J. Mar. Biol. Ass. U.K. (2001), **81**, 717–718
Printed in the United Kingdom

Occurrence of the Mediterranean parrotfish *Sparisoma cretense* (Perciformes: Scaridae) in south-eastern Apulia (south-east Italy)

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The Mediterranean parrotfish *Sparisoma cretense* is reported for the first time along the south-eastern coasts of Apulia (Ionian Sea, south-east Italy). Only juvenile specimens of *S. cretense* were observed during visual census surveys carried out in late August 2000, whereas adults were never observed in, or reported from, this region. Juvenile parrotfish were 3–4-cm long (TL), with a light-grey livery, pale-yellow heads and marked yellow margins around the eyes. They were recorded at 5–15 m depth, whereas they were absent near the surface (0–2 m depth) and in deeper areas (25–28 m depth). The possibility that climatic changes occurring in the Mediterranean basin (i.e. water warming) would be involved in the spreading of *S. cretense* outside its typical distribution range is discussed.

The Mediterranean parrotfish *Sparisoma cretense* (L.) is a necto-benthic fish mainly inhabiting rocky bottoms and sea grass beds between shallow waters and 50-m depth. It is a daytime feeder, grazing on algae, sea grasses and small invertebrates. Reproduction takes place between July and August–September (Petrakis & Papaconstantinou, 1990; De Girolamo et al., 1999). No data are so far available about the habitat requirements for juveniles and the recruitment period in the Mediterranean Sea. *Sparisoma cretense* is distributed in the eastern Atlantic from Senegal to Portugal. In the Mediterranean Sea, besides sporadic records from Giglio Island (Tuscan Archipelago, Italy; Bianchi & Morri, 1994) and the eastern Adriatic coasts (Bini, 1968), *S. cretense* is mainly distributed along the southern and eastern coasts of the basin (i.e. north Africa, Sicily and Aegean Sea; Vacchi et al., 1999a). This distribution pattern leads one to consider this fish to be among the so-called Mediterranean thermophilic southern species.

The northwards spread of thermophilic species has been considered by several authors as an indirect indication of the Mediterranean water warming. This seems particularly obvious when considering fish assemblages, whose changes in distribution patterns on a large spatial scale may reflect changes in the oceanographic–climatic conditions (Stephens et al., 1988).

Visual census surveys were carried out in late August 2000 at Torre del Serpe, located south of Otranto (southern Adriatic, Apulia, south-east Italy; Figure 1), which represents the geographic boundary separating the Ionian and Adriatic Seas. The stretch of coast studied is characterized by a calcarenitic plateau and vertical rocky walls, depending on depth. From the surface to ~ 5–6 m depth the rocky substrate is steep and chiefly covered by articulated Corallinaceae and *Cystoseira*. From 6–7 m to ~ 12–15 m depth there is a gently sloping plateau covered by photophilic algae with numerous medium–large boulders. Deeper, vertical or subvertical slopes may be observed from ~ 15 to 22–25 m, where the substrate mainly consists of so-called 'coralligenous formations' in the Mediterranean. At ~ 25–30 m depth, the slope decreases and the 'coralligenous formations' alternate with sand patches, which dominate in deeper areas. Visual censuses were carried out along transects 25-m long and 5-m wide. Transects were randomly placed at four bathymetric levels: 0–2 m, 5–7 m, 12–15 m, 25–28 m depth. Three sites (thereafter named as TS1, TS2 and TS3) were investigated at Torre del Serpe, with three replicates at each site and depth for a total of 36 visual censuses.

Abundance estimates of parrotfish at each site and depth level were expressed as number of individuals per 100 m^2. Analysis of variance was used to assess differences in the mean abundance of parrotfish. 'Site' was considered as the random factor and 'Depth' as the fixed orthogonal factor in the analysis.

All *S. cretense* recorded at Torre del Serpe were juveniles ~ 3–4 cm long (TL) with light-grey livery, pale-yellow heads and more marked yellow margins around the eyes. They were observed in all three sites investigated around Torre del Serpe at 5–7 m and 12–15 m depth, while no individuals were observed in very shallow waters nor at the deepest transects. No differences were detected among sites ($F=0.04$; $P=0.95$), while mean abundances significantly differed among depths ($F=25.8$; $P=0.001$), with densities at 5–7 m depth (mean ±SE: 1.3 ±0.3 ind 100 m^{-2} for all three sites) being lower than those recorded at 12–15 m depth (3.2 ±0.4 ind 100 m^{-2}) (Figure 2). The interaction 'Site×Depth' was not statistically significant ($F=0.22$; $P=0.97$), which permits assessment of the main effect of 'depth' on the distribution patterns of juvenile parrotfish.

The present note reports on the first record of early stages of the Mediterranean parrotfish *S. cretense* (3–4 cm TL) along the Italian coasts. The previous record of small-sized specimens from Ustica Island (Sicily, Italy; Vacchi et al., 1999a), and also from Kastellorizo Island (Dodecanese, Greece; Petrakis & Papaconstantinou, 1990), refer to specimens longer than 10 cm TL, which may be regarded as subadults. Due to the lack of literature data on habitat requirements and depth distribution of juvenile *S. cretense*, it is difficult to interpret the results obtained at Torre del Serpe. Juvenile fish were never observed below the margin of the rocky plateau around 12–15 m depth, where the bottom drops vertically to more

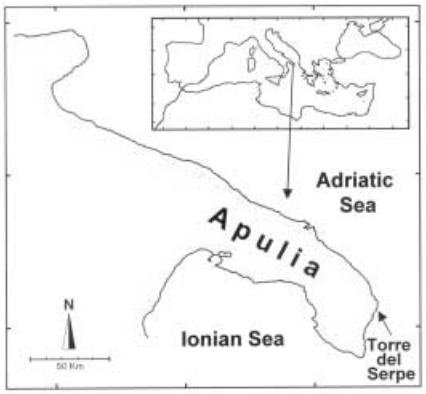

Figure 1. Location of the study area.

than 25-m depth. This suggests that the observed distribution pattern is hardly attributable to depth only, but is more likely related to the superimposed effects of sudden changes in the biotic cover and slope near the margin.

None of the several visual census surveys carried out from 1994 to 1997 on fish assemblages of the eastern Apulian coasts found juvenile and/or adult *S. cretense* (Marconato et al., 1996; Guidetti, 2000 and references therein). The origin of juvenile *S. cretense* observed at Otranto and the causes of the northwards expansion of the species cannot obviously be explained on the basis of these preliminary observations. Increasing numbers of recent observations indicate that a wide array of southern organisms (from algae to fish) are currently expanding their distributions northwards in the Mediterranean basin, a fact that has been interpreted as a signal of climate change (Bianchi & Morri, 1994; Francour et al., 1994; Astraldi et al., 1995; Vacchi et al., 1999b). The fact that we observed exclusively juvenile parrotfish does not agree with the patterns of spreading by Francour et al. (1994), who proposed that northern records of southern fish occur throughout migration of small numbers of adult specimens resulting in progressively increasing adult populations. Such a phase should be followed by recruitment and juveniles can then be found. At Torre del Serpe, however, adults were never observed. In addition, local fishermen never caught parrotfish neither know this species. The exclusive presence of juveniles could mean that eggs and/or larvae were carried by currents from other areas where adult spawners are present (Sicily or Greece?) throughout 'supply-side' mechanisms of dispersal. Then, *S. cretense* could have settled along the south-eastern Apulian coasts facing more favourable conditions than previously. However, may such conditions allow the establishment of well-structured populations in south-eastern Apulia? If the above hypotheses are true will be confirmed by future observations about the fate of these juvenile parrotfish (which will undergo less favourable conditions, such as low water temperatures during next winter) and by pluriannual observations of settlement events. This will highlight whether what occurred in summer 2000 was an exceptional event or if some change is actually happening, which would regularly favour the larval settlement of parrotfish. Subsequently, the establishment of true populations in areas like south-eastern Apulia, which are outside the typical distribution limits of *S. cretense*, will occur.

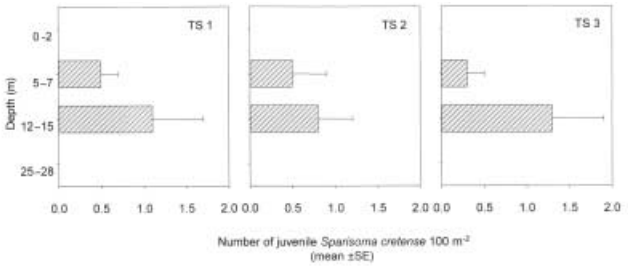

Figure 2. Mean abundance (SE) of juvenile parrotfish in the three sites (TS1, TS2, TS3) and at the four depth zones investigated.

Research funded by Regione Puglia (Interreg II Italy-Albany) and MURST (COFIN project). Thanks are due to J.G. Harmelin and M.L. Harmelin-Vivien for the critical reading of the text, and to three anonymous referees for their helpful suggestions.

REFERENCES

Astraldi, M., Bianchi, C.N., Gasparini, G.P. & Morri, C., 1995. Climatic fluctuations, current variability and marine species distribution: a case study in the Ligurian Sea (north-west Mediterranean). *Oceanologica Acta*, **18**, 139–149.

Bianchi, C.N. & Morri, C., 1994. Southern species in the Ligurian Sea (northern Mediterranean): new records and a review. *Bollettino dei Musei e degli Istituti Biologici dell'Università di Genova*, **58–59**, 181–187.

Bini, G., 1968. *Atlante dei pesci delle coste italiane*. Roma: Mondo Sommerso editrice.

De Girolamo, M., Scaggiante, M. & Rasotto, M.B., 1999. Social organization and sexual pattern in the Mediterranean parrotfish *Sparisoma cretense* (Teleostei: Scaridae). *Marine Biology*, **135**, 353–360.

Francour, P., Boudouresque, C.F., Harmelin, J.G., Harmelin-Vivien, M.L. & Quignard, J.P., 1994. Are the Mediterranean waters becoming warmer? Information from biological indicators. *Marine Pollution Bulletin*, **29**, 523–526.

Guidetti, P., 2000. Differences among fish assemblages associated with nearshore *Posidonia oceanica* sea grass beds, rocky-algal reefs and unvegetated sand habitats in the Adriatic Sea. *Estuarine, Coastal and Shelf Science*, **50**, 515–529.

Marconato, A., Mazzoldi, C., De Girolamo, M. & Stefanni, S., 1996. Analisi del popolamento ittico della zona infralitorale dell'oasi di Torre Guaceto (Br) con l'uso del 'visual census'. *Biologia Marina Mediterranea*, **3**, 152–154.

Petrakis, G. & Papaconstantinou, C., 1990. Biology of *Sparisoma cretense* in the Dodecanese (Greece). *Journal of Applied Ichthyology*, **6**, 14–23.

Stephens, J.S., Hose, J.H. & Love, M.S., 1988. Fish assemblages as indicators of environmental change in nearshore environments. In *Marine organisms as indicators* (ed. D.F. Soule and G.S. Kleppel), pp. 91–105. New York: Springer-Verlag.

Vacchi, M., Boyer, M., Bussotti, S., Guidetti, P. & La Mesa G., 1999a. Some interesting species in the coastal fish fauna of Ustica Island (Mediterranean Sea). *Cybium*, **23**, 323–331.

Vacchi, M., Sara, G., Morri, C., Modena, M., La Mesa, G., Guidetti, P. & Bianchi C.N., 1999b. Dynamics of marine populations and climate change: lessons from a Mediterranean fish. *Porcupine Marine Natural History Society Newsletter*, **3**, 13–17.

Submitted 16 January 2001. Accepted 3 April 2001.