

## Presence of 1 year-old dusky groupers along the French Mediterranean coast

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(Received 17 July 2002, Accepted 14 November 2002)

One year-old dusky groupers *Epinephelus marginatus* have been recently and regularly observed in different areas along the French Mediterranean coast. © 2003 The Fisheries Society of the British Isles

Key words: *Epinephelus*; grouper; Mediterranean; recruitment.

Since 1986 the number of observations of the dusky grouper *Epinephelus marginatus* (Lowe) along the French coast of the north-western Mediterranean Sea has steadily increased. Moreover, a change has been observed recently with a proportional increase of dusky groupers <40 cm total length ( $L_T$ ) (Francour & Finelli, 1991).

At the end of the 1980s, dusky groupers of 30–40 cm  $L_T$  were observed along the coast of the Department of Var, particularly in the Port-Cros National Park (Francour & Harmelin, 1988) and in the natural reserve of Scandola (Corsica) (Miniconi *et al.*, 1990; Francour & Finelli, 1991). Since 1990, groupers of 10 cm  $L_T$  have been reported in Corsica and along the coast of the Var (Lelong, 1993). A review of published and unpublished data was initiated by Francour & Ganteaume (1999) who analysed *c.* 150 dusky grouper ( $\leq 40$  cm  $L_T$ ) observations. This has been substantially improved in the present study with a review of *c.* 300 young dusky grouper observations. Several hypotheses highlighted in the study of Francour & Ganteaume (1999) were re-analysed and the recruitment of *E. marginatus* was characterized by addressing the following questions: Is the arrival of small groupers (<10 cm  $L_T$ ) along the Mediterranean French coast regular or not? Can a hypothesis be proposed to explain these new observations?

Observations of dusky groupers ( $\leq 40$  cm  $L_T$ ) were carried out by the members of the GEM (Groupe d'Etude du Mérou: <http://www.aquanaute.com/gem>) or by other scientists. In addition information was supplied by SCUBA and free divers with the help and support of the Biology Committee of the French Federation of Underwater Studies and Sports and different SCUBA diving clubs.

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The smallest individuals ( $\leq 25$  cm  $L_T$ ) were more frequently observed in shallow (0–25 m) water. Several individuals, however, between 20 and 25 cm were observed at a depth of  $\geq 30$  m. The largest individuals ( $25 < L_T \leq 40$  cm) were regularly observed at lower depths from 15 m to as deep as 60 m. All size groups were present in shallow waters (0–15 m depth).

Very small dusky groupers (2–3 cm), 1 month old, recruits from spawning in August (Marino *et al.*, 2001), were only observed during a short period of time (September to October). Individuals belonging to the size class 5–10 cm have been observed earlier, June in a few cases, but normally from July to August. These larger fish were probably recruited the previous year and so were 10–12 months old.

Even if information on dusky groupers along the Mediterranean coasts outside France is fragmentary and uncomplete, the presence of small groupers ( $\leq 20$  cm  $L_T$ ) may be a normal and regular phenomenon in the south of Spain (J. Mas, pers. comm.) and along the North African coasts (C. Chauvet, R. Semroud & D. Soltan, pers. comm.). In Sardinia, the observation of small individuals of *E. marginatus* (15–20 cm) was exceptional until 1989 (Russino *et al.*, 1991). For the south of Italy and the Adriatic Sea (Croatia), the presence of small dusky groupers ( $\leq 25$  cm  $L_T$ ) was reported recently, but little information was collected to describe the status of the assemblages of *E. marginatus* in these areas (S. Bussotti & P. Guidetti, pers. comm.).

The measured or estimated maximum and minimum sizes of dusky groupers observed between 1986 and 2001 are shown in Table I. The first groupers  $< 10$  cm  $L_T$  were observed in 1989 in Cerbère-Banyuls (only one individual) and in the south of Corsica (several observations) (Fig. 1). Many small dusky groupers were observed in Corsica (north and south) between 1990 and 1992, in 1996 and 2001. In 1992–1993, several observations were reported along the coast of the Var: mainly in the Port-Cros National Park and in Les Embiez Island. During 1996–1997, observations of small dusky groupers were made in Monaco and the Port-Cros National Park. In 1999, other observations of small dusky groupers were reported in the Côte Bleue Marine Park and in 2001 in the Port-Cros National Park and in the south of Corsica.

In Corsica and Sardinia, recruitment may have occurred in 1990 and 1991 and each year from 1995 till 2001 (except perhaps in 1997). For this area, data for 1991–1994 are missing. For the French coast (Corsica excluded) recruitment may have occurred in 1991, 1992, 1994 and each year since 1996. The observations of dusky groupers collected for the year 2002 were not sufficient to make conclusions about recruitment in 2001. In a few cases the very small size of the observed individuals ( $< 5$  cm  $L_T$ ) suggests that spawning occurred near the site of observation. In the other cases recruitment was assumed after observations of 1 year-old groupers the following year. These spawning areas correspond with suppositions made by Louisy & Culioli (1999) about the known or suspected reproductive sites of the dusky grouper in the north-western Mediterranean Sea: Corsica (Revellata, Lavezzi Islands), Var (Les Embiez, National Park of Port-Cros), Pyrénées-Orientales coasts (the Marine Reserve of Cerbère-Banyuls) and Spain (the Medes Islands) (Fig. 1).

Several factors may be responsible for the regular recruitment on the French coast since 1995: (1) a possible modification of the sex ratio caused by the settlement of small size dusky groupers, that now gives an advantage to females (young dusky groupers, *i.e.* females were absent from the French coast before 1990, Chauvet & Francour,

TABLE I. Summary of the length ranges observed of *Epinephelus marginatus* <40 cm  $L_T$ , on the French Mediterranean coast. The information is classified by areas (see Fig. 1), from the south to the north, then from the east to the west, *i.e.* in the direction of the Liguro-Provençal current. Places and years yielding several observations of small individuals ( $L_T < 10$  cm) are in bold

Year	South Corsica	North Corsica	Liguria	Monaco Cannes	Cavalaire	Port-Cros	Giens	Toulon	Embiez	Côte Bleue	Golfe du Lion	Cerbère-Banyuls
1986–87						30–40						
1988	7–7	40–40				40–40				44–44		
1989	8–8					40–40	30–40				20–30	5–10
1990	<b>7–16</b>	<b>7–40</b>				8–40						
1991		<b>5–17</b>			30–40	30–40		4–4			20–30	
1992		<b>10–25</b>		15–15	30–40	20–40	30–40		<b>2–40</b>	40–42	20–30	15–40
1993	20–20	20–35				<b>10–40</b>	10–10		<b>11–13</b>	36–40		25–40
1994					30–40	30–40			22–22			30–40
1995		30–40			30–40	30–40	5–40	30–40				
1996	15–15	<b>5–10</b>	15–20		30–40	<b>5–40</b>						
1997	5–10	30–40	15–30	<b>10–35</b>	20–30	<b>10–40</b>	20–40	25–40	35–35			
1998	15–15	35–40	15–20	15–40		3–40	25–35	5–35	15–15	10–17		
1999	7.5–7.5	8–8			25–25	15–45	15–15	5–40		<b>7.5–40</b>		16–16
2000	7.5–15			15–40		7.5–15		8–8		15–15		25–25
2001	<b>5–15</b>			15–30		<b>7.5–25</b>		17–17				

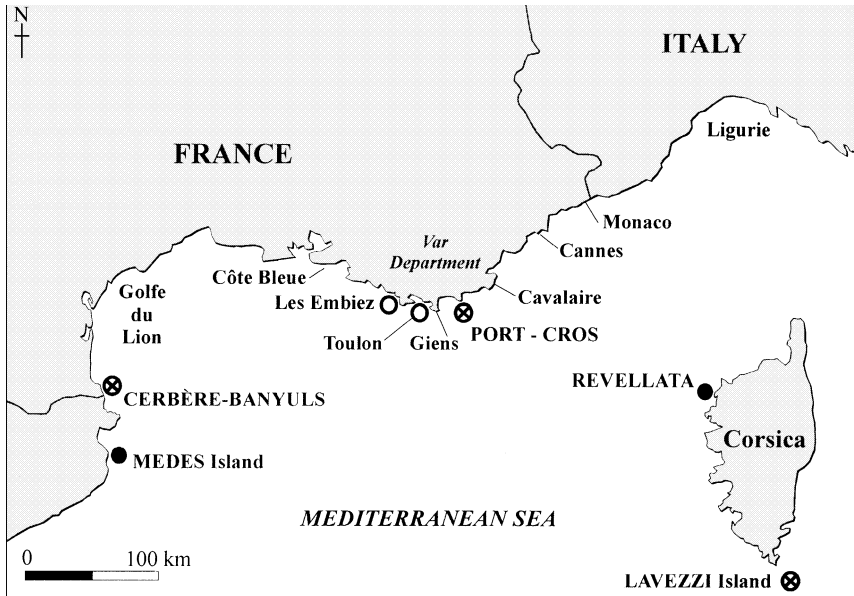


FIG. 1. Map of the main known or suspected reproductive sites of the dusky grouper in the north-western Mediterranean Sea (modified from Louisy & Culioli, 1999). ○, possible reproduction activity; ⊗, observed reproduction activity; ●, observed spawning. Upper case letters, marine protected areas.

1990); (2) the partial protection of the species brought by a moratorium (1993–2002); (3) the warming of the waters of the Mediterranean Sea (Francour *et al.*, 1994).

Despite these changes, the long life-span of *E. marginatus* (>30 years) and the age of sex change (between 10 and 15 years) make the impact of young dusky groupers on present adult populations limited. In addition, a possible removal of the legal protection of dusky groupers in France in January 2003 and a resumption of spearfishing could have an adverse impact on populations.

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