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Hybrids of *Abramis brama* with *Scardinius erythrophthalmus* and *Rutilus rutilus* from Lake Volvi, Macedonia, Greece

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Two specimens of the hybrid *Abramis brama* × *Scardinius erythrophthalmus* and a single specimen of the hybrid *A. brama* × *Rutilus rutilus* are reported and described from Lake Volvi, Macedonia, Greece. This is the first occurrence of either hybrid in Greek fresh waters.

Key words: *Abramis brama*; *Scardinius erythrophthalmus*; *Rutilus rutilus*; hybrids; Greece.

I. INTRODUCTION

Hybrids between the bream, *Abramis brama* (L.) and both the rudd, *Scardinius erythrophthalmus* (L.), and the roach, *Rutilus rutilus* (L.), have been widely reported in northern Europe (Berg, 1964; Wheeler, 1969). Schwartz (1972, 1981) in his bibliography of reported cases of hybridization in fishes listed 31 references for the *A. brama* × *S. erythrophthalmus* hybrid (and its reciprocal) and 80 references for the *A. brama* × *R. rutilus* hybrid. This suggests that instances of hybridization particularly between the two widespread and abundant species *A. brama* and *R. rutilus* are frequent. All three species are sympatric in the north-eastern parts of Greece (East Macedonia, Thrace) but despite this, and the frequency of hybridization elsewhere, hybrids between these taxa have hitherto not been reported. However, in 1984 and again in 1987 hybrid specimens (at first thought to be *A. brama* × *R. rutilus*) were captured in Lake Volvi. Careful examination of these specimens and comparison with specimens of the three putative parental species has shown that two of them are *A. brama* × *S. erythrophthalmus* hybrids and one is an *A. brama* × *R. rutilus* hybrid. A short description of the critical features of these hybrids is given and comparisons made with the parental species.

II. MATERIAL AND METHODS

Two specimens of *A. brama* × *S. erythrophthalmus* collected, respectively, in November 1984 (S.L. 201 mm) and on 12 August 1987 (S.L. 199 mm), BM(NH) register numbers 1988.11.29.19–20, and one *A. bramis* × *R. rutilus* collected November 1984 (S.L. 148 mm), BM(NH) 1988.11.29.21, all from Lake Volvi, Macedonia. Comparative material: *A. brama* five specimens (S.L. 179–236 mm), BM(NH) 1988.11.29.1–5, *R. rutilus* five specimens (S.L. 142–171 mm), BM(NH) 1988.11.29.6–12, and *S. erythrophthalmus* six specimens (S.L. 129–159 mm), BM(NH) 1988.11.29.13–18, all collected 31 October 1988 from Lake Volvi, Macedonia. All measurements were made using a dial caliper read to the nearest 0·1 mm.

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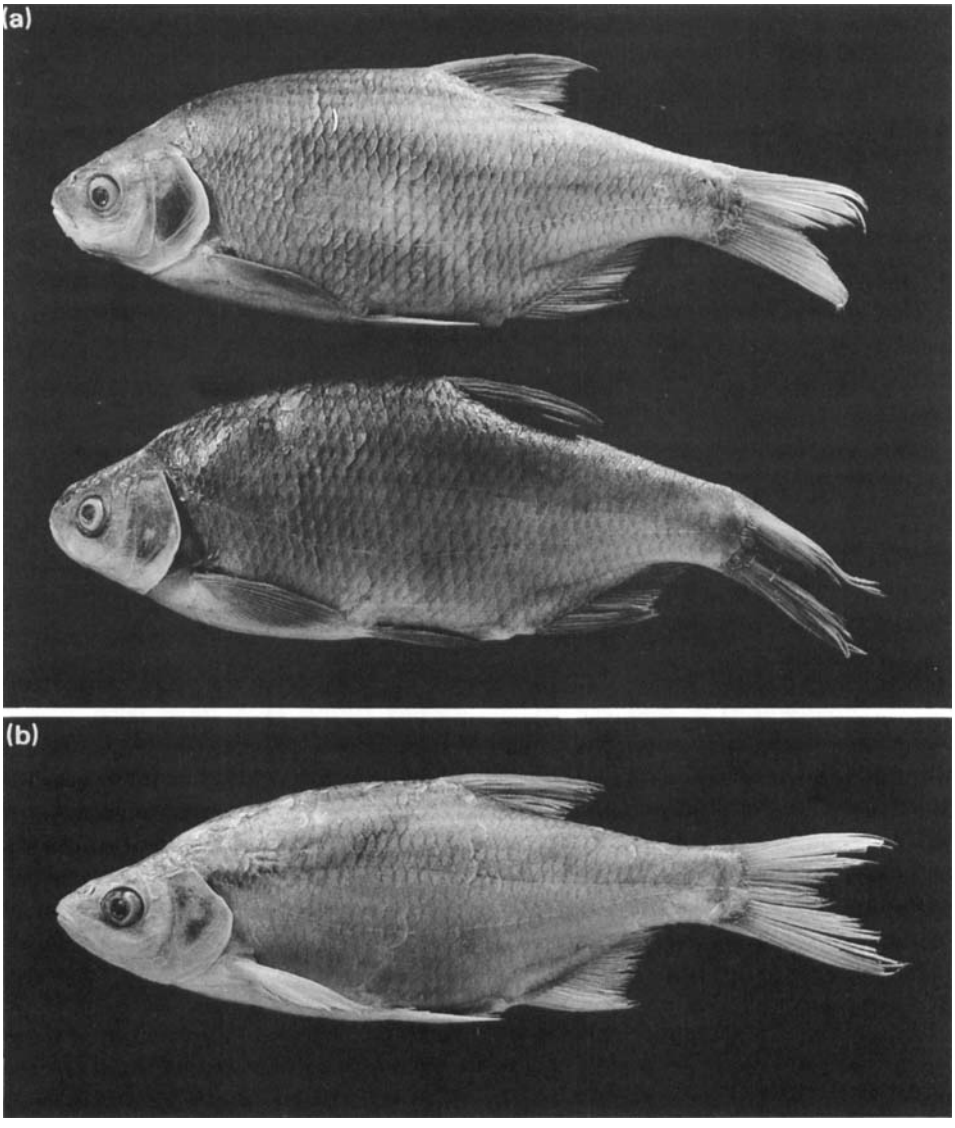

FIG. 1. (a) Two *Abramis brama* × *Scardinius erythrophthalmus* hybrids, 199 and 201 mm S.L. [BM(NH) register numbers 1988.11.29.20. and 1988.11.29.19)]. (b) *Abramis brama* × *Rutilus rutilus* hybrid, 148 mm S.L. [BM(NH) register number 1988.11.29.21]. All from Lake Volvi, Macedonia, Greece.

III. RESULTS AND DISCUSSION

Analysis of eight meristic features and 20 morphometric features shows, as would be expected, that the hybrids are intermediate in most features between their putative parental species.

The most distinctive characters of these three parent species are shown in Table I, with the hybrids inserted between the putative parents. This shows the distinctive features of *A. brama,* notably the characteristic high numbers of anal rays,

TABLE I. Comparison of meristic and morphometric features in *Scardinius erythrophthalmus, Abramis brama, Rutilus rutilus* and hybrid specimens

s.l. (mm)	*S. erythrophthalmus* 129–159				*S.e.* × *A.b.* 199–201		*A. brama* 179–236				*A.b.* × *R.r.* 148	*R. rutilus* 142–171			
	$\bar{x}$	$S\bar{x}$	S	Range			$\bar{x}$	$S\bar{x}$	S	Range		$\bar{x}$	$S\bar{x}$	S	Range
D. rays	8·2 ± 0·17		0·41	8–9	8	8	8·6 ± 0·25		0·55	8–9	8	9·6 ± 0·25		0·55	9–10
A. rays	11·0 ± 0·00		–	11	16	17	24·0 ± 0·32		0·71	23–25	15	10·8 ± 0·20		0·45	10–11
Lateral line	39·8 ± 0·70		1·72	38–42	48	48	56·3 ± 0·43		0·96	55–57	48	42·6 ± 0·40		0·89	42–44
Gill rakers	12·3 ± 0·21		0·52	12–13	20	18	27·4 ± 0·25		0·55	27–28	18	16·2 ± 0·38		0·84	16–17
Vertebrae	22 + 15, 37	23 + 16, 39	22 + 15 37		23 + 19, 42	22 + 19 41	23 + 21, 44	22 + 22 44			22 + 19 41	23 + 17, 40	22 + 18, 40	22 + 16 38	
Pharyngeal teeth	5.3/3.5,		5.2/2.5		6.1/2.5,	5.2/2.5	5/5	5/5			5/5	5/6	5/6	5/6	
% of s.l.															
Body depth	36·5 ± 0·58		1·42	34·9–38·3	38·7	38·4	34·1 ± 0·35		0·79	33·2–35·2	35·7	32·5 ± 0·43		0·97	31·6–33·7
Head depth	20·8 ± 0·17		0·41	20·0–21·1	21·0	21·9	21·2 ± 0·25		0·55	20·7–22·1	19·6	18·5 ± 0·12		0·26	18·1–18·8
Predorsal length	59·9 ± 0·41		1·00	58·2–61·2	60·9	59·0	60·1 ± 0·52		1·16	58·7–61·5	58·9	55·3 ± 0·25		0·55	54·8–56·2
Anal fin length	14·7 ± 0·29		0·71	14·0–15·5	20·8	19·5	26·9 ± 0·34		0·77	25·8–27·7	19·2	12·4 ± 0·53		1·19	10·8–14·0

lateral line scales, gill rakers on the first arch, and vertebrae, among meristic features. In morphometric features, only the depth of the head is notable, because the depth of the body (normally a striking feature in large specimens) has not developed in these small fishes. The predorsal length ($\bar{x}$ 60·1) is notable in comparison with *R. rutilus* ($\bar{x}$ 55·3) but is virtually the same as in *S. erythrophthalmus* ($\bar{x}$ 59·9). This is a reflection of the posteriorly positioned dorsal fin in both *A. brama* and *S. erythrophthalmus*. The characteristic features of *A. brama* are clearly reflected in the numbers of anal rays, scales, gill rakers, and vertebrae in all three hybrids.

Establishing the identity of the second parent is difficult due to the similarity between *S. erythrophthalmus* and *R. rutilus*. The meristic features given in Table I show that only the number of gill rakers and number of rows of pharyngeal teeth are clear-cut, although there is only a small overlap in the number of lateral line scales in the two species. For morphometric features, depth of body and depth of head are diagnostic, both reflecting the deeper body relative to length in *S. erythrophthalmus*. The posterior position of the dorsal fin in *S. erythrophthalmus* (compared to that in *R. rutilus*) is also demonstrated by the figures in the table.

Comparison of the figures for the hybrids in Table I shows that only one meristic feature (the number of pharyngeal teeth rows) and one morphometric feature (depth of head relative to the body length) are of value in establishing the identity of the second parent species. The latter feature suggests that head depth in *S. erythrophthalmus* ($\bar{x}$ 20·8) and *A. brama* ($\bar{x}$ 21·2) are more likely to result in hybrids with 21·0 and 21·9, respectively, while *A. brama* and *R. rutilus* ($\bar{x}$ 18·5) might be expected to produce the figure of 19·6 in a hybrid. This, however, is subjective and is not conclusive proof of the identity of the second parent. The number of rows of pharyngeal teeth offers an objective feature: *S. erythrophthalmus* has two rows of pharyngeal teeth, 5 in the outer row and 2 or 3 in the inner row in the comparative material, although Wheeler (1976) found 5.3 to be standard in a sample of 45 specimens from the British Isles; *R. rutilus* has only a single row of teeth, usually 5 teeth on the right bone and 6 on the left (the Greek comparative material also has 5 and 6 teeth as above); *A. brama* has a single row of 5 teeth each side. Because of these differences in numbers we feel confident in postulating that the two hybrids (199 and 201 mm S.L.), which both have second rows of teeth, are *A. brama* × *S. erythrophthalmus*; the third specimen (148 mm S.L.), which has a single row each side, we believe to be an *A. brama* × *R. rutilus* hybrid.

These decisions are confirmed by the degree of crenelation of the teeth in the hybrids. Of the parental species, *S. erythrophthalmus* has very strongly crenelate pharyngeal teeth with recurved tips in all but the smallest tooth of the outer row. Both *R. rutilus* and *A. brama* have smooth cutting edges to the teeth; only in newly attached teeth are there crenelations in the former species. In the hybrids, the smallest specimen (S.L. 148 mm) has only slightly crenelate teeth, whereas both the large specimens (S.L. 201, 199 mm) have major teeth strongly crenelate with hooked tips.

There are also minor differences in body pigmentation and head shape that support these identifications. Pigmentation of the anal fin and pelvic fins is pronounced in *A. brama*, with the melanophores closely concentrated. In *S. erythrophthalmus* there is concentration of melanophores only at the base of the anal fin on the inter-radial membrane. *R. rutilus* appears to have no melanophores in this

area. In the hybrids the two large specimens are pigmented at the anal base, the third specimen (S.L. 148 mm) is not so. The angle of the snout is more pointed in *R. rutilus* than in *S. erythrophthalmus* and *A. brama*. This difference appears to be observable in the hybrid *A. brama* × *R. rutilus* which has a distinctly pointed snout, but attempts to quantify the angle have not been successful.

All three hybrid specimens have a pronounced keel between the pelvic fin bases and the vent. This is evidence only for the parentage of *A. brama* which has a very acute keel, while that on the underside of *S. erythrophthalmus* is pronounced (in contrast to the rounded ventral region of *R. rutilus*). There seems to be little difference in this feature between the hybrids to confirm their parentage.

Among cyprinids, hybridization is more common in lakes than in rivers and has been attributed, when extensive, to changes in the habitat or within the population of fishes. High levels of hybridization sometimes follow the introduction of a closely related species to an existing population. Hybrids may also be produced in numbers following major disturbance to the habitat (e.g., fluctuating water levels, dredging, vegetation clearance). In the case of Lake Volvi it is difficult to suggest any causative factors. All three parent species are autochthonous and no major environmental changes have occurred in the lake. The only factor which might have affected these species is the lowering of water levels due to the severe droughts which have occurred in Greece in recent years.

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