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The identification of *Pomatoschistus minutus* (Pallas) and *Pomatoschistus lozanoi* (de Buen) (Pisces, Gobiidae)

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Sand gobies are extremely abundant in coastal waters and estuaries. *Pomatoschistus lozanoi* tends to be overlooked due to identification problems. This paper summarizes the characteristics to distinguish *P. lozanoi* from *P. minutus* and presents a new distinctive feature that allows identification of juveniles from 15–20 mm standard length onward. The known geographic distribution of *P. lozanoi* is extended northward to 53°30′ N and southward to 40° N on the coast of Europe. In northern Europe *P. lozanoi* seems better adapted to the estuarine habitat than previously thought.

Key words: *Pomatoschistus minutus; P. lozanoi*; identification.

I. INTRODUCTION

Sand gobies of the *Pomatoschistus minutus* complex are the most abundant demersal fish in the coastal waters of the continental shore of the North Sea (Redant, 1977; Van Noort *et al.*, 1984), the Wadden Sea (Fonds, 1973) and the inshore waters of England and Wales (Henderson, 1989).

The *P. minutus* complex consists of three species (Webb, 1980): *P. minutus* (Pallas, 1770), *P. lozanoi* (de Buen, 1923) and *P. norvegicus* (Collett, 1903). The first two are typically coastal and estuarine and co-occur on shallow sandy bottoms (Hamerlynck *et al.*, 1986). In many studies the species are lumped together under *P. minutus* because of identification problems (e.g. Doornbos & Twisk, 1987; Boddeke *et al.*, 1986; Henderson, 1989). This is unfortunate as all three species have a distinct ecology (Fonds, 1973; Hamerlynck *et al.*, 1986, 1990) and parasite load (Hamerlynck *et al.*, 1989).

Pomatoschistus norvegicus is a species of offshore mud and coarse shell deposits (Gibson & Ezzi, 1981; Miller, 1986), and is thus unlikely to occur with the other two.

The pattern of the sensory papillae of the modified lateral line system on the head provides the best key to identification (Miller, 1986). In many instances, especially in small juvenile fish, damage to the papillae during capture renders the pattern invisible. Checking the pattern is also time consuming. This paper summarizes the known characteristics and presents a new distinctive feature in the pigmentation pattern that allows correct identification of most specimens of both species from 15–20 mm S.L. onward.

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II. MATERIAL AND METHODS

From 1984 to 1989 more than a 100 000 *Pomatoschistus* were examined from the Belgian, Dutch, German and Danish coastal waters of the North Sea, the Wadden Sea, the Westerschelde and Oosterschelde estuary, the saline lake Grevelingen, Scottish waters and the Portuguese coast. The juvenile gobies of both species, used for the drawings in this paper were obtained on 11 August 1986 with a fine mesh 2 m beam trawl in the mouth of the Westerschelde. The fish were anaesthetized in a benzocaine (ethylamino-4-benzoate) solution in sea water and preserved in neutralized formaldehyde 7% final concentration. For analysis of the papillary pattern on the head the fish are placed under water in a petri dish and examined under a dissecting microscope. Strong lighting from the side, along the length axis of the fish, is used in order to create shadows behind the papillae. This increases the visibility of the papillae. All lengths are standard lengths.

III. RESULTS AND DISCUSSION

The study of length–frequency distributions and gonadosomatic indices confirms the finding of Fonds (1973) that the species have different spawning periods. In the Belgian coastal area this is from March to June for *P. minutus*, from June to August for *P. lozanoi*. This means that small juvenile gobies caught in the Belgian and Dutch coastal waters in May and June are *P. minutus*, those in September and October are *P. lozanoi*. In July and August juveniles of less than 35 mm length of both species co-occur. In Portuguese waters spawning periods seem to be three months earlier in both species (F. Moreira, pers. comm.; O. Hamerlynck, unpubl. data).

POMATOSCHISTUS MINUTUS

This species occurs on inshore sand and muddy sand in the eastern Atlantic, typically to about 20 m depth (Miller, 1986). Maximal size in our samples is 75 mm S.L. Juveniles occur quite high up in estuaries even at salinities as low as 5‰ (O. Hamerlynck, unpubl. data). It is a versatile microcarnivore feeding on a variety of benthic and epibenthic animals (Hamerlynck *et al.*, 1986). Spawning is from March to June in the North Sea (Fonds, 1973), from January to April in Portuguese waters (F. Moreira, pers. comm.).

In juveniles of 15–30 mm S.L. the dorsal half of the fish usually shows extensive pigmentation with small black spots. The lateral line has a row of large single and double radiating chromatophores (Fig. 1). Typically there are double chromatophores under the front and tail ends of the second dorsal fin. Most often the spot midway between the tail end of the second dorsal and the base of the tail fin is also double.

When fish reach a size of 30–35 mm S.L. the black spot on the first dorsal fin becomes prominent and is the easiest criterion for identification until the appearance of spawning pigmentation. The general aspect is quite dark due to a reticulate pigmentation of the dorsal half and a series of diffuse spots along the lateral line. When in doubt, e.g. damaged first dorsal fin and little pigmentation, the pattern of the papillae on the head should be checked. There are many patterns intermediate between the typical patterns as described by Webb (1980) and used in the identification key by Miller (1986). The best criterion is the second c-row: if this continues below the horizontal d-line it is a *P. lozanoi*, if it does not it is a *P. minutus* (Fig. 2).

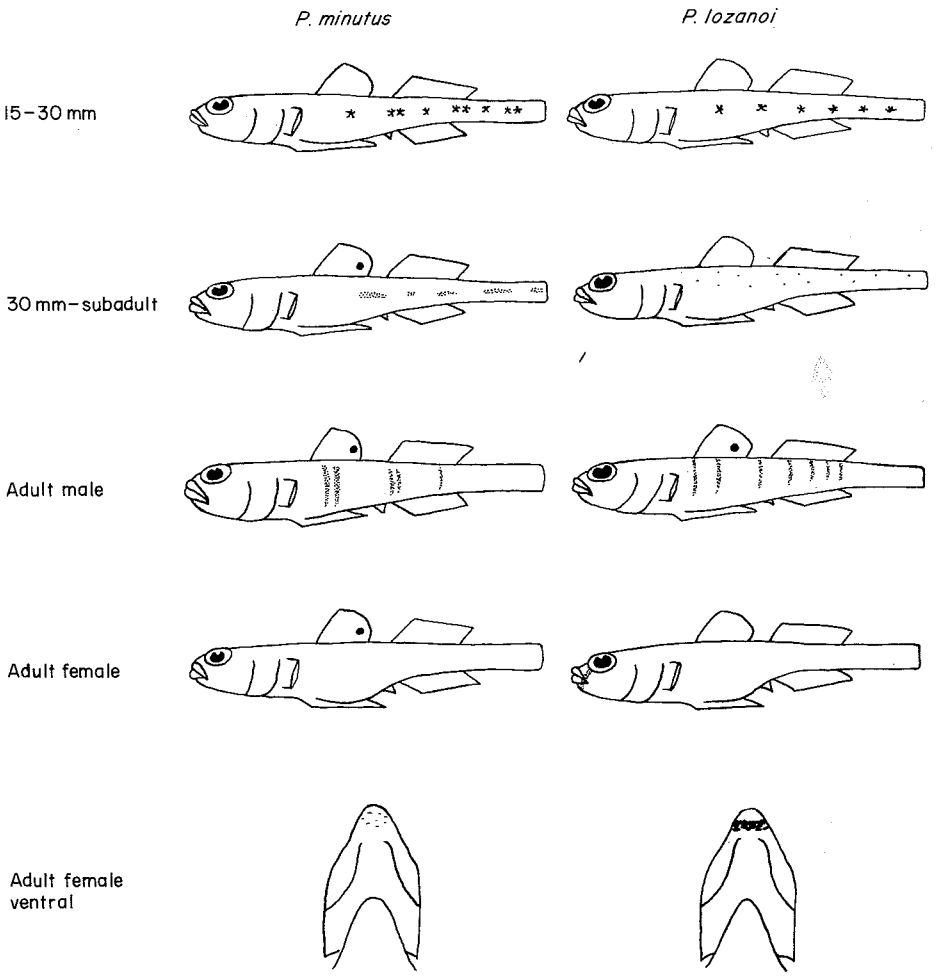

FIG. 1. Schematic representation of the main characteristics used for the identification of *Pomatoschistus minutus* and *P. lozanoi* at different sizes and when spawning. Pectoral and tail fins are not shown. The size of the chromatophores in the 15–30 mm size class is greatly exaggerated.

Ripe *P. minutus* males show two double dark vertical bars on the flank, besides some fainter dark lines. Ripe *P. minutus* females have much less pigmentation on the chin than *P. lozanoi*, there is no clear line between the eye and the mouth.

POMATOSCHISTUS LOZANOI

This species occurs inshore (to 70–80 m) and off the mouth of estuaries (Miller, 1986). Maximal size in our sample is 65 mm S.L.. It feeds mainly on mysids, pelagic copepods and juvenile *P. minutus* (O. Hamerlynck *et al.*, 1990). In most places where *P. minutus* occurs and the species has been looked for by experienced observers *P. lozanoi* is also present. In addition to the sites shown in Miller (1986) the species has been found on the west coast of Portugal at Figueira da Foz (40° N, on both the west and east coast of Scotland, and in German and Danish coastal waters at least to 50°30′ N in the North Sea. In fact *P. lozanoi* has been found in all

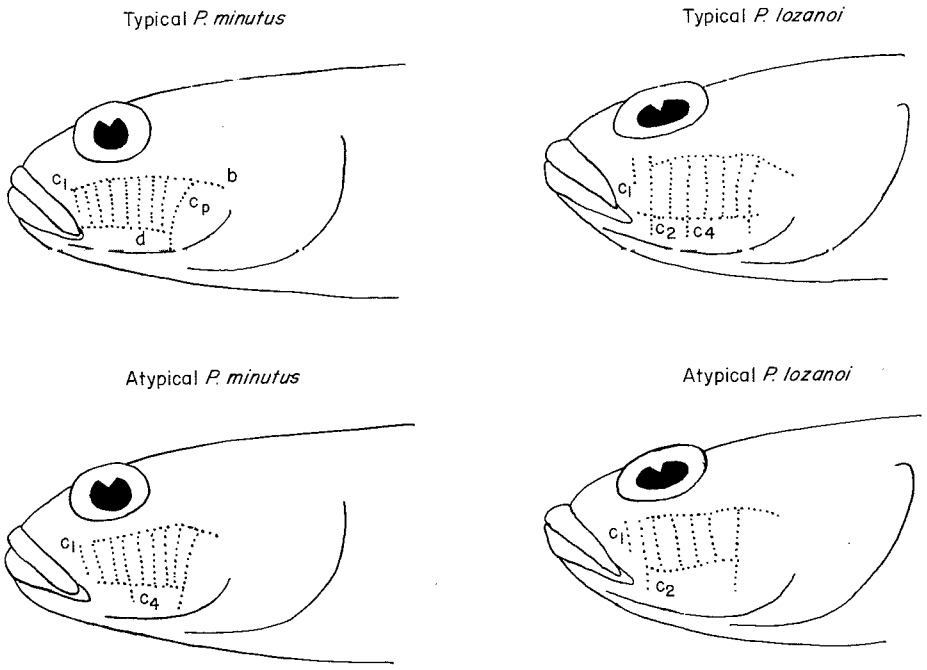

FIG. 2. Typical and atypical papillary patterns of *Pomatoschistus minutus* and *P. lozanoi*. For terminology of the head lateral-line system see Miller (1986).

the localities sampled. Thus it is likely to have been overlooked elsewhere. In the Westerschelde the species is as common as *P. minutus* and occurs in the same salinity range (O. Hamerlynck, unpubl. data). The species also occurs quite high up the Severn Estuary (Claridge *et al.*, 1985). This indicates a more estuarine character than suggested by Fonds (1973), who considered the species to be neritic, avoiding estuaries. In southern Europe however *P. lozanoi* may avoid estuaries as the species was not found in an intensive study of the Tagus Estuary (F. Moreira, pers. comm.).

The general appearance is more slender and much less pigmented than *P. minutus*. Living animals of all sizes are rather translucent and show diffuse reddish spotting. Formalin or alcohol preserved individuals usually have hardly any pigmentation on their dorsal half, except when spawning.

In juveniles of 15–30 mm S.L. the spots on the lateral line are characteristically single chromatophores, often mere dots or altogether absent (Fig. 1).

Unripe fish over 30 mm do not show the reticulate pigmentation of *P. minutus* and lack the black spot on the first dorsal fin. The continuation of the second c-row of papillae under the horizontal d-row, just behind the corner of the mouth is diagnostic (Fig. 2).

Ripe males show seven to nine, more or less regularly spaced dark vertical bars. These are not grouped in pairs as in *P. minutus*, although the first two are closer to one another than the more caudal ones. Ripe females have a characteristic ' moustache ': a dark line extending from the eye to the mouth. This dark pigmentation is continued under the chin as a very dark aggregation of pigment (Fig. 1).

TABLE I. Summary of the most important differences between *P. minutus* and *P. lozanoi*

	Character	*P. minutus*	*P. lozanoi*
General	Papillae	Second c-row not below d	Second c-row below d
15–30 mm	Lateral line	Double spots	Single spots
	Dorsal half	Pigmented	Unpigmented
30 mm subadult	First dorsal	Black spot	No black spot
	Dorsal half	Reticulated	Little or no pigmentation
Spawning male	Flank	Few double bands	Seven to nine single bands
Spawning female	Face	No 'moustache'	'Moustache'
	Chin	Slight pigmentation	Dark blotch

Though ripe females lack a truly black spot on the first dorsal, the pigmented bands on this fin may be confusing.

IV. SUMMARY

P. minutus and *P. lozanoi* co-occur abundantly on most shallow marine soft bottoms of the west coast of continental Europe at least from 40° N in Portugal to 55°30′ N on the Danish west coast. They also co-occur in the estuaries of northern Europe and around the British Isles.

The main identification criteria are summarized in Table I. Small juveniles of both species, below 15–20 mm, as a rule show hardly any pigmentation. When they do they are almost certainly *P. minutus*. Unpigmented individuals at these sizes cannot be identified at present. Conceivably this is possible by the use of quadratic discriminant functions (Froese, 1988). From 15–20 mm to 30–35 mm S.L. nearly all individuals can be positively assigned to either *P. minutus* (double spots) or *P. lozanoi* (single spots). Above 30–35 mm the black spot on the dorsal fin of *P. minutus* becomes diagnostic. Ripe females of *P. lozanoi* have much darker pigmentation around the mouth than *P. minutus*, especially under the chin. In ripe males the pigmentation pattern reflects the difference in chromatophores used in the identification of the juveniles: *P. minutus* males show dark double bands on the flanks. In *P. lozanoi* these bands are single and more numerous.

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