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Weketrema gen. n., a new genus for *Weketrema hawaiiense* (Yamaguti, 1970) comb. n. (Digenea: Lecithasteridae) recently found in Australian marine fishes

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Abstract. A new genus, *Weketrema*, is erected in the family Lecithasteridae for the species hitherto known as *Lecithophyllum hawaiiense*. *Weketrema hawaiiense* (Yamaguti, 1970) comb. n. is redescribed from *Scolopsis bilineatus* (Bloch) (Perciformes: Nemipteridae) from Lizard Island and Heron Island, Queensland, *Plectorhinchus gibbosus* (Lacepède) (Perciformes: Haemulidae) from Heron Island and *Cheilodactylus nigripes* Richardson (Perciformes: Cheilodactylidae) and *Latridopsis forsteri* (Castelnau) (Perciformes: Latridae) from Stanley, northern Tasmania. The new genus is distinguished from related members of the family Lecithasteridae by its complete lack of a sinus-sac. Although placed in the subfamily Lecithasterinae *pro tem*, its true subfamily position is not entirely clear. Comment is made on its unusual distribution, both in terms of zoogeography and hosts.

As more lecithasterid species are examined and emphasis is placed on the structure of the terminal genitalia, more unusual features are uncovered. This paper is a report of a known species, *Lecithophyllum hawaiiense* Yamaguti, 1970, re-examined using newly collected Australian material, Differential Interference Contrast (DIC) microscopy and serial sections. The structure of the terminal genitalia turns out to be different from that previously described in the group, such that it seems advisable that a new genus is erected.

MATERIALS AND METHODS

Digeneans collected from freshly killed fishes were fixed by being pipetted into nearly boiling saline and immediately preserved in 5% formalin or 70% ethanol. Wholemounts were stained with Mayer's haematoxylin, cleared in methyl salicylate and mounted in Canada balsam. Measurements were made through a drawing tube on an Olympus BH-2 microscope, using a Digicad Plus digitising tablet and Carl Zeiss KS100 software adapted by Imaging Associates, and are quoted in micrometres. The following abbreviations are used: BMNH, the British Museum (Natural History) collection at The Natural History Museum, London, UK; QM, Queensland Museum collection, Brisbane, Australia; USNPC, United States National Parasite Collection; IP, collection at the Institute of Parasitology, ASCR, České Budějovice, Czech Republic. Fish synonymy is based on Froese and Pauly (2000).

RESULTS

Family L e c i t h a s t e r i d a e Odhner, 1905
Subfamily L e c i t h a s t e r i n a e Odhner, 1905

Weketrema gen. n.

Diagnosis. Lecithasteridae: Lecithasterinae. Body small, elongate oval. Tegument unarmed. Pre-oral lobe distinct. Oral sucker subglobular, subterminal. Ventral sucker oval, pre-equatorial. Prepharynx absent. Pharynx oval. Oesophagus short or apparently absent. Intestinal bifurcation in mid-forebody. Drüsenmagen present. Caeca reach close to posterior extremity, end blindly. Testes 2, oblique to symmetrical, in anterior hindbody. Seminal vesicle saccular, mainly in posterior forebody. Pars prostatica vesicular, oval; gland-cell sheath delimited by narrow membrane. Sinus-sac and sinus-organ absent. Hermaphroditic duct naked, globular or collapsed. Genital atrium deep. Genital pore median, in mid-forebody. Ovary oval, entire, post-testicular. Seminal receptacle blind. Laurer's canal absent. Uterus almost entirely in hindbody, may almost fill hindbody anterior to vitellarium, may extend slightly into post-vitelline region. Eggs relatively large for hemiuroids, tanned, operculate. Metraterm distinct. Vitellarium consists of seven oval lobes, closely posterior to ovary. Excretory pore more or less terminal. Excretory vesicle divides in anterior hindbody; arms unite dorsally to pharynx.

T y p e-s p e c i e s : *Weketrema hawaiiense* (Yamaguti, 1970) comb. n.

E t y m o l o g y : *Weke*: Hawaiian common name of some of the mullid hosts of this species (Froese and Pauly 2000).

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Weketrema hawaiiense (Yamaguti, 1970) gen. n., comb. n. Figs. 1-3

Syn. *Lecithophyllum hawaiiense* Yamaguti, 1970

Description. Based on 22 wholemount specimens and one set of serial sections. Measurements in Table 1. Body small, elongate oval (Fig. 1). Tegument unarmed. Pre-oral lobe distinct. Oral sucker subglobular, subterminal. Ventral sucker oval, larger than oral sucker, just pre-equatorial. Pharynx oval. Oesophagus short or apparently absent. Intestinal bifurcation in mid-forebody. Drüsenmagen present. Caeca reach close to posterior extremity, end blindly.

Testes 2, subglobular to oval, entire, oblique to symmetrical, contiguous or close, in anterior hindbody. Seminal vesicle saccular, oval to subglobular, in posterior forebody, may overlap ventral sucker slightly, connected to pars prostatica by narrow, relatively thick-walled duct. Pars prostatica vesicular, oval, but narrowing proximally, with wide lumen, lined with anuclear cell-like bodies, surrounded by distinct sheath of large gland-cells, delimited by narrow-membrane. Sinus-sac and sinus-organ absent. Hermaphroditic duct naked, globular or collapsed, with distinct, single-layered wall, delimited from genital atrium by distinct distal narrowing (Figs. 2, 3). Genital atrium deep, more a deep relatively wide invagination of surface than a narrow tubular duct, with complex folded muscular walls, often with overhanging antero-lateral muscular lips and single posterior muscular lip, giving inverted T-shaped lumen in ventral view. Hermaphroditic duct and genital atrium surrounded by gland-cells. Genital pore median, in mid-forebody; aperture may be inverted T-shaped (reflecting shape of genital atrium), slit-like or gaping.

Ovary oval, entire, post-testicular, usually distinctly separated from posterior testis. Mehlis' gland postero-dorsal to ovary. Seminal receptacle globular, blind, dorsal to ovary. Laurer's canal absent. Uterus almost entirely in hindbody, may develop to almost fill most of hindbody anterior to vitellarium, does not extend more than slightly into post-vitelline region. Eggs relatively large for hemiuroids, tanned, operculate. Metraterm distinct, rectilinear, in posterior forebody, joins hermaphroditic duct laterally, through sphincter. Vitellarium consists of seven oval lobes, postero-ventral or ventro-lateral to ovary.

Excretory pore more or less terminal. Excretory vesicle divides in anterior hindbody; arms unite dorsally to pharynx.

Type-host and locality: *Parupeneus porphyreus* (Jenkins) (Perciformes, Mullidae), Hawaii (Yamaguti, 1970).

New records:

ex *Scolopsis bilineatus* (Bloch) (Perciformes: Nemipteridae). Stomach. Lizard Island, Queensland (14°40'S, 154°28'E; April 1997). Prevalence: 10% (4/39). QM G217746-8, BMNH 2000.11.3.1-2, IP D-451.

ex *Scolopsis bilineatus* (Bloch) (Perciformes: Nemipteridae). Stomach. Heron Island, Queensland (23°27'S, 151°55'E; Jan. 1996). Prevalence: 2% (1/51). QM G217749.

ex *Plectorhinchus gibbosus* (Lacepède) (Perciformes: Haemulidae). Stomach. Heron Island, Queensland (23°27'S, 151°55'E; July 1997). Prevalence: 100% (1/1). QM G217750-2, BMNH 2000.11.3.3-4.

ex *Cheilodactylus nigripes* Richardson (Perciformes: Cheilodactylidae). Stomach. Stanley, northern Tasmania (40°46'S, 145°20'E; Dec. 1999). Prevalence: 100% (2/2). QM G217753-7, BMNH 2000.11.3.5-6.

ex *Latridopsis forsteri* (Castelnau) (Perciformes: Latridae). Stomach. Stanley, northern Tasmania (40°46'S, 145°20'E; Dec. 1999). Prevalence: 25% (2/8). QM G217758-60, BMNH 2000.11.3.7.

Previous records:

1. Yamaguti (1970); 2. Dyer et al. (1988).

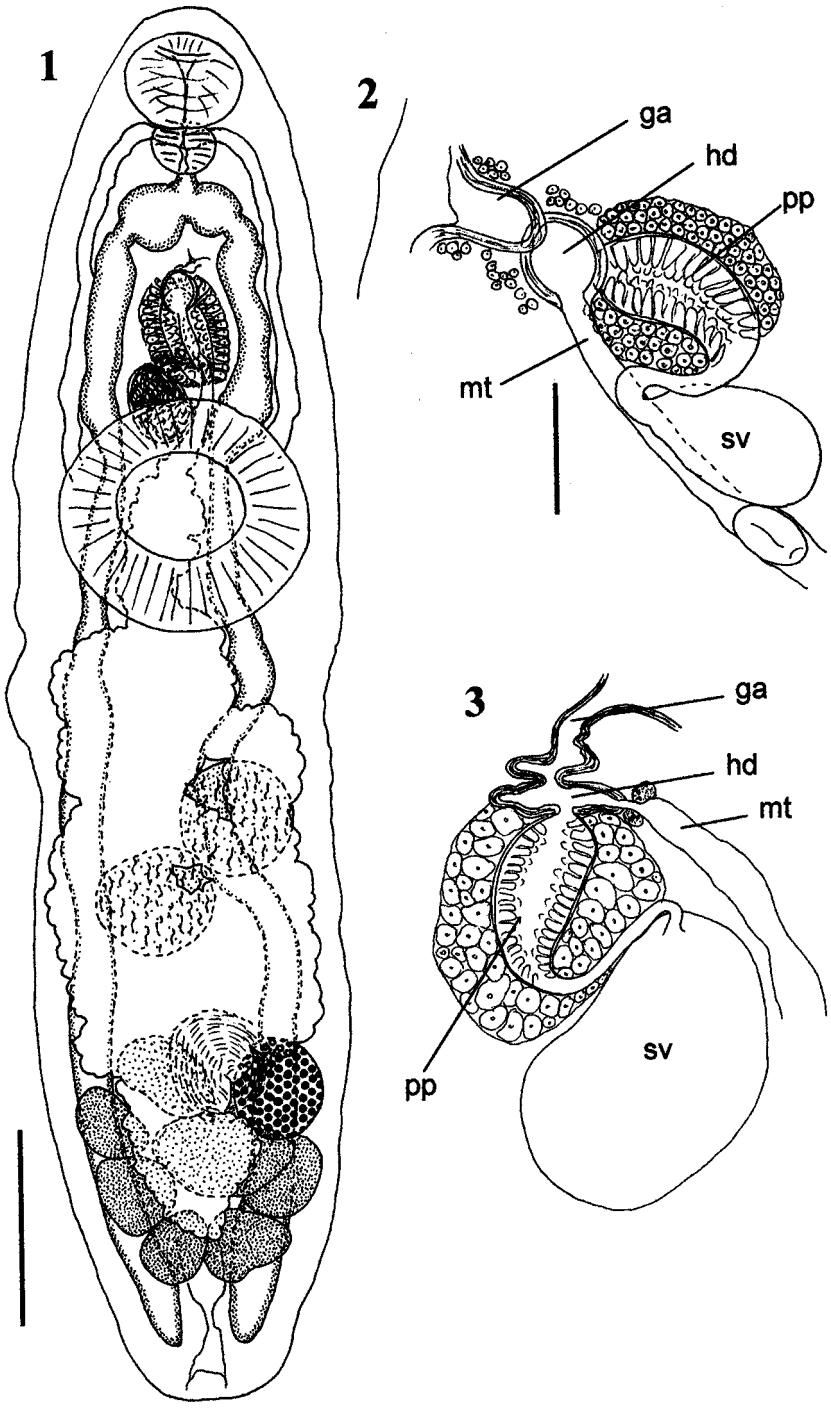
Description: 1.

Definitive hosts: Mullidae: *Mulloidichthys flavolineatus* [as *M. samoensis*] (1), *M. pfluegeri* (1), *Parupeneus bifasciatus* (1), *P. porphyreus* (1), *P. spilurus* (2).

Distribution: Hawaii (1), Okinawa (2).

DISCUSSION

The terminal genitalia of this form are distinct from that described in any other lecithasterid. The proximal part of the hermaphroditic region of the terminal genitalia is in fact very different from a conventional sinus-sac. Usually the hermaphroditic duct is relatively tubular, with a distinct gap, usually filled with fibrous connective tissue and a few gland-cells, between the wall of the hermaphroditic duct and the wall of the sinus-sac. In this case the sinus-sac is, apparently, absent and what remains can be described as a globular or collapsed, naked hermaphroditic duct. This new genus is not readily accommodated in any of the lecithasterid subfamilies as recognised by Gibson and Bray (1979). In general morphology it resembles lecithasterine genera such as *Lecithophyllum* Odhner, 1905, in which it was originally placed, and *Aponurus* Looss, 1907, but all lecithasterine genera have a distinct, well-developed sinus-sac. The Prolecithinae Yamaguti, 1971, represented by the single genus *Prolecitha* Manter, 1961, which lacks a sinus-sac and has a rather complex arrangement of the genital atrium (Abdul-Salam and Khalil 1987), but details of the terminal genitalia do not resemble those of *Weketrema.* Other features, such as the cyclocoel and multilobate ovary, indicate that the relationship is not close. The mainly pre-ovarian uterus might be considered to indicate an affinity with members of the Trifoliovariinae Yamaguti, 1958, and some species of this latter subfamily have weakly developed sinus-sacs (Bray and Cribb 2000a). Again, details of the terminal genitalia do not indicate a close relationship, nor does the structure of the vitellarium, which consists of seven or eight



Figs. 1-3. *Weketrema hawaiiense* (Yamaguti, 1970). **Fig. 1.** Ventral view, specimen from *Scolopsis bilineatus*, uterus in outline. **Fig. 2.** Terminal genitalia in lateral view in wholemount, specimen from *S. bilineatus*. **Fig. 3.** Terminal genitalia, showing 'collapsed' hermaphroditic duct, reconstructed from serial sections, specimen from *Cheilodactylus nigripes*. ga – genital atrium; hd – hermaphroditic duct; mt – metraterm; pp – pars prostatica; sv – seminal vesicle. Scale bars = 200 µm.

Table 1. Dimensions in µm of *Weketrema hawaiiense* (Yamaguti, 1970)

Host	*Scolopsis bilineatus*			*Plectorhinchus gibbosus*			*Latridopsis forsteri*		
Locality	Great Barrier Reef			Great Barrier Reef			Tasmania		
n	6			5			4		
	min	max	mean	min	max	mean	min	max	mean
Length	859	1,298	1,145	1,710	2,040	1,852	1,281	1,628	1,480
Width	245	310	287	325	380	346	295	392	360
Forebody	324	434	373	484	525	502	416	529	458
Pre-oral lobe	16	27	22	18	28	22	22	37	30
Oral sucker length	68	100	89	115	129	120	104	124	113
Oral sucker width	90	116	106	133	149	142	126	145	134
Pharynx length	43	58	50	63	70	66	60	66	63
Pharynx width	48	64	58	69	81	74	64	73	68
Oesophagus	0	11	5	0	7	3	0	5	2
IB to VS	169	275	213	289	323	306	227	344	282
Hermaphroditic duct length	36	36	36	25	67	47	35	49	41
Hermaphroditic duct width	32	32	32	25	51	40	15	51	38
GP to VS	100	191	136	175	211	187	154	237	186
Ventral sucker length	163	238	209	270	296	282	216	275	240
Ventral sucker width	166	245	219	289	317	302	220	281	252
VS to AT	10	120	61	148	313	199	20	138	106
Anterior testis length	74	135	103	121	174	150	79	126	96
Anterior testis width	67	122	95	121	191	158	76	121	98
AT to PT	0	3	0	0	140	35	5	51	36
Posterior testis length	65	116	99	111	145	135	84	131	100
Posterior testis width	60	116	93	112	166	142	81	125	99
PT to Ov	0	110	43	59	192	122	49	116	98
Ovary length	53	148	105	132	187	154	105	122	116
Ovary width	62	142	111	150	210	172	110	161	129
Vitelline field length	114	239	210	273	331	299	201	312	232
Vitelline field width	135	239	199	269	311	295	186	246	217
Post-vitelline region	26	103	76	100	152	122	82	170	111
Post-uterine region	60	158	110	99	173	130	91	136	118
Post-caecal region	33	53	42	28	90	57	31	57	43
Egg length	27	32	30	28	32	30	36	39	37
Egg width	15	19	18	17	22	19	15	19	17
Width % *	24	28	25	16	22	19	22	28	24
Forebody % *	28	38	33	25	30	27	28	33	31
Sucker-ratio	1.8	2.2	2.1	2.0	2.2	2.1	1.7	2.0	1.9
OS: Pharynx ratio	1.7	1.9	1.8	1.8	2.1	1.9	1.9	2.1	2.0
PVR % *	2.2	8.5	6.7	5.6	8.6	6.6	5.0	10	7.5
PUR % *	5.4	12	10	4.9	9.8	6.6	6.6	10	8.0
PT-Ov % *	0.0	8.5	3.5	3.5	9.8	6.4	3.8	8.1	6.5
VS-AT *	0.9	9.2	5.2	8.3	16	11	1.6	9.6	7.0
AT-PT *	0.0	0.2	0.0	0.0	6.8	1.7	0.4	3.1	2.3

* of body length, AT – anterior testis, GP – genital pore, IB – intestinal bifurcation, OS – oral sucker, Ov – ovary, PT – posterior testis, PUR – post-uterine region, PVR – post-vitelline region, VS – ventral sucker

elongate and, sometimes, branched lobes in trifoliovariines (Bray and Cribb 2000a). The 'fragility' of the present systematics of hemiuroid families and subfamilies is emphasised by recent molecular (Blair et al. 1998; Cribb et al. 2001) and morphological (Bray and Cribb 2000b) results, but the general morphological resemblance of *Weketrema* to lecithasterines has prompted us to place this new genus in that subfamily, awaiting further developments in hemiuroid systematics.

Despite discrepancies between our description and that of Yamaguti (1970), we consider that this form from four perciform host species at two sites on the Great Barrier Reef (GBR) and one from northern

Table 1. Continued.

Host	*Cheilodactylus nigripes*			*Parupeneus porphyreus*			*Parupeneus spilurus*
Locality	Tasmania			Hawaii			Okinawa
n	6			5			1
	min	max	mean	min	max	mean	
Length	1,361	1,734	1,448	1,522	2,380	2,043	1,437
Width	266	384	316	360	478	425	273
Forebody	382	549	461	355	660	557	259
Pre-oral lobe	12	31	22	12	37	24	14
Oral sucker length	97	144	110	121	141	131	128
Oral sucker width	121	165	135	142	175	161	136
Pharynx length	47	72	57	59	74	66	64
Pharynx width	61	83	69	59	75	70	56
Oesophagus	0	8	5	0	28	16	5
IB to VS	230	326	281	157	405	336	95
Hermaphroditic duct length	23	56	41	33	37	35	
Hermaphroditic duct width	39	51	46	34	39	36	
GP to VS	168	236	188	115	270	219	80
Ventral sucker length	212	310	246	294	381	341	263
Ventral sucker width	219	337	257	281	368	328	271
VS to AT	77	133	97	58	307	186	205
Anterior testis length	108	129	120	111	140	127	99
Anterior testis width	107	127	119	56	128	97	93
AT to PT	0	51	14	8	56	36	17
Posterior testis length	100	138	120	98	143	125	90
Posterior testis width	100	136	117	75	126	103	93
PT to Ov	0	133	81	133	443	237	148
Ovary length	108	164	133	98	143	127	89
Ovary width	130	163	142	109	157	141	107
Vitelline field length	183	241	209	160	368	260	194
Vitelline field width	202	253	226	182	307	238	151
Post-vitelline region	90	111	97	157	257	194	129
Post-uterine region	83	194	124	26	109	77	133
Post-caecal region	37	66	50	7	75	38	22-25
Egg length	32	42	37	31	35	32	31
Egg width	12	20	17	15	18	16	15
Width % *	19	23	22	18	26	21	19
Forebody % *	28	34	32	23	34	27	18
Sucker-ratio	1.8	2.0	1.9	2.0	2.1	2.0	2.0
OS: Pharynx ratio	1.8	2.1	2.0	2.1	2.4	2.3	2.4
PVR % *	5.4	8.0	6.8	8.0	11	10	9.0
PUR % *	6.1	11	8.5	1.5	4.6	3.7	9.2
PT-Ov % *	0.0	7.7	5.5	6.0	19	11	10
VS-AT *	4.5	9.7	6.8	3.4	13	8.7	14
AT-PT *	0.0	3.7	1.0	0.3	3.1	1.7	1.2

Tasmania is conspecific with his *Lecithophyllum hawaiiense*. Using wholemounts and one set of serial sections, we interpret the terminal genitalia, which we feel are very distinctive for this form, rather differently from Yamaguti (1970). We have examined seven specimens from the type-host on the slide labelled USNPC 63795, including the specimen labelled 'type' and one specimen recovered by Dyer et al. (1988) (USNPC 79975) from Okinawa. The material is not particularly well fixed and much is considerably flattened, but, as far as we can tell using DIC microscopy, the terminal genitalia correspond to our interpretation of our material, rather than the arrangement illustrated by Yamaguti (1970). We have measured the dorso-ventrally mounted specimens in mullids from Hawaii and Okinawa and include these measurements in Table 1. These mullid specimens are, in general, larger than those from Australian waters and

differ slightly in other ways from the quite variable Australian forms. Of the ratios given in Table 1, various features appear slightly distinct in the Australian specimens, including a longer forebody (overlapping), smaller ratio of pharynx width to oral sucker width (overlapping), shorter post-vitelline region (overlapping), longer post-uterine region, reflecting the fact that the uterus passes posteriorly to the vitellarium less frequently and to a lesser extent (overlap with Okinawa specimen – where the uterus does not extend posteriorly to the vitellarium), and shorter posterior testis to ovary length (overlapping). Whether these differences are of taxonomic significance is not readily decided. Some of the measurements may have been affected, possibly drastically, by flattening.

If it is accepted that *Weketrema hawaiiense* is, in fact, a widespread species then its host and geographical distribution is remarkable. Although reported from only five localities, these are so widely distributed that it seems certain that it must occur in many intermediate sites. A striking point is the fact that this species has been recovered from the cooler temperate waters of northern Tasmania in addition to the coral reefs of Hawaii, Okinawa and Queensland. Also extraordinary is the distribution in terms of hosts. All records are from perciforms. Early records were all from mullids, whereas we have found *W. hawaiiense* in a single species from each of the four families, Cheilodactylidae, Haemulidae, Latridae and Nemipteridae. Our examinations of mullids on the GBR are quite inadequate, however; only four specimens of two species, having been examined. From 119 specimens of 4 nemipterid species on the GBR, we have found this species at two localities in just one species. The range of families reported encompasses so much variation that it might be expected that many other perciform families would also be infected. The combination of the slight morphological distinctions between specimens from the various records in combination with the very unusual host and geographical distribution suggest that further study of this species is certainly warranted.

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