

New Data on the Systematics of Comb-fin Squids *Ctenopteryx* spp. (Cephalopoda: Ctenopterygidae) from the Canary Islands

Alejandro Escáñez^{1,2,*}, Álvaro Roura³, Rodrigo Riera^{4,5}, Ángel Francisco González³, and Ángel Guerra³

¹BioCephaLab, Departamento de Ecología e Biología Animal, Edificio de Ciencias Experimentales, Campus As Lagoas-Marcosende, Universidade de Vigo, 36310 Vigo, Spain

²Departamento de Biología Animal, Facultad de Biología, Avenida Astrofísico F. Sánchez, s/n, 38206, Universidad de la Laguna, Tenerife, Spain. E-mail: aescanez@msn.com

³ECOBIOIMAR, Instituto de Investigaciones Marinas (IIM-CSIC). Eduardo Cabello 6, 36208 Vigo, Spain. E-mail: aroura@iim.csic.es (Roura); afg@iim.csic.es (González); angelguerra@iim.csic.es (Guerra)

⁴Departamento de Ecología, Facultad de Ciencias, Universidad Católica de la Santísima Concepción, Casilla 297, Concepción, Chile. E-mail: rriera@ucsc.cl

⁵Centro de Investigación en Biodiversidad y Ambientes Sustentables (CIBAS), Universidad Católica de la Santísima Concepción, Casilla 297, Concepción, Chile

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The systematics of the comb-fin squid species is problematic and poorly resolved. In total, 53 specimens of comb-fin squids (*Ctenopteryx* spp.) were caught at depths ranging from 30 to 800 m off the Canary Islands (NE Atlantic Ocean). Mantle lengths of the individuals ranged from 18 to 43 mm and the sample included immature, mature male and mature female specimens. Two species of comb-fin squids, *Ctenopteryx canariensis* and *C. sicula*, were identified by combining traditional morphological characters with a molecular analysis of a fragment of the cytochrome c oxidase subunit I (COI) gene. Intra- and interspecific genetic distances and maximum likelihood tree analyses based on COI sequences available from GenBank suggest the existence of at least four species, two from the Pacific and two from the Atlantic Ocean. Our data expand the current geographic range of *C. canariensis* from the NE to NW Atlantic. In the GenBank database, several sequences of comb-fin squid in different species-specific clades have been attributed only to *C. sicula*, indicating the possible existence of cryptic species and the need to re-analyse these data.

Key words: *Ctenopteryx sicula*, *Ctenopteryx canariensis*, Cytochrome c oxidase subunit I (COI), Systematics, Central east Atlantic.

BACKGROUND

The genus *Ctenopteryx* Appellöf, 1890 is composed of a group of small, muscular mesopelagic squids within the monogeneric family Ctenopterygidae Grimpe, 1922. Comb-fin squids

are distributed in tropical and subtropical waters worldwide at depths from sea surface to 1,000 m, showing a gradual ontogenetic descent into deeper waters with increasing dorsal mantle length (ML) (Shea and Vecchione 2010). Generally, large specimens of ctenopterygiids with ML up to

*Correspondence: E-mail: aescanez@msn.com

100 mm are scarce in mid-water trawl samples, while small specimens are common in plankton nets (Vecchione et al. 2001). Unfortunately, most of the descriptions of *Chtenopteryx* species are based on damaged specimens collected from stomach contents of predators such as fishes and cetaceans, or small poorly preserved specimens (Young and Vecchione 2016).

The diagnostic characters that differentiate *Chtenopteryx* species are currently limited to the following: (i) the maximum number of sucker series on arms and tentacular clubs, (ii) the presence/absence and size of visceral photophores, (iii) the presence/absence of eyeball photogenic patches and (iv) mantle width relative to ML (Roper and Jereb 2010). Nesis (1987), Guerra (1992) and Roper and Jereb (2010) indicated that mature males develop a large, dorsally directed photophore in the posterior mantle cavity. Although Young and Vecchione (2010) indicated that males of some *Chtenopteryx* species possess a large photophore that lies within the shell sac, they did not consider this light organ as a diagnostic character within the genus. According to Young and Vecchione (2010), only *Chtenopteryx sicula* Vérany 1851, *C. sepioloides* Rancurel 1970 and *C. canariensis* Salcedo-Vargas and Guerrero-Kommritz, 2000 are currently considered to be valid species. In contrast, Jereb and Roper (2010) considered that *C. sicula* and *C. sepioloides* should be recognized. *Chtenopteryx chuni* Pfeffer, 1912 and *C. canariensis* have an undetermined status due to their small size and the low number of specimens studied. Several inappropriately described species like *C. neuroptera* Jatta, 1896; *C. fimbriatus* Appellöf, 1890 and *C. cyprinoides* Joubin, 1894 currently have been synonymized to *C. sicula* (Young and Vecchione 2016).

Chtenopteryx sicula is the type species of the genus. However, a detailed description of this squid has not been published to the best of our knowledge. Joubin (1900), Pfeffer (1912) and Naef (1923) re-described the species, but always based on poorly preserved material or very few and small individuals. Young and Vecchione (2016) examined two specimens from the Mediterranean Sea that do have the visceral photophore, which contrasts with the description by Naef (1923). Therefore, concerning photophores, *C. sicula* should have a large photophore on the ventral surface of the eyeball and a visceral photophore; however, sometimes these are not discernible as they are in other descriptions, e.g. lacking (Naef 1923; Jereb and Roper 2010), supposedly present (Nesis

1987), present (Guerra 1992), lacking or present (Young and Vecchione 2016). As a result, the identity of *C. sicula* remains questionable and its presence outside the Mediterranean is considered unresolved (Young and Vecchione 2016).

Chtenopteryx sepioloides was described based on four specimens found in the stomachs of lancetfish (*Alepisaurus pherox*) captured in the Pacific Ocean (Rancurel 1970). *Chtenopteryx chuni* was described by Pfeffer (1912) based on a single young specimen with 7 mm ML, from the outer edge of the Benguela Current in the South Atlantic Ocean and is currently considered as a taxon *inquirendum*. The original description of *C. canariensis* by Salcedo-Vargas and Guerrero-Kommritz, 2000 was based on four specimens - 2 mature males (63 and 65 mm ML), 1 immature female (55 mm ML) and 1 juvenile (12 mm ML) - collected from deep trawls (1,000 m) in the eastern Atlantic Ocean. The holotype (mature male) was captured south of the Canary Islands (26°20'N, 19°21'W). The description of this species differed from the remaining species of the genus by lacking photophores on both eyes and viscera (Salcedo-Vargas and Guerrero-Kommritz 2000).

The aim of this paper is to undertake a detailed morphological and molecular analysis of the two morphologically different comb-fin squid species recently caught off the Canary Islands and provide some additional diagnostic characters for these uncommon and poorly described mesopelagic squid species.

MATERIALS AND METHODS

Two specimens of *Chtenopteryx canariensis* and fifty-one *C. sicula* identified according with Guerra (1992) were caught between 30 and 800 m depth, with an open mid-water trawl of 300 m² mouth area and 45 m length. The mesh size was 80 cm near the opening, decreasing to 1 cm in the last 10 m of the cod end. The hauls were performed over the SW continental slopes off El Hierro, La Palma and Tenerife (Canary Islands, NE Atlantic Ocean) (Fig. 1), during the mesopelagic survey CETOBAPH carried out in April 2012 (4-19th), on board R/V "Cornide de Saavedra". Data from hauls are summarized in table 1. On board, the specimens were identified to the species level following Nesis (1987), Guerra (1992), Roper and Jereb (2010) and Young and Vecchione (2010), their ML was measured to the nearest mm and they were sexed. The specimens