



ORIGINAL ARTICLE

***Gaidropsarus granti* from a Ligurian seamount: a Mediterranean native species?**

Lidia Orsi Relini & Giulio Relini

Dipartimento di Scienze della Terra, dell'Ambiente e della Vita – DISTAV, Centro di Biologia Marina del Mar Ligure, Università di Genova, Genova, Italia

KeywordsDeep rocky substrata; Gadidae; *Gaidropsarus granti*; Ligurian Sea.**Correspondence**Lidia Orsi Relini, Centro di Biologia Marina del Mar Ligure, Dipartimento di Scienze della Terra, dell'Ambiente e della Vita – DISTAV, University of Genoa, Genoa, Italy.
E-mail: largepel@unige.it

Accepted: 9 September 2013

doi: 10.1111/maec.12122

Abstract

Two specimens of the Azorean rockling *Gaidropsarus granti* (Regan 1903) were caught in the period August 1989–January 1990 on a seamount located about 29 nautical miles south of Genoa, Ligurian Sea. The records remained unpublished because of errors in the literature concerning the two Macaronesian species *Gaidropsarus granti* and *Gaidropsarus guttatus*. Old and recent records of *G. granti* are now used to characterize morphological and ecological traits of this species. In particular, *G. granti* is unmistakably adapted to a sedentary life on hard substrata, and all records occurred in offshore slope waters, frequently on banks and seamounts. Ecological characteristics and biogeographical considerations are introduced in the discussion about the origin of the Mediterranean records of *G. granti*, specifically whether this fish should be considered an introduced or a native species.

Introduction

Because of the difficulties of sampling, deep-sea hard bottoms are little known environments and this lack of knowledge applies to fish. About 28.6 nautical miles (nm) south of Genoa, the eastern wall of the submarine canyon of the Bisagno River rises in a seamount (Fig. 1) whose top reaches 550 m under the sea surface from a base at about 2200 m on the bottom of the canyon. Named 'secca di Ulisse' (Ulysses Seamount), this peak is a popular fishing site for semi-professional and recreational fishermen, who reach the seamount with gear called 'filaccioni', arrays of hooks around a weighted rope that connects them to a float.

The edible species obtained by this method include *Pagellus bogaraveo*, *Merluccius merluccius*, *Schedophilus ovalis*, *Centrolophus niger*, *Polyprion americanus*, *Epigonus telescopus*, *Palinurus mauritanicus*, *Paromola cuvieri*. An amateur fisherman, Bruno Fida, preserved for us two specimens of a *Gaidropsarus* (in his opinion a nonedible species), which were identified as *Gaidropsarus granti* (Regan 1903). This rare deep-living species was discovered about a century ago in the Azores and later was confused with the shallow-water species *Gaidropsarus*

guttatus (Collett 1890), known from Madeira, the Azores and the Canaries. These notes report the presence of *G. granti* in the northernmost area of the Western Mediterranean and clarify its morphological and ecological characteristics in comparison with the other Macaronesian species, *G. guttatus*. Several records of *G. granti* in Italian waters remain unpublished or are confused with other *Gaidropsarus* species, and there is current debate about whether *G. granti* should be considered an introduced or a native species (*cf.* Golani *et al.* 2002).

Material Examined

Two specimens, total length (TL) 25.5 and 27.8 cm, caught using filaccioni on the Ulysses Seamount between 550 and 700 m depth, in the period August 1989–January 1990, were preserved by freezing. After formalin fixation these fish are now in the present laboratory collection. Their main biometric and meristic characteristics are given in Table 1. A third specimen was obtained more recently by trawl (not used for radiograph).

The following summary description of these specimens is in accordance with *Gaidropsarus granti* (Regan 1903): a

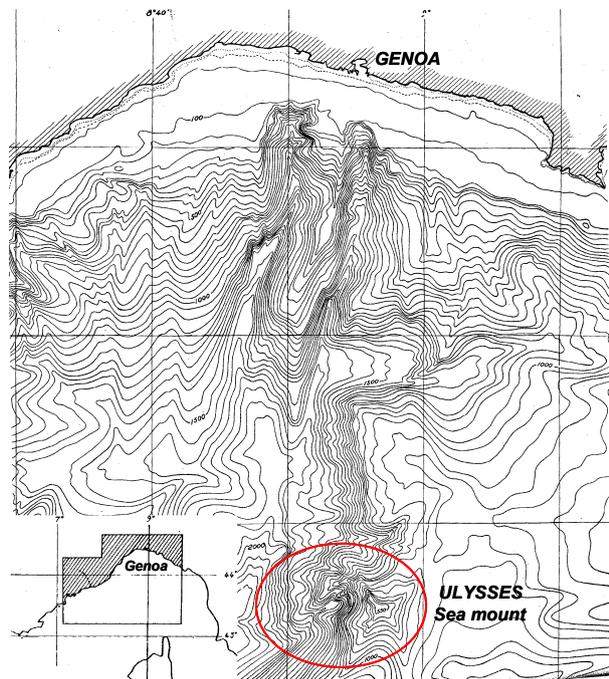


Fig. 1. Geographical location of the Ulysses Seamount.

Table 1. Biometric (measurements in cm) and meristic characteristics (N) of two specimens of *Gaidropsarus granti* caught on the offshore seamount of the Ligurian Sea.

| | 1st specimen | 2nd specimen |
|-----------------------------|--------------|--------------|
| Total length | 25.5 | 27.8 |
| Standard length | 23.2 | 25.0 |
| Head length | 5.5 | 6.0 |
| Eye longest diameter | 0.9 | 0.9 |
| Interorbital space | 0.8 | 0.9 |
| Pectoral length | 3.2 | 3.5 |
| Pelvic length | 3.6 | 4.9 |
| II Predorsal length | 8.8 | 9.3 |
| Preanal length | 12.0 | 13.7 |
| Vertebrae ^a | 47.0 | 47.0 |
| II Dorsal rays ^a | 57.0 | 58.0 |
| Anal rays ^a | 46.0 | 45.0 |
| Pectoral rays | 22.0 | 21.0 |

^aCounted on radiographs.

species with a short anterior ray of first dorsal fin (ray length less than eye diameter), with a large head (total length/head length ratio 4.7), 57–58 rays in the second dorsal fin, 45–46 in the anal fin, and 21–22 in the pectoral fin. Gillrakers in the form of dentated tubercles, five on the outer side of the first arch and seven on the inner side. The lateral line is inconspicuous, with 15 distinct units in the segment extending from the opercular rim to the bent (lateral line inflexion) included. Interorbital



Fig. 2. *Gaidropsarus granti*, adult female, 27.8 cm TL, Ligurian Sea.

space is slightly less than the longitudinal diameter of the eye. Teeth lie in large dense bands of conical elements with large sparse back-deflected canines, in numbers varying with size/age. The colour is deep pink, mottled by brown irregular blotches and lines. Dentition consists of bands of densely packed small conical elements and sparse larger canines on upper and lower jaws and vomer. In the present specimens the number of canines (by increasing size of fish) were: 3–5 in the upper jaw; 11–13 in the lower jaw and 3–4 on the vomer. The freshly caught fish were deep pink in colour, with brown blotches that formed asymmetrical patterns on the upper part of the body. In preserved specimens (Fig. 2) the pink colour vanishes, and is replaced by a cream base on which brown patterns become apparent. The lower surfaces are all cream, including the head. The upper part of the body has three longitudinal brown stripes, one dorsal and two dorso-lateral, separated by a light band, with a somewhat zigzagged contour. On the head the brown is interrupted by light spots and curved stripes; ventrally and in the tail region the dorso-lateral brown bands break into spots. Under the dorso-lateral brown band, are one or two irregular rows of spots, the most ventral smaller. Comparing the three available specimens, individual patterns are evident, particularly in the anterior half of the body. The dorsal fin is brown with a central longitudinal light band; pectoral and caudal fins cream with brown blotches; ventral fins all cream. The smallest specimens had red edges on dorsal and anal fins.

The first specimen appeared heavily infested by juvenile Nematoda; its gonads were very small and degenerated and included worms in the parenchyma. The second, and largest, fish had a spent-recovering ovary. Remains of crustacean decapods, in part still red in colour, were found in the guts of the two fish.

Discussion

Little is known about *Gaidropsarus granti*. It was described by Regan (1903) on the basis of two individuals, both 39 mm TL, which Mr O. Grant obtained in the Azores with the help of Major Chaves, director of the Museum of Ponta Delgada. In the 1990s only one type specimen could be found in the British Natural History Museum. In 1993, upon our request for information, A.

Wheeler was kind enough to show us an extract from a revision he was preparing on *Gaidropsarus*, giving the following characteristics (Table 2): second dorsal fin 60, anal rays 52, pectoral rays 21–21, pelvic rays 8/8, vertebrae 14+33 (on the basis of radiographs). He added: ‘Regan’s second type specimen may have been returned to the Azores Museum. It seems to have disappeared’ (letter of 4 May 1993).

The literature such as FNAM (Svetovidov 1986b), CLOFETA (Cohen 1990), FAO fisheries synopsis number 125 (Cohen *et al.* 1990) and FISHBASE (Froese & Pauly 2010) reports the capture of other individuals of *G. granti* in the Atlantic, but these reports derive from the confusion with another species. In fact, Collett, who had described *Gaidropsarus guttatus* based on two young specimens taken at Fayal during the Prince of Monaco’s cruise around the Azores in 1887 (Collett 1890, 1896), came back to the subject in 1905, adding information taken from two other specimens: one collected at Gran Canaria in shallow water, studied by Steindachner (1891), and a second fish obtained from the above-mentioned Major Chaves of Punta Delgada Museum.

While Collett (1905) was writing about *G. guttatus*, Svetovidov (1973, 1986a,b) assigned the two specimens of Collett (1905) to *G. granti*; *ipso facto* the distribution area

of *G. granti* was extended to the Canary archipelago and the habitat to shallow waters. Also Brito (1991) notes that the fish in the Canary archipelago are in fact those Steindachner identified (1891). The decision of Svetovidov is somewhat incomprehensible; in fact, he did not examine the specimens, as he himself states (1986a) excluding *G. granti* from his key to the genus *Gaidropsarus*. He wrote: ‘Not included in the Key, as it was not studied on the basis of specimens’. However in FNAM (Svetovidov 1986b) he prepared a key of genus *Gaidropsarus* in which the vertebral number 44 is assigned to this species. This point is a mistake (see Table 2) and must be disregarded.

The first fish (Table 2) that was collected at Gran Canaria had meristic data and colour very different from those of *G. granti*. The second fish (Table 2), a fully grown female of 32.2 cm TL, had a coloration somewhat different from that of the two individuals (18.3 and 21.3 cm TL) described by Collett (1890) as the species *G. guttatus*, but Collett (1905) also stated that ‘the fins and the number of their rays exhibit no divergence’ (Collett 1890; had given 2a Dorsal 50–54; Anal 43–46; Pectoral 16–17; Ventral 7). Thus this specimen was also definitely *G. guttatus*, not *G. granti*. On the basis of the old samples mentioned, the extension of the distribution of *G. granti* to the Canary Archipelago should be rejected. About a century later, a

Table 2. Main meristic data (numbers), morphological characteristics and habitat of two Macaronesian species of *Gaidropsarus*.

| | 2° dorsal | Anal | Pectoral | Ventral | Vertebrae | Total length (cm) | Colour | Habitat | References |
|--------------------|-----------|-------|----------|---------|-----------|-------------------|---------------------|-------------------------|---|
| <i>G. granti</i> | | | | | | | | | |
| type, Azores | 60 | 48 | 21 | 7 | – | 39 | Deep pink | Unknown | Regan (1903) |
| syntype, Azores | 60 | 52 | 21 | 8 | 47 | 39 | with brown blotches | Unknown | Wheeler (<i>in litteris</i> , 1993) |
| Ligurian Sea 1 | 57 | 46 | 22 | 7 | 47 | 25.5 | and stripes | Seamount – 550–700 m | Present note |
| Ligurian Sea 2 | 58 | 45 | 21 | 7 | 47 | 27.8 | | Seamount – 550–700 m | Present note |
| Rhodes | 56 | 47 | 20 | 7 | – | 31 | | Sand-360–400 m | Zachariou-Mamalinga (1999) |
| Galician bank | 56 | 51 | 21 | 7 | – | 33.8 | | Offshore bank 823 m | Bañón <i>et al.</i> (2002) |
| Sardinia 1 | 55 | 47 | 20 | 7 | 47 | 24.5 | | Slope mount – 120–136 m | Mura & Cau (2003) |
| Sardinia 2 | 60 | 49 | 20 | 7 | 47 | 31.9 | | Slope – 250 m | Pais <i>et al.</i> (2008) |
| FNAM | 60 | 52 | – | – | 44 | – | | | Svetovidov (1986a,b) |
| <i>G. guttatus</i> | | | | | | | | | |
| Azores (Fayal) | 50–54 | 43–46 | 16–17 | 7 | – | 18.3; 21.3 | Dark brown | Shallow water | Collett (1890) |
| Gran Canaria | 50 | 43 | 16 | – | – | 26 | with yellow spots | rocky bottoms | Steindachner (1891) and Collett, (1905) |
| Azores (S. Miguel) | a | a | a | a | a | 32 | | | Collett (1905) |
| FNAM | 53–57 | 45–49 | 17–19 | 7 | 47–49 | – | | | Svetovidov (1986a,b) |

^aNo divergences in respect of the types’ (Collett 1905).

study of fish of the Canarian slope did not include any *Gaidropsarus* (Uiblein *et al.* 1998).

Therefore, when the FNAM was published (1986) the sole available data about *G. granti* were those given in the description of the type by Regan (1903) and/or possibly derived by the study of the syntype. Since recording the present specimens in the Ligurian Sea, new information on this species has been accumulated:

- 1 A specimen of *G. granti* was collected in the Eastern Aegean Sea, at Rhodes. The fish, 31 cm TL (meristics in Table 2), has been ascribed to an accidental transport through the Strait of Gibraltar (Zachariou-Mamalinga 1999) (Table 2).
- 2 The Department of Oceanography of Fayal, Azores sampled new specimens (unpublished); a sample was lent to us for comparative studies.
- 3 One individual was found on an offshore bank at 823 m depth (Table 2) in North Spain (Bañón *et al.* 2002). The fish might indicate a northward expansion of the distribution area in relation to ocean warming.
- 4 *Gaidropsarus granti* was last found in the Canary Archipelago: in fact, one specimen was fished north of Lanzarote at 300 m depth (Brito *et al.* 2002).
- 5 Two individual fish were caught in Sardinia (Mura & Cau 2003; Pais *et al.* 2008). The latter paper tried to confirm an Atlantic origin of the fish by means of its parasites. However, *Anisakis simplex sensu strictu* larvae previously assigned to Atlantic areas, were more recently found in the Central Mediterranean (Algeria, Tunisia and Libya) in fish characterized by pelagic feeding, such as *Scomber scombrus* and *Merluccius merluccius* (Farjallah *et al.* 2008).

Thus the Mediterranean hosts four species of *Gaidropsarus*, two of coastal shelf waters, namely *Gaidropsarus vulgaris* and *Gaidropsarus mediterraneus*, and two deep eurybathic species, *Gaidropsarus biscayensis* and *G. granti*. *Gaidropsarus biscayensis* lives on muddy bottoms at circalittoral levels (100–200 m) and along the slope to 750 m (from results from national fisheries surveys in Ligurian waters; bottoms deeper than 750 m were not explored). *Gaidropsarus granti* in the Ligurian Sea was found on the hard substrata of the Ulysses Seamount between 500 and 700 m depth, and more recently also at 500 and 300 m (unpublished specimens). In Sardinia it was found at 120–136 m and 250 m; interestingly, the former location was a slope mount named 'banghittu', isolated from the shelf (Mura & Cau 2003).

The Macaronesian species *G. guttatus* is similar to *G. mediterraneus* in having in common the meristics and the general dark brown coloration, and inhabiting rocky environments in shallow waters. These could probably be considered the same species with two different colour patterns, mottled and uniform brown. It is interesting

that Mediterranean specimens of *G. mediterraneus* sometimes have irregular light spots on their dark brown dorsal and lateral surfaces, as we have verified in the collection of the Museum of Natural History of Genoa.

The peculiar coloration of *G. granti* makes this species unmistakable. Such a colour pattern has disruptive properties (an appropriate name should be 'leopard rockling') and suits a sedentary fish, which during the day rests on illuminated substrata. The top of banks and seamounts present such an environment. The presence in the stomach contents of crustacean decapods, all red in colour, recall pelagic prey and probably indicates important vertical displacements in relation to feeding, which could be nocturnal in the water column, as is the case in general for gadoid fish.

From a geographical point of view, available records of the fish are from the Atlantic (Azores, Lanzarote, Galician bank, an offshore Lusitanian area) and the Mediterranean [Aegean, Adriatic (*G. Bello*, personal communication), Tyrrhenian, Ligurian and Ionian Seas]. The specimens collected in the Mediterranean are smaller (maximum TL about 32 cm) than the Azorean ones (type and syntype 39 cm TL, Table 2), suggesting the existence of a Mediterranean population.

On the basis of this additional information, we face two possibilities:

- 1 Mediterranean specimens are not native.
- 2 Mediterranean specimens have been concealed till now by their unusual habitat such as offshore banks and deep-seamounts, but they are a native component of the Mediterranean fauna.

In terms of fish fauna, the biogeographical links between the Mediterranean and the Azores to date seem to be one-way, i.e. from the Mediterranean to the Azores. It is generally assumed that after the Messinian crisis, the Mediterranean Sea was recolonized by Atlantic species between about 5 and 4 million years ago, as soon as a permanent communication was restored in the area of Gibraltar. About the same age as the post-Messinian Mediterranean is assigned to the Azores archipelago, a complex of islands which are the result of the volcanic activity associated with the Azorean microplate, a hot point where North American, Euroasiatic and African plates come in contact (Morton *et al.* 1998). In fact, the oldest of nine oceanic islands, S. Maria and S. Miguel, are considered about 5 million years old.

Gibraltar Strait itself, where the old Mediterranean exported its species to, is at present surrounded by Lusitanian and Mauritanian areas (*sensu* Ekman 1953), which seem the most probable sources of the present fish fauna present in both the Mediterranean and the Azores.

The coastal fish fauna of the Azores includes about 100 species, 80% of which are found in the Mediterranean;

the main fishery resources, in terms on finfish, are included in this group (Morton *et al.* 1998). To explain this large Mediterranean affinity, apparently in contrast to the fact that the main surface currents that surround the archipelago flow from the West, we must recall that the Gulf Stream is recent, <3 million years old (Cronin & Dowsett 1996). The Macaronesian shallow water species *G. guttatus*, which is very close to *G. mediterraneus*, could be related to ancient Mediterranean links. At present, similar links pertain not to surface but to deep-sea fauna; in fact, Mediterranean deep waters flow out of Gibraltar and have been traced in large Atlantic areas, including the Mid-Atlantic Ridge, which forms the Azores. The deep-sea gadoid fishes of the Mediterranean are all present in the Atlantic, with the exception of *Lepidion lepidion*, which is still considered endemic. Many other fish previously supposed endemic have been found recently outside of Gibraltar, including *Rhincogadus hepaticus* and *Eretmophorus kleinenbergi* (Quignard & Tomasini 2000). So at present the hypothesis of a Mediterranean origin of the Azorean rockling cannot be rejected, nor can the idea that the Mediterranean population is native. The growing numbers of Mediterranean records related to the Atlantic ones reinforce this interpretation.

Acknowledgements

B. Fida preserved the Ligurian specimens of this study. R. Sero Santos and F. Porteiro of the Department of Oceanography of Fayal, Azores, sent materials in their care. R. Poggi and G. Doria, Museum of Natural History of Genoa, gave friendly assistance with the collections. D. Golani, E. Massuti and J. P. Quignard discussed the possible position of *G. granti* in the CIESM Fish Atlas at a preparatory meeting in Monaco, on the basis of three Ligurian specimens and the photos of the Rhodes specimen.

References

- Bañón R., Del Rio J.L., Piñeiro C., Casas M. (2002) Occurrence of tropical affinity fish in Galician waters, north-west Spain. *Journal of Marine Biological Association UK*, **82**, 877–880.
- Brito A. (1991) *Catálogo de los Peces de las Islas Canarias*. Francisco Lemus, La Laguna: 230.
- Brito A., Pascal P.J., Falcon J.M., Sancho A., Gonzales G. (2002) *Peces de las Islas Canarias. Catalogo Comentado e Ilustrado*. Francisco Lemus, La Laguna: 419 pp.
- Cohen D.M. (1990) Gadidae. In: Quero J.C., Hureau J.C., Karrer C., Post A., Saldanha L. (Eds), *Check-list of the Fishes of Eastern Tropical Atlantic (CLOFETA)*, Vol. 2. Junta Nacional de Investigaçao Cientifica e Tecnológica, Lisbon: 520–1079.
- Cohen D.M., Inada T., Iwamoto T., Scialabba N. (1990) FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis. No. 125, Vol. 10. Rome, FAO. 442p.
- Collett R. (1890) Diagnoses de poisson nouveaux provenant des campagnes de l'Hirondelle. *Bulletin de la Societe Zoologique de France*, **15**, 105–109.
- Collett R. (1896) Poissons provenant des campagnes du yacht l'Hirondelle (1885–1888). *Résultats des campagnes scientifiques du Prince de Monaco*, **10**, 1–198, pls.1–6.
- Collett R. (1905) On some fishes from the sea off the Azores. *Zoologischer Anzeiger*, **27**, 723–730.
- Cronin T.M., Dowsett H.J. (1996) Biotic and oceanographic response to the Pliocene closing of the Central American Isthmus. In: Jackson J.B.C., Budd A.F., Coates A.G. (Eds), *Evolution and Environment in Tropical America*. University of Chicago Press, Chicago: 76–104.
- Ekman S. (1953) *Zoogeography of the Sea*. Sidgwick and Jackson, London: 417 pp.
- Farjallah S., Slimane B.B., Busi M., Paggi L., Amor N., Bled H., Said K., D'Amelio S. (2008) Occurrence and molecular identification of *Anisakis* spp. from the North African coasts of Mediterranean Sea. *Parasitology Research*, **102**, 371–379.
- Froese R., Pauly D. (Eds) (2010) FishBase World Wide Web electronic publication. www.fishbase.org.
- Golani D., Orsi Relini L., Massuti E., Quignard J.P. (2002) Fishes. In: Briand F. (Ed.), *CIESM Atlas of Exotic Species in the Mediterranean*, Vol. 1. CIESM Publisher, Monaco: 256. www.ciesm.org
- Morton B., Britton J.C., Frias D.E., Martius A.M. (1998) *Ecologia costeira dos Açores. Soc. A. Chaves, Ass. Estudos Azoreanos Ponta Delgada, São Miguel, Açores*: 249.
- Mura M., Cau A. (2003) Sulla presenza di *Gaidropsarus granti* (Regan, 1903) (Osteichthyes, Gadidae) nel Mediterraneo centro-occidentale. *Biology Marine Mediterranean* **10**: 866–869.
- Pais A., Merella P., Follés M.C., Garippa G., Golani D. (2008) New data on *Gaidropsarus granti* (Regan, 1903) (Gadiformes: Lotidae) from the Mediterranean Sea, with emphasis on its parasites. *Science Marine*, **72**, 461–468.
- Quignard J.P., Tomasini J.A. (2000) Mediterranean fish biodiversity. *Biology Marine Mediterranean*, **7**, 1–66.
- Regan C.T. (1903) On a collection of fishes from the Azores. *Annals and Magazine of Natural History*, **12**, 346–348.
- Steindachner F. (1891) *Ueber einige seltene und neue Fischcharte aus dem Canarischen Archipel. Ichthyologische Beiträge*, 15 Sitzungsber. Akademie der Wissenschaften, Wien: 343–361.
- Svetovidov A.N. (1973) Gadidae. In: Hureau J.C & Monod Th. (Eds), *Check-list of the Fishes of the North-eastern Atlantic and of the Mediterranean*. UNESCO, Paris: 303–320.

- Svetovidov A.N. (1986a) Review of the three-bearded rocklings of the genus *Gaidropsaurus* Rafinesque, 1810 (Gadidae) with description of a new species. *Journal of Ichthyology*, **62**, 115–135. (translation of an article in *Voprosy Iktiologii*).
- Svetovidov A.N. (1986b) Gadidae. In: Whitehead P.J.P., Bauchot M.L., Hureau J.C., Nilsen J., Tortonese E. (Eds), *Fish of the North-eastern Atlantic and the Mediterranean*, Vol. 2. United Nations Educational, Scientific and Cultural Organization, Paris: 521–1014.
- Uiblein F., Bordes F., Castillo R., Ramos A.G. (1998) Spatial distribution of shelf- and slope-dwelling species collected by bottom longline off Lanzarote and Fuerteventura, Canary Islands. *Marine Ecology*, **19**, 53–66.
- Zachariou-Mamalinga H. (1999) The occurrence of the Atlantic fish *Gaidropsarus granti* in the Mediterranean Sea (South-Eastern Aegean Sea, Dodecanese, Greece, Eastern Mediterranean). *Annales Musei Goulandris*, **10**, 261–266.