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A comparison of Blennius ocellaris L. 1758, B. riodourensis Metzelaar 1919, and B. normani Poll 1949

(Pisces, Blenniidae)

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Abstract

154 specimens of *Blennius ocellaris*, 63 specimens of *B. normani*, and the only known specimen of *B. riodourensis* were compared in morphological and anatomical features. All three species were found to be valid ones. *B. normani* differs from *B. ocellaris* in having unbranched supraorbital tentacles and having a broader isthmus. There are additional, but not absolutely reliable differences between the two species in the presence or absence of small skin flaps below the dorsal fin, the colour of the head, and the number of dorsal fin spines elongated beyond the fin membrane. *B. riodourensis* differs from *B. ocellaris* and *B. normani* in having a lower first dorsal fin without an eyespot and without elongated spines, in having 16 rays in the second dorsal fin (versus 13–15 in the other two species) and in having 11 segmented caudal rays (versus 13 in the other two species). – Differences between Atlantic and Mediterranean specimens of *B. ocellaris* indicate a reduced gene flow between the two populations: Atlantic specimens have lower first dorsal fins, a longer lateral line, and frequently a different colour pattern. We refrain from naming two subspecies because of a very large variability in both populations. – Glandular thickening of the tips of the dorsal fin rays of male *B. ocellaris* and *B. normani* is described for the first time. In *B. ocellaris* and *B. normani*, males have significantly longer supra-orbital tentacles than do females. – The known range of *B. ocellaris* extends from eastern Ireland to northern Morocco in the Atlantic and encompasses the Mediterranean and the Black Sea. *B. normani* occurs at the Westafrican coast from northern Mauretania south to Angola. The only known specimen of *B. riodourensis* was found between the southern limit of *B. ocellaris* and the northern limit of *B. normani*.

Introduction

The butterfly blenny *Blennius ocellaris* (figure 2) was described by Linné in 1758. The species occurs in the Mediterranean and the Black Sea, and in the Eastern Atlantic from the British Isles to Morocco (Bath 1973). In 1949, Poll described an additional species, *B. normani*, which closely resembles *B. ocellaris*. This species was described from only three specimens taken at the mouth of the river Con-

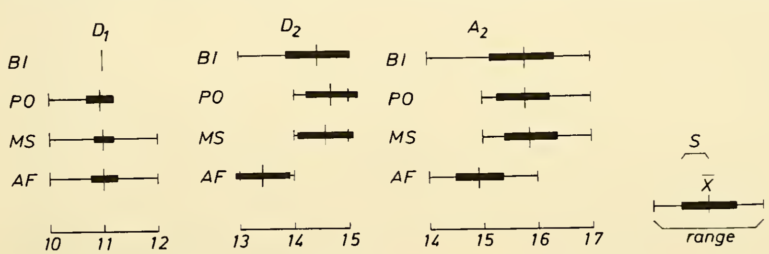


Fig. 1: Fin ray counts; mean (x̄), standard deviation (s), and range.

go. In the meantime additional specimens have been found more and more north of the type locality and the northernmost record of *B. normani* now is off Mauretania (Lloris & Rucabado 1979).

According to Poll's original description, *B. ocellaris* and *B. normani* differ in the shape of the supraorbital tentacles: simple, threadlike and short in *B. normani,* broad, flattened, comparatively long and bearing numerous branches in *B. ocellaris.* A specimen of *B. normani* from the Ivory coast, however, had supraorbital tentacles which were broad and flat, but did lack side branches (Wirtz 1980). The small skin flaps below the first spine of the dorsal fin which are typical for *B. ocellaris,* are lacking in *B. normani* according to the original description. However, both Bath (1977) and Wirtz (1980) found specimens of *B. normani* that had a skin flap on one or both sides of the body. Such specimens of *B. normani* which do not quite agree with the original description have lead to the suggestion that *ocellaris* and *normani* could overlap in distribution and interbreed; in this case *normani* would be a subspecies of *ocellaris* (Wirtz 1980). If this suggestion is correct there must be an area somewhere between the Ivory Coast and Morocco where specimens of intermediate character states are more common than north or south of it.

The third species in the genus, *Blennius riodourensis* Metzelaar, 1919 is known from only a single specimen from Rio d'Ouro (Spanish Sahara, now annexed by Morocco). This specimen is only 5 cm long and we had the suspicion that it could simply be a juvenile of *B. ocellaris.* Specimens of *B. ocellaris* of such a small size had not yet been described in the literature.

In Bath's (1977, 1982) revision of the Blenniini most species formerly called „*Blennius*" have been assigned to different genera. The genus *Blennius* now contains only the species *ocellaris* Linné, 1758, *riodourensis* Metzelaar, 1919, and *normani* Poll, 1949. Within the Blenniini, the genus *Blennius* has a very isolated position (Smith-Vaniz 1976, Bath 1977).

In a morphological and anatomical comparison of all specimens of *B.normani* and *B. riodourensis* we could obtain with a large number of *B. ocellaris,* we aimed to clarify the status of the species.

Material and Methods

1. Material

Thanks to the kind cooperation of many curators of fish collections we had available 218 specimens of the three species.:

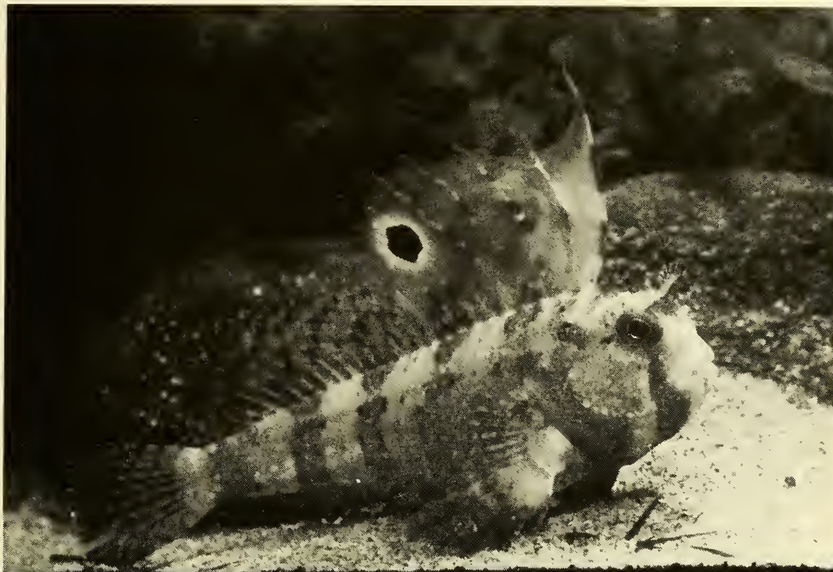
Blennius ocellaris:	British Isles:	25
	Portugal:	38
	Mediterranean Sea:	91
	total:	154
Blennius normani:		63
Blennius riodourensis:		1

The material of *B. ocellaris* was split into three regional sub-samples to detect possible geographic variation. "British Isles": Atlantic coast from northern latitude 48° to 55°, "Portugal": Atlantic coast of Portugal and Morocco, and "Mediterranean Sea".

The material belongs to the following collections:

ANSP Academy of Natural Sciences, Philadelphia – BMNH British Museum (Natural History), London – CAS California Academy of Sciences, San Francisco – HUJF Hebrew University, Jerusalem – IFAN Institut Français

Fig. 2: *Blennius ocellaris,* live animal from the Mediterranean Sea (PW 239; SL 8.2 cm); Fig. 3: Mediterranean specimen of *B. ocellaris* (USNM 48387/2; SL 12.7 cm); Fig. 4: Atlantic specimen of *B. ocellaris* (BMNH 1962.7.30.662; SL 8.7 cm).



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D'Afrique Noire, Ile de Gorée, Senegal – ISH Institut für Seefischerei, Hamburg – ISNB Institut Royal des Sciences Naturelles de Belgique, Brussels – ISTPM Institut Scientifique et Technique des Pêches Maritimes, La Rochelle – MB Museu Bocage, Lisbon – MK Museum A. KÖNIG, Bonn – MNHN Muséum National D'Histoire Naturelle, Paris – MSNG Museo Civico Di Storia Naturale, Geneva – MZDS Museo Zoologico Della Specola, Florence – PW Private collection P. Wirtz – SB Private collection H. Bath – SU Stanford University Collections (CAS), San Francisco – USNM United States National Museum (Smithsonian Institution) Washington, D. C. – ZMA Zoölogisch Museum, Universiteit van Amsterdam – ZMB Zoological Museum, University of Bergen – ZMH Zoologisches Museum, Hamburg – ZSM Zoologische Staatssammlung, München

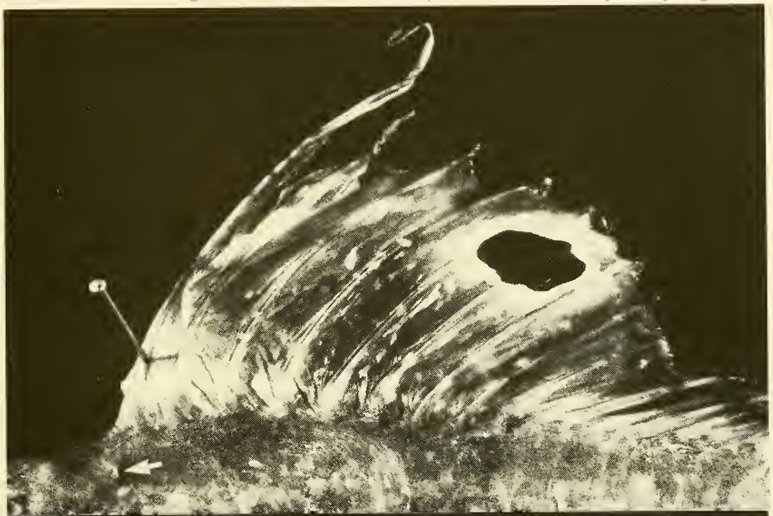
A "+" in the following list indicates specimens which were used for the osteological (x-ray) comparison.

Blennius ocellaris L., 1758

Registration Number	Locality	number of specimens
British Isles:		
ISH 3356/79	Little Sole Bank	1^{+}
BMNH 1889.2.1.4618–4619	Guernsey	2
ISH 37/59	Le Havre, France	1
BMNH 1933.3.8.251–255	Plymouth, England	5
ISNB 2644	Wolf Rock, England	1
ISTPM D 608	Cardigan Bay, Wales	1
PW 176	Red Wharf Bay, Wales	1
BMNH 1962.7.30.656, 657, 659, 660, 662	Isle of Man	5^{++}
BMNH 1912.12.30.155–157	Ireland	3
PW 387, 388/1–4	Galway Bay, Ireland	5^{++}
Portugal:		
USNM 205157	West of Strait of Gibraltar	3^{+}
MNHN 87–165, 166	Portimao, Algarve	2
BMNH 1971.7.21.178	Sezimbra Bay	1
ISTPM T 414	north of Lisbon	1^{+}
ZMA 113.484	north of Coimbra	1^{+}
MB 2547	Portugal [1])	1
MB 2548	Portugal	1
MB 2549-A-B	Portugal	2
MB 2550	Portugal	1
MB 2551-A-B	Portugal	2
MB 2552	Portugal	1
MB 2553-A-B-C-D	Portugal	4
MB 2554	Portugal	1^{+}
MB 2555-A-B-C	Portugal	3
MB 2556-A-B	Portugal	2
MB 2593-A-B-C	Portugal	3
MB 2594-A-B-C	Portugal	3
MB 2595-A-B-C-D-E	Portugal	5
MB 2596	Portugal	1^{+}

[1]) All specimens for which the locality "Portugal" is given are from two undefined places north of Lisbon and off the Algarve coast.

Fig. 5: First dorsal fin of a mediterranean *B. ocellaris* (SU 1684/9; SL 12.4 cm); arrow indicates skin flap on the nape; Fig. 6: First dorsal fin of a *B. normani* (MNHN 1966–40/3; SL 8.6 cm); first ray broken; Fig. 7: Strongly spotted head of a *B. ocellaris* from Plymouth (BMNH 1933.3.8.253/3).



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Mediterranean Sea:

BMNH 1970.12.2.97–103	Bahia Malaga, Spain	7^+
ZSM 19472	Banyuls, France	5^+
BMNH 1976.7.30.229.231	Banyuls, France	3
PW 239, 256	Banyuls, France	2
MK I/1878/162–164	Menton, France	3
MSNG 6816	Gulf of Geneva	7^+
USNM 48387	Gulf of Naples	4^+
SU 20895	Gulf of Naples	3^+
ZMH 17984	Gulf of Naples	1
MZDS 3516	Island Lipari, Sicily	1
SU 1583	Palermo, Sicily	1
SU 1737	Palermo, Sicily	1
USNM 213737	Gulf of Tunis	2^+
USNM 213747	Gulf of Tunis	3^+
MZDS 3992–3994	Bari, Italy	3
SU 1684	Venice	6^+
CAS 52239	Venice	2
CAS 52240–52242	Venice	3
PW 144	Piran, Istria, Jugoslavia	1
ZMH 702	Mljet, Jugoslavia	1
ZSM 23536	Naxos, Greece	3^+
HUJF 7505	Haifa, Israel	2^+
HUJF 10942	Tel-Aviv, Israel	3
HUJF 7690	Ashdod, Israel	1
HUJF 7886	Ashkelon, Israel	4^+
SB (12. 4. 77)	Alexandria, Egypt	5^{+++++}
SB (8. 5. 79)	Alexandria, Egypt	1^+
HUJF 7511	Mediterranean Sea	1
ANSP 10473–10484	Mediterranean Sea	12

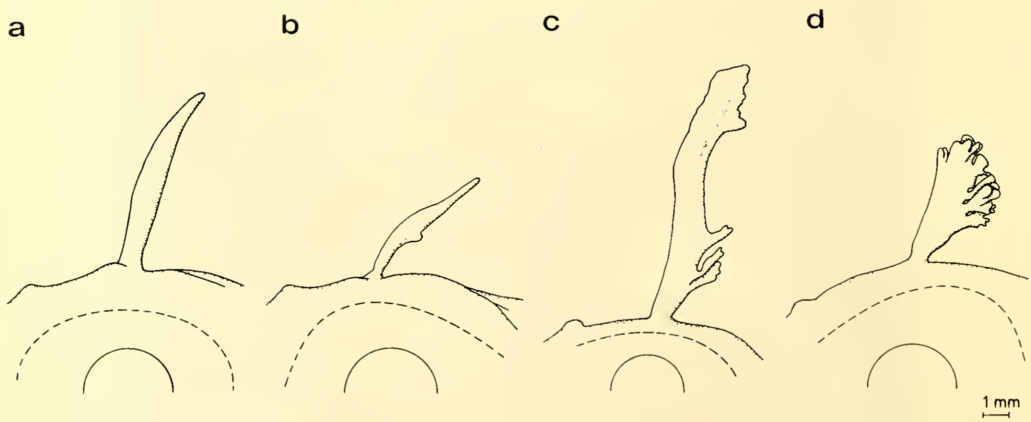
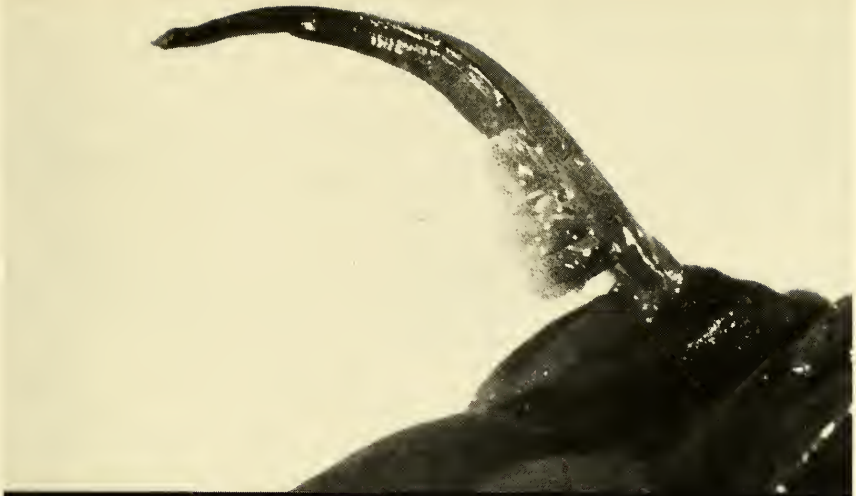


Fig. 8: Supraorbital tentacles of *B. normani* (a: USNM 213746/1 male, b: ISTPM Z 229/P 58 female) and *B. ocellaris* (c: USNM 48387/3 male, d: USNM 213747/1 female).

Fig. 9–11: *B. ocellaris*. Fig. 9: Supraorbital tentacle of a specimen from Portugal; Fig. 10: Radiograph (10 precaudal and 23 caudal vertebrae); Fig. 11: Glandular thickening of the tips of the rays of the second dorsal and the anal fin in a male *B. ocellaris*.



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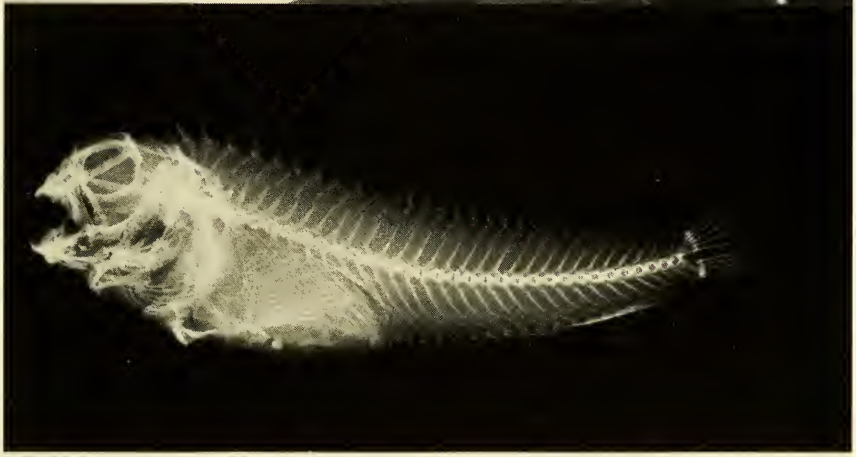

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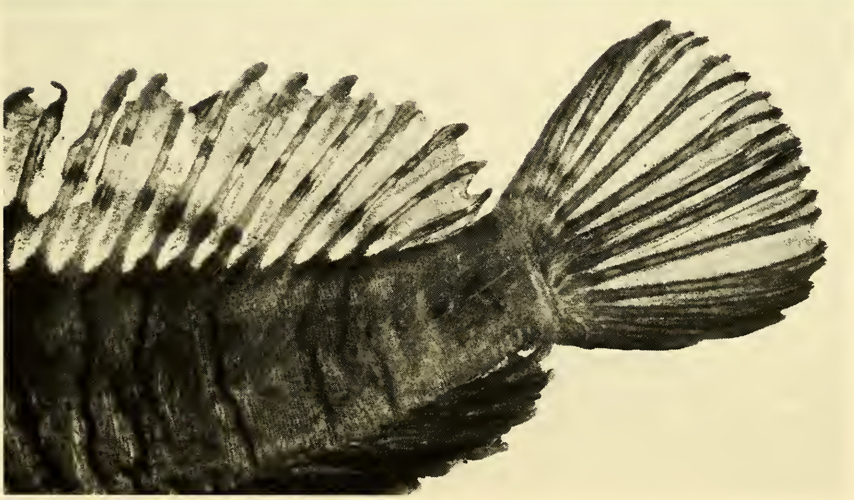

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Blennius normani Poll, 1949:

West-Africa:

ISTPM Z 229	south of Nuadhibu, Mauretania	1^{+}
ZMB 7636	north of Nuakschott, Mauretania	1^{+}
ISH 72/77	Nuakschott, Mauretania	1
IFAN 53.1051	Senegal	1^{+}
IFAN 55.1583	east of Gunjur, Gambia	1^{+}
ISH 1246/64	Port. Guinea	1
USNM 213748	Port. Guinea	3^{+}
USNM 213745	Atlant. Guinea	1
USNM 213746	Atlant. Guinea	2^{+}
USNM 213741	Sierra Leone	1
ISH 1161/64	Sierra Leone	2
USNM 213739	Liberia	1
USNM 213743	Liberia	1
USNM 213744	Liberia	1
USNM 213742	Liberia	1
USNM 213738	Liberia	1
USNM 213736	Liberia	1
USNM 213740	Liberia	3
ISH 1594/64	Liberia	1
IFAN 58.390	Sassandra, Ivory Coast	1
IFAN 63.6	Sassandra, Ivory Coast	1
ISH 1172/64	Sassandra, Ivory Coast	1
ANSP 151293	Ghana	2
USNM 201844	Togo	1
ISNB 15399	Nigeria	1^{+}
USNM 201841	Nigeria	1^{+}
ANSP 151292	Gabon	1
USNM 199532	Gabon	1
USNM 213750	Gabon	6^{++}
USNM 199531	Gabon	1
USNM 199533	Gabon	8
MNHN 1966–40	Pointe Noire, Kongo	4
MNHN 1966–41	Pointe Noire, Kongo	5
MNHN 1967–876	Pointe Noire, Kongo	1
ISNB 93/Holotypus	south of the mouth of the Congo, Angola	1^{+}
ISNB 94/Paratypus	south of the mouth of the Congo, Angola	1^{+}
ISNB 95/Paratypus	south of the mouth of the Congo, Angola	1^{+}
BMNH 1935.5.11.194	St. Pauls de Loanda, Angola	1

Blennius riodourensis Metzelaar, 1919:

ZMA 102.173/Holotypus	Rio d'Ouro (Span. Sahara)	1^{+}

2. Measurements

The measurements were taken with callipers to the tenth of a millimeter. 30 specimens were measured a second time which indicated a degree of error of 0–3%. Some of the specimens received were partly dissected or otherwise damaged. Not all measurements could therefore be taken from all specimens, which is indicated by different sample sizes in the tables.

Sex: The sexes can be told apart by the size and shape of the 2 spines of the anal fin (Guitel 1893): The first spine is very small in females, usually hidden below the skin of the genital papilla.

Total length (TL): From the tip of the snout to the end of the longest caudal fin ray.

Standard length (SL): From the tip of the snout to the posterior margin of the hypural plates as indicated externally on the skin of the specimen.

Head length (HL): From the tip of the snout to the rear edge of the fleshy margin of the opercle.

Preorbital snout length (PSL): From the anterior margin of the bony ring around the right eye to the tip of the snout.

Body height (BH): From the base of the first dorsal spine to anterior point of insertion of the ventral rays (i. e., not quite vertically, but with a slight posteriad inclination).

Table 1: Fin ray counts: Percent of specimens from the Mediterranean Sea (MS), Portugal (PO), British Isles (BI), and West Africa (AF) showing the character state indicated. N = sample size.

		MS	PO	BI	AF
D 1:	10	2.2	5.3	0	3.3
	11	96.7	94.7	100	95.1
	12	1.1	0	0	1.6
D 2:	13	0	0	4.0	62.3
	14	42.9	34.2	48.0	37.7
	15	57.1	65.8	48.0	0
A 2:	14	0	0	4.0	13.1
	15	17.6	23.7	16.0	80.3
	16	75.8	73.7	76.0	6.6
	17	6.6	2.6	4.0	0
N		91	38	25	61

Length of the first dorsal spine (1. D1): From the anterior base of the spine to its tip. Not measured when obviously damaged.

Length of the fifth dorsal spine (5. D1): Measured as 1. D1. Preliminary observations showed that this was a suitable measurement for the general height of the first dorsal fin.

Height of the second dorsal fin (D2H): The length of the longest ray of the second dorsal fin, measured as above.

Length of the supraorbital tentacle (T): From the base of the tentacle at the conjunctiva of the eye to the most distal point. Measured when the tentacles were wet, as they shrink considerably when drying. Both sides were measured and the larger value taken.

Eye diameter (ED): The eyes are slightly oval. The largest diameter of the inner edge of the bony rim was measured on both sides and the larger value recorded.

Width of the isthmus (IW): A needle was inserted each into the left and the right gill slit. The needles were moved towards each other until they were stopped by the points were the gill membranes are fused to the throat. The

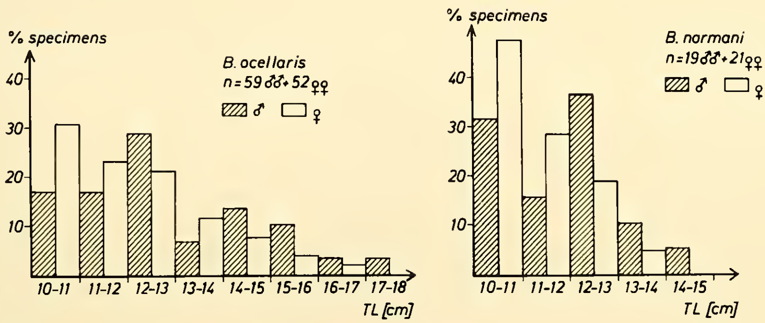

Fig. 12: Size frequency of *B. normani* and *B. ocellaris* males and females larger than 10 cm total length.

distance between these points was measured. These points were sometimes invisible externally, as the gill membranes could form a broad (up to 3 mm deep) fold across the throat.

Length of lateral line (LL): The distance of the rear end of the lateral line (which was best seen under a stereomicroscope and when the specimen was superficially wiped dry) to the posterior margin of the hypural plates. This value was then substracted from the standard length. The often used method of indicating the length of the lateral line by giving the number of the dorsal fin ray above its endpoint appears unsuitable: The endpoint of the lateral line can be between the height of 2 dorsal rays and the number of dorsal rays itself is variable. An exact measurement in mm seemed preferable.

Numbers of dorsal spines elongated beyond the fin membrane: The tips of dorsal spines are often elongated beyond the fin membrane. This can vary from a small skin flap to a conspicuous elongation. Spines were counted as elongated only when their tip was 2 mm or more away from the fin membrane. The degree of elongation decreased from anterior to posterior. A damaged spine was therefore counted as "elongated" when the following spine also fulfilled the criterion.

Number of broad dark bars on the body: The first bar counted was that above the base of the pectoral fin (a small bar anterior of this was not counted). Counting was done on the upper part of the body, as bars tended to blurr and to disappear on the ventral part of the body. Many older museum specimens were bleached to a state where colour patterns could no longer be seen. Occasional small bars of less than 2 mm width were not counted. When number of broad dark bars differed on the left and the right side, the larger value was used.

Colour pattern of head: Some specimens had a darkly spotted head. The area of the "cheeks" was scored as either "strongly spotted" or "lightly spotted" or "unspotted". Spotting pattern may have bleached in old specimens, but this is unlikely to have happened to the different samples in such an unequal way as to distort the results.

Position and size of eye-spot on dorsal fin: When an eye-spot was present on the first dorsal fin, its position and size was expressed by the serial numbers of the dorsal spines it covered. The notation 5.5–7.0 means that the anterior edge of the eye-spot was approximately halfway between the fifth and the sixth spine, the posterior edge close to the seventh spine, i. e., the eye-spot was 1.5 units long. Eye-spot shape was classified as either "round" or "oval".

Colour of eye-spot: The dark eye-spot was frequently surrounded by a light margin; this margin could be either "present", or "absent", or "incomplete".

Skin flap on the nape: The presence or absence of a small skin flap on the nape (cf. figure 5) was noted for both sides of the body.

Vertebrae: X-ray pictures were taken from 43 specimens (British Isles 5, Portugal 5, Mediterranean Sea 19, *normani* 13, *riodourensis* 1). The selection of specimens was not random; we selected some animals from the centres and the edges of the distribution, some animals which appeared typical, and some animals which were exceptional in other counts. A full spectrum of variation was aimed for by this selection procedure. Caudal and precaudal vertebrae were counted from the radiographs. The caudal vertebrae are those which bear a haemal spine and include the hypural vertebra.

3. Statistical procedures

Measurements that could be expressed as means plus/minus standard deviation were compared by t-test (in all such cases the data were normally distributed). Measurements which were scored in either two or three different classes (e. g., colour of head) were compared by chi-square and G-test (Clauss & Ebner 1975).

Results

1. Comparison of B. ocellaris and B. normani

a) Fin ray counts

Figure 1 shows the mean, standard deviation and range of the fin ray counts for the first dorsal fin, second dorsal fin and anal soft rays for the three study areas of *B. ocellaris* and for *B. normani.* Table 1 gives the distribution of character states. The variability of *B. ocellaris* fully encompasses the range of values for *B. normani,* even though *normani* have significantly fewer rays in the second dorsal and the anal fin.

The pectoral fin ray count on both sides of the body was 12 in nearly all 154 *ocellaris* and 61 *normani* specimens counted. Two *ocellaris* and two *normani* had 13 rays in one pectoral fin and one *normani* had 13 rays in both pectoral fins.

The most common fin ray counts for the four different regions therefore are:

Mediterranean Sea:	D XI15; P 12; V I3; A II16
British Isles:	D XI14; P 12; V I3; A II16
Portugal:	D XI15; P 12; V I3; A II16
Africa *(normani)*:	D XI13; P 12; V I3; A II15

Table 2 shows the number of spines elongated beyond the membrane of the first dorsal fin. There was a highly significant ($p<0.001$) difference between *B. normani* and the three *B. ocellaris* populations (which did not differ significantly): while most *ocellaris* had only the first or the first two spines elongated beyond the fin membrane, most *B. normani* had the first 5 to 8 spines elongated beyond the fin membrane (see also figure 5 and 6).

Table 2: Number of spines elongated beyond the membrane of the first dorsal fin and presence or absence of a skin flap on the nape (percent of specimens).

	MS	PO	BI	AF
number of elongated spines				
1- 2	68.8	63.2	80.0	0
3- 4	21.1	23.7	8.0	20.3
5- 6	7.7	10.6	4.0	39.0
7- 8	0	2.6	4.0	30.6
9-10	2.2	0	4.0	10.2
N	90	38	25	59
skin flap				
present on both sides	96.7	97.4	84.0	14.8
present on one side	3.3	2.6	4.0	9.8
absent	0	0	12.0	75.4
N	90	38	25	61

b) Skin flaps on the nape

Most *ocellaris* specimens had a small skin flap on the nape on both sides of the body: table 2. There were some *ocellaris* which had only one such skin flap and three specimens from the British Isles lacked them entirely (a state diagnostic for *B. normani* according to POLL's (1949) original description). Most *B. normani* had no skin flaps, but six specimens had one, and 9 specimens even two such skin flaps. The 15 *normani* what had a skin flap came from Congo (3), Gaboon (5), Guinea Bissao, Ivory Coast, Liberia (4), and Gambia, i. e., not from a particular, small area in the range of *B. normani* (cf. distribution).

c) Morphometric comparison

All morphometric data are expressed in % of standard length of specimens. Table 3 shows the results of measurements of head length, preorbital snout length, body height, length of the first dorsal spine, length of the 5th dorsal spine, height of the dorsal fin, and the quotient of length of the 5th dorsal spine divided by height of the second dorsal fin (i. e., the difference of height between the dorsal fins).

B. normani have a significantly longer head than the three *ocellaris* populations, but there is a large degree of overlap. The preorbital head length is comparatively similar in the four areas; only the difference between the two extreme values reaches significant levels; interestingly this is between *B. nor-*

mani and its closest *ocellaris* population ("Portugal"). Similarly, *B. normani* tends to have a higher body than the *ocellaris* populations and the difference is greatest to the "adjacent" Portugal area. *B. normani* tends to have a longer first ray of the dorsal fin than *ocellaris* does. The most surprising finding, also expressed in the following two measurements, is a clear reduction in height of the dorsal fin of British Isles specimens. While specimens from the Mediterranean Sea (fig. 3) have first dorsal fins conspicuously higher than the second dorsal fin, the two dorsal fins are of almost the same height in specimens from the British Isles, sometimes even of equal height (fig. 4).

Table 3: Morphometric comparison of specimens. Mean ($\bar{x}$) and standard deviation (s) as percent of standard length.

		MM	PO	BI	AF
Head length	$\bar{x}$	30.4	29.5	30.0	33.3
	s	1.20	1.56	1.19	1.33
	N	87	37	24	52
preorbital snout length	$\bar{x}$	8.4	7.8	8.2	8.7
	s	0.48	0.38	0.46	0.46
	N	87	37	25	52
body height	$\bar{x}$	29.0	26.4	28.0	32.0
	s	1.91	2.87	2.08	1.48
	N	85	36	23	52
1. D1	$\bar{x}$	43.9	44.6	34.5	50.0
	s	4.88	5.80	5.12	6.94
	N	85	34	24	47
	$\bar{x}$	30.4	23.8	21.4	29.8
5. D1	s	3.42	2.89	3.50	3.94
	N	86	36	24	50
	$\bar{x}$	21.1	18.4	19.5	20.6
D2H	s	1.82	1.68	1.94	1.66
	N	87	37	25	52
5.D1/D2H	$\bar{x}$	144.9	128.6	110.5	144.2
	s	14.43	12.81	12.97	15.52
	N	86	36	24	50

Table 4 compares the specimens in length of the supraorbital tentacle (expressed as length of the supraorbital tentacle/eye diameter), isthmus width, and length of lateral line. Specimens from Portugal tend to have the longest tentacles and once again *normani* differs most from its closest *ocellaris* population. There is a large degree of variability with values of 33,7% to 91%. Tentacle length is sex specific (see below). The width of the isthmus provides the clearest morphometric difference between *B. ocellaris* and *B. normani* . While the three *ocellaris* populations did not differ significantly from each other, the *normani* population did not only show a highly significant difference to them ($p<0.001$), but there also was no overlap in measurements: All *normani* had an isthmus width of at least 9.4% SL, whereas no *ocellaris* had an isthmus width larger than 8.8% SL. Isthmus width was therefore a character which could be used to determine the specific status of all specimens used in this study. Mediterranean specimens tended to have the shortest lateral line; they differed significanthly from the two Atlantic populations and from *B. normani* in this aspect, but there was no significant difference between *B. normani* and the *B. ocellaris* from Portugal or the British Isles.

Table 4: Morphometric comparison of specimens (continued)

		MM	PO	BI	AF
eye diameter	$\bar{x}$	8.7	8.1	8.1	9.5
	s	0.80	0.73	0.66	0.74
	N	87	37	25	52
length of supraorbital tentacle/eye diameter	$\bar{x}$	86.2	121.5	67.6	69.3
	s	32.72	17.83	26.10	17.63
	N	86	37	25	52
width of isthmus	$\bar{x}$	6.8	6.7	6.9	11.8
	s	0.93	0.96	0.88	0.98
	N	83	7	17	51
length of lateral line	$\bar{x}$	67.8	78.2	78.8	80.9
	s	4.99	5.39	7.92	4.60
	N	87	37	25	52

d) Colour pattern

The eye-spot on the dorsal fin was situated somewhere between the 5th and the 9th spine in the three *ocellaris* populations and somewhere between the 5th and the 8th spine in the *normani* population. The size of the eye spot varied between one and three "units" (cf. material and methods): table 5. The Mediterranean *ocellaris* had the smallest eye-spots, the Portuguese *ocellaris* and the *normani* specimens had the largest eye-spots. About half of the Mediterranean *ocellaris* had a round eye spot (cf. fig. 1); eye-spots were elongated (cf. fig. 8 and 9) more often in the Atlantic *ocellaris*, and almost all *normani* had distinctly elongated eye-spots: table 5. A light margin around the eye spot was present in 89% of the Mediterranean *ocellaris*, absent in 92% of the *normani:* table 5. Atlantic *ocellaris* have a light margin significantly less often ($p<0.001$) than do Mediterranean ones.

Whereas all three *ocellaris* populations contained at least 50% of specimens with a more or less spotted head (cf. fig. 7), no *normani* had a spotted head: table 6. Atlantic *ocellaris* differed from Mediterranean *ocellaris*, and even more from *normani*, by a large proportion of specimens with a strongly spotted head.

Table 5: Eye spot size, shape, and colour (percent specimens showing the character state indicated)

	MS	PO	BI	AF
size (units)				
1.0-1.5	68.1	2.3	10.0	3.4
2.0-2.5	31.9	84.2	90	81.4
3.0	0	10.5	0	15.3
N	91	38	20	59
shape: oval	55.1	59.5	78.9	94.7
round	44.9	40.5	21.1	5.3
N	89	37	19	57
light margin around eye spot				
present	89.0	13.2	40.0	6.6
partially present	0	15.8	5.0	1.6
absent	11.0	71.1	55.0	91.8
N	91	38	20	61

All populations contained specimens with 5 and specimens with 6 dark bands on the body: table 6. Again, the Atlantic *ocellaris* differ significantly ($p<0.001$) from the Mediterranean ones in having 6 bands more often. The *normani* do not differ significantly from the Mediterranean *ocellaris* in this feature, but the difference reaches $p<0.001$ when *normani* and Atlantic *ocellaris* are compared.

Table 6: Head colour and body colour (percent specimens)

	MS	PO	BI	AF
spotting of head				
strongly spotted	24.1	84.4	84.0	0
lightly spotted	29.1	6.3	12.0	0
unspotted	46.8	9.4	4.0	100
N	79	32	25	61
number of dark bands on body				
5	88.1	8.3	33.3	87.5
6	11.9	91.7	66.7	12.5
N	59	24	21	48

e) Shape of the supraorbital tentacles

While the shape of the supraorbital tentacles of *B. normani* specimens was fairly uniform, the shape of *B. ocellaris* supraorbital tentacles was extremely variable (fig. 8). *B. normani* almost always had simple, filamentous tentacles with a pointed tip; only 8 specimens had a minute branch on one of the tentacles; tentacle crosscut was usually triangular, but 8 specimens had a laterally flattened tentacle. *B. ocellaris* tentacles ended in a broad flattened tip and usually had numerous branches which themselves could be subdivided (cf. figures 1, 3, 7, 8). The *ocellaris* specimen with the lowest number of branches had a single branch on each of the supraorbital tentacles. The *ocellaris* tentacles were usually broad and laterally flattened. Figure 9 shows a supraorbital tentacle of a specimen from Portugal which has typical *ocellaris* features in its lower third and resembles a *normani* tentacle in its upper two thirds.

f) Size

The smallest specimen seen was a *Blennius normani* with a total length of 2.2 cm (SL 1.69 cm) found "off St. Pauls de Loanda, Angola" BMNH 1935.5.11. This specimen, which presents the southernmost record of the species had typical *normani* features. It had a high first dorsal fin like large specimens. The largest *B. normani* seen was a specimen from Guinea (USNM 213745) with a total length of 14.7 cm (SL 11.38 cm). The largest specimen of *B. ocellaris* seen (TL 17.3 cm, SL 13.9 cm) was from the Mediterranean Sea near Malaga, Spain (BMNH 1970.12.2.103). *Ocellaris* may reach a larger size than *normani,* but the difference could also be due to the smaller sample size for the latter species.

g) Osteology

The number of caudal and praecaudal vertebrae was determined from radiographs (figure 10). The counts for the 29 *ocellaris* specimens and the 13 *normani* specimens are given in table 7. As explained in "Material and Methods", the samples were not random ones but attempted to cover the whole spectrum of variability. Both species had a constant number of 10 praecaudal vertebrae. *B. ocellaris* typically had 23 caudal vertebrae, *B. normani* 22 or 21. The 5 *ocellaris* specimens with the lowest value of caudal vertebrae (22) were from Galway Bay, Portugal, Sardinia, and Alexandria (2), i. e., from the whole range of *ocellaris.* Likewise the seven *normani* with 22 caudal vertebrae were from the whole range of the species: Congo (3), Nigeria, Gambia, Senegal, and Mauretania. As one might expect from the fin ray counts of the second dorsal and the anal fin, *B. ocellaris* tend to have a higher number of caudal vertebrae than *B. normani.*

Table 7: Vertebral counts

n specimens	praecaudal	caudal
B.ocellaris		
2	10	24
22	10	23
5	10	22
B. normani		
7	10	22
5	10	21
1	10	20

h) Sexual dimorphism

The sex ratio in the sample of *B. ocellaris* (48% females, 52% males; n = 154) and in the sample of *B. normani* (51% females, 49% males; n = 63) did not differ from unity (p>0.9, sign test).

In many species of the family Blenniidae males differ from females in having a glandular thickening at the tips of some fin rays during the reproductive season (these glands are supposed to produce pheromones: LAUMEN et al. 1974), in having longer tentacles and in having a larger body size than do females (e. g. ZANDER 1972). We found glandular thickening of rays of the second dorsal fin and even of the rearmost rays of the anal fin in some males of *B. ocellaris* and of *B. normani* (figure 11). Such specimens had capture dates of April (Gulf of Naples) to July (Plymouth and Galway Bay) – a time which corresponds to that reported as the spawning season of *B. ocellaris* (WHEELER 1969, MINCHIN & MOLLOY 1980). Males of both *B. ocellaris* and *B. normani* had significantly longer tentacles than did females (p<0.001, t-test): table 8. The body size of males and females larger than 10 cm total length was compared (figure 12). Males of *B. ocellaris* and of *B. normani* tend to be larger than females.

Table 8: Tentacle length (% standard length) of male and female *B. ocellaris* (Mediterranean specimens only) and *B. normani*

		♂	♀
B. ocellaris	$\bar{x}$	9.3	5.6
	s	2.10	1.26
	n	43	43
B. normani	$\bar{x}$	7.7	5.5
	s	1.14	1.25
	n	25	27

i) Depth distribution

The labels of 51 *B. ocellaris* and 50 *B. normani* contained data on the depth of capture. 69% of the *B. ocellaris* and 88% of the *B. normani* were caught between 50–100 m. 3 *normani* specimens and 14 *ocellaris* specimens are from even greater depth, the record being an *ocellaris* from Sezimbra Bay, Portugal, with a depth of 366–439 m indicated (200–240 fathoms): BMNH 1971.7.21.178. Minimal depth record for *B. ocellaris* is 26 m (ISH 37/59) and for *B. normani* 20–50 m (ISNB 93, 94, 95). The typical habitat for both species is apparently the coastal shelf region.

2. Comparison of B. riodourensis with B. ocellaris and B. normani

Only the holotype of *B. riodourensis* is known. No additional specimens have been found in the last 65 years. With a standard length of 50.2 mm the specimen is quite small. It is a male, but because we did not want to damage the only known specimen we could not dissect it to find whether it was sexually mature.

The first dorsal spine was 7.5% longer than the longest ray of the second dorsal fin. The height of the first dorsal fin (as measured at the 5th spine) is 2.5% lower than the second dorsal fin (a state which is reached in some *ocellaris* specimens from the British Isles). Mediterranean specimens of *ocellaris* smaller than the *riodourensis* and the smallest *normani* already have a first dorsal fin higher than the second one. No spine in the first dorsal fin of *riodourensis* was elongated beyond the fin membrane, whereas all *ocellaris* had at least one and all *normani* at least three such spines (table 2).

The supraorbital tentacle was 1.76 times as long as the eye diameter. Tentacles of a similar length did not occur in *B. normani* and only a few *ocellaris* specimens from the Portugal population had tentacles with up to 1.91 times the eye diameter (table 4). The shape of the tentacle differs from all *ocellaris* and *normani* tentacles seen (cf. figure 11 in Bath 1977) by having a single very long side branch originating close to the base.

The lateral line of the *riodourensis* specimen had a length of 60% SL. All *normani* had longer lateral lines and only two *ocellaris* specimens (from the Mediterranean Sea) had a shorter lateral line (table 4).

The width of the isthmus could not be measured without damaging the specimen. A broad (at least 3.7 mm deep) fold covered the throat. No *B. normani* and only a few *B. ocellaris* had a similarly deep fold across the throat.

The *riodourensis* holotype had an olive-green colour, not seen in any other, even older museum specimens of *ocellaris* or *normani.* Under a stereomicroscope some pigmentation indicated the presence of 5 dark bands on the body- a colour pattern also indicated in Metzelaar's (1919) original drawing and frequently found both in *B. ocellaris* and in *B. normani.* There is no eye-spot discernible on the first dorsal fin.

The fin ray formula is DX16; P13; VI3; AII16. While 10 spines in the first dorsal fin is a rare condition in *B. ocellaris* and *B. normani* (found in only 6 of 218 specimens), the presence of 16 rays in the second dorsal fin is a unique feature of *riodourensis* (cf. table 1). Only 2 *ocellaris* and 3 *normani* were found which had 13 pectoral rays and only one of these (a *normani*) had 13 rays in both pectoral fins; the typical situation for *ocellaris* and *normani* is 12 rays in both pectoral fins.

The number of praecaudal and caudal vertebrae is 10 + 22 – a state frequently encountered in *ocellaris* and *normani* (table 7). The caudal skeleton did not show clear differences to that of *ocellaris* or *normani.* According to Bath (1977), *riodourensis* differs from *ocellaris* and *normani* by having the uppermost segmented dorsal ray inserting on the urostyle as well as on the minimal hypural (versus only on the minimal hypural). Smaller specimens of *ocellaris* and *normani,* however, have a caudal skeleton like that of *B. riodourensis,* i. e., a very small minimal hypural.

The caudal fin had four dorsal and 3 ventral procurrent rays and 11 segmented caudal rays. This situation is unique to *riodourensis;* all *normani* and *ocellaris* radiographed had 13 segmented caudal rays.

The *riodourensis* specimen does have a small skin flap on both sides of the nape, but their position is different from the one found in all *normani* and *ocellaris.* Whereas the skin flaps of *normani* and *ocellaris* were just above the first supratemporal pore of the lateral line system (cf. figure 5), the skin flaps of the *riodourensis* specimens are higher, directly at the base of the first dorsal spine (cf. figure 11 in Bath 1977).

3. Geographical distribution

The literature contains the following references on the distribution of *B. ocellaris, B. normani,* and *B. riodourensis.*

B. ocellaris:

1) Askalon, Israel; STEINITZ (1949) – 2) Haifa, Israel; 1 specimen BMNH (pers. comm. CHAMBERS) – 3) Zypern; 1 specimen BMNH (pers. comm. CHAMBERS) – 4) Siros, Greece; BATH (1977) – 5) Izmir, Turkey; BATH (1977) – 6) Marmara Sea; SVETOVIDOV (1964) – 7) Black Sea; SVETOVIDOV (1964) – 8) Corfu, Greece; BATH (1977) – 9) Novi, Jugoslavia; BATH (1977); Losinj, Jugoslavia; BATH (1977); Between Cricvenica and Senj, Jugoslavia; PROBST (1972); Rovinj; OBRENOVIC & STEVCIC (1977) – 10) Triest, Jugoslavia; BATH (1977) – 11) Venice, Italy; SEGANTIN (1968) – 12) Messina, Italy; PAPAKONSTANTINOU (1975), BATH (1977) – 13) Sferracavallo, Sicily; 5 specimens ISNB (pers. comm. GOSSE) – 14) Tunis, Tunesia; BATH (1977); 2 specimens BMNH (pers. comm. CHAMBERS) – 15) Kap Monte Santu, Sardinia; 1 specimen ISNB (pers. comm. GOSSE) – 16) east of Muravera, Sardinia; 2 specimens ISNB (pers. comm. GOSSE) – 17) Cagliari, Sardinia; CHAROUSSET (1968), BATH (1977) – 18) Kap Spartivento, Sardinia; 2 specimens ISNB (pers. comm. GOSSE) – 19) Kap Frasca, Sardinia; 3 specimens ISNB (pers. comm. GOSSE) – 20) Skikda (Philippeville), Algeria; 1 specimen BMNH (pers. comm. CHAMBERS) – 21) Golf of Genova; PAPAKONSTANTINOU (1975) – 22) Nizza, France; 1 specimen ISNB (pers. comm. GOSSE) – 23) Villefranche, France; SARDOU (1973) – 24) Banyuls, France; BATH (1977), 1 specimen ISNB (pers. comm. GOSSE), 2 specimens BMNA (pers. comm. CHAMBERS); Port Vendres, France; BATH (1977) – 25) Blanes, Spain; MATALLANAS (1979) – 26) Mallorca; PROBST (1972) – 27) Kilkieran Bay and Galway Bay, Ireland; O'CEIDIGH (1959), DUNNE (1972); East of Glengad head off Co Donegal, Ireland; MINCHIN & MOLLOY (1980) – 28) Galway Bay, Ireland; FIVES & O'BRIEN (1976), DUNNE & KOENNECKER (1976) – 29) English Channel; BMNH (pers. comm. CHAMBERS) – 30) Plymouth, England; FORD (1922) – 31) Sezimbra Bay, Portugal; ALMEIDA (1981) – 32) Portimao, Portugal; ALMEIDA (1981) – 33) Casablanca, Morocco; WIRTZ (1980) – 34) Morocco; POSTEL (1959) – 35) Senegambia; POSTEL (1959)[2])

B. normani:

36) Cabo Blanco, Mauretania; LLORIS & RUCABADO (1979) – 37) Plateau continental off Mauretania; MAIGRET (1974) – 38) Senegambia; WIRTZ (1980) – 39) Sierra Leone; CADENAT (1960) – 40) Sassandra, Ivory Coast; WIRTZ (1980) – 41) Nigeria; BAUCHOT (1966) – 42) Pointe Noire, Congo; ROUX (1957), BATH (1977) – 43) South of the mouth of the Congo, Angola; POLL (1949, 1959)

B. riodourensis:

44) Rio d'Ouro (Spanish Sahara); METZELAAR (1919)

Some of these specimens mentioned in the literature have been used by us in the present study: 37 is probably identical with ISTPM Z 229; 39 is IFAN 53.1051, 55.1583; 40 ist IFAN 58.390,63.6; 42 (BATH 1977) is MNHN 1966–40, 1966–41, 1967-876; 43 is ISNB 93, 94, 95; 44 is ZMA 102.173.

There is a specimen of *B. ocellaris* labelled as coming from the Cape of Good Hope at the Rijksmuseum of Natuurlijke Historie, Leiden (Netherlands), registration number RMNH 1714. This is a misplacement of some kind. We have seen the specimen; it is a *B. ocellaris* with typical Mediterranean features.

Figure 13 shows the location of the specimens seen during this study plus the following records for *B. ocellaris* from areas not covered by us and mentioned above: 3, 5, 6, 7, 8, 9, 15, 16, 17, 19, 20, 25, 26, 27, 29, 33.

In the Atlantic, the northernmost record of *B. ocellaris* is given by a specimen "east of Glengad head off Co Donegal", Ireland (MINCHIN & MOLLOY 1980) and the southernmost record is from northern Morocco (35°20'N).

B. normani is apparently restricted to the Westafrican coastal area. The northernmost record is from Cap Blanc, Mauretania (20°03'N, 17°35'W): ISTPM Z229. The southernmost record is given by a

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[2]) This is probably a *B. normani;* we did not see the specimen.

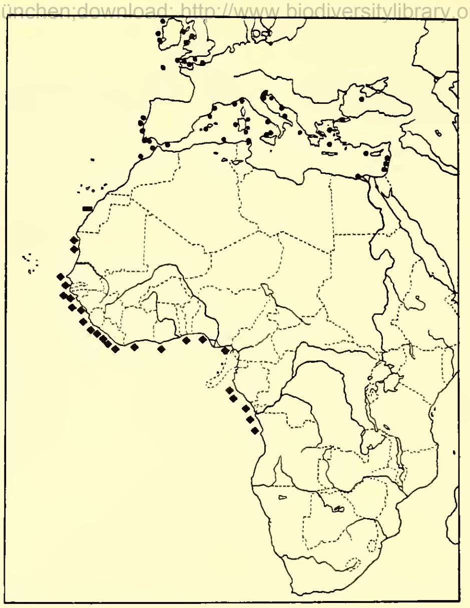

Fig. 13: Geographical distribution of ● *B ocellaris,* ♦ *B. normani,* and ■ *B. riodourensis* specimens seen by us, plus additional records of ● *B. ocellaris* from the literature.

2.2 cm long specimen with typical *normani* features from Loanda, Angola (9°S, 13°E): BMNH 1935.5.11.194. The distribution of *B. normani* corresponds to the "West African province" proposed by Briggs (1974).

The sole specimen of *B. riodourensis* is labelled "Rio d'Ouro", the old name for Spanish Sahara. While this position is less exactly given than the other ones it is still apparent that *B. riodourensis* was found just between the southern limit of *B. ocellaris* and the northern limit of *B. normani.*

Discussion

The comparison of 154 *B. ocellaris* specimens, 63 *B. normani* specimens and the holotype of *B. riodourensis* has shown that all three species are valid ones. *B. normani* differs from *B. ocellaris* in having threadlike supraorbital tentacles, one of which may carry a minute side branch, whereas *B. ocellaris* typically has broad flattened tentacles carrying numerous branches. *B. normani* also has a broader isthmus than *B. ocellaris.* In addition, the following features are usually (but not always) different: more than 3 dorsal spines are elongated beyond the fin membrane in *B. normani* (less than 4 in most *B. ocellaris),* the head is unspotted in *B. normani* (usually spotted in *B. ocellaris),* small skin flaps on the nape are usually present in *B. ocellaris* and frequently absent in *B. normani,* the gill membrane usually forms a small fold across the isthmus in *B. ocellaris* and only rarely does so in *B. normani.* The *ocellaris* population closest to *normani* (i. e., specimens from "Portugal") do not show an increased tendency to have intermediate expression of character states. The *B. riodourensis* specimen is unique in having 16 rays in the dorsal fin, no eye-spot on a low first dorsal fin, no spines of the dorsal fin elongated beyond the fin membrane, and 11 segmented caudal rays.

At present the distribution of the three species is not known to overlap.

The skin flap on the nape is a synapomorphic character of the genus *Blennius* (its function is entirely unclear). As it can be found in all three species, its presence appears to be the ancestral state and its reduction in *B. normani* (where only 25% of the specimens have a skin flap on at least one side of the body) is the derived condition. This is also indicated by the sporadic occurence of specimens with a skin flap throughout the range of *normani*. The reduction of the gill opening (resulting in a broad isthmus no longer covered by a fold of the gill membranes) appears to be another specialized condition of *B. normani*. The ancestral state of the lateral line is unclear, but a reduction of lateral line length would indicate a derived condition for *B. normani*, an increase in lateral line length would indicate a joint derived state in *ocellaris* and *riodourensis*. Rare cases of a flattened tentacle or even a minute sidebranch indicate that the simple tentacle of *normani* is a derived state and the more complex branched tentacle of *ocellaris* and *riodourensis* the ancestral state for the genus. While *normani* obviously has several derived characters, there are no certain joint derived states (synapomorphies) of either *normani* and *riodourensis* or *ocellaris* and *riodourensis* and the intrageneric relationship remains at present unclear.

B. ocellaris showed an unexpected degree of variability. Atlantic specimens tended to have a longer lateral line, a lower first dorsal fin, a more pronounced spotted colour pattern on the head and a reduction of the light margin around the eye-spot on the first dorsal fin. The observation that specimens from Portugal are often even more distinct from Mediterranean specimens than those from the British Isles indicates a strong restriction of gene flow through the Straits of Gibraltar. Figures 3 and 4 show the extent to which Mediterranean and Atlantic *ocellaris* specimens can differ. We refrain from giving separate suspecific status to *B. ocellaris* from the Atlantic only because (whereas specimens with "Atlantic" features are not found in the Mediterranean Sea) *ocellaris* specimens which resemble Mediterranean ones can be found throughout the Atlantic.

A large degree of variability of Atlantic specimens versus Mediterranean ones could be due either to the greater latitudinal range inhabited by the former (see for instance Barlow 1961 on the effect of geographical distribution on fin ray numbers) or could be due to a founder effect: The *ocellaris* which entered the Mediterranean when the Straits of Gibraltar opened after the Miocene dessication of the Mediterranean Sea (Hsü et al. 1973) may have shown only part of the variability of the species. The observation that in some features the *ocellaris* specimens from Portugal differ from Mediterranean ones even more than other Atlantic specimens lends support to the view that the large variability of Atlantic *ocellaris* is caused by the greater latitudinal range inhabited.

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References

Almeida, A. J. 1981: Revision des Poissons Blennidés de la Collection de l'Aquário Vasco da Gama. (Pisces: Blenniidae). – Relatórios de Actividades do Aquário Vasco da Gama No 8: 1–11

Barlow, G. W. 1961: Causes and significances of morphological variation in fishes. Syst. Zool. 10: 105–11

Bath, H. 1973: Blenniidae. In: Hureau, J. C. & Monod, T. (eds.): Checklist of the fishes of the north-eastern Atlantic and the Mediterranean. "Clofnam": 519–527. Unesco, Paris

— — 1977: Revision der Blenniini. – Senck. biol. **57**: 167–234

— — 1982: Beitrag zur Revalidation von *Parablennius ruber* (Valenciennes 1836) mit kritischen Bemerkungen zur Gültigkeit der Gattung *Pictiblennius*. Senck. biol. **62**: 211–224

Bauchot, M.-L. 1966: Poissons marins de l'Est Atlantique Tropical. Téléostéens Perciformes. V. Blennioidei. – Atlantide Rep. No. 9 sci. Res. of the Danish Exped. to the Coasts of tropical West Africa 1945–1946: 63–91. Copenhagen

Briggs, J. C. 1974: Marine zoogeography. New York

CADENAT, J. 1960:+ Notes d'ichthylogie ouest-africaine XXX. – Bull. IFAN **22**, sér A 4: 1358–1420
O'CEIDIGH, P. 1959:+ The Blennies, genus Blennius L., of Kilkieran Bay. Connemara. – Ir. Nat. J. **13**: 72–73
CHAROUSSET, F. 1968: Beitrag zur Kenntnis der Schleimfische (Blenniidae) Sardiniens. – DATZ **21** (9): 270–274. Stuttgart
CLAUSS, G. & EBNER, H. 1975: Grundlagen der Statistik für Psychologen, Pädagogen und Soziologen. – Deutsch, Zürich u. Frankfurt/M., 2. Aufl. 1975: 257–267
DUNNE, J. 1972:+ Some interesting fish recorded from Galway Bay and adjacent areas during 1970 and 1971. – Sci. Proc. R. Dublin Soc. **3**, (Ser. B) No 12: 159–163
DUNNE, J. & KOENNECKER, G. 1976: Some inshore fishes from the Connemara coast. – Irish Naturalists Journal **18**, No 9: 267–270
FIVES, J. M. & O'BRIEN, F. J. 1976: Larval and post-larval stages of fishes recorded from the plankton of Galway Bay, 1972–73. – J. mar. biol. Ass. U. K. (1976) **56**: 197–211
FORD, E. 1922: On the young stages of *Blennius ocellaris*, *Blennius pholis*, and *Blennius gattorugine*. – J. mar. biol. Ass. U. K., London **12**: 688–692
GUITEL, F. 1893: Description des orifices genito-urinaires de quelque *Blennius*. Arch. Zool. Exper. Gen., 3. ser.: 611–658
HSÜ, K. J., RYAN, W. B. F. & CITA, M. B. 1973: Late Miocene dessication of the mediterranean. Nature **242**: 240–244
LAUMEN, J., PERN, U. & BLÜM, V. 1974: Investigations on the function and hormonal regulation of the anal appendices in *Blennius pavo*. J. exp. Zool. **190**: 47–56
LLORIS, D. & RUCABADO, J. 1979:+ Especies ictiologicas de las expediciones pesqueras realizadas en la plataforma del NW de Africa 1971–1975. – Result. Exped. Cient. B/0 Cornide **8**: 3–151
MAIGRET, J. 1974: Extrait du laboratoire des peches de Nouadhibou. – Bull. Labo. Peches Nouadhibou **3**: 131–152. Nouadhibou, Mauritanie
MATALLANAS, J. 1979: Contribucion al estudio de la ictiofauna de la zona explotada por las barcas de pesca de Blanes (Mar Catalana). – Bol. soc. Hist. Nat. Baleares **23**: 127–145
METZELAAR, J. 1919: Over tropisch atlantische Visschen: 291. Dissertation, Amsterdam
MINCHIN, D., MOLLOY, J. 1980: Notes on some fishes taken in Irish waters during 1978. Ir. Nat. J. **20**: 93–97
OBRENOVIC, S., STEVCIC, Z. 1977: Ein Beitrag zur Kenntnis der Familie Blenniidae (Pisces, Blennioidea) aus der Umgebung von Rovinj. Acta Biol. Jugosl. (E Ichthyol) **9**: 11–14
PAPAKONSTANTINOU, K. A. 1975: Symbolae eis taen Meletaen tou genous *Blennius* L. 1758 taes Mesogeiou thalassaes. – Dissertation, Athen
PIERON, M. H. 1914: Quelques observations sur les moeurs du *Blennius ocellaris* L., Poissons. – Mus. Hist. Nat. Paris **20**: 13–15
POLL, M. 1949: Résultats scientifiques des croisières du Navire-Ecole Belge "Mercator", vol. IV. – Mém. Inst. roy. Sci. nat. Belg. (2) **4** (33): 244–245
— — 1959: Poissons V. Téléostéens acanthoptérygiens (pt. 2). Expédition océanographique Belge dans les eaux côtières Africaines de l'Atlantique Sud (1948–1949). – Rés. sci. **4** (38): 56–67. Bruxelles
POSTEL, E. 1959–1960: Liste commentée des poissons signalés dans l'Atlantique tropico-oriental nord, du Cap Spartel au Cap Roxo, suivie d'un bref apercu sur leur répartition bathymétrique et géographique. – Bull. Soc. Sci. Bretagne **34** (1/2): 130, 161, (3/4): 256–257
PROBST, K. 1972: Ein Tiefseetaucher – der Seeschmetterling. Wo finden wir Blennius ocellaris? – Aquarien Magazin: 474–475
ROUX, Ch. 1957:+ Poissons marins. In: Mollusques, Crustacées et Poissons marins des côtes d'A. E. F. en collection au Centre d'Océanographie de l'Institut d'Etudes Centrafricaines de Pointe Noire. – O. R. S. T. O. M., Paris: 137–368
SARDOU, J. 1973: Contribution à la connaissance de la faune ichthyologique de la Mediterranée. Les Blenniidae de la région de Villefranche-sur-Mer. – Rev. Trav. Inst. Pêches marit. **37** (2): 207–213
SEGANTIN, G. M. 1968: Blenniidae del litorale veneto. – Bol. Mus. Stor. Nat. Venezia **18**: 41–69
SMITH-VANIZ, W. F. 1976: The sabre-toothed blennies. Acad. Nat. Sci. Philadelphia Monogr. 19, 1–196
SPRINGER, V. G. 1968: Osteology and classification of the fishes of the family Blenniidae. – Bull. U. S. Nat. Mus. **284**: 1–85, Washington
STEINITZ, H. 1949: Contributions to the knowledge of the Blenniidae of the Eastern Mediterranean I. – Rev. Fac. Univ. Istanbul (B) **14**: 140–146
SVETOVIDOV, A. N. 1964: Ryby cernogo morja. Leningrad

WHEELER, A. 1969: The Fishes of the British Isles and nort-west Europe. Macmillan, London: 435–437

WIRTZ, P. 1976: A Key to the European Blennioidea. – Vie et Milieu **26**, fasc. 1, sér. A: 145–156

— — 1977: Welcher Blenniide ist das? – Aquarien-Magazin: 204–215

— — 1980: A Revision of the eastern-atlantic Tripterygiidae (Pisces, Blennioidei) and notes on some Westafrican Blennioid fish. – Cybium, 3e série, **11**: 83–101

ZANDER, C. D. 1972: Zur Verbreitungsgeschichte der Gattung *Blennius* (Blennioidei, Pisces). – Mitt. hamburg. zool. Mus. Inst. **68**: 213–230

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