



## A new *Aforia* (Gastropoda: Conoidea: Cochlespiridae) from Galicia Bank (NW Iberian Peninsula)

### Una nueva *Aforia* (Gastropoda: Conoidea: Cochlespiridae) del banco de Galicia (NO Península Ibérica)

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#### ABSTRACT

A gastropod collected in 1720 m depth at the foot of the Galicia Bank is described as a new species in the genus *Aforia* (Cochlespiridae). The family placement is supported by the characters of the radula. The disjunct distribution (Northern Pacific, Antarctic and subantarctic areas, and here NE Atlantic) of species currently assigned to the genus *Aforia* is discussed.

#### RESUMEN

Se describe un gasterópodo recogido a 1720 m de profundidad al pie del banco de Galicia como una nueva especie del género *Aforia* (Cochlespiridae). Su inclusión en esta familia es acorde con los caracteres de la rádula. Se discute la distribución discontinua (Pacífico Norte, Antártida y áreas subantárticas, y aquí Atlántico NE) de las especies actualmente asignadas al género *Aforia*.

#### INTRODUCTION

The exploration of the deep-sea benthos of Western Europe has been active since the end of the XIX century and has increased spectacularly since the last two decades of the XX century. Nevertheless, contrary to the coastal area where the finding of a new species is now exceptional, there is still much to be discovered even among large and spectacular benthic animals of the bathyal and abyssal zones.

The Galicia Bank is a seamount located about 200 km west of the NW Iberian Peninsula, culminating at ca. 600

m depth on a large (ca. 6250 km<sup>2</sup>) plateau, and separated from the mainland shelf by depths of ca. 2500 m in the Galicia Inner Basin. It is irregularly shaped, with the N-NW part gently sloping down to the abyssal plain and the eastern edge forming a cliff down to ca. 1800 m. The substrate is composed of basaltic lavas and oceanic crust, covered by sediments which are largely of pelagic origin (ERCILLA, CASAS, VÁZQUEZ, IGLESIAS, SOMOZA, JUAN, MEDIALDEA, LEÓN, ESTRADA, GARCÍA-GIL, FARRÁN, BOHOYO, GARCÍA & MAESTRO, 2011). Regarding

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water masses in contact with the sea bottom (FIÚZA, HAMANN, AMBAR, DÍAZ DEL RÍO, GONZÁLEZ & CABANAS, 1998), the bank is reached from the South by quite diluted Mediterranean Outflow Water at two depth intervals, the upper core centred around 780 m and the lower, most saline core around 1100-1200 m. In the deeper part, North Atlantic Deep Water is present regionally with a core situated ca. 2500-3000 m, but a wedge of the fresher and colder Labrador Sea Water (LSW) situated around 1800 m and moving southwards, locally accentuates the gradient with the lower Mediterranean outflow.

The information about the bank and its ecosystems, and the few scientific surveys have highlighted the high concentrations of nutrients and the presence of deep-sea corals in the shallower part of the bank (DUINEVELD, LAVALEYE & BERGHUIS, 2004). The bank has been visited by several expeditions in the past, among which the French Campaign SEAMOUNT 1 (Muséum National d'Histoire Naturelle, Paris, 1987), in which 12 stations were sampled (BOUCHET & MÉTIVIER, 1988). In 2009, the Diva-Artabria II-09 campaign was conducted within the project "Latitudinal gradients of biodiversity in the deep sea of the Atlantic Ocean" and sampled Galicia Bank. Also in 2009, the Spanish Institute of Oceanography (IEO) conducted the ECOMARG programme on several sites of the northern Iberian margin including Galicia Bank. Although quite abundant material was obtained, no comprehensive list of molluscs was ever published and the only reports regard isolated species (e.g. ROLÁN MOSQUERA & PEDROSA, 1981), often in the context of broader taxonomic work (e.g. BOUCHET & WARÉN, 1993; GOFAS, 2007).

INDEMARES is an EU-funded LIFE+ project aimed at documenting ten offshore areas of Spanish waters as prospects for marine Natura 2000 areas, thereby fulfilling the commitments of the Marine Strategy Framework Directive of the EU. Galicia Bank is one of these ten areas and was the target of the cruise INDEMARES 0711 from July, 18 to August, 10 2011, with the R/V "Miguel

Oliver" (of Secretaría General de Pesca, Spanish Ministry of Agriculture, Food and Environment), under the expedition leader Dr. Alberto Serrano (Instituto Español de Oceanografía). This expedition made operations with rock dredge (15 hauls, 779-1697 m depth), beam trawl (11 hauls, 744-1720 m depth) and otter trawl (9 hauls, 751-1764 m depth), along with box core samples, suprabenthic sled hauls, pelagic net operations, underwater video recording and CTD measurements.

Here we present the description of a large conoidean gastropod collected during the INDEMARES 0711 cruise. The unique specimen comes from the deepest beam trawl operation, situated in the transition zone between Galicia Bank proper and the Galicia Inner Basin, near the foot of the eastern cliff of the bank.

## MATERIAL AND METHODS

During INDEMARES 0711 cruise, the beam trawl was towed for 15 minutes after settling on the bottom, at a speed of two knots. The mesh was 10 mm but consistently brought up a finer fraction as it got clogged by the sediment. The samples were sieved immediately on board, in sea water, on a set of 10, 5, 2 and 0.5 mm meshes; the two coarser fractions were sorted also on board and immediately fixed in 96° ethanol, and the specimen studied here was processed in this way. The finer fractions were mostly fixed in totality for posterior sorting in the lab.

### The sample

Haul V10 was a successful beam trawl operation which brought on board over 10,000 macroscopic specimens totaling over 9,600 grams (for the fractions sorted on board). The sediment was a pteropod ooze, in which shells of *Cavolinia inflexa* (Lesueur, 1813) were the most conspicuous component. The bottom sea-water temperature at the corresponding depth on the nearest CTD profile was 6.36 °C, and the salinity 35.3824 ‰. From the nearest box core (BC16, 42° 43.536' N - 11°

28.128' W, 1751 m), sediment was a poorly sorted very fine sand, with 2.411% over 500  $\mu\text{m}$ , 51.280 % 63-500  $\mu\text{m}$  and 46.309 < 63  $\mu\text{m}$ , and had an organic matter content of 3.69%.

Most abundant species of the macrobenthos in terms of biomass were the deep-sea eel *Synaphobranchus kaupii* Johnson, 1862 (80 specimens, 1510 g) and the holothurian *Benthogone rosea* Koehler, 1895 (27 specimens, 1880 g). Other abundant elements collected alive were unidentified ophiuroids, the bivalves *Limopsis cristata* Jeffreys, 1876 (most abundant species overall, 702 specimens) and *Parvamussium propin-*

*quum* (Smith, 1885) (570 specimens), the large scaphopod *Fissidentalium capillosum* (Jeffreys, 1877) (150 specimens), the gastropods *Kryptos koehleri* (Locard, 1896) (129 specimens), *Amphissa acute-costata* (Philippi, 1844) (87 specimens) and *Scaphander punctostriatus* (Mighels & Adams, 1842) (59 specimens). In total, 37 live-taken molluscan species were identified in the sample (23 gastropods, 11 bivalves and 3 scaphopods). Shells of *Fissidentalium* occupied by sipunculids were also abundant. The haul also contained a single specimen of a large gastropod, which appeared to be a new species and is described herein.

## SYSTEMATIC PART

### Genus *Aforia* Dall, 1889

Type species: *Pleurotoma circinata* Dall, 1873 [Recent, Bering and Okhotsk seas], by original designation.

#### *Aforia serranoi* spec. nov. (Figs. 1-6)

**Type material:** Holotype, live taken specimen (MNCN15.05/60099), BANGAL 0711, haul V10 (R/V "Miguel Oliver", 08 08 2011).

**Type locality:** East of Galicia Bank (42° 41.875' N, 11° 26.708' W, 1,720 m to 42° 42.36' N, 11° 26.93' W, 1,723 m).

**Etymology:** The species name is dedicated to the expedition leader Dr. Alberto Serrano, of Instituto Español de Oceanografía.

**Description:** Shell fusiform, comprising eight whorls, white, rather opaque. Protoconch comprising about 1.75 whorls, smooth and globose, corresponding only to protoconch I, with a maximum diameter of 1.2 mm, height 1.45 mm. Protoconch-teleoconch transition indistinct, indicated by the onset of a deep anal sinus and a keel. Teleoconch sculpture dominated by a distinct keel running near the middle of the whorls, slightly closer to the abapical suture, and a second keel, much less pronounced, running on the body whorl in continuation of the suture. Subsutural ramp very slightly concave just below the suture, then flat down to the main keel, covered by very faint, flat spiral cordlets and by flexuous growth lines reflecting the former positions of the anal sinus. Sculpture between keels and on the abapi-

cal part of the body whorl, of fine, flat and rounded spiral cords, much more definite than on the subsutural ramp. Subsutural ramp practically smooth on the three upper spire whorls, which have two low cords below the keel. Cords becoming more distinct on the subsutural ramp starting on fourth whorl, from 7 on the 4<sup>th</sup> whorl to 9 on the penultimate and last ones. Cords closely spaced, with variable width and interspaces variable from slightly broader than the cords to half the width of the cords. Number of cords below the keel increasing from 2 to 4 on fourth whorl and to 6 on penultimate whorl; six spiral cords between the keels on the last whorl and 23 on the shell base and canal. Body whorl prolonged by a tapering siphonal canal, which is not separated from the rest of the whorl by any discon-

tinuity of the profile. Aperture elongate-pyriform, tapering gradually towards the siphonal canal. Columellar and parietal edge continuous, lined with a very thin callus. Outer lip simple, rather thin, with a broad parabolic shaped anal sinus between the suture and the peripheral keel.

Dimensions: shell length 33.6 mm, width 11.2 mm; body whorl length 22.5 mm (measured along the axis on Fig. 1), aperture length (with canal) 17.9 mm, aperture length (without canal) 10.5 mm.

Animal rather stout, with a small head provided with cylindrical tentacles, blind. Operculum large, 8 mm in length, oval, spiral, with nucleus strongly shifted to left, semitransparent and brownish.

Radula relatively short, consisting of ca. 30 transverse rows of teeth, 10 nascent, 1.39 mm in length (13% of aperture length without canal). Radula comprising three teeth per row permanently attached to the basal membrane. Central tooth wide, weak, with arched posterior margin, with slightly elevated edges of posterior and lateral margins, and anterior margin indistinct, fused with the subradular membrane. A single small triangular cusp emanating from posterior margin. Lateral teeth small (length around 180  $\mu\text{m}$  or 1.7% of aperture length without canal), duplex, rather flat, with pointed major limb with sharp edges, and large accessory limb of same length.

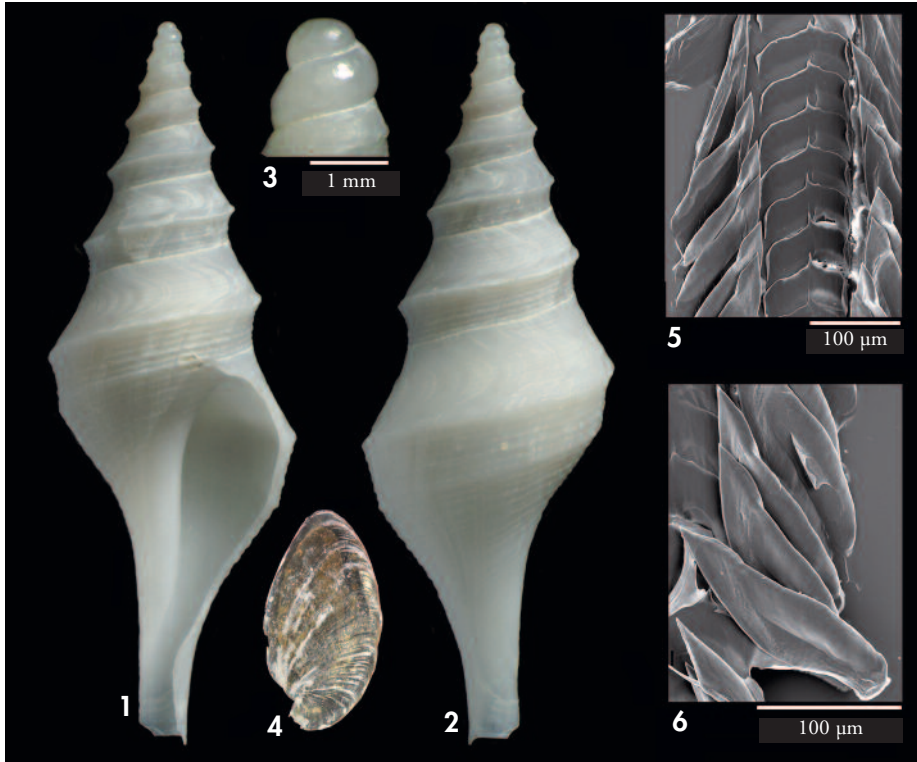
*Systematic placement and species comparisons:* *Aforia* is currently considered an extremely broadly distributed genus comprising 18 Recent species found from upper boreal waters in the Pacific to Antarctica (WoRMS, 2013). The integrity of the group has never been studied molecularly (only a single Antarctic species, *Aforia magnifica* (Strebel, 1908) can be found in Genbank). Therefore, the genus is currently defined mostly on rather loose conchological grounds and, to a lesser extent, on radular characters. Seven species of *Aforia* from north Pacific and three from Antarctic and sub-Antarctic waters have been studied in this respect, and all these have rather similar radulae, including *A. serranoi* spec. nov.

However, the radula of all known Cochlespiridae species is very similar and hardly can be an ultimate proof that boreal, Antarctic and subantarctic species of *Aforia* are congeneric. Thus, pending additional molecular data on different *Aforia* species, we tentatively attribute the new species to the genus *Aforia* as broadly conceived on the grounds of shell and radula similarities with the other known species.

The type species of the genus, *Aforia circinata* (Dall, 1873) described from Alaska (Nateekin Bay, Unalashka, Aleutian Islands) is twice as large (the holotype measures 7.35 cm with a similar number of whorls) as *Aforia serranoi* spec. nov. and lacks the abapical keel, having instead the base of the body whorl regularly rounded. Similarly, the abapical keel is absent in all other species of *Aforia* described from the north Pacific (although most of them, except *A. kincaidi* (Dall, 1919) are currently considered as synonyms of *A. circinata*).

Other species of *Aforia* are known from Antarctic waters (Dell, 1990), among which *A. magnifica* (Strebel, 1908) and *A. multispinalis* Dell, 1990 most resemble the species described here. They share the configuration of spiral keels with flat spiral cords in between, but are twice as large and with a less acute spire in the former and more prominent keels in the latter. *Aforia staminea* (Watson, 1881), from Marion and Prince Edward and Kerguelen Islands is also larger than *A. serranoi* spec. nov., and lacks the abapical spiral keel (WATSON, 1886). *Aforia goniodes* (Watson, 1881), described from Atlantic waters (Río de La Plata, Argentina), is smaller and stouter and also lacks the abapical keel (WATSON, 1886).

SYSOEV AND KANTOR (1987) reviewed on conchological and anatomical grounds the Pacific species of *Aforia* and close genera and described three new subgenera, one exclusively fossil. They also followed the opinion of POWELL (1966) on the synonymy of *Irenosyrinx* Dall, 1908 (type species *Pleurotoma (Leucosyrinx) goodei* Dall, 1890, type locality north-western Patagonia, 1920 m) with



Figures 1-6. *Aforia serranoi* spec. nov. Holotype, MNCN15.05/60099, East of Galicia Bank (42° 41.87' N, 11° 26.71' W, 1720 m to 42° 42.36' N, 11° 26.93' W, 1723 m). 1, 2: ventral and dorsal view of shell, actual size 33.6 mm; 3: detail of protoconch; 4: operculum, largest diameter 8 mm; 5: partial view of the radula; 6: detail of marginal teeth.

*Figuras 1-6. Aforia serranoi spec. nov. Holotipo, MNCN15.05/60099, Este del banco de Galicia (42° 41,87' N, 11° 26,71' W, 1720 m, a 42° 42,36' N, 11° 26,93' W, 1723 m). 1, 2: vista ventral y dorsal de la concha, tamaño real 33,6 mm; 3: detalle de la protoconcha; 4: opérculo, diámetro mayor 8 mm; 5: vista parcial de la rádula; 6: detalle de los dientes marginales.*

*Aforia* (*Aforia*). The generic status of *Irenosyrinx* is not yet finally accepted, although in the latest classification (BOUCHET, KANTOR, SYSOEV & PUILLANDRE, 2011) the genus is listed questionably as a subgenus of *Aforia*.

BOUCHET AND WARÉN (1980) treated *Irenosyrinx* as a separate genus, and included one species described from the Western Atlantic, *I. hypomela* (Dall, 1889) (= *Surcula tenerrima* Locard, 1897) and distributed also in the central Atlantic. It is readily distinguished from *A. serranoi* spec. nov. by a very weak upper keel and the absence of the second abapical

one and much stronger spiral elements on the subsutural ramp.

A large shell (25 mm) figured by BOUCHET AND WARÉN (1980) under the name *Ancistrosyrinx clytotropis* (Sykes, 1906) is possibly congeneric with *Aforia* and it is the known species that comes morphologically closest to the species described here, at least in the European realm. This shell comes from the northern coast of Spain (700-1120 m) and differs in being considerably stouter, with a more pronounced, protruding adapical keel and has the abapical keel marked by a duplicated cord. Sykes'



holotype collected off the West coast of Portugal ("Porcupine" Sta. 17, 39° 42' N, 09° 43' W, 1980 m) is considerably smaller (8 mm), but maintains the same profile as the early whorls of the shell figured by BOUCHET AND WARÉN (1980). It should be mentioned that BOUCHET AND WARÉN (1980) think that all extant material of *A. clytotropis* including the type is probably fossil.

*Remarks on distribution:* The present report is the first record of *Aforia* in the North Atlantic Ocean. The geographic distribution of *Aforia*, if the generic assignment of the new species is correct, is intriguing. Given that *Ancistrosyrinx clytotropis* (Sykes, 1906) is the morphologically closest species to *Aforia serranoi* spec. nov., it would turn out that morphology suggests they are congeneric.

The paucispiral protoconch of all species in this genus clearly indicates a lecithotrophic (probably entirely intracapsular) development, which would preclude long-distance pelagic dispersal

in the larval stage. There are however more instances of this kind of distribution among gastropods with intracapsular development, the most noteworthy and best documented being that of a group of closely related genera of the muricid subfamily Trophoninae (HARASEWYCH, 1984).

POWELL (1951: 63-66) discussed bipolarity but pointed out that the distribution of *Aforia* achieves continuity with the presence of species such as *A. persimilis* (Dall, 1889) off the Pacific coast of Central and South America. In the Atlantic, there are no relevant data along the West African slope, but *A. serranoi* spec. nov. was found in the context of water masses flowing from the North. Taking into account that the slope fauna of the NW Atlantic is relatively well known, such a source area for this species is unlikely and therefore its occurrence off Western Europe remains unexplained and could have originated in a different paleoceanographic setting.

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