RAFFLES BULLETIN OF ZOOLOGY 1992 **40**(2): 201-220

A SYNOPSIS OF THE MALAYAN SPECIES OF *LEPIDOCEPHALICHTHYS*, WITH DESCRIPTIONS OF TWO NEW SPECIES (TELEOSTEI: COBITIDAE)

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ABSTRACT.- Six species of *Lepidocephalichthys* are known from the Malay Peninsula (West Malaysia and Thailand south of the Isthmus of Kra). *Lepidocephalichthys berdmorei* is apparently the largest species of the genus and is distinguished in having more vertebrae than any other species (26-28 + 10-13 = 38-39). *Lepidocephalichthys hasselti* is the most widely distributed species of the genus and occurs usually in swamps and marshes, including paddy fields. *Lepidocephalichthys katik*, new species, is distinguished by its long nasal barbel, low vertebrae number (20+8=28), lower lip with four barbels and 6-7 serrae along inner margin of second pectoral ray; with a maximum known size of 13.5 mm SL and females reaching maturity at 13 mm SL it is the smallest known member of the suborder Cobitoidei. *Lepidocephalichthys furcatus* (synonym: *L. berdmorei* auct.) is usually found in ponds and standing water, among aquatic plants; it is the only species in Southeast Asia to have a forked caudal fin. *Lepidocephalichthys pristes* is recorded for the first time outside Borneo from the North Selangor peat swamp forest and from Sumatra; it is distinguished by the males having the second pectoral ray bearing 8-11 serrae. *Lepidocephalichthys tomaculum*, new species, inhabits peat and freshwater swamps from Johor, Selangor, Pahang, and Terengganu; it is distinguished by its relatively massive appearance, reddish brown colour in life, absence of ocellus on caudal fin base, and by the male having pectoral rays 7-8 fused.

INTRODUCTION

The genus *Lepidocephalichthys* is distributed from Sri Lanka and Pakistan to South China and Western Indonesia (Pethiyagoda, 1991; Talwar & Jhingran, 1991; Kottelat, 1989; Kuang, in Chu & Chen, 1990; Kottelat & Whitten, 1993). It includes small loaches (less than about 100 mm SL) inhabiting a variety of habitats from hill streams to paddy fields. Its systematics is still not clear and many new species still await description. We present here a synopsis of those species known to inhabit the Malay Peninsula (West Malaysia and Thailand south of the isthmus of Kra) and name two undescribed ones known from that area.

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MATERIAL AND METHODS

Measurements and counts follow methods explained in Kottelat (1990), except that measurements of specimens of *L. katik* were obtained from camera lucida drawings; vertebrae counts follow Roberts (1989). Abbreviations used are: ANSP, Academy of Natural Sciences, Philadelphia; MHNG, Muséum d'Histoire Naturelle, Genève; MNHN, Muséum National d'Histoire Naturelle, Paris; MZB, Museum Zoologicum Bogorense, Bogor; NMW, Naturhistorisches Museum, Wien; NRM, Naturhistoriska Riksmuseet, Stockholm; ZSI, Zoological Survey of India, Calcutta; ZMA, Zoölogisch Museum, Amsterdam; ZRC, Zoological Reference Collection, National University of Singapore; ZSM, Zoologische Staatssammlung, München. CMK is the first author's collection.

KEY TO THE SPECIES OF *LEPIDOCEPHALICHTHYS* IN THE MALAY PENINSULA

1. Caudal fin forked ..... *L. furcatus*
   Caudal fin rounded or truncate 2

2. Second pectoral ray of male enlarged and bearing 6-11 serrae along its inner margin; pectoral rays 7-8 of male not modified; dorsal origin in front of pelvic origin 3
   Second pectoral ray of male not modified; pectoral rays 7-8 of male fused and swollen, often with a longitudinally elongated protuberance along dorsal surface; dorsal origin above or behind posterior extremity of pelvic base 4

3. Posterior rim of anterior nostril with a long nasal barbel; inner margin of second pectoral ray with 6-7 fine serrae; maximum known size 13.5 mm SL ..... *L. katik*
   Posterior rim of anterior nostril not produced into a barbel; inner margin of second pectoral ray with 8-11 serrae; maximum known size 40 mm SL ..... *L. pristes*

4. Back with a series of 3-7 predorsal and 3-6 postdorsal narrow black transverse bars; caudal fin with a fine reticulated pattern (sometimes appearing as numerous fine vertical bars); pigment density on median caudal rays as on other caudal rays; a black spot at base of five uppermost branched caudal rays; dorsal origin distinctly behind posterior extremity of pelvic base ..... *L. tomaculum*
   Back without series of predorsal and postdorsal transverse black bars; caudal fin with series (usually 3-6) of vertical bars; pigment on median caudal rays more closely set than on other caudal rays; a black spot usually present at caudal base, but at base of branched rays 3-6; dorsal origin above posterior extremity of pelvic base 5

5. Caudal base with a large black spot at base of branched rays 3-6; body spotted to blotched; relatively large size, up to at least 80 mm SL; 26-28 + 10-13 = 38-39 vertebrae; pectoral rays 7-8 of male fused to form a cylindrical ray-like structure about 5 times diameter of other rays (Fig. 1a) ..... *L. berdmorei*
   Caudal base usually with an ocellated black spot centered at base of branched rays 3-4; body with a median longitudinal stripe or a row of adjacent black spots, with a unpigmented stripe above it, back marmorated, finely spotted or blotched; size up to ca. 45 mm SL; 22-25 + 10-13 = 33-37 vertebrae; pectoral rays 7-8 of male fused to form a vertically orientated plate (Fig. 1b) ..... *L. hasselti*

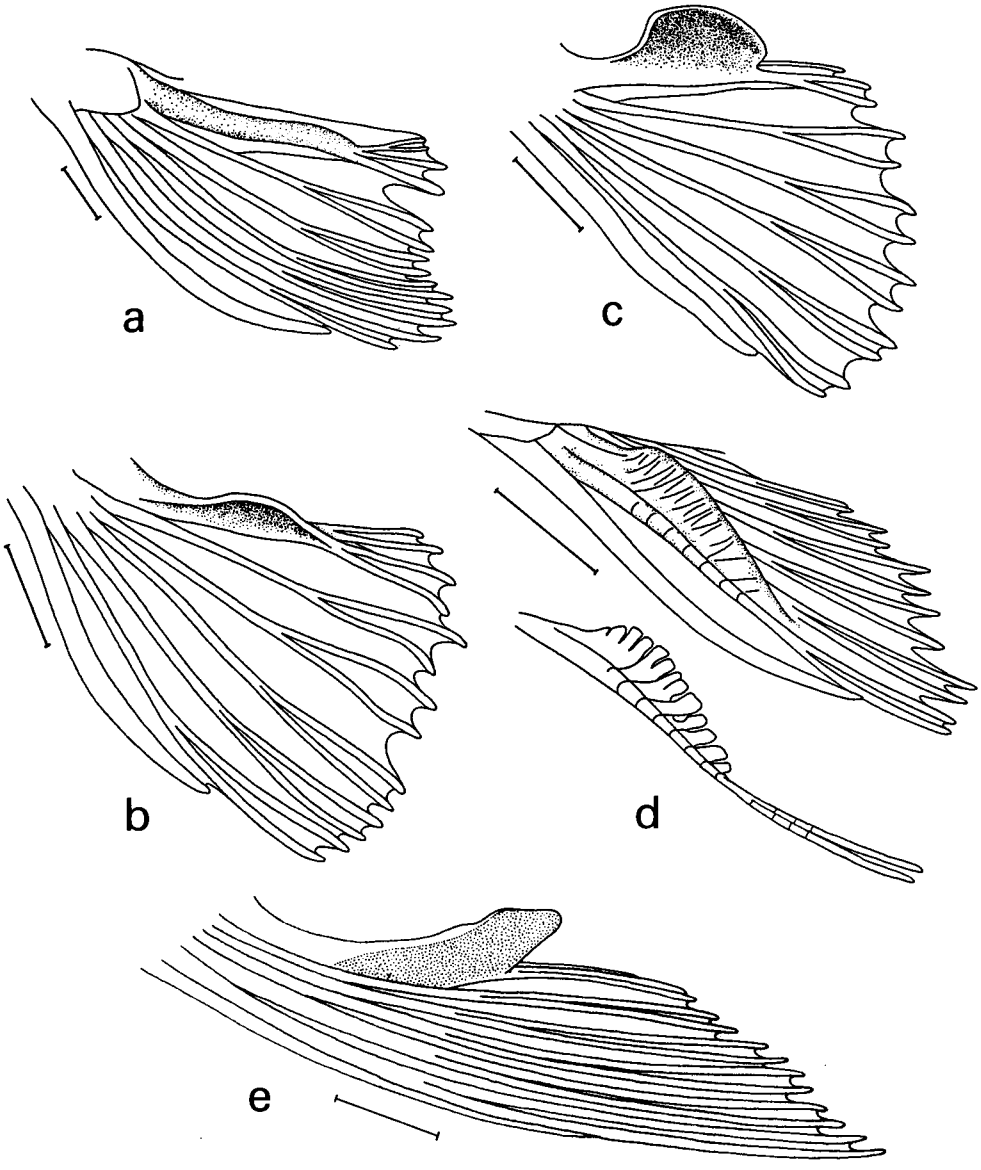

Fig. 1. Left pectoral fin of males *Lepidocephalichthys* species: a, *L. berdmorei*, CMK 5380, 47.1 mm SL; b, *L. hasselti*, ZRC 701, 30.4 mm SL; c, *L. furcatus*, ZRC 13671-13750, 24.0 mm SL; d, *L. pristes*, ZRC 20836-20849, 39.1 mm SL, with details of second ray after removal of skin; e, *L. micropogon*, NRM 16839, 37.7 mm SL.

Table 1. Vertebrae numbers of the species of *Lepidocephalichthys* occurring in the Malay Peninsula.

	precaudal									caudal						total													
	20	21	22	23	24	25	26	27	28	8	9	10	11	12	13	28	29	30	31	32	33	34	35	36	37	38	39		
L. berdmorei																													
Malay Peninsula							2	3					5												2	3		CMK 5175, 5380
							5	2					2	5											1	5	1	ANSP 68471 (paratypes of *L. cataractus*)
Irrawaddy basin								2	4			2	3	1												3	3	CMK 4014
Salween basin							3	3						5	1											2	4	CMK 5514
Mekong basin							1	3					2	2												3	1	CMK 5230
L. hasselti																													
Java				2	3	5						1	4	5									5	3	2			MHNG 1372.40-50
Malay Peninsula			1	8								1	8							2	7							CMK 8263
				1	2								3								1	2						ANSP 68487 (paratypes of *L. taeniatus*)
L. cf. *hasselti*																													
Thailand (Salween)					9	4							4	6	3								1	8	4			CMK 4933
Viet Nam				2	1								2	1							1	2						CMK 7255
L. furcatus																													
Central Thailand			1										1							1								CMK 5503
Malay Peninsula			3	5	1							5	4						1	5	3							CMK 8151
L. katik																													
Malaya	1									1						2	1											CMK 8034, ZRC 9344-9347
L. pristes																													
Malay Peninsula			2								1	1						1	1									ZRC 14916-14917
Kapuas				10	5					1	6	8							4	10	1							CMK 6673
Mahakam				6	1						1	5	1							6	1							CMK 7758, 6966
Sarawak				1	2					1	1	1							2		1							CMK 5990
Sumatra			1	4	3						6	2							4	4								CMK 8280
L. tomaculum																													
Pahang					1								1										1					ZRC 2276
Johor						1	1					1	1											2				CMK 7382
Selangor					2	5	1					6	2								1	5	2					ZRC 14938-14939, CMK 8033
L. guntea						1	2						3											1	2			ZSM 27397
L. jonklaasi						2	1					3										2	1					CMK 7117
L. lorentzi						1	1					1	1											2				CMK 6967
L. micropogon				6	4								1	8	1							6	4					NRM 10823
L. sandakanensis						3	1					2	2									2	2					ZSM 27565
L. thermalis					1	2						1	2									2	1					CMK 7163

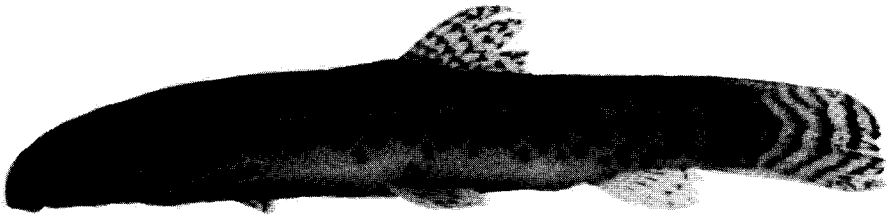

Fig. 2. *Lepidocephalichthys berdmorei*, CMK 4032, 56.7 mm SL, Thailand: Mae Nam Kok basin.

***Lepidocephalichthys berdmorei* (Blyth)**
(Fig. 2)

Acanthopis (sic) *berdmorei* Blyth, 1860: 168 (original description; type locality: Tenasserim provinces; holotype: ZSI/F 2646/1).

Lepidocephalus cataractus Fowler, 1939: 60, fig. 10 (original description; type locality: Thailand: waterfall at Trang; holotype: ANSP 68470).

Lepidocephalus guntea burmanicus Rendahl, 1948: 64, fig. 30 (original description; type locality: Shweli Kyaung, 24 miles East of 24°N 96°E; holotype: NRM 20829).

Material examined.- IRRAWADDY BASIN: BURMA: 8 ex. (CMK 4014), Pwe Kauk waterfall, 8 km E of Maymio on road to Lashio (22°05'N 96°35'E), coll. M. Kottelat, 24.iv.1983. — SALWEEN BASIN: THAILAND: Tak Prov.: 2 ex. (CMK 4912), Huai Mae Charno, 4 km S of Amphoe Mae Ramat on road 1085 (16°58'N 98°35'E), coll. M. Kottelat, 6.iii.1985. - 5 ex. (CMK 5514), 2 ex. (ZRC 21046-21047), Huay Phlu at Ban Pang San, 3 km NW of about 56 km-mark on Tak - Mae Sot road (16°48'N 98°47'E), coll. P. Hobelman, 4.xi.1985. — MEKONG BASIN: THAILAND: Chiang Mai Prov.: 3 ex. (CMK 4032), Nam Mae Mao at Ban Huai Phak Phai (19°59'N 99°05'E), coll. M. Kottelat & P. Hobelman, 24.iii.1983. - 1 ex. (CMK 4291), same data, cleared and stained. - 1 ex. (CMK 5230), market at Fang, coll. M. Kottelat, 11.iv.1985. — MALAY PENINSULA: THAILAND: 3 ex. (CMK 5380), Ranong Prov.: stream on road from Ranong to Kra Buri, km 37 (10°15'N 98°45'E), coll. M. Kottelat, 24.iv.1985. - 3 ex. (CMK 5342), Phangnga Prov.: tributary of Khlong Khao Thalu at Ban Bang Kan, road from Phangnga to Kapong, km 22 (8°33'N 98°28'E), coll. M. Kottelat, 22.iv.1985. - 1 ex. (CMK 7942), Tham [cave] Tuapan, coll. P. Leclerc, 19.vii.1991. - 2 ex. (CMK 5175), Surat Thani Prov.: Khlong Sok at Ban Khlong Sok (8°49'N 98°35'E), coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 4.iv.1985. - Paratypes of *Lepidocephalus cataractus*, 8 (out of 15) ex. (ANSP 68471), (41.9-62.9 mm SL), Trang Prov.: waterfall at Trang [a 40-ft fall of the Trang river at Chong, 12 mi. E of Trang] (7°30'N 99°47'E), coll. R. de Schauensee *et al.*, 13.x.1936.

Diagnosis.- *Lepidocephalichthys berdmorei* is distinguished from all other species in the genus known to us in having more vertebrae (26-28 + 10-13 = 38-39). Other diagnostic characters are: large size (up to 80 mm SL, more than in any other *Lepidocephalichthys*); very regular body depth, almost equal throughout; pectoral rays 7-8 of male fused to form a cylindrical ray-like structure about 5 times diameter of other rays (Fig. 1a); dorsal origin above posterior extremity of pelvic base; colour pattern (Fig. 2) with a yellowish to brown body with patterning varying from finely speckled to coarsely spotted but always with a mid-lateral series

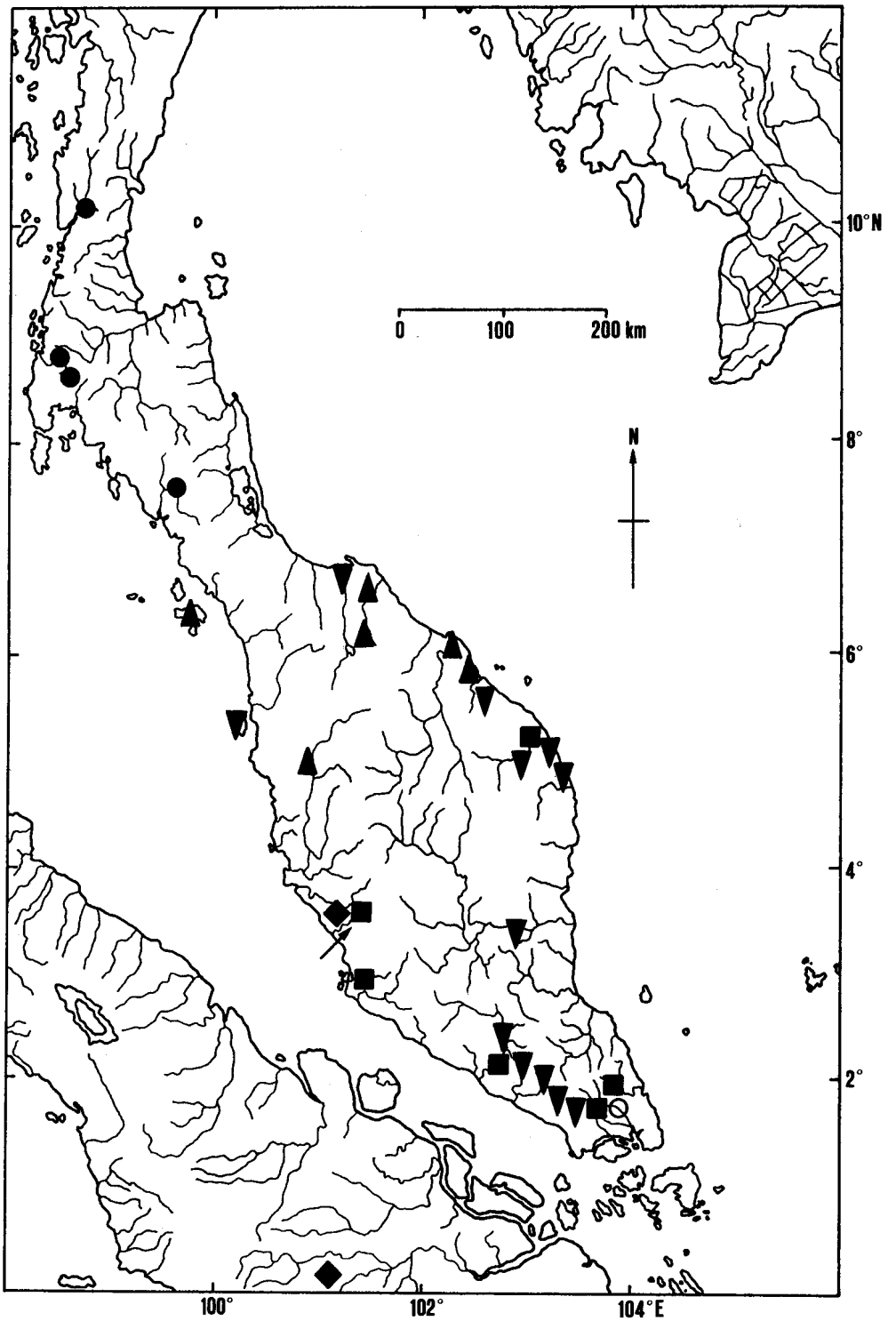

Fig. 3. Distribution of *Lepidocephalichthys* species in the Malay Peninsula: *L. berdmorei* (circle), *L. hasselti* (triangle), *L. katik* (hollow circle, presumed type locality), *L. furcatus* (inverted triangle) and *L. tomaculum* (square,' arrow points to type locality).

of large, irregular spots, caudal fin with series (usually 3-6) of vertical bars; pigment on median caudal rays slightly more closely set than on other caudal rays; caudal base with a large black spot at base of branched rays 3-6.

Discussion.- See below account of *L. furcatus* for a discussion of one of the species identified as *L. berdmorei* by earlier authors (Smith, 1945; Rendahl, 1948; Banarescu & Nalbant, 1968). Our material agrees in all characters listed by Blyth (1860) and Day (1869: 550) for the holotype. Most useful of his characters are the size ($3\,^1/_2$ inches = 88.2 mm), 7 pelvic rays, rounded caudal, position of dorsal and pelvic, and colouration.

Although we have not examined Blyth's types, we are confident in identifying our material as *L. berdmorei* on the basis of Blyth's description and Tilak & Husain's (1981: 14) figure of the holotype; we have examined the types series of Rendahl's *L. guntea burmanicus* as well as specimens from the Irrawaddy and Salween basins and see no characters which could differentiate them from *L. berdmorei*. A final conclusion would have to await new collections from the Sittang River basin. We have examined eight paratypes of Fowler's *L. cataractus* and find them to agree with our concept of *L. berdmorei*.

Distribution.- *Lepidocephalichthys berdmorei* is known from the Irrawaddy, Sittang, Salween, Chao Phraya and Mekong basins in Burma, Thailand and China, and from the Malay Peninsula as far South as Trang (Fig. 3), Thailand. It is known from clear water streams with moderate to swift current, usually with large gravel or boulder substrate and is not known from large lowland streams.

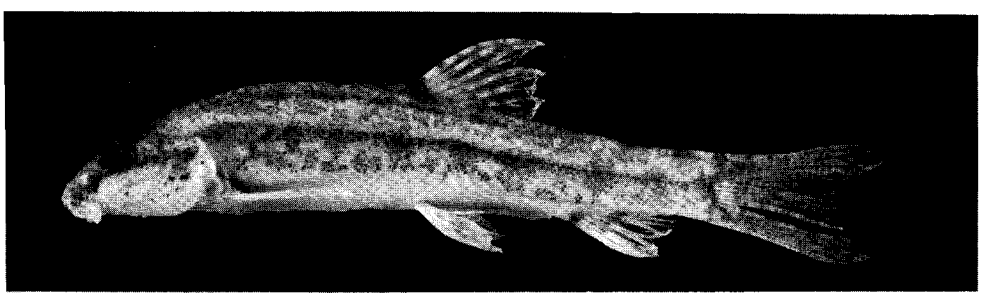

Fig. 4. *Lepidocephalichthys furcatus*, CMK 5606, 27.2 mm SL, Thailand: Pattani River basin.

Lepidocephalichthys furcatus (de Beaufort)
(Fig. 4)

Lepidocephalus furcatus de Beaufort, 1933: 31 (original description; type locality: Bukit Merah Reservoir, Perak; syntypes: ZRC 1445 [3], ZMA 100.979 [1], location of remaining 2 syntypes unknown).

Material examined.- CENTRAL THAILAND: 1 ex. (CMK 5503), Nakhon Sawan Prov.: Bung Bo Raphet, coll. S. Lumlertdacha, 10.vii.1985. — MEKONG BASIN: 2 ex. (CMK 7968), Laos: Mekong River at Vientiane, coll. T. Scholz, 1.vi.1989. — MALAY PENINSULA: THAILAND: 7 ex. (CMK

5606), Yala Prov.: road from Yala to Pattani, km 8; swamp caused by Pattani River dam, coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 27.iii.1985. - 1 ex. (CMK 5906), same data, cleared and stained. - 1 ex. (CMK 5487), Naratiwat Prov.: Mae Nam Sai Buri basin: blackwater swamp 500 m E of Ban Ba Khon, coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 31.iii.1985. — MALAYSIA: Penang: 17 ex. (ZRC 1472), Pulau Betong, Kampong Trang, coll. E. R. Alfred, 27.x.1961. - Terengganu: 1 ex. (ZRC 652), Sungai Tok Dor, coll. E. R. Alfred, 4.vii.1966. - 72 ex. (ZRC 25412-25483), 72 ex. (CMK 8244), pool at km 94 on road from Kuala Terengganu to Kota Bahru, South of Jerteh (5°32'38.5"N 102°43'43.9"), coll. M. Kottelat, P. K. L. Ng *et al.*, 19.iii.1992. - 9 ex. (ZRC 1466), Merchang and Kuala Brang, coll. M. W. F. Tweedie, iii.1950. - 8 ex. (ZRC 25018-25025), 7 ex. (CMK 8206), stream at about km 6 on Kuala Brang - Terengganu road (5°04'25.0"N 103°03'19.8"E), coll. M. Kottelat, P. K. L. Ng *et al.*, 19.iii.1992. - 1 ex. (ZRC 651), Sungai Merchang, 3.vii.1958. - 9 ex. (ZRC 653), Rantau Abang, coll. E. R. Alfred, 30 VII 1966. - 9 ex. (ZRC 649), Rantau Abang, coll. C. K. Quek, 16.viii.1966. - 24 ex. (ZRC 650), Rantau Abang, coll. E. R. Alfred, 2.vii.1958. - 10 ex. (ZRC 17215-17224), Rantau Abang, stream at km 154 on road from Kuala Terengganu to Kuantan, coll. K. Lim, 11.ix.1991. - 60 ex. (ZRC 24193-24252), 54 ex. (CMK 8151), Rantau Abang, swamp at km 56 on road from Kuala Terengganu to Kuantan (4°54'40,4"N 103°21'54.1"E), coll. M. Kottelat, P. K. L. Ng *et al.*, 18.iii.1992. - 14 ex. (ZRC 17300-17313), Rantau Abang, stream about 1 km W of East Coast highway, about 53 km S of Kuala Terengganu, coll. K. Lim, 10-11.ix.1991. - 7 ex. (ZRC 24646-24652), Rantau Abang, swamp at 56 km, Kuantan - Kuala Terengganu Road, coll. T. H. T. Tan & D. S. L. Chung, 3-5.viii.1992. - Pahang: 1 ex. (ZRC 654), Lake Chini, coll. 205 SQN RAF Changi, 22.viii.1967. - Johor: 2 ex. (ZRC 18716-18717), km 120 on Segamat - Johor Bahru road, coll. P. Ng *et al.*, 21.x.1991. - 2 ex. (ZRC 16754-16755), near Layang Layang, coll. P. Ng & R. Yeong, x.1989. - 80 ex. (ZRC 13671-13750), 10 ex. (CMK 7429), Layang Layang, coll. P. K. L. Ng, 6.ii.1991. - 1 ex. (ZRC 19401), 1 ex. (CMK 7894), about 2 km N of Ayer Hitam on road to Yong Peng (about 1°53'N 103°12'E), coll. M. Kottelat, P. K. L. Ng & K. Lim, 18.viii.1991. - 1 ex. (ZRC 19401), Sungai Machap, between Ayer Hitam and Simpang Renggam (approx. 1°52'N 103°18'E), coll. P. K. L. Ng, K. Lim & M. Kottelat, 18.viii.1991. - 9 ex. (ZRC 23230-23238), Sungai Labis along Muar - Labis Road, coll. M. Kottelat, K. Lim *et al.*, 26.vii.1992. - 2 ex. (ZRC 18716-18717), ca. 120 km, Segamat - Johor Bahru Road, coll. P. K. L. Ng *et al.*, 21.x.1991.

Comparison material.- *L. micropogon*: BURMA: 29 ex. (NRM 16839), Pegu R., coll. R. Malaise, 21.x.1934. - 10 ex. (NRM 10823), same data. - 3 ex. (NMR 13879), Mandalay (?), coll. O. Hetzel, don S. O. R. Hägglöf. - 5 ex. (NRM 10824), Kawkareik R., coll. R. Malaise, x.1934. - 1 ex. (NRM 16840), Mandalay.

Diagnosis.- This species is distinguished from all other described *Lepidocephalichthys* in Southeast Asia in having a forked caudal fin. Additional characters are the small size (up to 50 mm SL), sexual dimorphism (males have a large vertically orientated, semicircular plate on pectoral rays 7-8; Fig. 1c); dorsal above or slightly in front of pelvic origin; a dark <-shaped mark at base of caudal fin, with a black spot at base of branched rays 3-5.

Discussion.- This species was listed as a synonym of *L. micropogon* (Blyth, 1860) by Kottelat (1989: 13) who also included in its synonymy *L. berdmorei* of Smith (1945: 295) and Banarescu & Nalbant (1968: 347). We consider here that *L. micropogon, L. furcatus* and *L. berdmorei* are three valid species. The report of *L. berdmorei* by Smith is based on a record by Suvatti (1936: 60) which could not be confirmed and a record by Koumans (1937: 63) whose specimens (in Naturhistorisches Museum Basel) have been examined by the first author in 1981 and which agree with our present concept of *L. berdmorei*.

Kottelat's (1989) tentative synonymy was influenced by Smith's (1945) key reporting an emarginate caudal fin and Rendahl's (1948) and Banarescu & Nalbant's (1968) descriptions and

illustrations as *L. berdmorei* of fishes with a forked caudal fin from Burma and Assam, respectively. The *L. berdmorei* of Banarescu & Nalbant has since been re-identified as *L. caudofurcatus* (Tilak & Husain, 1978) by Tilak & Husain (1981: 15).

Identification of any of these forked-caudal species as *L. berdmorei* is incorrect, as Blyth (1860: 168) clearly placed his *A. berdmorei* in a group of *Acanthopsis* species (misspelt *Acanthopis*) characterized by 'a more elongate shape, dorsal fin placed somewhat backward and distinctly posterior to the ventrals, tail rounded more or less, and the head not so much compressed as in the others, with the eyes placed high' and a length of three and a half inches (= 88.2 mm, probably total length). The holotype of *L. berdmorei* has been re-examined by Day (1869: 550) and illustrated by Tilak & Husain (1981: 14). It obviously does not agree with the species called *L. berdmorei* by Rendahl, Smith, Banarescu & Nalbant, etc. Blyth's *A. micropogon* on the other hand has a 'head and body very much compressed, the tail furcate', 'dorsal in the middle of the entire length and opposite to the ventrals', the head 'much compressed'. The length indicated by Blyth ($2^1/_2$ inches = 63.0 mm) is probably total length and would correspond to about 50 mm SL. Day (1878: 610) and Tilak & Husain (1981: 14) placed *A. micropogon* in the synonymy of *L. berdmorei*, without discussion; we do not see how this synonymy could be supported.

The type material of *A. micropogon* was preserved in ZSI but is apparently lost; or at least it is not mentioned in Menon & Yazdani's (1968) catalogue of the types in ZSI or by Tilak & Husain (1981). The "Tenasserim provinces" of the time of Blyth are not similar to today's Tenasserim Province of Burma; judging from the title of Blyth's paper, the type locality might be in the Sittang river basin. No collection from this basin is presently available for redescribing *L. micropogon*, but we have examined material from the Irrawaddy (Mandalay) and the Salween (Kawkareik) basins, two basins entirely surrounding the Sittang basin (whose headwaters have been pirated by the Irrawaddy at about Mandalay), and from Pegu, at the divide between the Sittang and Irrawaddy basins. In the absence of any character suggesting that they could differ from Sittang basin material, we consider them as conspecific.

The size indicated by Blyth (63 mm) and Rendahl (59 mm SL) for *L. micropogon* is larger than the largest Malayan specimen of the forked-caudal species we have examined (30 mm SL) and a direct comparison of both shows that they are distinct species differing also in shape of the sexually dimorphic modified 7-8th pectoral rays of males, shape of barbels and lower lip, dark colour marks at caudal base and vertebrae counts (23-24+11-13=35-36 in *L. micropogon*, vs 22-24 + 10-11 = 32-34 in *L. furcatus*).

The sexual dimorphism of *L. micropogon* was not described by Rendahl (1948); his 48 specimens include only two dessicated males (NRM 13879, 34.0 and 38.2 mm SL). Pectoral rays 7-8 are fused and swollen, dorsally concave and ending with a vertical plate-like process on the posterior third of the rays (Fig. 1e.). This process is apparently homologous to the vertical plate of *L. furcatus* in which species it extends along the whole length of the rays.

In *L. micropogon* the barbels are short (about 0.5-1.0 eye diameter) and the lobes of the lower lip are fleshy, with a pointed tip; their posterior extension beyond corner of mouth is at most equal to length of gape of mouth (see also Rendahl, 1948, fig. 36). In *L. furcatus* the barbels are long (about 1.5-2.0 eye diameter); the lobes of the lower lip are truncate and fringed posteriorly; their posterior extension beyond corner of mouth is about twice the length of the gap of the mouth.

Rendahl's specimens are now bleached so that we have to rely on his figure 35 for information on the colour pattern of *L. micropogon* which does not seem to be dramatically different from that of *L. furcatus*. The black marks at caudal base (often species specific in cobitoids, see Kottelat, 1990) are still distinct and agree with Rendahl's figure. They include a widening of the epaxial stripe, 2-4 thin blackish vertical stripes superimposed over the posterior extremity of that stripe and a superficial pigment patch at base of caudal branched rays 2-6.

Several nominal species have been reported from India as having notched, lunate or forked caudal fins (described or identified as *L. annandalei* Chaudhuri, 1912, *L. menoni* Pillai & Yazdani, 1976, *L. goalparensis* Pillai & Yazdani, 1976, *L. caudofurcatus* (Tilak & Husain, 1978)). Some of them might possibly be synonyms of *L. micropogon*, but the existing descriptions are not informative, and the illustrations accompanying several of these are crude and not very useful. Clearly, a critical re-examination of the specimens and redescription of the Indian species in a way compatible with international standards is necessary in order to clarify their identity.

Distribution.- *Lepidocephalichthys furcatus* is known from the Chao Phraya basin (Central Thailand), the Mekong basin and the Malay Peninsula (Fig. 3). It has usually been collected in swamps, flooded river sides, shallow lakes and reservoirs among dense vegetation.

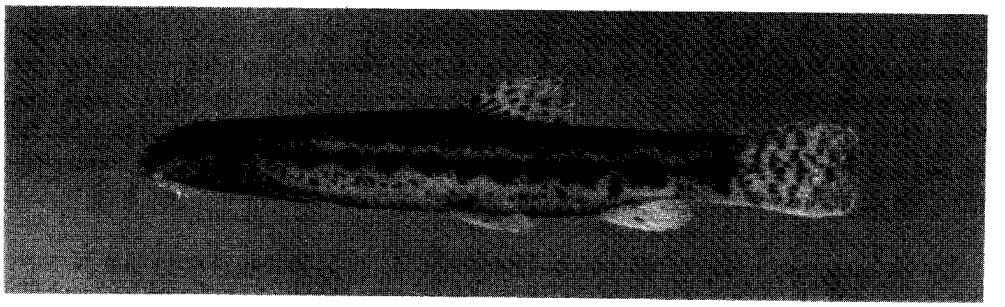

Fig. 5. *Lepidocephalichthys hasselti*, ZRC 21767-21788, 28.5 mm SL, Malaysia: Kelantan.

Lepidocephalichthys hasselti (Valenciennes)
(Fig. 5)

Cobitis hasselti Valenciennes, in Cuvier & Valenciennes, 1846; 74 (original description; type locality: Rivière Tjelankahan, Java; based on a drawing sent by Kuhl and van Hasselt; no type material).

Lepidocephalichthys nudus Machan, 1931: 222 (original description; type locality: Stausee Kalen bei Soerabaya [Kalen reservoir near Surabaya], Java; syntypes: NMW 16151-16156 [6]).

Lepidocephalus taeniatus Fowler, 1939: 63, figs. 11-12 (original description; type locality: Thailand: waterfall at Trang; holotype: ANSP 68486).

Material examined.- MALAY PENINSULA: THAILAND: paratypes of *Lepidocephalus taeniatus*, 3 (of 5) ex. (ANSP 68487), (31.3-37.3 mm SL), Trang Prov.: waterfall at Trang [a 40-ft fall of the Trang river at Chong, 12 mi. E of Trang] (7°30'N 99°47'E), coll. R. de Schauensee *et al.*, 13.x.1936. - 24 ex. (CMK 5124), Pattani Prov.: swamp near Mae Nam Sai Buri, 43 km NW of Narathiwat on road 42; Ban

La Han, coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 29.iii.1985. - 1 ex. (CMK 5135), Narathiwat Prov.: Khlong Wi (tributary of Mae Nam Sai Buri), at Ban Ba Khon, road from Ruso to Sisa Khon, km 8, coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 30.iii.1985. — MALAYSIA: 2 ex. (ZRC 5212-5213), Kedah: Langkawi Island, coll. P. K. L. Ng, xii.1987. - 2 ex. (ZRC 647), Kelantan: Kota Bharu, Pengkalan Chepah, coll. M. W. F. Tweedie, 1939. - 22 ex. (ZRC 21767-21788), 21 ex. (CMK 8263), Kelantan: vicinity of Air Terjun waterfall near Pasir Puteh, 4 km after turnoff from Jerteh - Kota Bahru road (5°49'03.9"N 102°20'44.3"E), coll. M. Kottelat, P. K. L. Ng *et al.*, 20.iii.1992. - 5 ex. (ZRC 1443), Perak: Sauk, coll. A. Herre, 19.iii.1937. — SUMATRA: 113 ex. (ZMA 119.974), Deli [Medan], coll. de Bussy, 1913. — JAVA: syntypes of *L. nudus*, 6 ex. (NMW 16151-16156), (23.8-30.7 mm SL), Stausee Kalen bei Soerabaya [Kalen reservoir near Surabaja] coll. V. Pietschmann, viii.1929. - 4 ex. (ZRC 701), Bandung Tjibiru, coll. H. S. Hardjasasmita, 20.x.1968. - 5 ex. (ZRC 646), same data. - 5 ex. (ZRC 682), Bogor, Inland Fisheries Dept., 1968. - 1 ex. (ZRC 676), Bogor, coll. Achmad, iii.1967. - 44 ex. (ZMA 109.264), Bogor, M. Weber, 1899. - 11 ex. (MHNG 1372.40-50), Sukabumi, coll. Walsh.

Comparison material.- *L.* cf. *hasselti*: SALWEEN BASIN: THAILAND: Tak Prov.: 7 ex. (CMK 4911), Huai Mae Charno, 4 km S of Amphoe Mae Ramat on road 1085 (16°58'N 98°34'E), coll. M. Kottelat, 6.iii.1985. - 18 ex. (CMK 4933), 5 ex. (ZRC 21041-21045), Mae Nam Moei, 5 km W of Amphoe Mae Sot (16°41'N 98°01'S), coll. M. Kottelat, 7.iii.1985. — CHAO PHRAYA BASIN: THAILAND: 3 ex. (CMK 4959), Nan Prov.: Mae Nam Nan basin: Nam Kon at Chang Klang Market, 77 km N of Nan on road 1080 (19°17'N 100°52'E), coll. M. Kottelat, 9.iii.1985. - 3 ex. (CMK 5004), Phrae Prov.: Mae Nam Yom basin: tributary of Mae Nam Yom, road 1023 from Amphoe Long to Amphoe Wang Chin, 8 km S of junction with Lampang - Phrae highway (17°58'N 99°38'E), coll. M. Kottelat, 12.iii.1985. — MEKONG BASIN: THAILAND: 2 ex. (CMK 5031), Loei Prov.: Nam Nan, 2 km upstream of Amphoe Dan Sai (17°16'N 101°09'E), coll. M. Kottelat, 14.iii.1985. - 7 ex. (CMK 5054), Udon Thani Prov.: swamp, 6 km N of Udon Thani where road 2 crosses the railway (17°28'N 102°48'E), coll. M. Kottelat, 16.iii.1985. - 3 ex. (CMK 5063), Sakhon Nakhon Prov.: stream at Ban Na Kham, on the road from Kalasin to Sakhon Nakhon (17°07'N 104°03'E), coll. M. Kottelat, 17.iii.1985. - 15 ex. (CMK 5076), Nakhon Phanom Prov.: road from Nakhon Phanom to Amphoe Tha Uthen, km 17 (17°31'N 104°41'E), coll. M. Kottelat, 17.iii.1985. - 1 ex. (CMK 5119), Buriram Prov.: swamp along road from Amphoe Phrasat to Amphoe Prakhon Chai, km 25 (14°37'N 103°05'E), coll. M. Kottelat, 19.iii.1985. — CAMBODIA: 2 ex. (CMK 4250), Stung O Krien, km 330, road from Saigon to Stung Treng, coll. F. d'Aubenton, 28.ii.1964; cleared and stained. - 1 ex. (CMK 4810), road from Phnom Penh to Sianoukville, Tuk Sap, coll. F. d'Aubenton, 30.i.1961. - 3 ex. (CMK 4811), same data, 14.ii.1961. - 1 ex. (CMK 4812), same data, 30.i.1962. - 8 ex. (CMK 4813), trail from Phnom Penh to Sianoukville, km 164, coll. F. d'Aubenton, 30.i.1962. - 5 ex. (CMK 4814), Stung Po Ben, Khum Treng, on road from Phnom Penh to Kompong Thom, coll. F. d'Aubenton, 25.i.1962. - 1 ex. (CMK 4815), road from Phnom Penh to Sianoukville, km 87, coll. F. d'Aubenton, 25.iii.1962. - 8 ex. (CMK 4816), Srepok River at bridge on road from Stung Treng to Ratanakiri, coll. F. d'Aubenton, 19.ii.1964. - 3 ex. (CMK 4817), trail from Ratanakiri to Boum Long, coll. F. d'Aubenton, 22.ii.1964. - 2 ex. (CMK 4818), road from Longphok to Boum Long, Stung bridge, coll. F. d'Aubenton, 22.ii.1964. - 1 ex. (CMK 4819), road from Stung Treng to Boum Long, km 25, coll. F. d'Aubenton, 27.ii.1964. - 7 ex. (CMK 4820), road from Saigon to Stung Treng, km 330; Sr. O Krien, coll. F. d'Aubenton, 28.ii.1964. - 2 ex. (CMK 4821), road from Phnom Penh to Sianoukville, coll. F. d'Aubenton, 5.iii.1964. - 3 ex. (CMK 4822), Kirikum, coll. F. d'Aubenton, 12.iii.1964. - 1 ex. (CMK 4823), same data. - 1 ex. (CMK 4824), road from Phnom Penh to Sianoukville, km 111.7, coll. F. d'Aubenton, 13.iii.1964. - 12 ex. (CMK 4825), road from Phnom Penh to Sianoukville, km 136, coll. F. d'Aubenton, 13.iii.1964. - 15 ex. (CMK 4826), road from Phnom Penh to Sianoukville, km 170, coll. F. d'Aubenton, 22.iii.1964. - 1 ex. (CMK 4827), road from Phnom Penh to Sianoukville, km 153, coll. F. d'Aubenton, 13.iii.1964. - 1 ex. (CMK 4828), O-Po-Kampon, Than Pra Ham, coll. F. d'Aubenton, 18.vi.1964. — VIET NAM: 3 ex. (CMK 7254), Dong Nai Prov.: Lake Tri An, coll. D. Serov, xi.1990. - 3 ex. (CMK 7255), Phu Khanh Prov.: near Ninh Hoa, coll. D. Serov, ix.1990.

Diagnosis.- *Lepidocephalichthys hasselti* is distinguished from other described species of *Lepidocephalichthys* in Southeast Asia in usually having an ocellated black spot centered at base of branched caudal rays 3-4; if the ocellus is not present, the black or darker area is present (Fig. 5). Additional characters useful in identifying the species are: size up to ca. 45 mm SL; body with a median longitudinal stripe or a row of adjacent black spots, with a unpigmented stripe above it, back marmorated, finely spotted or blotched; caudal fin with series (usually 3-6) of vertical bars; pigment on median caudal rays more closely set than on other caudal rays; pectoral rays 7-8 of male fused to form a vertically orientated plate (Fig. 1b); dorsal origin above posterior extremity of pelvic base.

Discussion.- The above diagnosis applies to all the material listed above from Java, Sumatra and the Malay Peninsula (including paratypes of *L. taeniatus*). We have compared directly Javanese material with the types of *L. nudus* and *L. taeniatus* and could not observe characters likely to indicate that they are not conspecific. Indochinese material usually identified as *L. hasselti* (e. g. Smith, 1945; Kottelat, 1989) also agrees with this definition, except that no sexual dimorphism could be observed even in large series; we conclude that they probably represent a distinct species. A new species of *Lepidocephalichthys* is currently being described from the Mekong basin in southern Yunnan (Chen Yifeng, pers. comm.), we suspect that it might be the same species and refrain from naming it until after that description is published and direct comparison becomes possible.

Distribution.- *Lepidocephalichthys hasselti* is known from Java, Sumatra, and the Malay Peninsula (Fig. 3). In the Malay Peninsula, *L. hasselti* is apparently unknown south of Perak; this disjunct distribution might suggest that more than one species is involved, but we could not observe characters supporting this hypothesis. The species occurs in a variety of habitats but is more commonly collected in standing or slowly moving waters, often with muddy or heavily silted bottoms, including paddy fields.

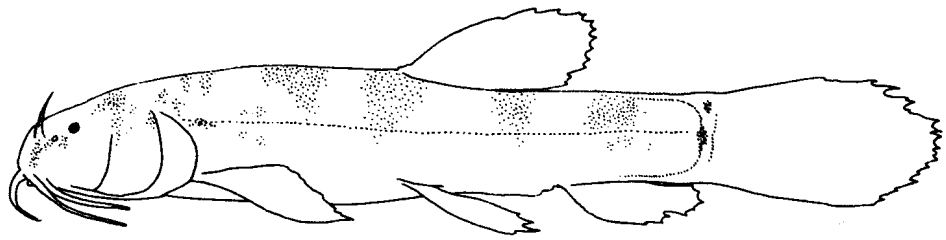

Fig. 6. *Lepidocephalichthys katik*, ZRC 9345-9347, female, paratype, 13.0 mm SL, Malaya.

Lepidocephalichthys katik, new species
(Figs. 6-7, Table 2)

Material.- Holotype - Male (12.9 mm SL) (ZRC 9344), Malaysia, no other data (see below).

Paratypes - 3 males, 2 females, 3 ex. (ZRC 9345-9347), 2 ex. (12.5-13.5 mm SL) (CMK 8034) Malaysia, no other data (see below).

Diagnosis.- *Lepidocephalichthys katik* is distinguished from all other species in the genus by its minute size (up to 13.5 mm SL, females 13 mm SL have ovaries with eggs about 0.2 mm diameter) and by a suite of unique characters: a very long nasal barbel, a lower lip with four long barbels, an unbranched and strongly-curved suborbital spine and 20 + 8-9 = 28-29 vertebrae (less than in any other species). Additionally, it has a serrated second pectoral ray (a character shared with males *L. pristes*) with 6-7 serrae.

Description.- A species of *Lepidocephalichthys* of very small size (largest known specimen 13.5 mm SL); body compressed, its depth increasing from head to dorsal origin and then decreasing to caudal peduncle. General appearance is illustrated in Figure 6. Selected morphometric data are given in Table 2. Dorsal fin with 3 simple and 6 branched rays, last one split to the base; dorsal origin above origin of pelvic. Pectoral fin with 8 rays; in males, second ray thickened, with about 6-7 fine serrae along median part of inner margin (Fig. 7a). Pelvic fin with 6 rays. Anal fin inserted almost immediately behind vent, with 3 simple and 5 branched rays, last one not split to the base. Caudal fin with 6-7 + 8 principal rays (5-6 + 7 branched).

Body entirely scaled, except belly in front of pelvic fins. Head naked. Suborbital spine simple, strongly curved (Fig. 7b). Three pairs of barbels (two pairs of rostral ones and one at each corner of the mouth). Lower lip interrupted medially, each half with two barbels, the median pair of barbels with one or two proximal pointed papillae (Fig. 7c). Anterior nostril pierced at the anterior base of a long barbel (Fig. 7d). Eye reduced, only about 2.0-2.5 % HL.

Vertebrae 20 + 8-9 = 28-29 (Table 1). Bony capsule of air bladder without a pair of spinous processes at its inferior extremity.

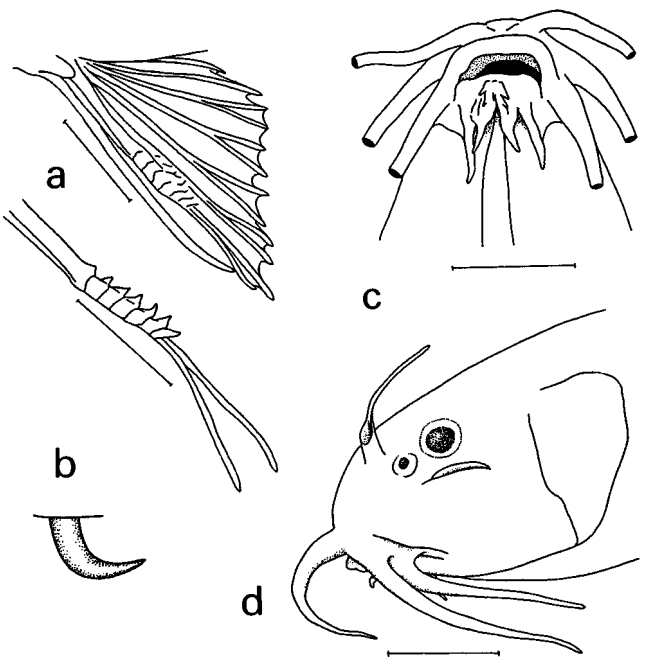

Fig. 7. *Lepidocephalichthys katik*, ZRC 9345-9347. a, pectoral fin of male, 12.5 mm SL, with details of second ray after removal of the skin; b, suborbital spine, schematic; c, mouth, 13.0 mm SL; d, close-up of head, 13.0 mm SL. Scale bars 1 mm.

Table 2. Morphometric data of holotype (*) and 5 paratypes of *Lepidocephalichthys katik*, ZRC 9344-9347, CMK 8034, in percent of standard length rounded to the nearest 0.5 %, except standard length in mm. m, male; f, female.

sex	m	m	m *	f	m	f
Standard length (mm)	12.5	12.7	12.9	13.0	13.4	13.5
Total length	-	130.0	131.0	133.0	113.5	123.5
Lateral head length	28.0	27.5	26.0	25.5	27.0	26.0
Predorsal length	57.0	-	55.5	57.5	55.5	59.0
Prepelvic length	57.0	56.5	54.5	56.0	53.5	57.5
Preanal length	81.0	81.5	78.0	78.0	80.5	82.4
Head depth	18.0	-	18.5	17.0	18.0	16.5
Body depth (at pelvic origin)	18.0	-	18.5	18.5	18.0	18.8
Depth of caudal peduncle	11.5	10.0	11.0	12.0	11.5	11.8
Eye diameter	2.0	2.5	2.5	2.5	2.5	2.4

Colouration.- Preserved specimens are light brown and faded, with indistinct remains of 4-5 darker saddles on the back.

Distribution and habitat.- *Lepidocephalichthys katik* is known from six specimens from Malaysia in ZRC which are believed to be from Mawai, Johor, as they were in the same jar as the paratype ZRC 9328 of *Nagaichthys filipes* Kottelat & Lim, 1991, whose locality was tentatively accepted as Mawai, Johor (see Kottelat, 1991: 286 for discussion).

Biology.- Four of the six specimens are males with thickened second pectoral ray and serrae. The second pectoral ray is not enlarged and does not bear serrae in the two other specimens (13.0 and 13.5 mm SL); both have a distended belly and the dissected 13.5 mm SL specimen has ovaries with apparently 50 eggs at various development stages, the largest ones (some 12-15) being about 0.3-0.4 mm diameter; this suggest a continuous reproduction, with a few eggs spawned every day or every few days. With transmitted light, eggs could also be observed in the belly of the 13.0 mm SL female. The stomach of the dissected female was empty.

Lepidocephalichthys katik differs from all other species of the genus by several reductive characters which we consider as paedomorphic or as specialization associated with small adult size (low vertebrae number, simple suborbital spine, naked head, reduced eye). The relatively long fins is a character present at similar size in the juveniles of various species of Cobitoidei (pers. obs.). Continuous spawning (or 'multiple spawning within year') has been hypothesized by Burt *et al.* (1988) to be associated with less seasonal environments, smaller body size, and smaller relative ovary sizes.

Etymology.- *"Katik"* is the Malay word for stunted or short. The name is used as a noun.

Remarks.- The Anjungan and Banjermasin specimens referred to as *Lepidocephalichthys* sp. 2 by Kottelat (1991) and specimens from Kalimantan Tengah received through Tyson Roberts after this paper had been accepted for publication are very similar to *L. katik*. They share the small size (up to 16.9 mm SL), presence of a pair of nasal barbels and the shape of the lower lip. However, they are distinguished by having a bifid and almost straight suborbital spine; they apparently represent another species of miniature loach which we intend to describe soon.

Fig. 8. *Lepidocephalichthys pristes*, CMK 7886, 26.9 mm SL, North Selangor peat swamp forest.

***Lepidocephalichthys pristes* Roberts**
(Fig. 8)

Lepidocephalichthys pristes Roberts, 1989: 105 (original description; type locality: Borneo: Kalimantan Barat: Kapuas R. basin: 30 km W of Sintang; holotype: MZB 3257).

Material examined.- MALAY PENINSULA: MALAYSIA: Selangor: 9 ex. (ZRC 14928-1493), 3 ex. (CMK 7886), North Selangor peat swamp forest, stream at km 43 marker on road from Tanjong Malim to Sungai Besar, coll. Honours Class, 18.vi.1991. - 1 ex. (ZRC 14913), North Selangor peat swamp forest, stream at km 34 marker on road from Sungai Besar to Tanjong Malim, coll. Honours Class, 17.vi.1991. - 5 ex. (ZRC 14916-14920), North Selangor peat swamp forest, stream 0.7 km after km 41 marker on road from Sungai Besar to Tanjong Malim, coll. Honours Class, 19.vi.1991. - 5 ex. (ZRC 14921-14925), North Selangor peat swamp forest, stream at km 47 marker on road from Sungai Besar to Tanjong Malim, coll. Honours Class, 19.vi.1991. - 2 ex. (ZRC 15141-15142), North Selangor peat swamp forest, stream at km 43 marker on road from Tanjong Malim to Sungai Besar, coll. Honours Class, 19.vi.1991. - 2 ex. (ZRC 14914-14915), North Selangor peat swamp forest, Sungai Tengi, coll. Honours Class, 20.vi.1991. - 11 ex. (ZRC 17844-17854), North Selangor peat swamp forest, stream at km 43 marker on road to from Tanjong Malim to Sungai Besar (39 km from Tanjong Malim), coll. P. K. L. Ng *et al.*, 24.viii.1991. - 26 ex. (ZRC 20763-20788), same locality, coll. S. Lim & K. Lim, 14.ix.1991. - 14 ex. (ZRC 20836-20849), 26 ex. (ZRC 20763-20788), North Selangor peat swamp forest, stream at 43 km, Tanjung Malim - Sungai Besar Road, coll. S. Lim & K. Lim, 14.ix.1991. — BORNEO: 3 ex. (CMK 5990), Sarawak: W of Kuching, road from Bau to Lundu, km 49.1, Sungai Stunggang, coll. K. E. Witte. - 7 ex. (CMK 6673), Kalimantan Barat: Sungai Kepayang, 7 km SE of Anjungan on road to Pontianak (0°20'N 109°08'E), coll. M. Kottelat *et al.*, 21.iv.1990. - Holotype (MZB 3527), Kalimantan Barat: 30 km W of Sintang on road from Sanggau to Sintang, coll. T. R. Roberts, 18.vii.1976. - 1 paratype (MZB 3531), Kalimantan Barat: Sungai Seriang, 37 km W of Putussibau, coll. T. R. Roberts, 12.viii.1976. - 11 ex. (CMK 6966), Kalimantan Barat: Danau Temuan near Nanga Embaluh (approx. 0°53'N 112°37'E), M. Kottelat *et al.*, 28.iv.1990. - 1 ex. (ZSM 27256), Kalimantan Tengah: streams at km 11, 29, 1nd 35 on road from Palangkaraya to Kasungan, coll. H. Linke, 1988. - 10 ex. (CMK 7758), 3 ex. (ZRC 21048-21050), Kalimantan Timur: unnamed left-side blackwater tributary of Mahakam River, about 2 km upriver of Mujub (0°01'S 115°43'E), M. Kottelat, 3.viii.1991. — SUMATRA: Riau Province: 8 ex. (CMK 8280), 2 ex. (ZRC 21017-21018), Kampar Kiri basin, Sungei Simpang Dua, 16.4 km after bridge over N branch of Kampar Kiri on road from Pekanbaru to Renggat, coll. M. Kottelat & R. Dudley, 4.iv.1992. - 3 ex. (CMK 8300), Kampar Kiri basin, Sungei Timek, 38.4 km after bridge over N branch of Kampar Kiri on road from Pekanbaru to Renggat, coll. M. Kottelat & R. Dudley, 4.iv.1992.

Diagnosis.- *Lepidocephalichthys pristes* is distinguished from all other species of the genus (except *L. katik*) by its sexual dimorphism. The males have the second pectoral ray enlarged in a kind of lamina whose inner margin bears 8-11 medially directed serrae (Fig. 1d). From *L. katik*, it differs, among others, by a larger size (40 mm SL, vs 13.5) and by the absence of a long nasal barbel (vs presence).

Discussion.- Since described in 1989 from the Kapuas River basin, *L. pristes* has been collected from Sarawak, Kalimantan Tengah, Kalimantan Timur and Sumatra (Riau). It is not recorded from Java, but might occur there too. No significant inter-population differences could be observed, except that the Selangor material has less precaudal vertebrae than the Bornean material (22, vs 23-24). Vertebrae number of the various populations are presented in Table 1.

The serrated second pectoral ray in *Lepidocephalichthys* and does not seem to be homologous with the slender and finely serrated lamina circularis of *Cobitis choii* Kim & Son (1984) (of which *C. lebedevi* Vasilieva & Vasiliev (1985) is possibly a synonym). Species sharing this character may have to be considered as a distinct genus once interrelationships within *Lepidocephalichthys* are investigated.

Distribution.- In the Malay Peninsula, *L. pristes* is known only from the North Selangor peat swamp forest (Fig. 3). It has originally been described from the Kapuas basin and is known from Sarawak, Kalimantan Timur and Kalimantan Tengah in Borneo, and Riau Province in Sumatra.

Fig. 9. *Lepidocephalichthys tomaculum*, ZRC 14239, female, paratype, 39.2 mm SL, North Selangor peat swamp forest.

Lepidocephalichthys tomaculum, new species
(Figs. 9-10, Table 3)

Lepidocephalus macrochir (not of Bleeker, 1854: 97): Kottelat & Whitten, 1993: pl. 28.

Material.- Holotype - Male (33.2 mm SL) (ZRC 14938), stream at 34 km mark on road from Sungai Besar to Tanjong Malim, North Selangor peat swamp forest, Sungai Bernam basin, Selangor, Malaysia (approx. 3°40'N 101°20'E) coll. P. K. L. Ng *et al.*, 17.vi.1991.

Paratypes - MALAYSIA: 21 ex. (ZRC 14939-14966), 6 ex. (CMK 8033) (18.9-39.2 mm SL) same data as holotype. - 19 ex. (ZRC 648) (13.7-35.2 mm SL) Selangor: 2 miles from Batu Tiga on road to Subang, coll. E. R. Alfred, 5.vi.1966. - 2 ex. (CMK 7382) (28.5-30.6 mm SL) Johor: Sungai Mupor, about km 15

on road from Kota Tinggi to Mersing (1°52'N 103°56'E) coll. M. Kottelat, P. K. L. Ng & K. K. P. Lim, 22.i.1991. - 1 ex. (ZRC 2276) (39.2 mm SL) Johor: Bukit Serampang, coll. L. K. Charles, 1.i.1959. - 2 ex. (ZRC 18729-18730) (12.0-31.3 mm SL) Johor: about 500 m after 119 km on Segamat - Johor Bahru road, coll. P. K. L. Ng *et al.*, 21.x.1991.

Other material.- MALAYSIA: 2 ex. (ZRC 16753a-b) (25.5-35.0 mm SL) Johor: near Layang Layang, coll. P. K. L. Ng & R. Yeong, x.1989. - 1 ex. (ZRC 9300) (25.7 mm SL) Terengganu: small stream near Kampong Chering China, 13 miles south of Kuala Terengganu on the road to Kuala Brang, coll. Wee Beng Tang, 1966.

Diagnosis.- *Lepidocephalichthys tomaculum* inhabits peat swamps and swampy areas of Peninsular Malaysia and is distinguished from any congener by the following combination of characters: body depth almost uniform from head to base of caudal fin; body reddish brown in life with dark brown markings; back with a series of 3-7 predorsal and 3-6 postdorsal narrow black transverse bars; caudal fin with a fine reticulated pattern (sometimes appearing as numerous fine vertical bars); a black spot at base of five uppermost branched caudal rays; pectoral rays 7-8 of males fused but not known to be modified into a thick cylindrical ray-like structure; vertebrae 24-26 + 10-11 = 34-36; maximum known size 39 mm SL.

Table 3. Morphometric data of holotype and 3 paratypes of *Lepidocephalichthys tomaculum*, in percent of standard length, except standard length in mm.

	ZRC 14938 holotype	ZRC 14940 paratype	ZRC 14939 paratype	ZRC 2276 paratype
Standard length (mm)	33.2	28.8	39.2	39.2
Total length	122.3	130.6	122.4	120.2
Lateral head length	19.6	20.5	18.4	18.4
Predorsal length	57.2	61.5	57.4	59.2
Prepelvic length	50.9	53.8	52.8	50.8
Preanal length	79.2	82.3	82.9	79.6
Head depth	11.7	10.8	11.5	10.7
Body depth (at pelvic origin)	15.7	16.0	17.6	18.1
Depth of caudal peduncle	11.4	13.2	13.0	13.3
Length of caudal peduncle	13.0	13.9	13.3	14.0
Eye diameter	3.3	3.8	3.3	3.6
Interorbital width	3.9	4.5	4.1	4.8
Snout length	6.9	6.9	6.4	5.9
Height of dorsal fin	18.4	20.5	16.6	16.6
Height of anal fin	15.7	17.7	14.5	12.5
Length of pectoral fin	16.0	15.6	14.0	10.7
Length of pelvic fin	15.7	15.6	13.5	11.7

Description.- A species of *Lepidocephalichthys* of moderate size (largest known specimen 39.2 mm SL); body compressed, its depth almost uniform from head to caudal peduncle. General appearance is illustrated in Figure 9. Morphometric data of the holotype and 3 of the largest specimens (28.8-39.2 mm SL) are given in Table 3. Dorsal fin with 3 simple and 6 branched rays, last one split to the base; dorsal origin behind vertical of posterior extremity of pelvic base. Pectoral fin with 8 rays, last 2 rays fused in adult males (more than 28 mm SL) (Fig. 10a). Pelvic fin with 7 rays. Anal fin inserted almost immediately behind vent, with 3 simple and 5 branched rays, last one split to the base. Caudal fin with 8+8 principal rays (7+7 branched).

Body entirely scaled, except belly between pectoral bases. Head scaled on cheeks; operculum and vertex naked. Suborbital spine bifid, outer prong straight, inner prong curved and only slightly longer and stronger than outer one. Three pairs of barbels, two pairs of rostral ones reaching slightly behind vertical of posterior margin of eye and one at each angle of mouth reaching about middle of postorbital area of head. Lower lip interrupted medially, each half with an inner thickened lobe ending in a barbel-like pointed tip; margin of membrane connecting this lobe and the barbel at corner of the mouth fringed especially in the median area (Fig. 10b). Anterior nostril at the tip of a short conical tube.

Vertebrae: 24-26 + 10-11 = 34-36 (Table 1). Bony capsule of air bladder without a pair of spinous processes at its inferior extremity.

Colouration.- Preserved specimens are brown. Lower half of body becoming increasingly speckled with yellow and belly entirely yellow. Sides with an indistinct mid-lateral row of blackish irregular spots extending at least as far back as level of anal origin. Back usually with a series of short transverse bars, more or less regular or irregular, 3-7 predorsal ones (always including one at dorsal origin) and 3-6 postdorsal ones. Base of caudal fin darker, usually with a blackish patch at base of uppermost branched rays (homologous to ocellus of several other cobitid and balitorid species). Head with a blackish stripe from tip of snout to eye and a dark brown stripe extending from eye longitudinally backwards to about middle of postorbital area of head. Top of head mottled, cheek yellowish. Caudal and dorsal fins hyaline with dark brown reticulation on rays and membrane (general appearance is of numerous thin vertical lines, but actual pattern is reticulated). Pectorals, pelvic and anal fins with one or two rows of more or less distinct brown spots on fin rays.

In life, ground colour is reddish brown and the markings are blackish brown.

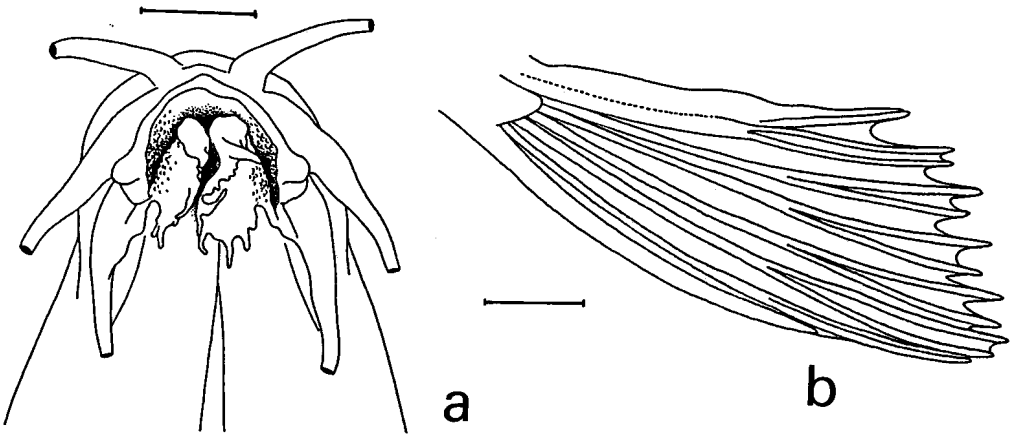

Fig. 10. *Lepidocephalichthys tomaculum.* a, mouth of ZRC 14939, 39.2 mm SL; b, left pectoral fin of holotype, 33.2 mm SL, showing the fused pectoral rays 7-8. Scale bars 1 mm.

Distribution and habitat.- *Lepidocephalichthys tomaculum* has been collected in peat and freshwater swamps, as well as in slow flowing streams of Selangor, Pahang, Johor, and Terengganu, West Malaysia (Fig. 3). In the North Selangor peat swamp forest, it has only been collected from a small, quiet, well-shaded stream with slow-flowing black water (pH ca. 3.5). The fishes were found in dense mats of aquatic weeds (*Utricularia* sp.), and from the long grass on the edge of the stream. At Layang Layang and Sungai Mupor, they were collected in shallow water less than 0.5 m deep, with mud, leaf litter and debris bottom, slow flowing to almost stagnant water, well shaded and vegetated, water brownish, pH ca. 5. The Segamat specimens were obtained from a slow flowing, disturbed black water stream.

Etymology.- *Tomaculum* is the Latin word for sausage, this fish having been called for some time 'sausage loach' by us. A noun in apposition.

Acknowledgments.- We are grateful to Mrs. Yang Chang Man (ZRC) and Peter K. L. Ng for their support, Harald Ahnelt (then NMW), François d'Aubenton (then MNHN), Barbara Herzig (NMW), Isaäc Isbrücker (ZMA), Sven O. Kullander (NRM), Volker Mahnert (MHNG), Han Nijssen (ZMA), and Scott A. Schaefer (ANSP) for the loan of specimens under their care or hospitality in their institutions; to Tyson Roberts for the gift of comparison material, and his critical comments on the manuscript; to Marianne Müller (ZSM) for taking the photographs; and to Paul Gassner and Nicole Ritter (ZSM) for the x-rays.

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