µm long at apex of rostellum, decreasing to 4–8 at the base.

Mature segments often square, 295–1900 × 290–2000; genital atria in anterior half of lateral margin; cirrus sac elongated oval, crosses longitudinal excretory ducts, 85–393 × 42–141; cirrus unarmed, 17–19 µm diam.; testes 40–130/segment, medullary, extending forward between and in front of vasa deferentia, 40–113 diam.; ovary fan-shaped, postero-medial to each cirrus sac, 141–435 max. diam.; vagina opens behind cirrus sac; seminal receptacle among ovary lobes, oval to spindle-shaped, 47–190 × 24–85; vitelline gland postovarian, oval to kidney-shaped, smooth or slightly lobed; gravid segments longer than wide, 0.9–6.0 × 0.3–3.2 mm; egg capsules 42–94, median and lateral to longitudinal excretory vessels; eggs 28–50, embryos 23–40, hooks 14–21 µm.

***Joyeuxiella fuhrmanni* (Baer, 1924) Fuhrmann, 1935**
(Table 2, Figs. 5–7)

Synonyms: *Dipylidium fuhrmanni* Baer, 1924; *Dipylidium* sp. Kofend, 1917; *Joyeuxiella paucitestis* Mettrick & Beverley-Burton, 1961.

Material examined:

Felis serval South Africa Types and cotypes from the Muséum d'Histoire

Naturelle, Geneva, nos 4/86–94 and the Veterinary Research Institute, Onderstepoort Muséum d'Histoire Naturelle, Geneva, 100/46–47
F. serval Belgian Congo Veterinary Research Institute, Onderstepoort
F. catus South Africa Veterinary Research Institute, Onderstepoort
F. lybica South Africa Veterinary Research Institute, Onderstepoort 66579
 genet South Africa Veterinary Research Institute, Onderstepoort, 25314/8/36

Originally identified as *J. paucitestis* from:

Genetta rubiginosa Southern Rhodesia BM (NH) 1963. 7. 25, 15–19, 20, paratypes

The complete range for the species is given below and records by different authors are compared in Table 2.

Strobila up to 80 mm long (relaxed), approx. 1.0 mm wide with up to 200 segments; scolex dorso-ventrally flattened, 132–469 × 230–713; 'neck' 141–2500; suckers round or oval, 94–165 diam.; rostellum of *pasqualei*-type, bluntly conical, 141–268 × 56–137, armed with 10–16 rows of rose-thorn-shaped hooks with blades longer than bases, 9–17 µm long near apex of rostellum decreasing to 4–9 at the base.

Mature segments broader than long, 114–1188 × 542–1667; genital atria in anterior half of lateral margin; cirrus sac elongated oval to pyriform, reaches or crosses excretory vessels, 118–273 × 35–118; cirrus 14–21 µm diam.; testes oval, 20–60 per segment, 47–81 diam.; extending forward between but rarely in front of the vasa deferentia which typically reach the anterior margin of the segment; ovaries fan-shaped, posteromedial to cirrus sac, 118–282; seminal receptacle among ovary lobes, oval to spindle-shaped, 47–212 × 28–85; vitelline gland postovarian, oval to kidney-shaped, occasionally irregular, 75–165 × 38–85; gravid segments longer than wide, 1.1–4.0 × 0.6–1.75 mm; egg capsules 35–71, typically median to excretory vessels, few occasionally lateral; eggs 31–50, embryos 20–40, hooks 15–19 µm long.

Table 2. *Joyeuxiella fuhrmanni* (Baer, 1924): comparison of specimens described by various authors

	Types and co-types		Types and co-types		Types and co-types		Types and co-types	
	Baer (1924, 1925)	present study	present study	Mettrick & Beverley-Burton (1961)	Witenberg (1932) (one specimen)	Mettrick & Beverley-Burton (1961)	present study	
length	up to 36 mm	12-37 mm	10.5-80 mm	up to 94 mm	14 mm	up to 20 mm	10 mm	
width	1.6 mm	≈ 1.0 mm	≈ 1.0 mm	up to 1.6 mm	0.7 mm	up to 0.9 mm	—	
no. segments	180-200	55-180	34-165	—	75	—	27-32	
scolex	240 diam.	469 × 315-450	132-333 × 300-713	350 diam.	280 diam.	230-250 diam.	200 × 268 (1)	
neck	300	141-1370	141-2500	1130 × 260	—	260-350 × 180-210	380 (1)	
suckers	200	94-146 × 94-125	94-165	90 × 130-140	—	70 × 80-90	85-113	
rostellum	230 × 100	183 × 85	141-268 × 56-137	140-170 × 90	—	50-80 × 60	150 × 61 (1)	
no. hook circles	14-16	12-15	12-16	17-19	—	10	10-11	
hook size	8	9-14	12-17	12-16	—	10-12	10.5-12	
mature segment	—	—	114-1188 × 619-1667	520 × 1130	—	1100 × 700	528-1619 × 542-676	
cirrus sac	250-300 × 20-50	118-188 × 35-75	141-273 × 47-118	240-260 × 50-70	100-140	240-250 × 70-80	165 × 47-56	
cirrus diam.	—	—	14-21	20	—	17-18	19-21	
testes no.	40-50	≈ 30	20-60	33-42	35-40	31-42	35-45	
max. diam.	70	—	47-81	50-60	—	60-80	59-78	
ovary max. diam.	—	118-141	188-282	120-160	—	160-190	141-291	
vit. gl. size	—	37-56	75-165 × 38-85	40-60	—	70-80	61-78	
rec. sem.	—	47-56 × 37	66-212 × 28-85	100 × 50	—	100-120 × 50	64-118 × 21-59	
gravid segment	2.1 × 0.9 mm	1.1-1.9 ×	1.4-4.0 ×	4.9 × 1.6 mm	—	2.62 × 0.87 mm	—	
egg capsule	42-46	0.7-1.0 mm	0.6-1.8 mm	54-59	—	40	—	
		35-47	50-71					

***Joyeuxiella echinorhyncoides* (Sonsino, 1889)
Fuhrmann, 1935 (Table 3, Figs. 8–11)**

Synonyms: *Taenia echinorhyncoides* Sonsino, 1889; *Dipylidium echinorhyncoides* (Sonsino, 1889) Diamare, 1892; *Dipylidium echinorhyncoides* (Sonsino, 1889) Lühe, 1894; *Joyeuxia echinorhyncoides* (Sonsino, 1889) López-Neyra, 1927.

Material examined:

<i>Canis</i> sp. (jackal)	South Africa	Veterinary Research Institute, Onderstepoort, 63077
<i>Vulpes</i> sp. cat	Palestine (Jaffa) Jerusalem	Zool. Mus. Humboldt- Univ., Berlin, 6049 Zool. Mus. Humboldt- Univ., Berlin, 6048
<i>Tatera</i> <i>indica</i> fox	Iran Kuwait	C.I.P. 3090 C.I.P. 3983
fox	Iraq	BM (NH) 1977.8.25 100–102
<i>Fennecus</i> (= <i>Vulpes</i>) <i>zerda</i>	USA (Chicago)	BM (NH) 1967.9.28 13–15

The complete range for the species is presented in the following description and records by individual workers are compared in Table 3.

Strobila up to 260 mm long, 0.5–2.5 mm wide with 90–283 segments; scolex dorso-ventrally flattened, 165–427 × 188–670; neck 180–1620; suckers round or oval, 118–179 max. diam.; rostellum 188–540 × 56–150, cylindrical with bulbous tip and armed with 20–30 alternating circles of thorn-like hooks with blades longer than bases; hooks 17–26 long near apex decreasing to 9–11 at base; base of rostellar invagination armed with irregularly arranged hooks.

Mature segments usually wider than long, 380–694 × 523–1100; paired genital atria in anterior half of proglottis margin; cirrus sac elongated oval to pyriform, crosses longitudinal excretory vessels; cirrus unarmed, 14–17 diam.; testes oval, 25–120 per segment, 40–85 max. diam., filling medulla and typically extending forward between and anterior to vasa deferentia; vagina opens posteriorly to cirrus sac; ovaries posteromedian to cirrus sacs, fan-shaped, max. diam. 165–282; seminal receptacle oval/spindle-shaped, within ovarian lobes, 80–118 × 33–61; vitelline gland postovarian, round or

Table 3. *Joyeuxiella echinorhyncoides* (Sonsino, 1889): comparison of specimens described by various authors

	Sonsino (1889)	Diamare (1893)	Witenberg (1932)	present study
length	70 mm	70 mm	30–260 mm	21–145 mm
width	—	—	—	0.5–2.5 mm
no. segments	—	—	90–250	90–283
scolex	400–450 diam.	—	250–670 diam.	165–427 × 188–422
neck	—	—	—	180–1620
suckers	180	—	—	118–179
rostellum	260 long	—	310–540 × 110–150	188–329 × 56–80
no. hook circles	12	16	23–25	20–30
hook size	18→5	10	19–26→9–11	17–26→11
mature segment	—	—	3–5 × 2–3 mm	380–694 × 523–1100
cirrus sac	—	—	110–420	103–282 × 52–94
cirrus diam.	—	—	—	14–17
testes no.	—	—	30–120	25–64
max. diam.	—	—	40–80	47–85
ovary max. diam.	—	—	—	165–282
vit. gl. size	—	—	—	71–118
rec. sem.	—	—	—	80–118 × 33–61
gravid segment	—	—	—	1.06–4.5 × 0.8–2.0 mm
egg capsules	—	—	60–70	52–83
egg size	—	—	30–40	35–45

oval, entire or slightly lobed, 71–118; gravid segments longer than wide, 1.06–4.5 × 0.8–2.0 mm; egg capsules almost entirely median to excretory vessels, 52–83, eggs 30–45 μm in diameter.

No specimens of either *Joyeuxiella gervaisi* (Setti, 1895) (synonym *Dipylidium gervaisi* Setti, 1895) or of *J. dongolense* (Beddard, 1913) (synonym *D. dongolense* Beddard, 1913) were available for examination and each is considered to be *species inquirenda* for the reasons discussed below.

Only three species of the genus are thus considered to be valid and a key for their identification is presented below.

Key to species of *Joyeuxiella* Fuhrmann, 1935

1. Rostellum cylindrical, hook blades longer than bases, egg capsules median to longitudinal excretory vessels *J. echinorhyncoides*
Rostellum conical, hook blades shorter than bases 2
2. Testes present anterior to vasa deferentia, egg capsules median and lateral to longitudinal excretory vessels *J. pasqualei*
Testes absent anterior to vasa deferentia, egg capsules median to longitudinal excretory vessels *J. fuhrmanni*

Discussion

Some of the characters previously used to differentiate between species of the genus *Joyeuxiella* are unreliable because they vary according to the state of contraction or sexual maturity of the specimen or overlap between species to the extent that they cannot be used for diagnosis. Characters considered most useful are the shape of the rostellum and rostellar hooks and the distribution of the testes and egg capsules. Some early descriptions are inadequate by present standards or apparently refer to more than one species, leaving the status of some species in doubt.

J. pasqualei, the oldest of the species allocated to *Joyeuxiella*, is considered valid. It was one of two species retained by Witenberg (1932) and the con-

fusion resulting from his designation of this species as the type species has been outlined above. The advice of Dr. R.V. Melville of the International Commission on Zoological Nomenclature is that the genotype should be cited as *J. chyzeri* (Ratz, 1897), synonym of *J. pasqualei* (Diamare, 1893). The synonymy of *J. chyzeri* with *J. pasqualei*, discussed below, is a taxonomic and not a nomenclatorial problem.

Specimens of *J. chyzeri* examined during the present study consisted of scoleces and one mature strobila which corresponded with the range of characteristics established for *J. pasqualei*. Parrot & Joyeux (1920) and Meggitt (1927) allocated specimens from experimentally infected cats and from an unknown, possibly Egyptian, host, respectively, to this species. Neither gave a full description and Meggitt's specimens may not belong to this species, as López-Neyra (1928) suggested. López-Neyra & Muñoz-Medina (1919) identified specimens from cats experimentally infected with cysticercoids from salamanders as *J. chyzeri* but did not provide a complete description of the adults. The type specimens were reported lost by Witenberg (1932) who synonymized the species with *J. pasqualei*. The synonymy is confirmed here.

Joyeuxiella rossica (Skryabin, 1923) was based on two specimens from the USSR (Novocherkassk), one from a dog also infected with *Dipylidium caninum* and the other from a cat. Currently, no specimens are available for examination. The original description conforms with that of the genus *Joyeuxiella* except that the egg capsules each contain several eggs. Witenberg (1932) synonymized the species with *J. pasqualei* because the specimens otherwise resembled it and the gravid segments probably belonged to *D. caninum*. This is probably the case and the synonymy, also proposed by Yanchev & Genov (1978), is accepted here.

The cotypes of *J. fortunatum* (Meggitt, 1927) and other material identified by Meggitt as this species consist of scoleces and immature fragments, which cannot be distinguished from *J. pasqualei*. The original description is inadequate by current standards and deterred López-Neyra (1928) from including the species in *Joyeuxia*. Witenberg (1932) concluded that the type material, loaned to him by

Meggitt, consisted of scoleces of *Joyeuxiella pasqualei* and fragments of *Diplopylidium acanthotetra* (Parona, 1887). His synonymy of *J. fortunatum* with *J. pasqualei* is confirmed here.

The cotypes and other specimens of *J. aegyptica* (Meggitt, 1927) (the latter identified by Meggitt) fall within the range established for *J. pasqualei*, with which they are considered synonymous. The species was originally distinguished by characters which have been found to vary according to the state of sexual maturity of the specimen, and by the number of hook circles, which varies in *J. pasqualei* within fairly wide limits. The cirrus is not armed, as stated in the original description.

The type specimens of *J. pasqualeiformis* (López-Neyra, 1928) were unfortunately not available for examination at the time this study was in progress but the original description (Table 1) conforms to the range established for *J. pasqualei* with which it is considered synonymous.

The characteristics of *J. guilhoni* Troncy, 1970, determined by examination of the cotypes, are compared with the original description in Table 1. They are considered to fall within the range established for *J. pasqualei*. Troncy (1970) differentiated the species only from *J. fuhrmanni*, which he thought it most resembled, by the size of the rostellar hooks, depth of the genital atrium, cirrus sac crossing the excretory vessels, number and size of the testes, shape and diameter of the vagina and shape of the ovary and vitelline gland. The length of the hooks falls within the range of both *J. fuhrmanni* and *J. pasqualei*, as does the size of the testes established by examination of the cotypes. The cirrus sac crosses the excretory vessels in both species. The depth of the genital atrium and shape of the ovary are affected by the degree of contraction of the strobila. The vitelline glands in the cotypes are oval to kidney-shaped, compact or slightly lobed rather than consistently bilobed or trilobed. The diameter of the vagina varies according to the state of sexual activity. The presence of a group of testes between the vasa deferentia and the anterior margin of the segment and of egg capsules lateral to the excretory vessels indicates that this species is a synonym of *J. pasqualei*.

J. fuhrmanni was characterized by Baer (1924,

1925) by the absence of testes anterior to the vasa deferentia and of egg capsules lateral to the longitudinal excretory vessels; he considered this species and *Joyeuxiella* sp. (Kofend, 1917) to be identical. Witenberg (1932) examined a contracted type specimen, stated that the distribution of the testes was a function of contraction and synonymized it with *J. pasqualei*, without comment on the distribution of the egg capsules. Ortlepp (1933) found the testes not to extend anterior to the vasa deferentia in specimens from a cat in South Africa and rejected the synonymy, as did Mettrick & Beverley-Burton (1961). In specimens examined during the present study, the distribution of the testes and egg capsules conformed to Baer's original description and the species is considered to be valid. Some egg capsules occur lateral to the excretory vessels in some segments of a few specimens but not to the extent seen in *J. pasqualei*. The small size of the worm and the small number of segments, although typical of many specimens, could be host-induced or result from a crowding effect and cannot be relied on for identification.

The specimens of *Joyeuxiella* sp. (Kofend, 1917) are no longer available but their description conforms to that of *J. fuhrmanni* and the view of Baer (1924, 1925) and of Witenberg (1932), who examined the originals, that they are the same as *J. fuhrmanni* is accepted.

Mettrick & Beverley-Burton (1961) differentiated *J. paucitestis* from the species listed by Yamaguti (1959) by the size and arrangement of the rostellar hooks and number of testes per segment. Examination of the paratypes indicated that these characters fall within the range now established for *J. fuhrmanni* (Table 2) which it further resembles in the absence of testes anterior to the vasa deferentia and with which it is synonymized. The distribution of the egg capsules was not mentioned in the original description and the paratypes have no gravid segments.

J. echinorhyncoides can be distinguished from all other species allocated to the genus by the shape of the rostellum and the shape, size and arrangement of the hooks. The arrangement of the hooks is never as regular as in the *pasqualei*-type scolex and the length of their blades exceeds that of their bases,

giving them a spine-like appearance. The base of the rostellar invagination is armed, which is never the case in the *pasqualei* type. Some egg capsules may be found lateral to the excretory vessels in a few specimens but never in such great numbers as in *J. pasqualei*. The species was originally described in 1889, not 1899 as stated by López-Neyra (1928) and repeated by Wardle & McLeod (1952) in their translation of his key. The species name has been spelt in different ways by different authors and although it was originally given as *echinorhynchoides* (Sonsino, 1889), the spelling *echnorhynchoides* has come into common use. The advice of Dr. R.V. Melville is that although the original derives from an incorrect latinization of a Greek word ($\epsilon\chi\upsilon\sigma$ = *-rhynch-*), this is no reason, under Article 32a (ii) of the Code, to correct the spelling. The original spelling is therefore retained.

The original and only description (Setti, 1895), of *J. gervaisi* was based on specimens from a *Genetta tigrina* from Eritrea which died in a zoo in Genoa, Italy. It is consistent with *Joyeuxiella* but inadequate by present standards and no specimens could be traced for examination. The characters of the hooks and mature segments resemble those of *J. pasqualei* but Witenberg (1932) thought that the position and shape of the cirrus pouch and shape of the egg capsules resembled *Diplopylidium*. This is supported by the position of the genital atria in gravid segments but contradicted by the vaginae opening behind the cirrus sacs and the presence of 8 to 12 circles of thorn-shaped rostellar hooks. The distribution of the egg capsules is similar to that in *J. fuhrmanni*. Southwell (1922) recorded *J. gervaisi* from *Felis viverrina* and *Paradoxurus hermaphroditicus* in Calcutta Zoo but did not describe it. In the absence of specimens the species is regarded as *species inquirenda*.

J. dongolense was originally described (Beddard, 1913) from five specimens from a *Genetta dongolana* which died in London Zoo. The description provides great histological detail but few facts of taxonomic significance and suggests features of *Joyeuxiella* and of *Diplopylidium*. The length of the hooks is cited as 2 μm by López-Neyra (1928), repeated by Wardle & McLeod (1952), but is not given in the original description. The type speci-

mens are lost, there are no other records of the species and no prospect of establishing the identity of the original specimens. *J. dongolense* is therefore regarded as *species inquirenda*.

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References

- Baer, J.G. (1924) Contribution à la faune helminthologique Sud Africaine. Note préliminaire. *Annales de Parasitologie humaine et comparée*, **2**, 239–247.
- Baer, J.G. (1925) *Contribution to the helminth fauna of South Africa*. Thesis (D.Sc., Neuchâtel). Pretoria, South Africa; Government Printing and Stationery Office, 79 pp.
- Beddard, F.E. (1913) Contributions to the anatomy and systematic arrangement of the Cestoidea. X. On two new species of tapeworms from *Genetta dongolana*. *Proceedings of the Zoological Society of London*, (1913), 549–571.
- Diamare, V. (1893) Di un'altra nuova specie del gen. *Dipylidium* Lt. *Bollettino della Società di Naturalisti in Napoli, Serie I, VII*, 9–13.
- Fuhrmann, O. (1935) Rectification de nomenclature. *Annales de Parasitologie humaine et comparée*, **13**, 386.
- Hughes, R.C., Baker, J.H. & Dawson, G.B. (1941) The tapeworms of reptiles. Part I. *American Midland Naturalist*, **25**, 454–468.
- Kofend, L. (1917) Cestoden aus Säugetieren und aus *Agama colonorum*. Vorläufige Mitteilung. *Anzeiger der Akademie des Wissenschaften Wien, Mathematische-Naturwissenschaftliche Klasse*, **54**, 229–231.
- López-Neyra, C.R. (1927) Considérations sur le genre *Dipylidium* Leuckart. *Bulletin de la Société de Pathologie exotique*, **20**, 434–440.

- López-Neyra, C.R. (1928) Recherches sur le genre *Dipylidium* avec descriptions de quatre espèces nouvelles. *Bulletin de la Société de Pathologie exotique*, **21**, 239–253.
- López-Neyra, C.R. & Muñoz Medina, J.M. (1919) Estudio del ciclo evolutivo seguido por algunas especies correspondientes al género *Dipylidium* Leuckart. *Boletín de la Real Sociedad Española de Historia Natural, Madrid*, **19**, 494–504.
- Meggitt, F.J. (1927) Report on a collection of Cestoda, mainly from Egypt. Part II. Cyclophyllidea: Family Hymenolepididae. *Parasitology*, **19**, 420–450.
- Mettrick, D.F. & Beverley-Burton, M. (1961) Some cyclophyllidean cestodes from carnivores in Southern Rhodesia. *Parasitology*, **51**, 533–544.
- Neveu-Lemaire, M. (1936) *Traité d'helminthologie médicale et vétérinaire*. Paris (Vigot Frères), xxiii + 1514 pp., 787 figs.
- Ortlepp, R.J. (1933) *Joyeuxia fuhrmanni* Baer, 1924, a hitherto unrecorded cestode parasite of the domesticated cat in South Africa. *Onderstepoort Journal of Veterinary Science*, **1**, 97–98.
- Parrot, L. & Joyeux, C. (1920) Les cysticercoïdes de *Tarentola mauritanica* L. et les ténias du chat. *Bulletin de la Société de Pathologie exotique*, **13**, 687–695.
- Round, M.C. (1968) *Check list of the helminth parasites of African mammals of the Orders Carnivora, Tubulidentata, Proboscidea, Hyracoidea, Artiodactyla and Perissodactyla*. Technical Communication of the Commonwealth Bureau of Helminthology, No. 38, vi + 252 pp.
- Setti, E. (1895) *Dipylidium gervaisi* n.sp. e qualche considerazioni sui limiti specifici nei cestodi. *Atti della Società ligustica di Scienze Naturali e Geografiche Genova*, **6**, 99–106.
- Sonsino, P. (1889) Studie e notizie elmintologiche. *Atti della Società Toscana di Scienze Naturali (Memorie) Pisa*, **6**, 191–194.
- Southwell, T. (1922) Cestodes in the collection of the Indian Museum. *Annals of Tropical Medicine and Parasitology*, **16**, 127–152.
- Troncy, P.M. (1970) Contribution à l'étude des helminthes d'Afrique, principalement du Tchad. *Bulletin du Muséum d'Histoire Naturelle, Paris*, 2e Série, Year 1969, **41**, 1487–1511.
- Wardle, R.A. & McLeod, J.A. (1952) *The zoology of tapeworms*. Minneapolis: University of Minnesota Press, xxii + 780 pp. (London: Geoffrey Cumberlege, Oxford University Press).
- Witenberg, G. (1932) On the cestode subfamily Dipylidiinae Stiles. *Zeitschrift für Parasitenkunde*, **4**, 542–584.
- Yamaguti, S. (1959) *Systema Helminthum. Vol. II. The cestodes of vertebrates*. New York and London: Interscience Publishers, vi + 860 pp.
- Yanchev, Ya. & Genov, T. (1978) [The helminth fauna of the wild cat (*Felis silvestris*) in Bulgaria.] *Khelmintologiya, Sofia*, No. 6, 81–101.

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