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Short note

# Foraging associations of the Red Sea goatfish (*Parupeneus forsskali*) with native fishes in the Mediterranean Sea

## Fressgemeinschaften der Rotmeer-Barbe (*Parupeneus forsskali*) mit heimischen Fischarten im Mittelmeer

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**Summary:** Feeding associations of the Lessepsian species *Parupeneus forsskali* (Fourmanoir & Guézé, 1976) with several native Mediterranean fish species are reported for the first time in the Mediterranean Sea from the coasts of Turkey. The observations demonstrate the acceptance of *P. forsskali* into the Mediterranean feeding guilds.

**Keywords:** Lessepsian fish, feeding behavior, shoaling, Mullidae

**Zusammenfassung:** Fressgemeinschaften von *Parupeneus forsskali* (Fourmanoir & Guézé, 1976), einem Lessep'schen Einwanderer, mit mehreren heimischen Mittelmeerfischarten werden erstmals für das Mittelmeer von den Küsten der Türkei berichtet. Die Ergebnisse zeigen, dass *P. forsskali* in den Fressgemeinschaften des Mittelmeeres akzeptiert wird.

**Schlüsselwörter:** Lessep'sche Fischart, Fressverhalten, Schwarmbildung, Mullidae

More than 120 fish species native to the Indian Ocean and the Red Sea have entered the Mediterranean Sea since the opening of the Suez Canal in 1869 (Golani 2025). One of those migrant species is the Red Sea goatfish *Parupeneus forsskali* (Mullidae), a native of coral reefs in the Gulf of Aqaba (Ben-Tuvia & Kissil 1988). *Parupeneus forsskali* was first observed in the Mediterranean Sea at the southeastern coast of Turkey in 2000 and since then it has widened its range westward into the Aegean Sea (Çınar et al. 2006; Vagenas et al. 2024). The expansion of the range of *P. forsskali* indicates that the species has adapted itself to the Mediterranean habitats. Although growth and diet of *P. forsskali* in the Mediterranean have been studied (Vagenas et al. 2024; Michail et al. 2024), its interactions with native species have so far not been reported. Here I present three sets of observations of the feeding activities of *P. forsskali* in the company of native Mediterranean fish species.

The observations given here were made on different dates within the last three years while snorkeling in shallow (≤ 2 m) water near the shore at two locations along southern and southwestern Turkey. The number of fish were counted on photographs or video screenshots. The terminology of Lukoschek & McCormick (2000) was used to categorize the observed fish associations. Briefly, "attendant associations" have less than about 10 individuals and consist of one or two nuclear individuals of one species followed by individuals of one or more species. A subtype is a "following and scavenging" associations that are formed between large predatory carnivores, such as mullids as the nuclear individuals and one or more usually carnivorous followers. In contrast, "shoaling associations" are larger and the distinction between the leading and attending individuals is less clear.

I made two sets of observations in a cove at the western coast of the Gulf of Antalya (36.5271° N 30.5525° E). The first one was on 19 October 2023 when I photographed a feeding *P. forsskali* that was accompanied by two native white seabreams (*Diplodus sargus*) and three

juvenile fishes that appeared to be rivulated rabbitfishes (*Siganus rivulatus*) (Fig. 1). The latter species is also a migrant from the Red Sea (Louisy 2022). All five fishes were following the goatfish. Therefore, this small foraging association may be categorized as a following and scavenging type (Lukoschek & McCormick 2000). The second observation in the same cove was in the morning of 6 June 2025 at a near-shore reef at a depth of about 1.5 m. There I encountered a large shoal consisting of *P. forsskali* and three native Mediterranean species, three (one young adult and two juvenile) parrotfish (*Sparisoma cretense*), two rainbow wrasses (*Coris julis*) and two ornate wrasses (*Thalassoma pavo*) (Fig. 2A, B). The largest number of *P. forsskali* counted in any one photograph or video screenshot was 20, although in most photographs and screenshots 18 or 19 of them were visible. Two or three *P. forsskali* were adults and the rest were medium-sized juveniles. I followed the shoal for approximately 12 minutes from the surface while maintaining a distance of about 3 to 4 m between myself and the fish. The fish did not seem to be intimidated by my presence and moved along the bottom as a loosely connected group. The individual fish did not seem to interact with each other directly and each one foraged on its own. *Parupeneus forsskali* fed on rock surfaces and by digging in the sand. On several occasions I saw a large *P. forsskali* specimen swimming rapidly and erratically in the water column 30 to 40 cm above the bottom. The fish was apparently chasing a prey; in videos its distinctly white barbels could be seen moving quickly in the water, but the prey itself was not visible (Fig. 2C). I had not witnessed this behavior in this species before. The three *S. cretense* were visible among *P. forsskali* in almost all photographs and videos. They fed mostly on rock surfaces; on a few occasions the largest *S. cretense* fed from under rocks. At least one *C. julis* was visible in most photos and videos, while another *C. julis* and two *T. pavo* entered and left the shoal repeatedly. The presence of a relatively large number of individuals and the lack of any obvious interactions between the species suggest that the observed foraging association may be categorized as a shoaling association (as opposed to an attendant association) under the scheme of Lukoschek & McCormick (2000).

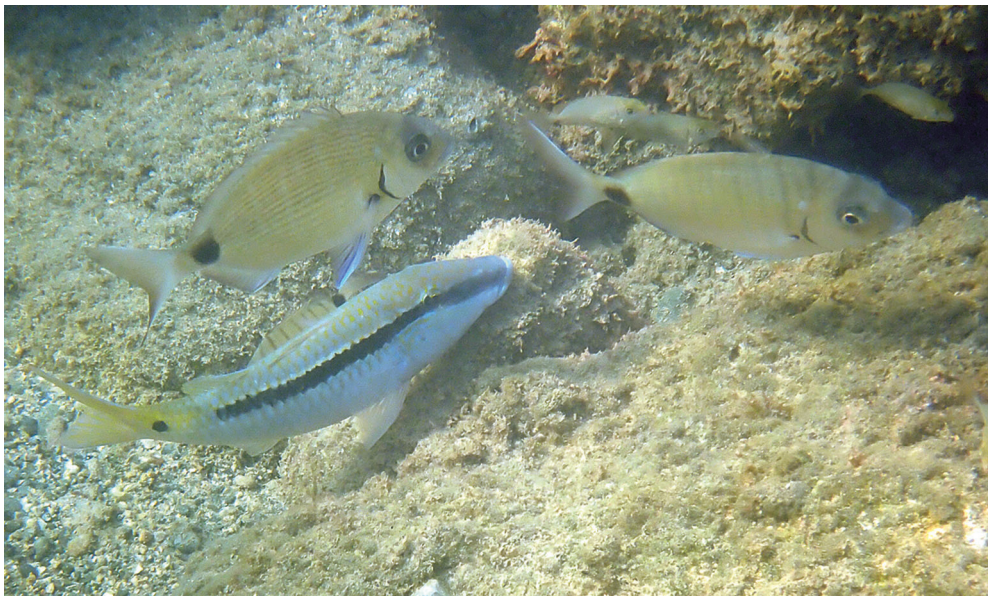

**Fig. 1:** *Parupeneus forsskali* feeding in the company of two *Diplodus sargus* and three juvenile *Siganus rivulatus* (in the background). Gulf of Antalya (36.5271° N 30.5525° E).
**Abb. 1:** Fressgemeinschaft von *Parupeneus forsskali* in Begleitung von zwei *Diplodus sargus* und drei Jungtieren von *Siganus rivulatus* (im Hintergrund). Golf von Antalya (36,5271° N 30,5525° E).

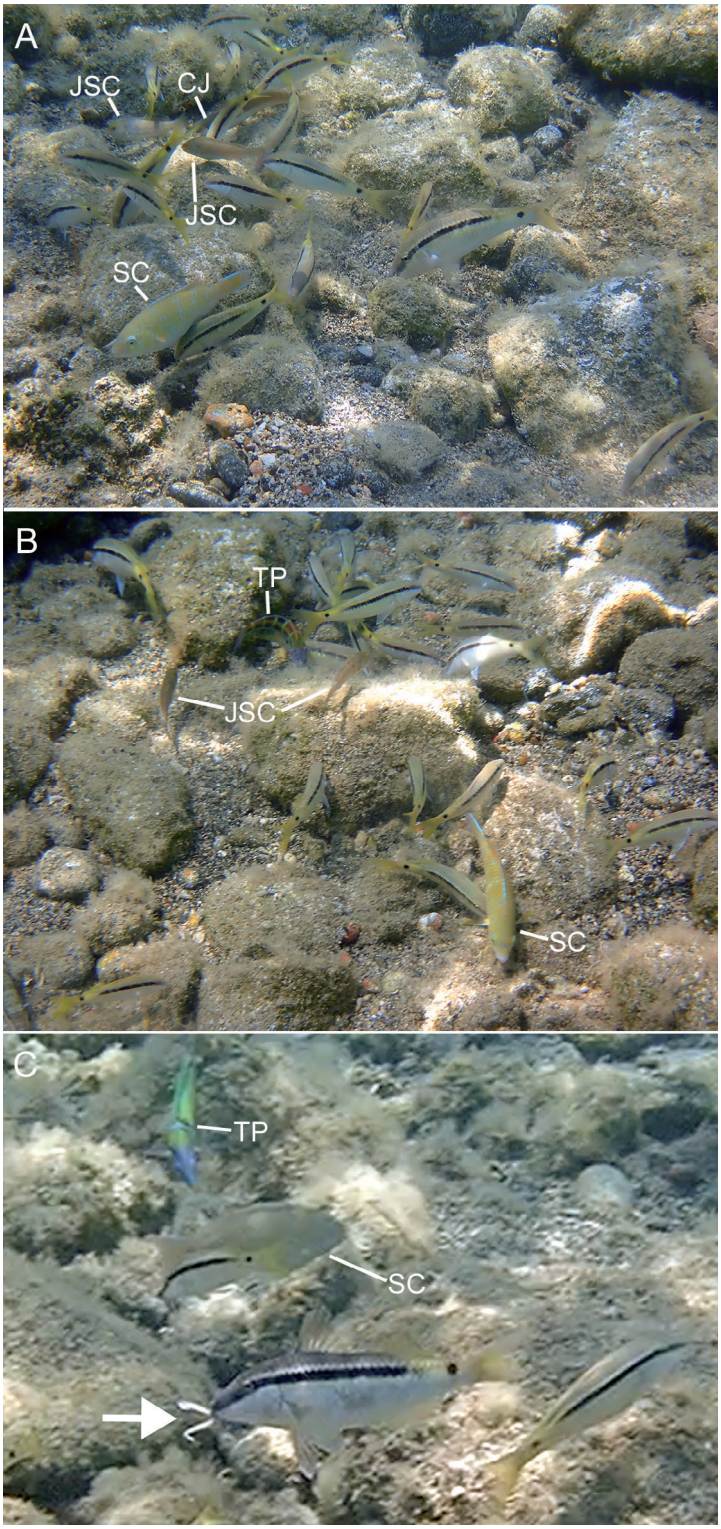


**Fig. 2:** A large shoaling association of *Parupeneus forsskali* with native Mediterranean fishes. **A** 18 *Parupeneus forsskali* with one young adult (SC) and two juvenile (JSC) *Sparisoma cretense* and one *Coris julis* (CJ). **B** 19 *Parupeneus forsskali* with three *Sparisoma cretense* and one *Thalassoma pavo* (TP). **C** Video screenshot of one of the largest *Parupeneus forsskali* apparently chasing a prey in the water column with its barbels extended anteriorly (arrow). Gulf of Antalya (36.5271° N 30.5525° E).

**Abb. 2:** Eine größere Fressgemeinschaft von *Parupeneus forsskali* mit heimischen Mittelmeerfischarten. **A** 18 *Parupeneus forsskali* mit einem jungen erwachsenen (SC) und zwei juvenilen (JSC) *Sparisoma cretense*, sowie einem *Coris julis* (CJ). **B** 19 *Parupeneus forsskali* mit drei *Sparisoma cretense* und einem *Thalassoma pavo* (TP). **C** Video screenshots von einem der größten *Parupeneus forsskali* Individuen während er offensichtlich mit nach vorne gestreckten Barteln (Pfeil) Beute im Freiwasser jagt. Golf von Antalya (36,5271° N 30,5525° E).

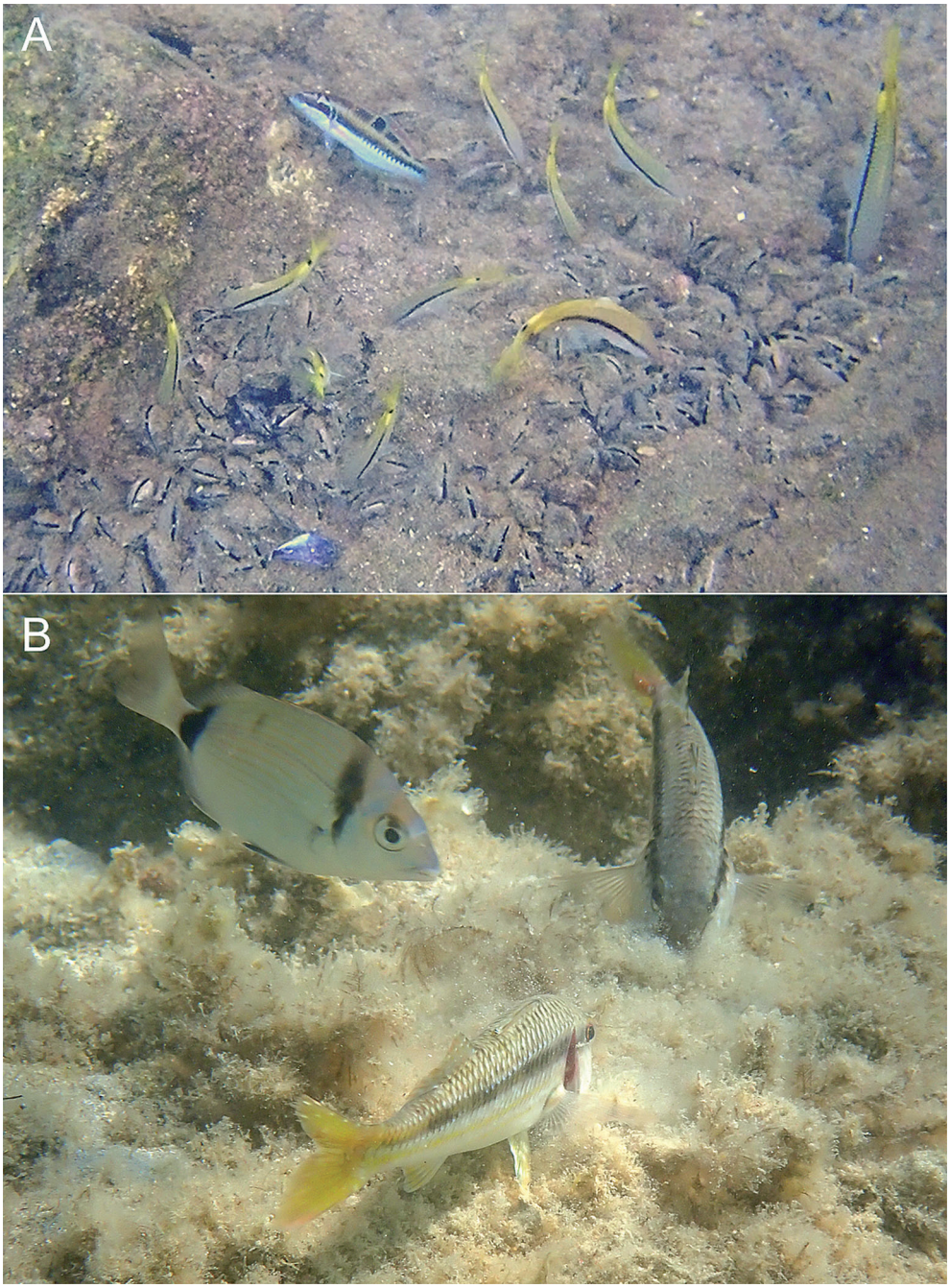


**Fig. 3: A** Adult and juvenile *Parupeneus forsskali* and one *Coris julis* feeding together. Gulf of Fethiye (36.6527° N 29.1042° E). **B** Two *Mullus surmuletus* feeding under the watchful eyes of a *Diplodus vulgaris*. Southern Karaburun Peninsula (38.2454° N 26.3793° E).

**Abb. 3: A** Adulte und juvenile *Parupeneus forsskali* und ein *Coris julis* fressen zusammen. Golf von Fethiye (36.6527° N 29.1042° E). **B** Zwei *Mullus surmuletus* fressen in Begleitung von einem *Diplodus vulgaris*. Südliche Karaburun Halbinsel (38,2454° N 26,3793° E).

The third observation was in the morning of 4 October 2024 at the shore of a small island in the Gulf of Fethiye (36.6530° N 29.1047° E). I encountered a shoal of 24 *P. forsskali* and one *C. julis* (Fig. 3A). Relative lengths of *P. forsskali* suggested that five were young adults while the rest were juveniles. I followed the shoal for about one minute. In this case the fish also moved together as a loose group and each individual foraged on its own. These limited observations suggest that although adult *P. forsskali* may forage without its conspecifics (Fig. 1), juveniles seem to prefer to feed in shoals (Fig. 2, Fig. 3A).

In its native habitat in the Red Sea, when *P. forsskali* is feeding, it attracts other fish species as followers (Zander 2016). Thus, the presence of follower species accompanying feeding *P. forsskali* in the Mediterranean is not unusual. Both adult and juvenile *P. forsskali* are carnivores and feed primarily on decapods, amphipods and polychaetes (Vagenas et al. 2024; Michail et al. 2024). The native *C. julis*, *T. pavo* and the *Diplodus* species are also carnivores, while *S. cretense* is an omnivore (Froese & Pauly 2026). Therefore, it is not surprising that these species can associate with *P. forsskali*. They are probably attracted by the prey-searching behavior of *P. forsskali*, especially its tendency to dig in the sand. In large shoals individual fish appeared to be feeding independently of each other (Fig. 2, Fig. 3A). However, being in the company of other fish is probably advantageous to each fish as their simultaneous search activities expose more prey items (Lukoschek & McCormick 2000).

There are two native mullids present throughout the Mediterranean, the striped red mullet (*Mullus surmuletus*) and the red mullet (*Mullus barbatus*), that are both carnivorous bottom feeders and have body dimensions similar to those of *P. forsskali* (Louisy 2022; Froese & Pauly 2026). *Mullus surmuletus* has a depth range that is shallower than that of *M. barbatus* and its feeding activities often attract small numbers of follower fish (De Pirro et al. 1999; Jaerisch et al. 2010). On numerous occasions in the Aegean Sea, I have observed *M. surmuletus* feeding in the company of usually one or two individuals of other native fish species forming following and scavenging type foraging associations (Fig. 3B). But I have not witnessed shoals of *M. surmuletus* containing as many fish as present in the second and third examples of shoaling associations of *P. forsskali* presented here. Studies of the diet of *P. forsskali* led Vagenas et al. 2024 and Michail et al. 2024 to suggest that competitive interactions may develop between *P. forsskali* and the native *Mullus* species. The observations presented here demonstrate that *P. forsskali* has incorporated itself into the Mediterranean feeding guilds and provide support for possible competition between *P. forsskali* and *M. surmuletus* as *P. forsskali* enters further into the territory of *M. surmuletus*.

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