

**FIRST VALID RECORD OF *Gymnothorax vicinus*  
(PISCES: MURAENIDAE) FOR MACARONESIAN ECOREGION  
(CANARY ISLANDS): A PROCESS OF TROPICALIZATION?**

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**RESUMEN**

Se registra por primera vez en Canarias la presencia de la morena *Gymnothorax vicinus* (Castelnau, 1855), demostrando que los registros previos existentes para Canarias, Madeira y Azores se debieron a errores de identificación. La detección de esta especie tropical en 2008 en la isla de El Hierro —la de aguas más cálidas de la ecoregión macaronésica— inicialmente nos condujo a pensar en un proceso de colonización reciente relacionado con el calentamiento global (tropicalización). Sin embargo, la información obtenida de los pescadores habla de una especie nativa en su límite norte de distribución, con poblaciones muy reducidas. Estos han capturado muy esporádicamente algún ejemplar desde hace muchos años. Su reciente detección e incremento de la frecuencia de captura, en áreas donde los peces litorales están bien estudiados, obedece probablemente a que las condiciones ambientales actuales le son favorables y han permitido incrementar la población. Este proceso ya se había observado en Canarias con otras especies termófilas. El análisis de los datos relativos a su posterior captura en Tenerife lleva a la misma conclusión.

**Palabras clave:** Atlántico Oriental subtropical, cambio climático, calentamiento global

**ABSTRACT**

We herein present the occurrence of the moray eel *Gymnothorax vicinus* (Castelnau, 1855) in the Canary Islands, highlighting that these truly are the first valid records for Macaronesia, since previous existing records for the Azores, Madeira and Canary Islands were caused by misidentification. The appearance of this tropical species in 2008 in the island of El Hierro —the one with the warmer waters in the entire Macaronesian ecoregion— initially leads to thinking of a connection with global warming (tropicalization). Nevertheless, information obtained from local fishermen speaks of a indigenous thermophilic species in its north limit of distribution, with a very small populations. Fishermen have captured specimens only intermittently for many years now. Its recent detection in an area where littoral fish are widely studied has probably been caused by the increasingly favourable environmental conditions,

which has triggered an increase in its population. This process had already been observed in the Canarias amongst other thermophilic fish species. Results of the analysis of data regarding their subsequent catch in Tenerife leads to the same conclusion.

**Key words:** Eastern Subtropical Atlantic, climatic change, global warming.

## 1. INTRODUCTION

*Gymnothorax vicinus* (Castelnau, 1855) is a moray eel known to inhabit littoral rocky bottoms (down to 40 m of depth) in both tropical Atlantic shores (BÖHLKE *et al.*, 1989; BÖHLKE & SMITH, 2002). In Eastern Atlantic, it has only been recorded with certainty in Cape Verde Islands (BLACHE, 1967; BÖHLKE *et al.*, 1989; BRITO *et al.*, 1999; WIRTZ *et al.*, 2013), where its occurrence is rather frequent (A. BRITO & J. M. FALCÓN, non-published data), Fernando Poo (BLACHE, 1967; BÖHLKE *et al.*, *op. cit.*), Ghana (BÖHLKE *et al.*, *op. cit.*) and Sao Tome and Principe (see AFONSO *et al.*, 1999; WIRTZ *et al.*, 2007), although the latter authors base their research on old records and have not found the species during their recent research expeditions. Despite the existence of very old works pointing out the presence of *G. vicinus* in the Macaronesian archipelagos —Azores, Madeira and the Canaries— (JORDAN & GUNN, 1898; BLACHE, 1967; BÖHLKE, 1981; BAUCHOT, 1986; BÖHLKE *et al.*, 1989; SMITH & BÖHLKE, 1990; BÖHLKE & SMITH, 2002; WIRTZ *et al.*, 2008; FROESE & PAULY, 2010), its actual occurrence in those islands has been questioned (BRITO, 1991; SANTOS *et al.*, 1997; BRITO *et al.*, 2002). Through the analysis of the references given, it becomes evident that only two of them are based on the study of fishes that were caught for certain in the waters of those islands: JORDAN & GUNN (1898) —with doubts of the correct affiliation of the specimens— and WIRTZ *et al.* (2008).

Recently, we have had the opportunity to study six specimens and photographs of *G. vicinus* caught within years 2008 and 2014 in the island of El Hierro (Canary Islands) and unloaded in the only official point of first sale of fish in the island, located in the port of La Restinga. We also had the possibility to examine pictures taken of a different specimen caught in 2014 in Tenerife. The appearance of this moray in the westernmost island of the Canaries —also the one where waters reach warmer temperatures— led us to starting a discussion on whether it is a recent colonization process linked to the warming of the waters in the Canaries (tropicalization), or if it may be a consequence of the population growth of a indigenous thermophilic fish species, with very small populations inhabiting the northernmost distribution limit, and their spread over the islands' thermal gradient from the ones with warmer waters (occidentalization), just like what has already happened with other tropical species BRITO *et al.* (2005).

## 2. MATERIALS AND METHODS

Two specimens caught in the island of El Hierro September 2009 and May 2010 were examined. Besides, pictures of other four specimens were taken in September 2008, September 2009 and July 2014. All of them came from different localities in the island of El Hierro and were caught by local fishermen in depths ranging from 10 to 20 m. Pictures of a specimen caught in Punta del Hidalgo (Tenerife) about 5m deep on October 2013. The first two

specimens, which were studied in detail, are now in the ichthyological collection of Departamento de Biología Animal (Ciencias Marinas) de la Universidad de La Laguna. Morphometric and meristic parameters were taken according to BÖHLKE (1989), and specifications for Muranidae family in Böhlke *et al.* (*op. cit.*) were followed. In addition to the study of the specimens, we had talks with local moray-fishermen so as to gather all the information they had on this species.

### 3. RESULTS

The studied specimens (figure 1) show morphometric and meristic characteristics as described in table 1. Characteristics match up with those described by BLACHE (1967) and BÖHLKE *et al.* (*op.cit.*). The biggest specimen reached a total length of 152 cm, exceeding the 122 cm that were recorded up till now as the maximum size for this species (BÖHLKE & SMITH, 2002). *G. vicinus* belongs to the group of Atlantic moray of the *Gymnothorax* genus that show a sharp elongated snout, jaws clongate, eye above midjaw, smooth uniserial teeth in jaws and vomer, with some long canine teeth anteriorly. The species can be easily identified by the general colour of its body as well as by the presence of a dark mark in the corner of the mouth (BÖHLKE *et al.*, 1989).

Coloration of the specimens studied by us corresponds almost entirely with the description by BLACHE (*op. cit.*), that is, olive grey or dark brown —slightly lighter in ventral area— and the absence of marks (figure 1). This coloration is dominant in the tropical Eastern Atlantic, as we have been able to observe in Cape Verde Islands too. The dark mark in the corner of the mouth always stands out, although it can look more or less intense depending on the colour of the surroundings. The only remarkable variation is the one found in the biggest specimen: the white rim of its anal and dorsal fins is considerably thinner than the standard; it can be seen only in its caudal most part.

The biggest specimen, caught in May 2010, is a male individual that shows gonads in initial growth stage after the rest phase. Whereas the second specimen caught in September 2009, is a female individual with ripe gonads close to the spawning. Ovocytes sizes went from 0,7 to 1,1 mm.

### 4. DISCUSSION

JORDAN & GUNN (1898) doubtfully identify three specimens of moray from the Canary Islands as *G.vicinus*. Doubts arise due to coloration being different than the one attributed to *G.vicinus*. In fact, the white-mottled pattern described by these authors seems more likely to correspond with *Gymnothorax polygonius* (Poey, 1876), which is a frequent species in deep littoral waters of the archipelago (BRITO *et al.*, 2002) and also in fish markets all over the Canary Islands. However, BLACHE (*op. cit.*), in his excellent work on moray eels in the Western African coastline, accepted this reference and also pointed out the high probability of the species occurring in Madeira based on a not very clear reference by KAUP (1856), who identifies it as *Thyrsoidea cancellata* (non Rich., 1844). The other authors mentioned in the introduction have based their conclusions on the reference by BLACHE (*op. cit.*) —in some cases even misplacing geographical location— and on the recent catalogue of littoral fishes in Madeira by WIRTZ *et al.* (2008).



Catalogues of fishes in the Azores (SANTOS *et al.*, 1997) and the Canaries (BRITO *et al.*, 2002) do not comprise *G. vicinus*, since the above mentioned authors find the existing references of *G. vicinus* to be caused by confusions with *G. polygonius*. Only in the recent catalogue of Madeira (WIRTZ *et al.*, *op. cit.*) is this species included on the basis of an specimen deposited in the Museu Municipal do Funchal (reference: MMF 36398) that was caught at a depth of 150 m —this is an unusual depth for *G. vicinus*—. The specimen was re-examined in 2009, at our request, by one of the authors of the catalogue, who confirmed it to actually be a specimen of *G. polygonius* (M. J. BISCOITO, *com. in litt.*).

The appearance of *G. vicinus* precisely in El Hierro —the island with the most tropical-like environmental conditions and ichthyofauna in the Canaries and the entire Macaronesia ecoregion (FALCÓN *et al.*, 1996)—, makes it possible to suspect of a recent colonization process related to the rising temperatures of Canarian waters (tropicalization), as it has happened in other cases of tropical fish with high swimming capability or specialized planktotrophic larvae (BRITO *et al.*, 2005). One argument supporting such hypothesis is that of the wide and comprehensive study of littoral fish that has been carried on over time in this marine community (BORTONE *et al.*, 1991; FALCÓN *et al.*, *op. cit.*; CLAUDET *et al.*, 2010), largely because of the creation of a marine reserve in the island in 1996. Moreover, *G. vicinus* turns out to be one of the less cryptic and more aggressive of moray (BÖHLKE & SMITH, *op. cit.*), as we have had the chance to confirm in Cape Verde Islands (Brito & Falcón, *obs. pers.*), where these moray often follow divers that approach the crevices they hide in.

Nonetheless, the most experienced moray eel fishermen from El Hierro have known this species for over 30 years now, and even have a common name for it, “Morena congrio”, that refers to the apparent morphologic similarities *G. vicinus* has with the Conger eel, *Conger conger*. They also describe *G. vicinus* as the most combative of moray eels. Data gathered from fishermen indicates that it is a very rare species that is caught only sporadically with long periods of time when not one specimen can be seen or caught. In fact, despite the numerous studies of ichthyofauna and fish conducted in the island along the past three decades, it had never before been recorded. The specimens we have studied are the only ones recorded in the captured unloaded fish within 2008-2014. All of this speaks of a native species in its limit of geographical distribution, with really small populations that are now probably growing larger due to the favourable environmental conditions that prevail. Development of gonads in the specimen we studied, as in relation with the dates of capture, leads us to believe that they breed in El Hierro and that the spawning takes place from the end of the summer to the beginning of the autumn —period of time when the temperatures are the highest of the year in these waters—. BLACHE (*op. cit.*) found mature specimens of both sexes in June in Cape Verde Islands, while in the Western tropical Atlantic they are recorded within June and December (BÖHLKE *et al.*, *op. cit.*).

Regarding Punta del Hidalgo (Tenerife), fishermen also point out that they have very rarely caught a specimen only in two specific areas, and that they have become increasingly normal to find over the past few years. This way, the process in both cases seems similar, that is to say, the case of a growth in population of long established species related to the warming of the waters —the sea temperature in these having raised over a degree since the early 90s—. Nevertheless, in the case of Tenerife, a process of initial expansion (occidentalization) from the spawning stock in El Hierro cannot be ruled out, since a similar colonization pattern has been noticed in other littoral fish (BRITO *et al.*, 2005).

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**Figure 1.-** *Gymnothorax vicinus*: Preserved specimens, 152 cm total length male (A); the first specimen identified (non-preserved), right after its capture in September 2008 (B).

**Table 1.-** Morphometric and meristic data of the specimens of *Gymnothorax vicinus* studied.

Morphometric parameters	Size (mm)		Meristic parameters	Number	
	1 (male)	2 (female)		1	2
Total length	1520	1100	Branchial pores Infraorbital pores	3/3 4/5	2/3 4/4
Preal length	640	477			
Trunk length	450	325			
Depth at anus	101	85			
Depth at gill opening	141	85			
Predorsal length	137	108			
Head length	198	146			
Jaw length	83	66			
Snout length	38	29			
Eye diameter	16	13			
	<b>Mass (Kg)</b>				
Total mass	7.0	2.8			