THE CYPRINID FISHES OF *ACANTHOBRAMA* HECKEL AND RELATED GENERA

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Pp. 291–315; 11 *Text-figures*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ZOOLOGY Vol. 24 No. 6

LONDON : 1973

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 *a separate supplementary series of longer papers was instituted, numbered serially for each Department.*

This paper is Vol. 24, *No.* 6 *of the Zoological series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.*

World List abbreviation
Bull. Br. Mus. nat. Hist. (Zool.)

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 7 March, 1973 *Price* £1·15

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CONTENTS

	Page
INTRODUCTION: Measurements, abbreviations and geographical names .	293
Acanthobrama and related genera	294
Acanthobrama: definition and key to the species	295,6
A. centisquama Heckel	296
A. marmid Heckel	296
A. lissneri Tortonese	302
A. telavivensis nov.	304
Mirogrex terraesanctae	
M.t. terraesanctae Steinitz	306
M.t. hulensis nov.	310
DISCUSSION AND ACKNOWLEDGMENTS	312-13
REFERENCES	314

SYNOPSIS

The genus *Acanthobrama* has been redefined to exclude *A. terraesanctae* Steinitz. This has been made the type of a new genus, *Mirogrex*, characterized by the high numbers and slender form of the gill-rakers. Two subspecies of *M. terraesanctae* are recognized and defined and a description is given of a new species of *Acanthobrama* from the Mediterranean rivers of Israel. The relationships of these genera are discussed.

INTRODUCTION

THE part of this work on collections in European museums was done by Trewavas many years ago in connection with the naming of Tigris specimens. The discovery by Fishelson and Goren of a new species of *Acanthobrama* renewed interest in the genus and we decided to amalgamate our contributions as a revision of the genus. We independently discovered the differences between the Lake Kinnereth (Tiberias) and Huleh populations of *Acanthobrama terraesanctae* Steinitz and regarded them as subspecies, finally deciding to separate them from *Acanthobrama* as a new genus.

Measurements, abbreviations and geographical names

SL = standard length, i.e. without caudal fin. The last dorsal or anal ray cleft to the base or the last two in contact at the base are counted as one, the usual practice in Cyprinidae. Vertebral counts start behind the complex vertebra with the first bearing a normal rib and include the urophore as one.

The names Sea of Galilee, Lake Tiberias and Lake Kinnereth are synonymous. We use the spelling Huleh for the former lake and swamp region and Hula for the part of it that remains as Hula Natural Reserve. Names of localities in Syria and Iraq, although variously transliterated, will, we believe, present no difficulty.

ACANTHOBRAMA and related genera

In southwest Asia there are recognized two cyprinid genera, *Acanthobrama* Heckel and *Capoetobrama* Berg, that have in common:

1. A smooth, rigid last simple dorsal ray.
2. A keel on the belly between the pelvic fins and the anus. In this place there is no median ventral row of scales, but the two ventral rows meet at a sharp angle or are narrowly separated by a narrow strip of naked skin ('soft keel').
3. A single row of pharyngeal teeth on each side.
4. 13–23 rays in the anal fin.

We now propose the separation of *Acanthobrama terraesanctae* Steinitz as type species of a third genus, *Mirogrex* nov. The characteristics of the three genera are set out in Table 1.

TABLE 1. Differences between the genera *Acanthobrama, Mirogrex* and *Capoetobrama*.

	Acanthobrama	*Mirogrex*	*Capoetobrama*
Geographical range	Orontes to Yarkon; Jordan Valley; Tigris–Euphrates	Jordan Valley	Aral Sea basin
Mouth: position	terminal or subterminal	terminal	ventral
shape	horse-shoe	narrow horse-shoe	slightly curved, nearly transverse
angle with horizontal	20°–40°	40°–50°	0° (horizontal)
Length of head, % SL	22·5–28·0	25–29	18–20
Length of lower jaw, % SL	8–11	9·5–12·5	6·5–7·0
Outer gill-rakers on first arch: lower part	8–12	13–20	12–13
whole arch	12–15	(17) 20–28	14–16 (17)*
Anal fin-rays	12–23	14–18	18–23
Scales lat. line	51–100	69–80	54–64
D-lat. line	9½–20	11½–17½	8–10
Vertebrae	32–38	34–36	38–40

* 17 is the number given by Nikolskii (1938). The other numbers are taken from 5 specimens in the B.M.(N.H.).

The monotypic genus *Capoetobrama*, type species *C. kuschakowitschi* (Kessler), is, to judge by its mouth, its long intestine (3¼ times SL according to Berg) and compressed, bevelled pharyngeal teeth, adapted to feeding on mud. It differs from *Acanthobrama* in much the same way as *Varicorhinus* (or *Capoeta*) differs from *Barbus*. In two species of *Acanthobrama* and in *Mirogrex* (our new genus) we obtain measurements for the intestine of 81–133% SL.

Both geographically and structurally *Capoetobrama* is more distinct from *Acanthobrama* than is *Mirogrex*. The latter comes within the range of *Acanthobrama* both geographically and in most of the characters tabulated, but differs from both other genera in the high numbers and slender form of the gill-rakers (fig. 1), adapted to a largely planktonic diet. The parallel suggested here is with *Engraulicypris*, the plankton-feeding cyprinid of African lakes, which seems to be derived from the mainly fluviatile *Barilius*, a predator on invertebrates and fishes.

ACANTHOBRAMA Heckel

Heckel, 1843 : 1033.
Trachibrama Heckel, l.c. (lapsus for *Acanthobrama*, see Heckel, op. cit. vol. 3, 1846 : 359).

TYPE SPECIES: *Acanthobrama marmid* Heckel, 1843 : 1075, designated by Bleeker, 1863 : 210.

DEFINITION: A soft keel between the ventral rows of scales for half or more of the distance from anus to pelvic base; pharyngeal teeth 5–5 or 5–4; scales 51–100 in the lateral line (excluding 2 or 3 on the caudal fin); last simple dorsal ray strong and rigid for one half to the whole of its length; gill-rakers 8–12, usually 9–11, on lower part of anterior arch (unknown in *A. centisquama*), 12–15 on the whole arch; 12–23 rays in the anal fin; length of head 22·5–28% of SL, of lower jaw 8–11%.

DISTRIBUTION: Tigris and Euphrates and their tributaries; R. Kueik at Aleppo; R. Orontes and Amik Göl; waters of Damascus; Jordan system; Mediterranean rivers of Israel from Na'amen to Yarkon.

Acanthobrama mirabilis Ladiges (1960 : 132 fig. 4) from R. Menderes (Meander) seems to be a *Vimba vimba tenella* (Nordmann) and there is no reliable record of *Acanthobrama* west of the Orontes, unless one of *A. marmid* from near Tarsus, quoted from Kosswig MS by Ladiges (1960) is verified.

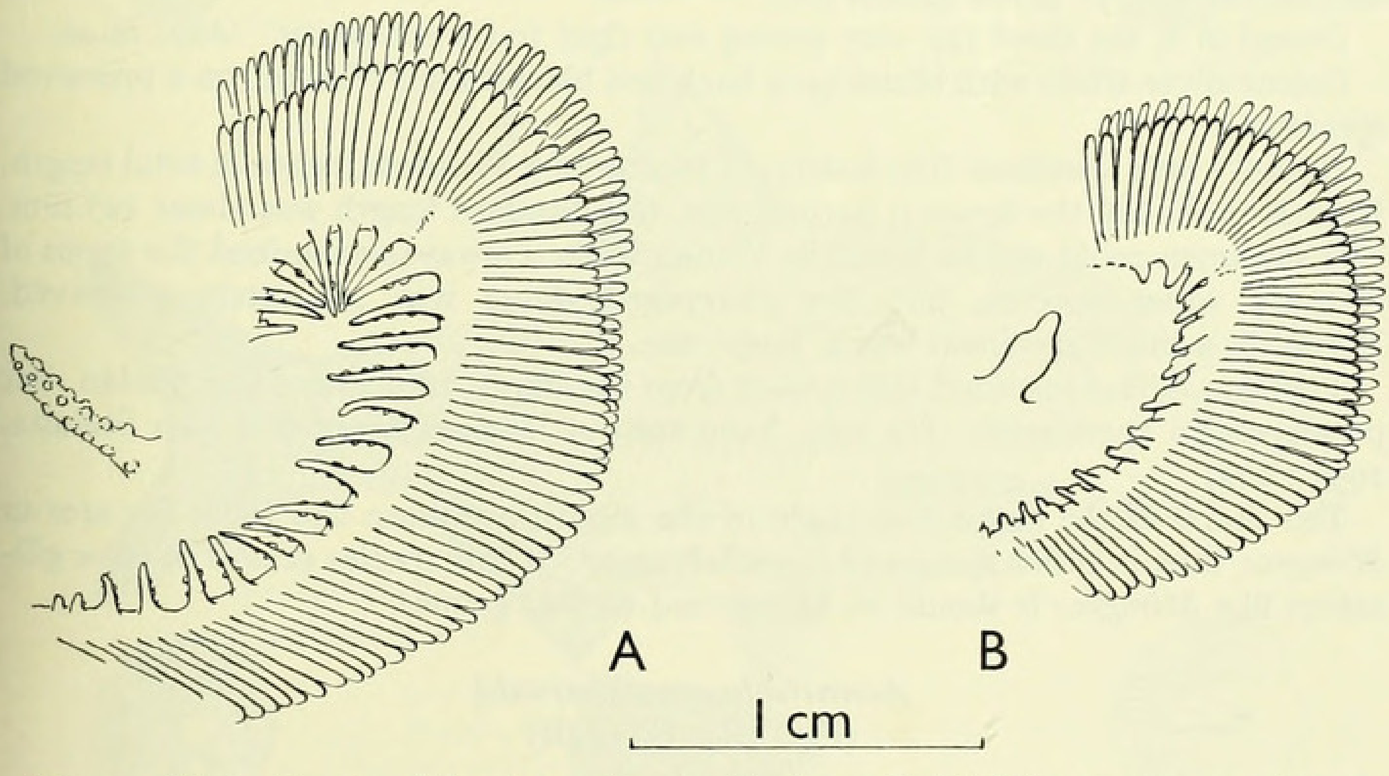

FIG. 1. First gill-arch with outer series of gill-rakers of, (A) *Mirogrex terraesanctae*, a specimen of 143 mm SL from Lake Tiberias; and (B) *Acanthobrama marmid*, a specimen of 116 mm SL from Houreira, Syrian Euphrates. For each a single raker is shown enlarged in oral aspect.

KEY TO THE SPECIES

1	Branched dorsal rays 8, rarely 7 or 9; total anal rays 17–23	2
–	Branched dorsal rays 7, rarely 8; total anal rays 12–16 (17)	3
2	Anal rays 23; scales in l.l.90–100; last simple dorsal ray 27% SL . .	***centisquama***
–	Anal rays 17–22; scales in l.l.54–72; last simple dorsal ray 15–26% SL . .	***marmid***
3	Scales in l.l.59–69; rigid part of stiffened dorsal ray about 70% of whole ray .	***lissneri***
–	Scales in l.l.51–60; rigid part of stiffened dorsal ray 50–65% of whole ray	***telavivensis***

A. centisquama and *A. marmid* reach a larger size (up to 150 mm SL) than any recorded for *A. lissneri* and *A. telavivensis* (up to 113 mm SL).

Acanthobrama centisquama
(Figs 2A and 4A)

Heckel, 1843 : 1074 pl. 9 fig. 1 (Damascus); Tortonese, 1952 : 272 (Amik Göl in the Orontes basin).

Holotype in the Vienna Museum.

The following description is compiled from Heckel's description and figure and Tortonese's brief note.

Depth of body 28·3% of the Standard Length, length of head 23·6%, length of dorsal spine 27% (Heckel, fig.) or more (Tortonese). Pectoral fin extending to above base of pelvic.

Snout projecting slightly beyond the oblique mouth. Diameter of eye 25% of length of head, interorbital width about 31·5%. Pharyngeal teeth 5–5 (fig. 4A).

Scales small, without radii, 90–100 in the lateral line, 20 between origin of dorsal and lateral line, 10 below lateral line.

Dorsal iii 8, the third ray very strong and rigid to its extremity. Anal iii 20.

Colour silver-white with bluish grey back and blackish fins (Heckel, on a preserved specimen).

Heckel's only specimen (the holotype) measured 7 Viennese inches in total length. If, as is probable, the figure is natural size, the standard length was about 127 mm. The specimen could not be found in Vienna when Trewavas examined the types of Heckel's other species, but the pharyngeal bone was separately preserved. Tortonese's single specimen was a 'large' one.

Tristram (1884) recorded this species from the upper affluents of the Jordan, but preserved no specimens. He may have seen *A. lissneri* there (see also Steinitz, 1953 : 225).

The shape of the snout and angle of the mouth are more like these features in *Mirogrex* then in other species of *Acanthobrama*. If this species proves to have gill-rakers like *Mirogrex* it should be transferred to that genus.

Acanthobrama marmid
(Fig. 1B, 2B, 3, 4B)

Heckel, 1843 : 1075, pl. 9, fig. 2 (Aleppo, R. Kueik); Berg, 1949 : 839 (R. Karasu and Lake Balikli, nr. Erzerum); Steinitz, 1952 : 294, fig. 2.

A. arrhada Heckel, 1943 : 1076 (footnote); 1846 : 237, pl. 18, fig. 2 (Tigris at Mosul).

A. cupida Heckel, 1843 : 1077 (footnote); 1846 : 235, pl. 18, fig. (R. Kueik at Aleppo).

A. marmid orontis Berg, 1949 : 839 (R. Orontes).
A. marmid morpha *elata* Berg, 1949 : 839 (Lake Balikli).
Syntypes of *A. marmid, A. arrhada* and *A. cupida* in Vienna (see below, p. 8).
Syntypes of *A. m. orontis* and *A. m.* morpha *elata* in U.S.S.R. (Leningrad?).

Description based on the 43 specimens listed below, namely the syntypes of *A. marmid, A. cupida* and *A. arrhada* and samples from the Shatt-al-Arab, Tigris system, Euphrates system in Syria and the Hatay Province of Turkey; some of

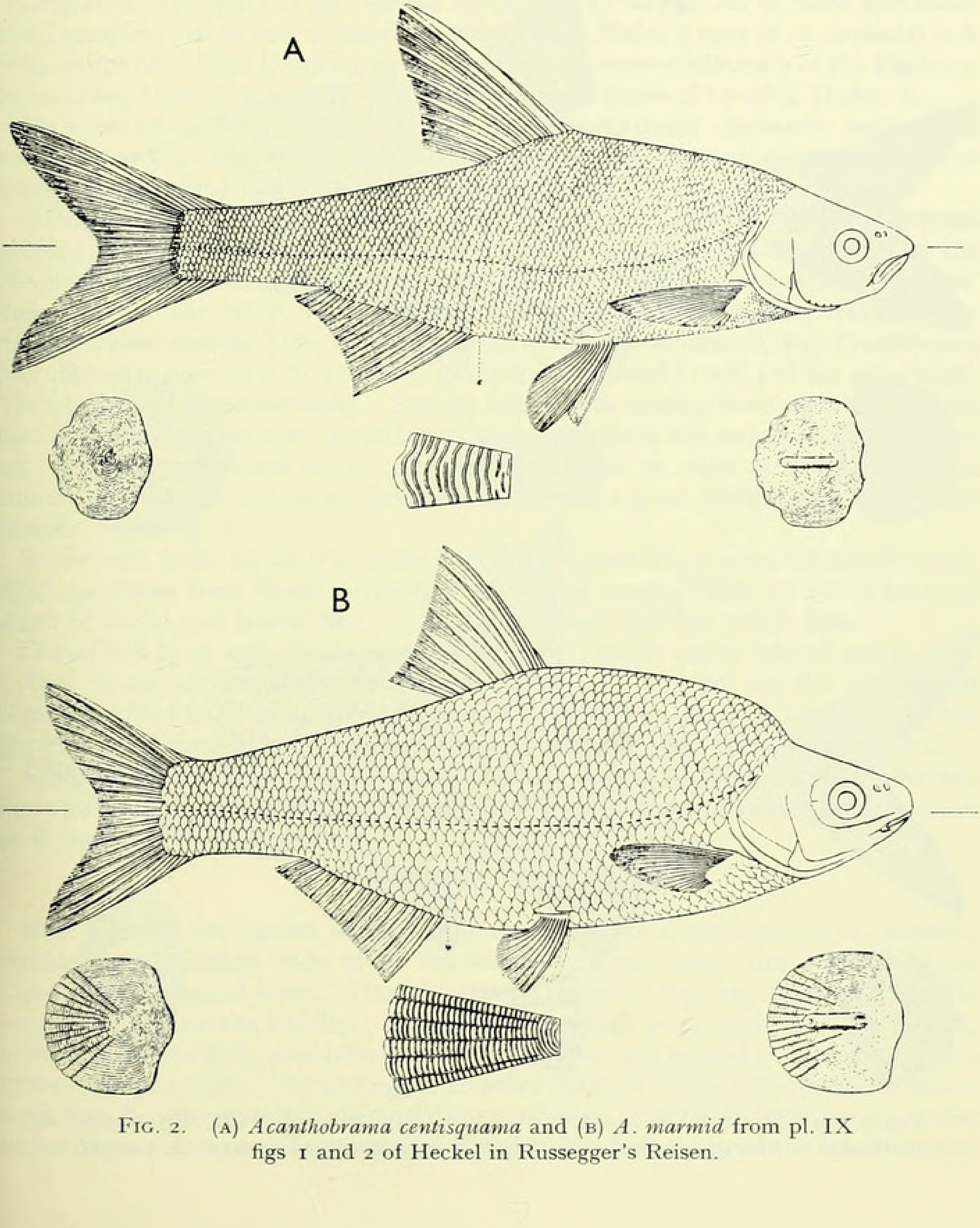

Fig. 2. (a) *Acanthobrama centisquama* and (b) *A. marmid* from pl. IX figs 1 and 2 of Heckel in Russegger's Reisen.

Heckel's types are from R. Kueik, a separate system related to the Euphrates. The description also takes into account Berg's descriptions of samples from the source region of the Euphrates and from the Orontes.

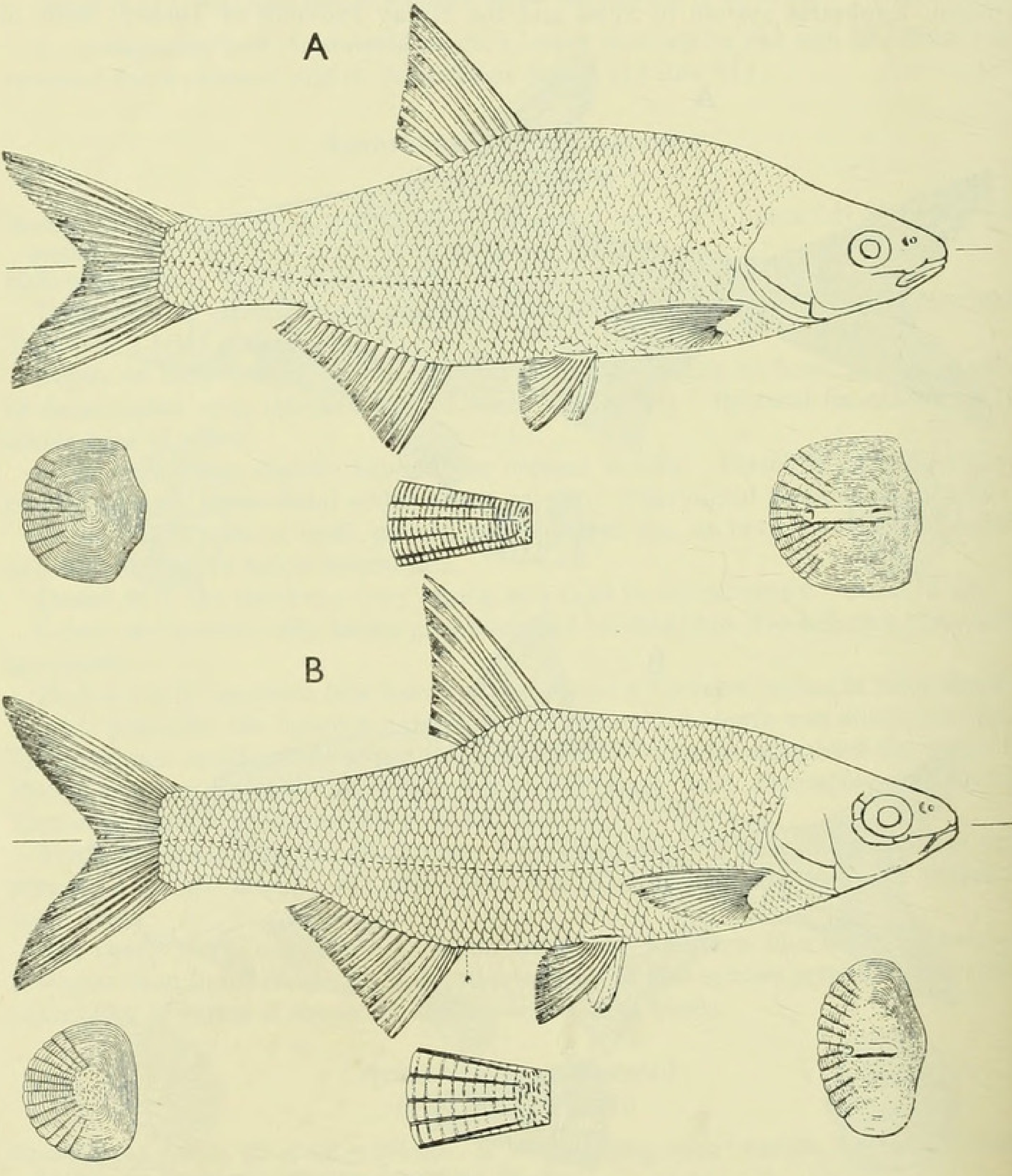

FIG. 3. (A) *Acanthobrama cupida* and (B) *A. arrhada* from pl. XVIII, figs 1 and 2 of Heckel in Russegger's Reisen, both names considered synonyms of *A. marmid*.

Depth of body 26–35% of SL, in none of the Tigris or Shatt-al-Arab specimens exceeding 32%, in none of the Euphrates or Kueik specimens less than 30% (except three young of 44–63 mm SL). Length of caudal peduncle 14·5–20% SL, 1·2–1·8 times its own depth.

Length of head 22·5–27·8% SL; less than 24 only in a few specimens longer than 130 mm SL and in some of the (rather badly preserved) specimens from Basra.

Length of pectoral fin 17–24% SL; fin extending nearly or quite to base of pelvic.

Length of rigid part of last simple dorsal ray 17–22·6% SL in most specimens of all samples; but in one of the 8 specimens from Mosul (types of *A. arrhada*) it is 26%, in one of 10 from Basra 24, in one of 4 from an eastern tributary of the Tigris 25. In contrast, three of 6 from R. Kueik have a short spine of 15–16% (Table 2).

Diameter of eye 23·5–38·5% of length of head, negatively allometric; interorbital width 29–37·5%; length of lower jaw 33–42%. Jaws meeting evenly in front or lower a little behind upper; mouth nearly horizontal.

Gill-rakers in outer series of first arch (2–4) + (0–1) + (9–11), short, with a basal swelling (fig. 1B). Pharyngeal teeth 5–5 in four sets prepared by Heckel in the Vienna Museum, three labelled *A. marmid* and one 'No. 55. *Trachybrama leucopsis*' from Mosul. The latter was evidently a MS name, replaced for publication by *Acanthobrama arrhada* (The name *leucopsis* was never published, but *Trachibrama* (sic) slipped in once on p. 1033 where, as Heckel explained in vol. 3 of the same work, it is a *lapsus* for *Acanthobrama*). One set has a tooth missing from each side, but its base is present on the bone, probably at the stage where the replacement tooth had not yet been ankylosed to it. The anterior tooth on each is compressed and bluntly pointed, the others are bevelled, often with a good cutting edge. (See also Steinitz, 1952, fig. 2).

Scales with radii; 54–69 (72) in the lateral line (excluding 1–3 on the caudal base), eight specimens from Mosul covering most of this range (Table 2); 10–13 between origin of dorsal and lateral line, 4–7 between lateral line and pelvic base.

Dorsal iii 8 in 37 individuals, iii 7 in 1, iii 9 in 1; origin above base of pelvic.

Anal 17–22, of which the first 3 are simple; 19 and 20 are the commonest numbers, found in 18 of 24 Tigris fishes and 14 of 18 from R. Kueik and the Syrian Euphrates. Origin below hind end of base of dorsal or just behind this vertical.

Sexual dimorphism: Heckel's material has not been examined for nuptial tubercles. No tubercles were found in the specimens in B.M.(N.H.), most of which are immature or, if mature, are ♀♀.

Notes on the synonymy

Most authors are agreed in regarding *A. cupida* as a synonym of *A. marmid*, considering the higher body of *A. marmid*, in extreme cases with a hump at the nape, as an ecological form. There is even no evidence that the types of *A. cupida* came from a separate locality. Berg found the high form again in Lake Balikli, considered it probably characteristic of still waters and named it according to his system 'morpha *elata*'. By analogy with other fishes, it seems sounder not to base a name on a feature that may characterize populations or individuals according to the degree of nourishment. Trewavas has tested on Heckel's material the other features

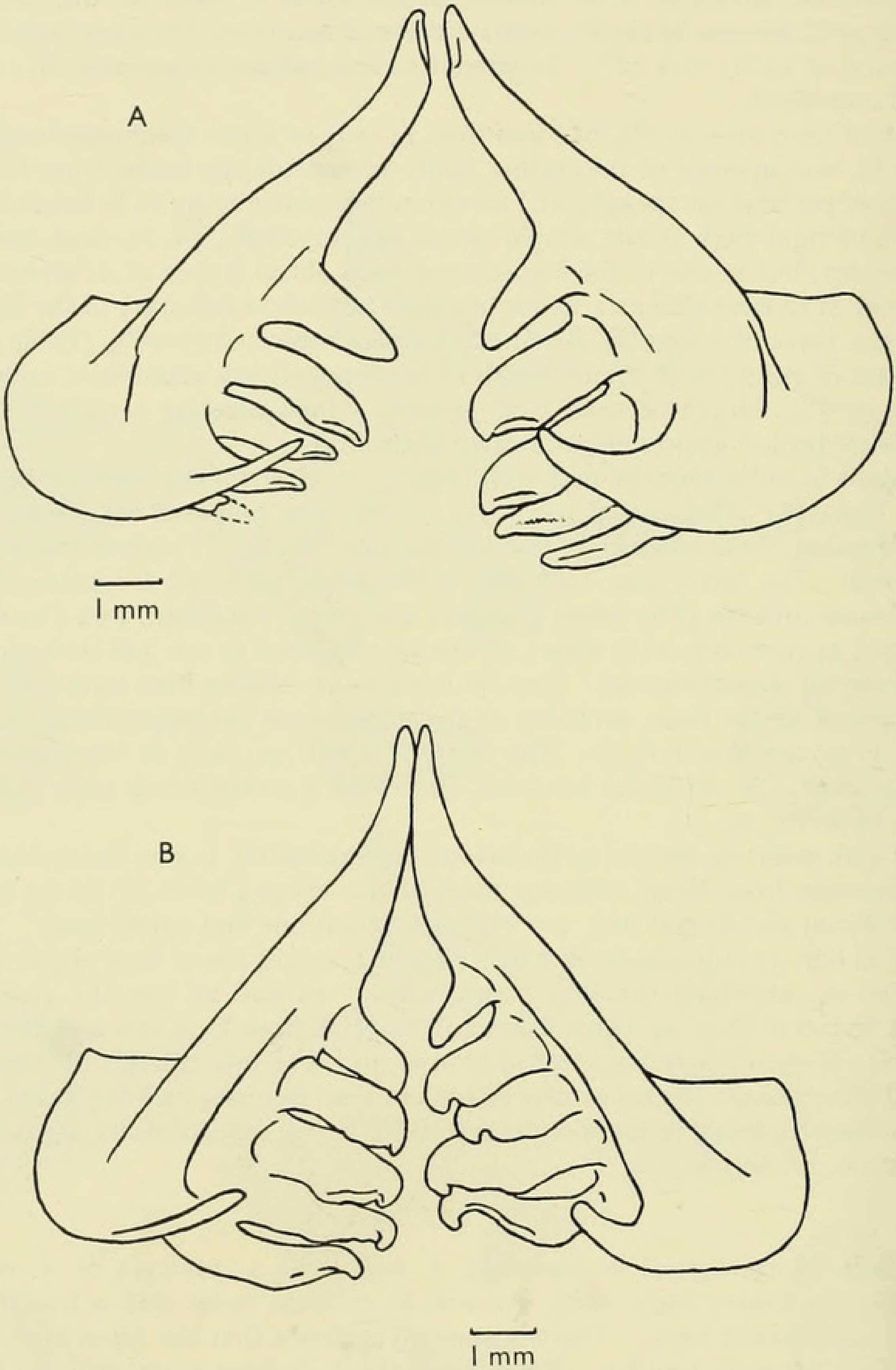

FIG. 4. Pharyngeal bones of, (A) *Acanthobrama centisquama*, a preparation by Heckel in the Vienna Museum; and (B) *A. marmid*, a preparation in the Vienna Museum under the name *'Trachybrama leucopsis'*, a MS name, replaced for publication by *Acanthobrama arrhada*, regarded as a synonym of *A. marmid*.

in which the species were stated to differ and finds that variation, allometric or individual, within the samples disposes of all of them.

A. arrhada was distinguished mainly on its longer, stronger dorsal spine. Table 2 shows that the length is very variable within a population. On the available evidence the highest ranges are found in the Tigris system, the lowest in R. Kueik, but this does not seem sufficient basis for specific or subspecific divisions.

A. m. orontis was established on the basis of two specimens with respectively 54 and 55 scales in the lateral line; but 54 are found not only in this but in 3 from Basra and 1 from an eastern tributary of the Tigris. Berg's specimens from the upper Euphrates region were equally exceptional in the other direction, having a range of 65–72. While it is possible that the upper Euphrates holds a small-scaled population and the Orontes a large-scaled one, the samples are too small to prove this in view of the wide range at Mosul. Parallel local ranges are found in populations of *Varicorhinus damascinus* in the same area (see Kosswig, 1952, fig. 1).

MATERIAL EXAMINED

Museum and reg. no.	No. of specimens	SL (mm)	Locality	Collector or donor
Vienna 55346	2	87,125	R. Kueik at Aleppo	Kotschy
,, 55348 (syntypes of *A. marmid*)	2	114,133	,, ,, ,,	,,
Vienna 55340 (syntype of *A. cupida*)	1	125·5	,, ,, ,,	,,
Vienna 55342 (syntype of *A. cupida*)	1	101·5	,, ,, ,,	,,
Vienna 55334 (syntypes of *A. arrhada*	6	65–146	R. Tigris at Mosul	,,
Vienna 55335 (syntype of *A. arrhada*)	1	151	,, ,, ,,	,,
Vienna 55336 (syntype of *A. arrhada*)	1	145	,, ,, ,,	,,
University of Mosul	1	96	,, ,, ,,	University of Mosul
B.M.(N.H.)				
1920.3.3.147–56	12	69–92	Basra, Shatt-al-Arab	C. Christy
1931.12.21.22–25	4	66–85	R. Tigris at Mosul	Bombay Nat. Hist. Soc.
—	4	50–109	Greater Zab (eastern trib. of Tigris) at Eski Kelek	Government of Iraq
—	1	86	R. Tenjera, trib. of Diyala, Tigris system	,, ,, ,,
1935.9.12.30	1	108	Kara Su, trib. of Euphrates in Hatay Province, Turkey	Bird
1968.12.13.108–112	5	44–111	Quadi Khneizer, Syrian Euphrates system	Beckman
1968.12.13.113–118	6	56–117	Syrian Euphrates at Hooreira	,,

TABLE 2. *A. marmid.* Data on the length of the last simple dorsal ray, expressed as % of SL; and ranges of numbers of scales in the lateral line (l.l) in the same samples. The samples have been divided into size groups and show that the variation does not follow any regular allometric pattern.

Locality	No.	SL (mm)	Whole ray	Rigid part	l.l.
Basra	1	69	29	24	54–60
	7	83–92	22·4–26·0	17·0–18·6	
Trib. Tigris	3	49–64	24–30	18–22	54–64
	1	86	30	25	
Mosul	2	61, 64	21·3, 21·7	—	56–69
	1	96	28	22	
	2	100, 120·5	—	20, 21	
	3	138–146	22·0, 22·6, 30·5	19, 17, 26	
	1	151	—	18·7	
Syrian Euphrates	1	44	31	16	56–66
	4	47–117	26–29·5	18·8–22·6	
R. Kueik	1	87	24·8	18·8	61–67
	5	101–133	19–21	15–18	
R. Orontes (Berg)	2	106, 121	21·5	—	54, 55

Acanthobrama lissneri

(Figs 5, 6A, 8)

Leuciscus zeregi (part. nec Heckel); Günther, 1868 : 220 (Lake Tiberias); Annandale, 1913 : 31 (after Günther).

Alburnus sellal (nec Heckel); Lortet, 1883a : 169 (but not pl. xvi fig. 2, which is probably a true *A. sellal* from the Orontes) (Lake Tiberias); Tristram, 1884 : 176 (record, after Lortet); Barrois, 1894 : 273 (record, after Lortet); Annandale, 1913 : 31 (after Lortet).

Acanthobrama lissneri Tortonese, 1952 : 271 (L. Tiberias).

Holotype, SL 75 mm, and two paratypes, 60 mm and 69 mm, in the Zoological Museum, University of Turin, Italy. A third paratype, SL 67 mm, in B.M.(N.H.) (1951.12.4.1).

DESCRIPTION, based on 25 specimens recently collected in L. Tiberias, on the material listed below in the British Museum (Natural History) and on a specimen of 113 mm SL in Lortet's collection from L. Tiberias, with certain details from his ten smaller specimens (Mus. Lyon 3637) and incorporating details from Tortonese's description of the holotype.

Depth of body 21·5–26·5% SL, length of head 24–28%; length of caudal peduncle 18·5–24·0%, 1·7 to 2·6 times its own depth.

Snout 25·0–30·0% length of head, diameter of eye 27·0–38·0% (negatively allometric), interorbital width 30·0–35·0%, length of lower jaw 36·0–43·0%.

Angle of mouth 20–40° with the horizontal. Gill-rakers on first arch (2–3) + (0–1) + (8–11), but 5 on the upper limb in the largest specimen examined. Pharyngeal teeth 5–5.

Scales 59–69 in the lateral line, 9½–14½, mode 10½, between origin of dorsal and lateral line, 4½–6½, mode 5½, between lateral line and pelvic fin. The scales are thinner than in other species.

Origin of dorsal fin behind vertical of origin of pelvic, but over or just behind pelvic base. Origin of anal at or just behind vertical of posterior end of dorsal base. D ii–iii 7–8 (8 in only one of fourteen counted). Last simple ray (in four in which it is complete) 21–24% SL, its rigid part about 70% of the whole (where both could be measured). Anal of 12–17 rays, two or three of which are simple, the first a mere nodule; modal numbers 14 and 15 with nearly equal frequency (table 3).

Pectoral not extending to origin of pelvic, its length 17–21% SL. Pelvic reaching anal fin.

Vertebrae behind complex 35 or 36 (table 6).

Sexual dimorphism: Among those in the B.M.(N.H.) one ♂ of SL 54 mm and two ♀♀ of 54 and 55·5 mm have gonads starting to swell. In the ♂ there are a few tubercles on the upper sides of the pectoral fins.

All the Tiberias specimens at Lyon assigned by Lortet to *Alburnus sellal* belong to this species, and it was from one of these that he took the uniseriate pharyngeals described. Specimens collected by Chantre in the 'Lac d'Antioche' and determined by Sauvage (Mus. Lyon 3655) (see Sauvage, 1882 and Lortet, 1883b) are true *Alburnus*, with the pharyngeal teeth in two series.

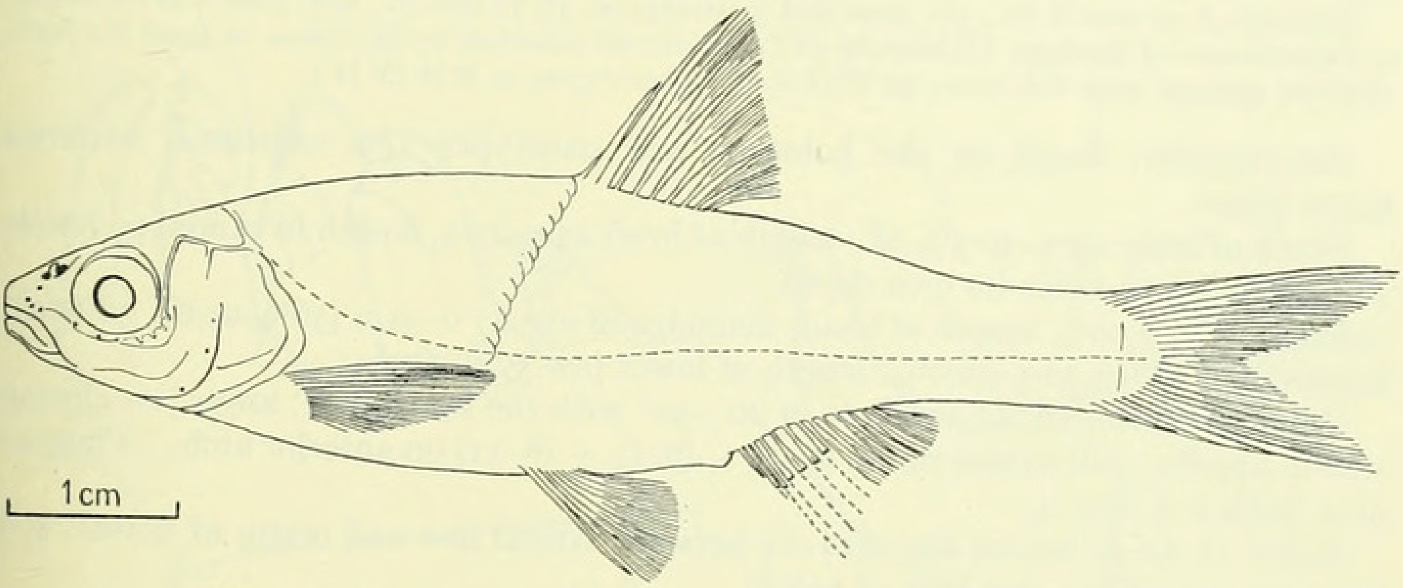

FIG. 5. *Acanthobrama lissneri*, paratype, B.M.(N.H.) 1951.12.4.1.

MATERIAL EXAMINED.

Museum and reg. no. B.M.(N.H.)	SL (mm)	Locality	Collector or donor
1949.9.16.50–54	51–55·5	Samakh, at S. end of L. Tiberias, nr. outflow of R. Jordan	C. K. Ricardo-Bertram
1949.10.10.65–66	42, 53·5	S. of Galilee	Craig-Bennett
1863.11.3.6–7	43·5, 51·5	,, ,,	Beddome
1951.12.4.1. (paratype)	67	L. Tiberias	H. Steinitz coll., E. Tortonese pres.
1968.12.13.119–123	41–47	Springs of Muzerib Nr. Deraa, Syria (Yarmuk system)	W. C. Beckman
Mus. Lyon			
3637 (7 specimens)	55–113	L. Tiberias	Lortet
,, (4 ,,)	62·5–80·5	,,	,,

Museum and reg. no. B.M.(N.H.)	SL (mm)	Locality	Collector or Donor
Tel-Aviv University			
P 3113	50–104	L. Tiberias	M. Goren
P 3016	92–102	Nahal Amud (Jordan drainage)	,,
P 3017	76–92	Beith Netofa	,,
P 3019	36	R. Kini (Kishon drainage)	,,
P 3020	25–50	R. Kishon	,,
P 3022	28–35	Beith Sh'an Valley	,,
P 148	65–75	Hula	?

Acanthobrama telavivensis n. sp.
(Figs 6B, 7, 8)

Rutilus tricolor (nec Lortet)?; Bodenheimer, 1935 : 431.

Holotype ♂ 50 mm in SL, no. 3001 and 3 paratypes, 58–72 mm SL, nos. 3002–4 in collection of Department of Zoology, University of Tel-Aviv; all collected by M. Goren in Rosh Ha'Ayin (Yarkon springs, near Tel-Aviv) 30.VIII.1968; 3 paratypes in B.M.(N.H.).

Description, based on the holotype and paratypes and additional material listed below.

Depth of body 25·5–30·5% SL, length of head 23·0–27·5, length of caudal peduncle 20·0–22·5, 1·5 to twice its own depth.

Snout 24·0–27·0% length of head, diameter of eye 27·0–31·0 (36% at SL 38 mm), interorbital width 32·5–38·0%, length of lower jaw 37·0–41·5.

Mouth subterminal, at an angle of 20°–40° with the horizontal; lower jaw closing within upper. Gill-rakers short, (2–3) + (0–1) + (8–11) on anterior arch. Pharyngeal teeth 5–5 or 5–4.

Scales 51–60 in lateral line, 11½–14 between lateral line and origin of dorsal, 4–7 between lateral line and base of pelvic.

Origin of dorsal behind origin of pelvic and in some behind whole of pelvic base; origin of anal a little behind vertical of posterior end of dorsal base. D ii–iii 7 (f. 11) or iii 8 (f. 2); length of last simple ray 23·0–28·5% SL, of which about 50–65% is rigid, moderately thick. Anal of 14–16 (17) rays, of which the first three are simple, the first a nodule (table 3).

Pectoral fin extending to origin of pelvic or nearly, its length 20·0–21·5% SL. Pelvics not reaching anus in female, extending beyond it in male.

Vertebrae behind complex 32–34, mode 33 (table 6).

Sexual dimorphism: In two ♂♂ of 78 mm from Na'amen there are tubercles on the upper sides of the pectoral fins. Other specimens examined were either female or not caught in breeding condition and had no tubercles.

Colour silvery on flanks, countershaded from grey above to white beneath; a dark longitudinal band from behind head to base of caudal at two thirds height of body.

Size: up to 80 mm SL.

Distribution: Coastal rivers of Israel, except Kishon; abundant in R. Yarkon, but (now) rare in Na'aman, Taninim and Rubin.

Material examined.

Museum and reg. no.	SL (mm)	Locality	Collector
Tel-Aviv University			
P 3001 Holotype	50	Rosh Ha'Ayin Yarkon Springs	M. Goren
P 3002–4 Paratypes	58–72	,,	,,
P 3005–6	15–95	,,	
P 3212	25–65	Nahal Tuth, R. Dalia drainage	,,
B.M.(N.H.)			
1969.11.19.22–24 (formerly Tel-Aviv P 2871–3)	58–68 Paratypes	R. Yarkon	L. Fishelson
1920.12.23.1–2	38, 80	Nahal Rubin	Aharoni
1949.9.16.15–22	60–79	R. Na'aman	C. K. Ricardo-Bertram
Hebrew University, Jerusalem			
3114	63	R. Na'aman	?

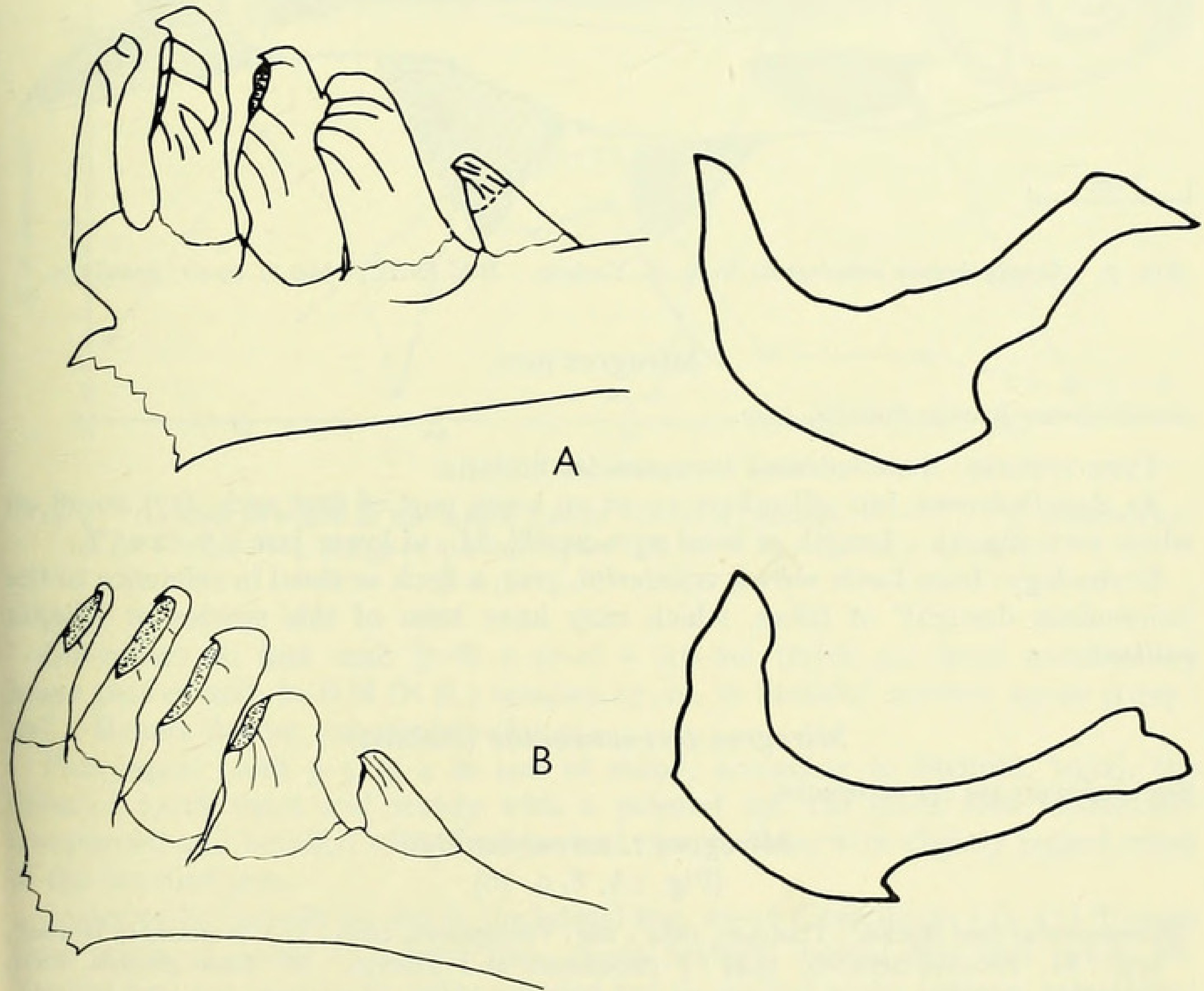

Fig. 6. Pharyngeal teeth and bone of right side in, (A) *Acanthobrama lissneri*; (B) *A. telavivensis*; teeth viewed from the right with flange of bone omitted.

TABLE 3. Frequencies of numbers of anal rays in samples of *Acanthobrama lissneri* and *A. telavivensis* examined by Goren and Trewavas respectively.

	A. lissneri						*A. telavivensis*				
No. of rays	12	13	14	15	16	Mean ± SD	14	15	16	17	Mean ± SD
Goren	1	2	13	12	3	14·4 ± 0·9	2	20	8		15·2 ± 0·5
Trewavas		4	6	8	1	14·3 ± 0·9	3	5	4	1	15·2 ± 0·9
Totals	1	6	19	18	4		5	25	12	1	

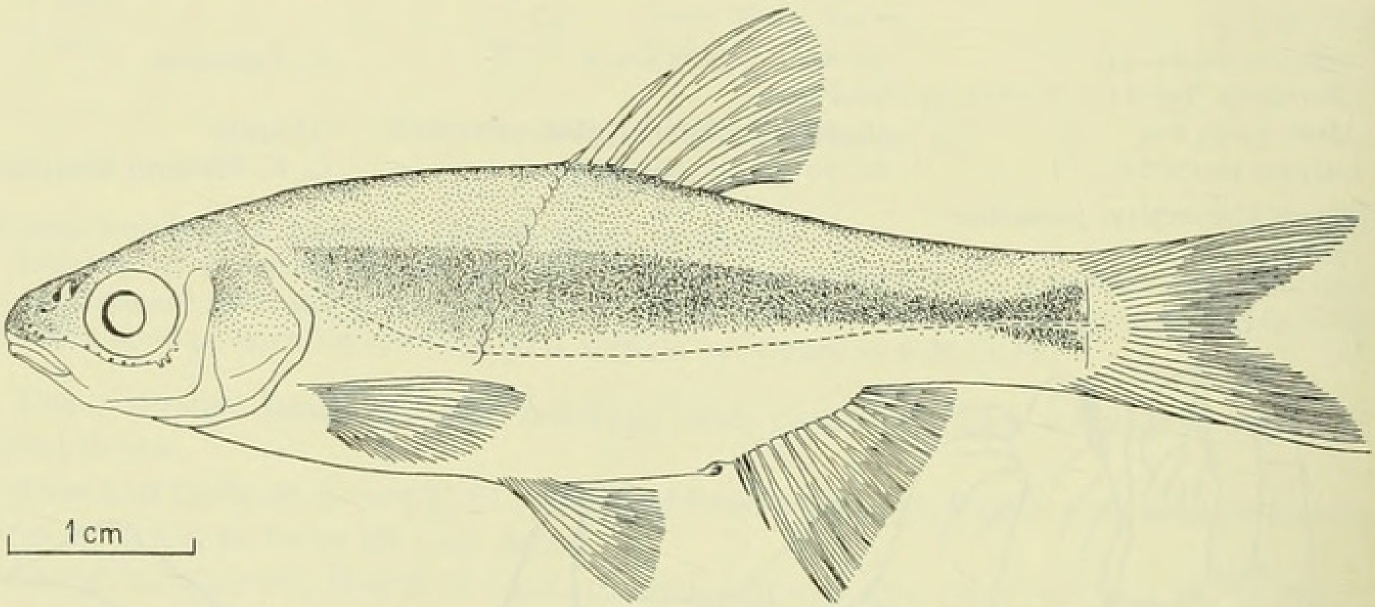

FIG. 7. *Acanthobrama telavivensis* from R. Yarkon. B.M.(N.H.) 1969.11.19.22; paratype.

Mirogrex nov.

Acanthobrama (part.); Steinitz, 1952.

TYPE-SPECIES: *Acanthobrama terraesanctae* Steinitz.

As *Acanthobrama*, but gill-rakers 13–20 on lower part of first arch, (17) 20–28 on whole arch (fig. 1). Length of head 25·0–29·0% SL, of lower jaw 9·5–12·25%.

Etymology: from Latin *mirus*, wonderful, *grex*, a flock or shoal in reference to the 'miraculous draught' of fishes, which may have been of this species or *Tilapia galilaea*.

Mirogrex terraesanctae (Steinitz)

For synonymy see the subspecies.

Mirogrex t. terraesanctae
(Fig. 1A, 8, 9, 10)

Alburnus sellal (nec Heckel); Tristram, 1884 : 167; Vinciguerra, 1926 : 219; Norman in Hornell, 1935 : 82; Ricardo-Bertram, 1944 : 7 (bionomics and fishery). All these records, Lake Tiberias.

Acanthobrama terraesanctae Steinitz, 1952 : 295, fig. 1; 1953 : 212; 1959 : 43–64, figs 1–6, tables i–xvi (bionomics); Komarowsky, 1952 (food).

Holotype: ♂ SL 147 mm, Hebrew Univ. Jerusalem. Cypr. 976. Paratypes: ♂ SL 123 mm, ♀ SL 153 mm, Hebrew Univ. Jerusalem. Cypr. 977 and 978. All collected in Lake Tiberias by Dr Steinitz, 20.III.1950.

DESCRIPTION based on data from Steinitz (1952 and 1959) and on samples in the B.M.(N.H.) collected in 1935, 1938 and 1943 with some meristic data from specimens collected by Goren 1968/9. Proportions are taken from specimens of 95–150 mm SL, meristic characters also from some smaller.

Depth of body 21·5–26·0% of SL, length of head 25·0–29·0, length of pectoral fin 17·0-20·5, length of caudal peduncle 17·5–23·0, 1·7–2·4 times its own depth.

Snout flat or very slightly decurved, its length 26·5–31·5% length of head at SL 70 mm and more. Diameter of eye 31·5% length of head at 70 mm SL to 22% at 150 mm SL; depth of preorbital bone 18–21, interorbital width 29–33, length of lower jaw (36) 38–42. Mouth oblique, with the mental process of the lower jaw slightly projecting; angle of cleft of closed mouth 40–50°.

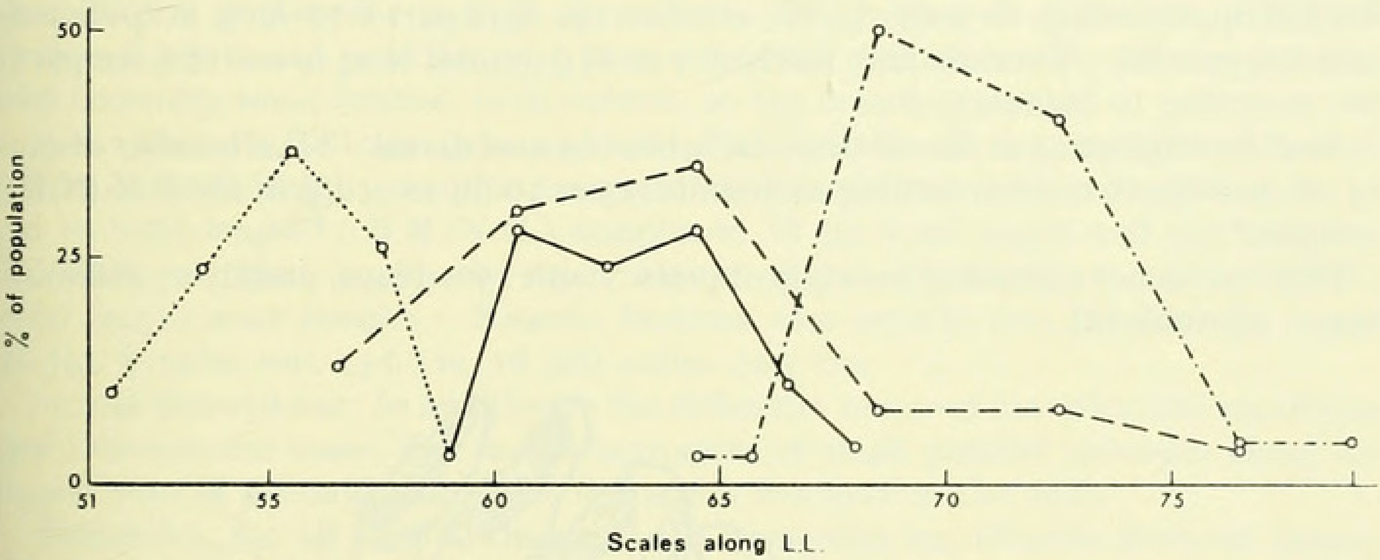

FIG. 8. Number of scales in the lateral line in ——— *A. lissneri*, · · · · · · · · · *A. telavivensis*, —·—·—·— *Mirogrex t. terraesanctae* and — — — — — *M. t. hulensis*.

Gill-rakers on first arch (5–8) + (0–1) + (16–20) (table 4); usual numbers on lower part of arch in B.M.(N.H.) samples 17–19, in Steinitz' account 19–20 (1959 : 57). Rakers slender, tuberculate (fig. 1).

Pharyngeal teeth 5–5 (5–4 in one of many, according to Steinitz, 1952), the anterior tooth short and sturdy with a pointed tip, the other four moderately compressed and bevelled with short hooked tips, in some with slightly jagged edges of the bevelled area.

Scales 55–80 (usually 69–80) in the lateral line, 15–16 (Steinitz) or $13\frac{1}{2}$–$17\frac{1}{2}$ (Goren) from origin of dorsal to lateral line, $4\frac{1}{2}$–$7\frac{1}{2}$ between lateral line and pelvic fin. Ventral keel not prominent, belly rounded but no median scales between pelvics and anus; the two ventral rows of scales may meet or may be separated by a narrow strip of naked skin ('soft keel').

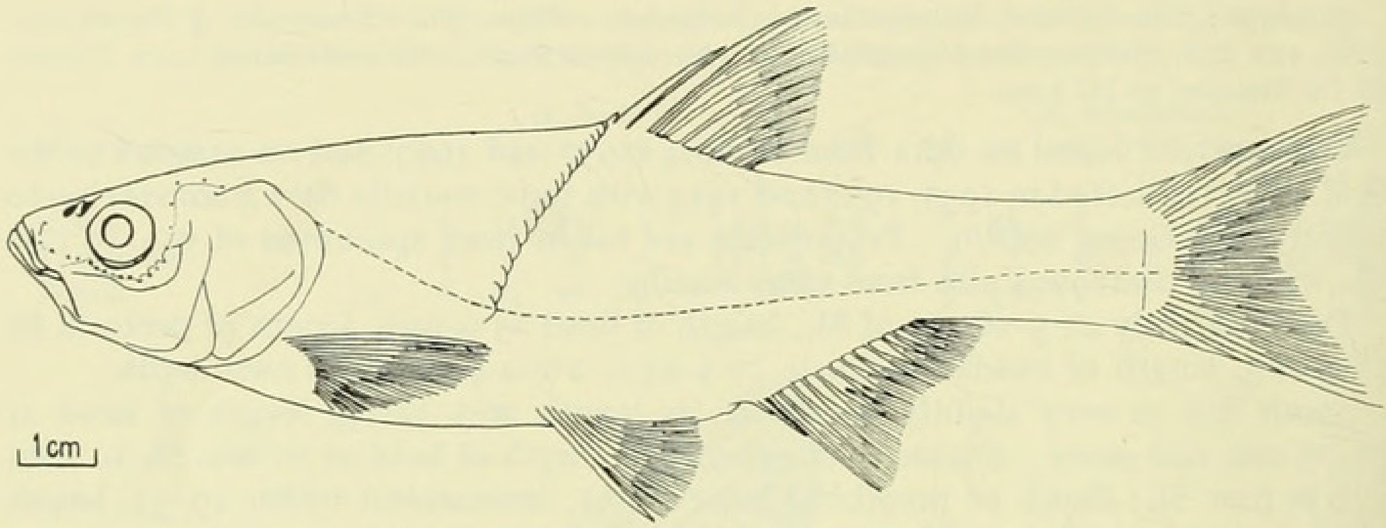

FIG. 9. *Mirogrex terraesanctae terraesanctae*, L. Tiberias.

Dorsal fin originating just behind vertical of anterior end of base of pelvic fin; first ray usually a mere nodule, third with thickened, rigid proximal portion and flexible tip, the whole 18·5–19·0% SL, of which the rigid part is 72–86% in specimens over 100 mm SL. Formula iii 8, rarely iii 7 or iii 9 (a total of 13 in one of a sample of 760 according to Steinitz).

Anal fin originating at the vertical just behind base of dorsal. Total number of rays 14–18, usually 16 or 17 according to Steinitz, 15 or 16 (iii 12 or 13) in the B.M.(N.H.) samples.*

Pectoral fin not extending to origin of pelvic; with 15–19 rays, usually 17 (Steinitz, 1959 : 56, table ix).

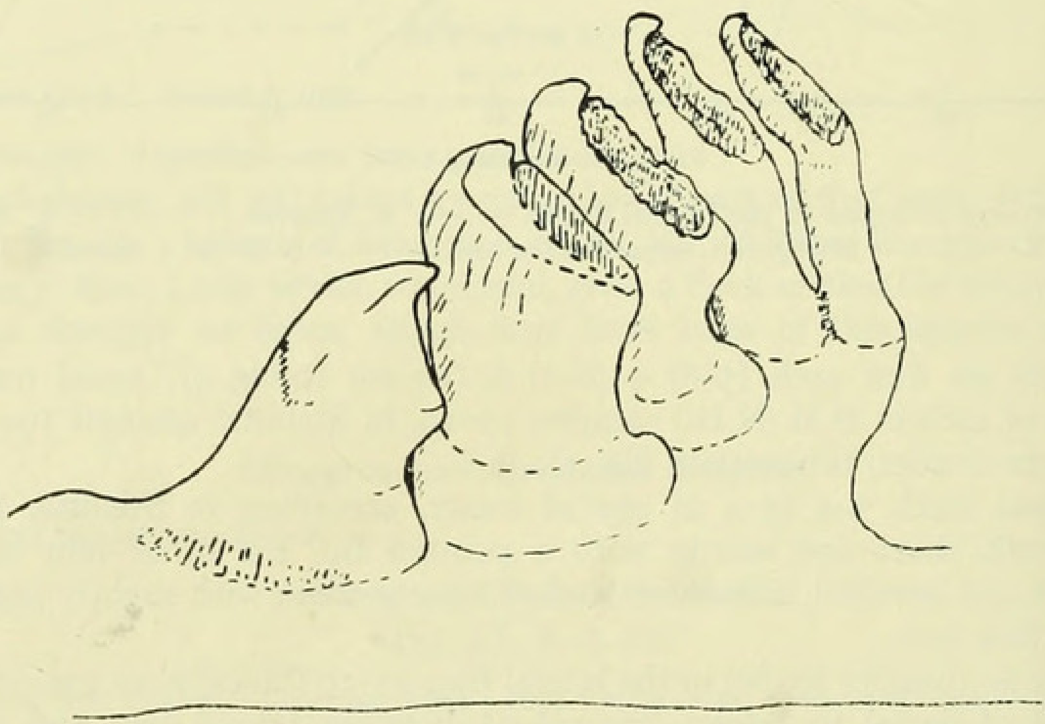

FIG. 10. Pharyngeal teeth of left side from holotype of *M. t. terraesanctae*. From Steinitz, 1952, fig. 1.

* Possibly Steinitz counted the two last, often closely apposed rays separately; see p. 293.

TABLE 4. Frequencies of gill-raker numbers on lower part of anterior arch in *M. t. terraesanctae* and *M. t. hulensis* excluding one at the epi-ceratobranchial joint.

Gill-rakers	13	14	15	16	17	18	19	20
M. t. terraesanctae								
B.M.(N.H.)				3	8	13	8	2
Tel-Aviv			1	7	9	10	3	
M. t. hulensis								
B.M.(N.H.)		1	8	3	1	1		
Tel-Aviv	3	11	8	1				

Pelvic usually not reaching vent; with 8 or 9 rays (Steinitz, 1959 : 56 table x).

Vertebrae, excluding the complex vertebra, 34–37, mode 36 (the figures 39–41, mode 40 quoted from Lissner by Steinitz, 1959, must have counted the complex vertebra as 4 or 3 according as the urophore was counted or not).

Colour: Silvery to steel-blue, with counter-shading; top of head dark grey, a dark blotch on anterior part of operculum; skinny edge of operculum yellowish. Bases of pelvic and anal fins and parts of caudal yellowish, this colour spreading and becoming more intense, even reddish, at the breeding season.

Size: Ricardo Bertram (1944) records that individuals may occasionally reach 20 cm in total length; samples examined by Lissner and Steinitz ranged up to 19 cm in total length*; B.M.(N.H.) samples to 18 cm total length and 150 mm SL. Of these, all that could be sexed above 13 cm (Steinitz) or 14 cm (B.M.) total length were females. Ricardo Bertram also reports that the average length of 791 females was 13·6 cm, of 986 males 10·3 cm.

Sexual dimorphism: In addition to the difference in size of maturity and maximum size between the sexes, ripe males have rows of small pointed tubercles along the upper sides of pectoral and pelvic fins and a few also on the anal.

Bionomics: for all that is known of the bionomics see Ricardo Bertram (1944), Steinitz (1959) and Komarowsky (1952). Briefly, *M. terraesanctae* in L. Tiberias is a pelagic fish, feeding on plankton, mainly zooplankton. The species forms big shoals and migrates to the shallows for spawning from December to the beginning of April.

MATERIAL EXAMINED.

Museum and reg. no.	SL (mm)	Locality	Collector or donor
B.M.(N.H.)			
1935.3.28.3	150	Lake Tiberias	Hornell
1935.11.1.9–10	70, 120	,,	Craig-Bennett
1949.10.10.61–64	135–146	,,	,, ,, (1938)
1949.9.16.23–28	70–115	,,	C. K. Ricardo-Bertram
1949.9.16.29–49	90–152	,,	,,
Tel-Aviv University			
P 3014, 3018	95–120	,,	M. Goren

* Steinitz gives 'total length' for his length classes in tables xv and xvi of 1959, but mentions 'standard length' for the same ranges on p. 61. Probably total length was correct, i.e. including caudal fin with the lobes folded together as usual in fishery research.

Ripe ovarian eggs measure 1·1 to 1·9 mm in diameter and when laid adhere to the pebbles. In adult fish outside the spawning season reserves of fat accumulate among the viscera.

Mirogrex t. hulensis subsp. n.
(Fig. 11)

Alburnus sellal (nec Heckel); Norman & Trewavas in Washbourn & Jones, 1938 : 55 (Lake Huleh).

Holotype of the subspecies: ♀, 158 mm SL collected in the former L. Huleh by R. Washbourn in 1936. B.M.(N.H.) 1936.4.6.20. Paratypes 6 others with same data as holotype, B.M.(N.H.) 1936.4.6.21–26; and 5, 104–205 mm SL collected by M. Goren in Hula Natural Reserve, the part of L. Huleh remaining after drainage of the main part of the lake and swamps. Tel-Aviv University nos. 3007–3010.

Data are taken from the holotype and paratypes, 7 other specimens collected in 1943 by Dr C. K. Ricardo-Bertram and 19 collected by Goren and used for frequencies and means of the contrasting characters.

M. t. hulensis differs from *M. t. terraesanctae* in the deeper body, contrasting in both the greatest depth and the depth of the caudal peduncle; in the lower numbers of gill-rakers; and in having a pharyngeal formula of 5–4 in all specimens examined for this purpose (tables 4 and 5).

The pharyngeal teeth were examined in seven specimens in the B.M.(N.H.) and several in the Tel-Aviv collection. In those (4 examined) collected by Washbourn in 1935 (and others collected by Goren) the shape of the teeth is like that in the nominate subspecies, but in the 3 examined from Dr Ricardo-Bertram's collection of 1943 the anterior tooth or two anterior teeth on each side is (or are) stout and flat-topped (fig. 11).

The differences in the gill-rakers and pharyngeal teeth doubtless reflect a different balance in the food. The former Lake Huleh was shallow with broad swampy areas and abundant stands of emergent vegetation including papyrus, to the submerged stems of which adhered an epiphytic fauna and flora including dense colonies of the gastropods *Melanopsis costata* (Olivier) and *Theodoxis jordani* (Sowerby), as noted by Tristram (1865 : 588). Tristram did not find these molluscs alive in Lake Tiberias, but Bodenheimer (1935) says they occur everywhere in running water, and Barrois lists them as the two commonest species along the shores of Lake Tiberias.

TABLE 5. Contrasting proportions and numbers of scales in lateral line in *M. t. terraesanctae* and *M. t. hulensis* between total lengths of 65 and 225 mm. BD = depth of body, PH = height of caudal peduncle, PL = length of caudal peduncle, all expressed as % SL; l.l. = scales in lateral line.

	M. t. hulensis n = 23		*M. t. terraesanctae* n = 30		t(v) test for level of
	Range	Mean ± SD	Range	Mean ± SD	significance
BD	22·0–33·1	28·4 ± 2·2	18·3–23·8	20·8 ± 2·1	0·5%
PH	3·9–12·3	11·0 ± 1·3	7·6– 9·6	8·7 ± 1·4	0·5%
PL	18·9–24·4	20·6 ± 1·3	18·0–20·7	19·4 ± 1·0	0·5%
l.l.	55–76	64·02 ± 4·81	66–80	70·05 ± 3·06	0·5%

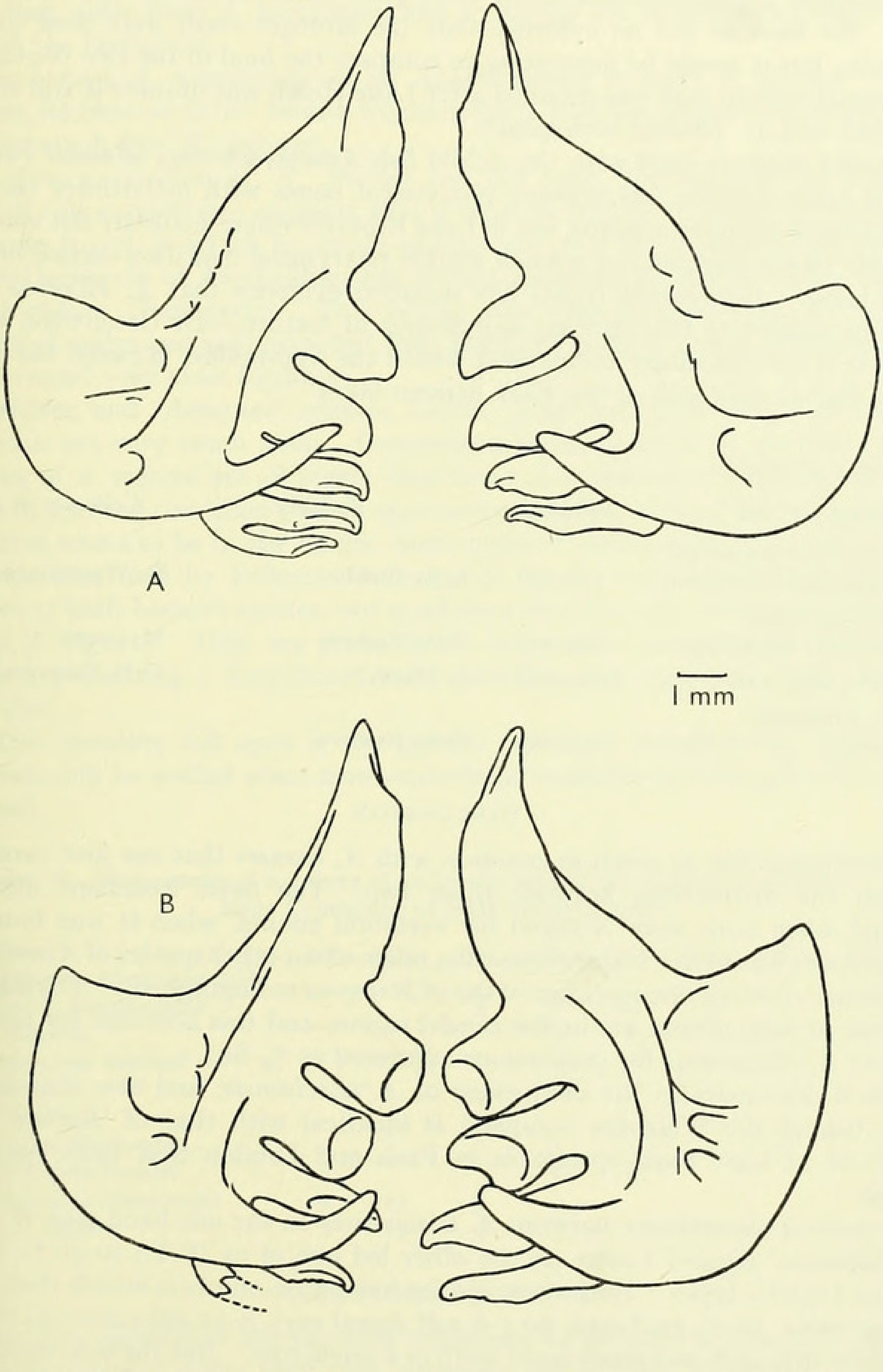

FIG. 11. *Mirogrex t. hulensis*, pharyngeal bones from two individuals collected by, (A) R. Washbourn in 1935; and (B) C. K. Ricardo-Bertram in 1943.

In any case, the two lakes present many contrasts and it is likely that the specialization towards a plankton diet would have gone much farther in Tiberias than in Huleh. We have as yet no evidence that the stronger teeth were used to crush snail shells, but it would be interesting to compare the food of the two populations, for the small reserve that was retained after Lake Huleh was drained is still strongly contrasted with L. Tiberias ecologically.

A parallel suggests itself with the cichlid fish *Astatoreochromis alluaudi* Pellegrin, which in Lake Victoria has massive pharyngeal bones with molariform teeth and subsists largely on aquatic snails, but in Lake Edward, where snails are not abundant, uses softer food-items and has a much weaker pharyngeal dentition carried on much smaller bones. Greenwood (1965) has recorded evidence that *A. alluaudi* is still flexible in respect of this striking morphological feature. Dr Greenwood tells us that there is an even closer comparison within the Cyprinidae, between the populations of *Barbus altianalis* of the East African lakes.

Material examined.

Museum and reg. no.	SL (mm)	Locality	Collector or donor
B.M.(N.H.) 1936.4.6.20–26 Holotype and Paratypes	131–158	Lake Huleh	R. Washbourn
Tel-Aviv University P 3007–3011 Paratypes	104–205	Hula Reserve	M. Goren
B.M.(N.H.) 1949.9.16.1–7	108.5–168	L. Huleh	C. K. Ricardo-Bertram
Tel-Aviv University P 143–145	83–169	Hula Reserve	

DISCUSSION

A. telavivensis has so much in common with *A. lissneri* that our first care was to establish the distinctions between these two. The most trenchant distinction appeared when both were X-rayed for vertebral counts, when it was found that *A. telavivensis* was in this feature below the range of our other species of *Acanthobrama* and *Mirogrex* (except one specimen of the 28 *Mirogrex* radiographed). The additional vertebrae in both genera are in the caudal region, and this accounts for the higher values in *A. telavivensis* for proportions expressed as % SL.

Table 6 demonstrates the uniqueness of *A. telavivensis*, and also that its range (32–34 behind the Weberian complex) is identical with that of '*Rutilus*' *tricolor* Lortet—or at least those specimens in Paris and London that have been radiographed.

The general resemblance between *A. telavivensis* on the one hand and '*R.*' *tricolor* and '*Alburnus*' *vignoni* Lortet on the other led one of us (E.T.) to go to Lyon to examine Lortet's types. Both these species have scale-numbers within the range for *A. telavivensis*, 12–13 anal rays, (6) 7–8 soft dorsal rays, 8–11 gill-rakers on the lower part of the first arch and pharyngeal teeth in a single row. But the last simple dorsal ray is no thicker than the first branched and there is no ventral keel. In most specimens examined there are a few median ventral scales just behind the pelvic base, followed by 4 or 5 paired, which may overlap or may be separated by a narrow strip of skin. They could not be admitted into the genus *Acanthobrama*. Specifically they differ from *A. telavivensis* also in having the mouth at an angle of 40°–50° with the horizontal.

If we accept *A. telavivensis* as an *Acanthobrama* in spite of its low vertebral numbers, its likeness to '*R.*' *tricolor* would indicate that the ancestor of *Acanthobrama* was very much like '*R.*' *tricolor*.

The generic position of '*R.*' *tricolor* has not been determined. Dr Banarescu (personal communication) suggests that it may be related to subgenus *Orthroleucos* Derzhavin (1937), in which he would include not only the type species *R.* (*O.*) *atropatenus* Derzhavin of Azerbaidjan but certain southern European forms, including *R.* (*O.*) *rubilio* (Bonaparte). This brings into consideration species with lower numbers of scales and anal rays, but from them '*R.*' *tricolor* and *A. telavivensis* must have diverged very close together.

R. tricolor and '*Alburnus*' *vignoni* Lortet, both described from the waters of Damascus, are very much alike. Comparison is complicated by the fact that the syntypes of *A. vignoni* are all bigger than those of *R. tricolor*. Allowing for the difference in size and condition (the *A. vignoni* are all plump fishes) the only important distinction seems to be in the longer, more pointed vertical fins of *R. tricolor*. The specimens identified by Pellegrin (1923) as *R. tricolor* cover the size-ranges of the syntypes of both Lortet's species, but at all sizes they have fins of the relative proportions of *A. vignoni*. They are probably all conspecific, the syntypes of *R. tricolor* perhaps representing a long-finned subpopulation, but only more field work can decide this.

Another question left open is the generic status of *Acanthobrama centisquama*, which can only be settled when more material is available and the gill-rakers can be examined.

TABLE 6. Frequencies of numbers of vertebrae behind the complex vertebra in some Cyprinidae of south-western Asia.

	32	33	34	35	36	37	38	39	40
Capoetobrama kuschakewitschi							1		1
Mirogrex t. terraesanctae			1	2	18	1			
M. t. hulensis				5	1				
Acanthobrama marmid									
Basra				1	6				
Mosul						2	2		
Syrian Euphrates				1	1	2	2		
Acanthobrama lissneri				2	8				
Acanthobrama telavivensis	2	12	6						
'*Rutilus*' *tricolor*	1	3	4						

ACKNOWLEDGMENTS

We are very grateful to the following colleagues for giving one of us (E.T.) facilities to examine material under their care, described respectively by Heckel, Lortet and Pellegrin: Dr P. Kähsbauer (Naturhistorisches Museum, Vienna), Dr L. David

(Musée d'Histoire Naturelle, Lyon) and Madame M. L. Bauchot (Museé National d'Histoire Naturelle, Paris).

We were also privileged to receive at the British Museum (Natural History) in 1956 and 1961 material collected in the Tigris basin and presented or lent by the Minister for Agriculture, Iraq, at the relevant times, as well as a collection made in Syria by Dr W. C. Beckman in 1956–8 when he was on a United Nations mission.

Dr P. Banarescu has kindly discussed with one of us (E.T.) the possible generic relationship of *R. tricolor* Lortet.

Goren and Fishelson worked on collections made by Goren during 1968–69 in the lakes and rivers of Israel in connection with wider studies on the populations of freshwater fishes and also had the opportunity, provided by the late Prof. H. Steinitz, of examining material preserved in the Hebrew University of Jerusalem. The junior author (M.G.) wishes to acknowledge his gratitude to Dr Z. Yaron of Tel-Aviv University for his help with advice and material.

A contribution from Tel-Aviv University Funds enabled us to have figs 5, 7 and 9 drawn by Mrs Sharon Chambers.

Vertebral counts were made from radiographs prepared in Tel-Aviv University and the British Museum (Natural History).

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