Zootaxa 1012: 1–12 (2005)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

1012

Aplysina chiriquiensis, a new pedunculate sponge from the Gulf of Chiriquí, Panamá, Eastern Pacific (Aplysinidae, Verongida)

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Abstract

A new pedunculate aplysinid sponge, *Aplysina chiriquiensis*, is described from shallow waters (1.5–35 m) in the Gulf of Chiriquí, western Panamá, Eastern Pacific. The species *chiriquiensis* is a common component of coral reefs and soft coral reefs in that region. After examining the systematic status of related taxa we conclude that there are only two valid taxa of stalked *Aplysina*, *A. bathyphila* Maldonado and Young from the Caribbean, and our new species from the eastern Pacific. *A. chiriquiens* is a yellow to purplish, stalked and branching sponge with oscules arranged in one or more rows along the branches. The branches can be cylindrical with smooth tapering ends, or stubby and laterally compressed. *A. chiriquiensis* is the first *Aplysina* species described from Panamá, and its distribution elsewhere in tropical and subtropical Eastern Pacific has yet to be evaluated.

Key words: *Aplysina,* taxonomy, new species, Porifera, Eastern Pacific Ocean

Introduction

The family Aplysinidae Carter, 1875 (order Verongida) comprises massive, tubular, or ramose sponges with a skeleton of pithed, amber-colored fibers forming a regular reticulum of polygonal meshes without specialized arrangement near the sponge surface (Bergquist and Cook, 2002). Most aplysinids are yellow to green, brown, or purple in life

Accepted by J.N.A. Hooper: 1 Jun. 2005; published: 28 Jun. 2005

and when preserved or exposed to air, undergo a conspicuous oxidative color change to brown, dark purple, or black. Three valid genera are currently recognized in the family, that is, *Aplysina* Nardo ,1834, *Verongula* Verrill, 1907, and *Aiolochroia* Wiedenmayer, 1977, and their species are mainly found in the Caribbean and in the Mediterranean seas (Bergquist & Cook, 2002). All species of Verongida studied biochemically possess typical brominated tyrosine derivatives as secondary metabolites (Ciminiello et al.,1997; Braeckman and Van Soest, 1999). The genus *Aplysina* is the most species–rich in the family: two species are known from the Mediterranean, eight are currently recognized in the Caribbean, seven in the western Atlantic off Brazil, and three from the Eastern Pacific off the coast of Mexico. Further south along the coast of Ecuador, a species of *Aplysina* was recorded under a *nomen nudum* as it was only mentioned in a table (Desqueyroux-Faundez & van Soest, 1997: 462). *Aplysina* species have also been recorded from the Indopacific (Red Sea, Indian Ocean, Australia) but their status remains unclear and in need of revision.

During 2002 and 2003, expeditions of the Smithsonian Tropical Research Institute to the Gulf of Chiriquí on the western coast of Panamá, several species of sponges were collected and recorded from coral reefs and coral communities in 1.5 m to 35 m depth**.** One of the most abundant species was the ramose, pedunculate aplysinid described below.

Materials and Methods

Sponges were fixed in 10 % formalin in seawater and preserved in ethanol 70 %. Skeletal and histological slide–mounts for light microscopy were prepared according to standard methodology (Rützler, 1978). Type material of *Verongia pedunculata* Lévi deposited at the Museum National d'Histoire Naturelle, Paris (MNHN 10–754) was re–examined for comparison. Other comparative material was examined in the sponge laboratory of the National Museum of Natural History, Washington, D.C. The measurements of skeleton dimensions were made at representative locations on each specimen and included fiber diameter, pith diameter, and the diameters (minimum and maximum) of the meshes. Type material is deposited in the Porifera collection of the Smithsonian Institution's National Museum of Natural History (USNM) in Washington, DC.

Order Verongida Bergquist, 1978
Family Aplysinidae Carter, 1875

Genus Aplysina, Nardo, 1834

[*Aplasia*] Nardo, 1833 (preoccupied). *Aplysina* Nardo, 1834. *Fistularia* Bowerbank, 1844. *Verongia* Bowerbank, 1845. *Luffaria* Duchassaing and Michelotti, 1864.

Type species. *Aplysina aerophoba* Schmidt, 1862 (by subsequent designation; de Laubenfels, 1948).

Diagnosis. Aplysinidae characterized by a regular skeleton network of polygonal meshes made of one size class of single fibers. Fibers are amber-colored and have a laminated bark and a pith that appears black in transmitted light. Both bark and pith are free of inclusions of foreign material. Specimens of most species turn from yellowish to dark brown, purple or black by an oxidative reaction when exposed to air.

Remarks. The latest review of the genus is found in Bergquist and Cook (2002).

Distribution. Mediterranean, Caribbean, South-Atlantic, Eastern Pacific, South Australia.

***Aplysina chiriquiensis* new species**
Figures 1–3

Material examined. Holotype (USNM 1071034), paratype A (USNM 1071035), paratype B (USNM 1071036), all from the type locality. Type locality—Bajo Banderas (10–35 m), Gulf of Chriquí, Panamá. Collector: H.M. Guzman, July 3 2003.

Other material. Specimens formerly identified as *Aplysina ecuatorensis* Desqueyroux-Fandez & van Soest, 1997 (nomen nudum): ZMA Porifera 11262. holotype fragment in alcohol, and ZMA 14900, alcohol specimen. Ecuador, collected by South East Pacific Biological Oceanography program (SEPBOP) Expedition stat. 18B 773, coordinates 0243'S 08033'W (-2.7167 -80.55), depth 20 m , donated by the Smithsonian Oceanographic Sorting Center (SOSC), date of collection: 1966, Galapagos Islands.

Description. Sponges are ramose, with branches departing from a common stalk (peduncle, 1–2 cm in diameter). Specimens range from 10 to 45 cm in height, with branches 2–40 cm long and 1–4 cm thick. In some specimens, branches are smooth, cylindrical to sub-cylindrical, and with tapering ends (Figs. 1, 2a). Others have stubby or laterally compressed branches, with annular swellings, finger–like or rounded projections, and knobby ends (Fig. 2b). External color ranges from pinkish-red or purple to bright yellow, or a combination of these colors. The color of the choanosome is bright yellow. All specimens are aerophobic, changing to dark green when exposed to air and to black after preservation in alcohol. The sponge surface is smooth to the naked eye, but microconulose when viewed by microscope, with regularly distributed conules 100–200 µm in height and 400–600 µm distant from each other. Sponges are compressible and elastic in consistency, almost rubbery. The oscules are circular, 2–4 mm in diameter, with a collar-like membrane, distributed in rows of one or more along the sides of the branches. The specimens with bumpy surfaces have oscules located on top of the round protuberances (Fig. 2d).

The skeleton consists of a reticulation made up of concentrically-laminated fibers, 30–210 µm in diameter, amber in color, but with a predominantly black-appearing (transmit-

ted light), granular pith occupying 15–70 % of the fiber diameter (Tab. 1). In the ectosome, in particular, fibers have a clear pith rather that a dark, granular one. It was found that the diameter, structure (smooth or granular) and color (clear, black) of the pith can vary greatly within one specimen. In general, fibers are thicker (Tab. 1) and less regular in diameter at the base or in the stalk than in the mid-section of the sponge body. The reticulum is formed by meshes of varied shapes (polygonal to oval), and mesh diameters range between 200 µm and 1200 µm.

FIGURE 1. Underwater photograph of various specimens of *Aplysina chiriquiensis* from the Gulf of Chiriquí, Panamá, Eastern Pacific (20 m deep). scale bar = 7 cm.

Etymology. named after the Gulf of Chiriqui where the types were collected and the species was found to be very abundant.

Habitat. At the type locality, *Aplysina chiriquiensis* is very abundant on coral reefs in 15–35 m depth. Its growth form (pedunculate ramose) and rubbery consistency seems well-suited to resisting strong currents.

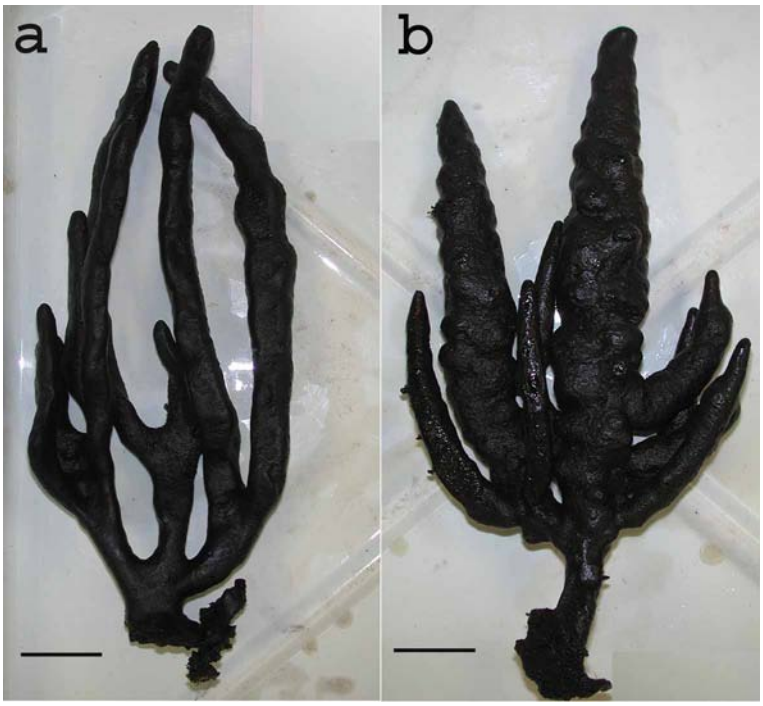

FIGURE 2. *Aplysina chiriquiensis*, external morphology. A) The holotype, a typical slender specimen with smooth tapering solid branches, scale bar = 6 cm; B) Paratype A (USNM 1071035), a stubby specimen, scale bar = 2 cm.

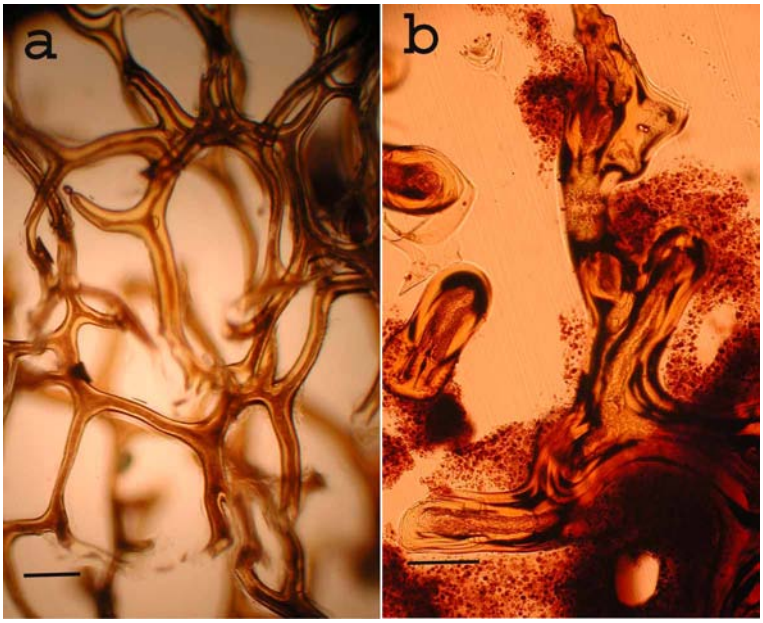

FIGURE 3. Skeletal morphology of *Aplysina chiriquiensis*. A) Cross section of fiber reticulation formed by oval to polygonal meshes. Notice the darker pith. Scale bar = 0.2 mm. B) Cross section of fiber reticulation from the pedunculate base. Notice the thick and deformed fibers. Scale bar = 0.1 mm.

TABLE 1. Skeletal measurements of type specimens of *Aplysina chiriquiensis* (range, mean ±1 standard deviation; n=number of measurements). Middle measurements are made half way the length of the branch from the surface to 1 cm towards the center, and base measurements are made on the stalk from the surface to 1 cm into the body. Measurements are in micrometers.

Specimen	Body region	Fiber diameter (n = 20)	Pith (% of fiber diameter, n=20)	Mesh diameter (n=10)
Holotype (USNM 1071034)	Middle	30–80 52 ± 12	20–40 32 ± 7	250–720 x 580–1200 356 ± 109 x 759 ± 159
	Base	60–110 74 ± 14	10–58 32 ± 12	250–490 x 540–1210 415 ± 96 x 745 ± 129
Paratype A (USNM 1071035)	Middle	60–100 76 ± 14	15–33 25 ± 5	210–660 x 320–950 391 ± 112 x 637 ± 177
	Base	50–180 117 ± 34	11–70 27 ± 24	210–490 x 320–710 317 ± 99 x 561 ± 120
Paratype B (USNM 1071036)	Middle	30–90 68 ± 17	18–33 29 ± 5	320–570 x 480–930 415 ± 96 x 745 ± 129
	Base	60–210 110 ± 35	13–41 26 ± 9	170–490 x 400–930 377 ± 92 x 674 ±168

Distribution. Gulf of Chiriqui (Panamá) and Galápagos Islands (Ecuador). Incidental observations have been received from "Archipiélago Las Perlas" in Panamá, and Costa Rica (Guzman, per.comm.), and from the Pacific coast of Colombia (Zea, per.comm.).

Discussion

We compared the distribution and taxonomic status of *Aplysina chiriquiensis*, with congeners reported from other geographical regions, including the Mediterranean, West Atlantic, and Pacific, and summarized the results (Tab. 2). From the approximately 60 species that have been included in the genus only 15 remain clearly valid. The rest have been either assigned to other genera and families (such as *Verongula*, *Pseudoceratina*, and *Suberea*), or were determined to be junior synonyms, or have uncertain taxonomic status. Descriptions of currently recognized *Aplysina* species are found in the following monographs: De Laubenfels (1948), Vacelet (1959), Wiedenmayer, (1977), van Soest (1978), Hechtel (1983), Alcolado (1984), Zea (1987), Gómez and Bakus (1992), and Pinheiro and Hajdu (2001). *Aplysina* is predominantly a New world genus (eight Caribbean and/or Brazilian species), two Eastern Pacific ones, with two species in the Mediterranean, one from the Red sea, one from South Africa and a dubious record from South Australia. Almost all Indo west Pacific records do not belong to *Aplysina* but to *Suberea* or *Pseudoceratina* (see Tab. 2).

TABLE 2. Distribution and taxonomic status of species formerly assigned to the Aplysinidae (the family remains Aplysinidae except for *Pseudoceratina* assigned to Pseudoceratinidae, and for *Suberea* assigned to Aplysinellidae). *specimens of these species recently studied by the authors.

Genus and species/subspecies	Author(s)	Distribution	Taxonomic status
*Aplysina azteca**	Gómez & Bakus, 1992	Mexican Pacific	*Suberea azteca* incertae sedis
Aplysina aerophoba	Nardo,1843	Mediterranean	*Aplysina aerophoba*
Aplysina aurea	Gammill,1998	Caribbean	incertae sedis
*Aplysina bathyphila**	Maldonado & Young, 1998	Caribbean	*Aplysina bathyphila*
*Aplysina chiriquiensis**	This study	Panamá, Ecuador, Costa Rica	*Aplysina chiriquiensis*
Aplysina cacos	Lendenfeld, 1888	South Australia	incertae sedis
Aplysina caissara	Pinheiro & Hajdu, 2001	Brazil	*Aplysina caissara*
Aplysina capensis	Carter, 1881	South Africa, Brazil?	incertae sedis, see Pinheiro & Hajdu, 2001
Aplysina carnosa	Schmidt,1862	Mediterranean	*Aplysina .aerophoba*
Aplysina cruor	Carter, 1886	South Australia	*Dendrilla cruor*
Aplysina digitata	Carter, 1885	South Australia	incertae sedis
*Aplysina ecuatorensis**	Desqueyroux-Faundez & van Soest, 1997	Galápagos Is.	Nomem nudum
Aplysina euplectella	(Hentschel, 1911)	South Australia	*Aplysina euplectella*
Aplysina fistularis aggregata	Topsent, 1931	Caribbean	*Aplysina fistularis*
*Aplysina fistularis ansa**	de Laubenfels. 1950	Bermuda	*Aplysina insularis*
Aplysina flagelliformis	Carter, 1882	Caribbean,	*Aplysina fulva*
Aplysina flagelliformis			
rugosa	Wilson 1902	Caribbean,	*Aplysina fulva*
Aplysina fragilis	Wilson 1902	Caribbean,	*Aplysina fulva*
Aplysina fusca	Carter,1880	Gulf of Mannaar	*Suberea fusca*
*Aplysina gerardogreeni**	Gomez & Bakus,1992	Mexican Pacific, Panamá	*Aplysina gerardogreeni*

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TABLE 2 (continued)

Genus and species/subspecies	Author(s)	Distribution	Taxonomic status
Aplysina gigantea	Hyatt, 1875	Caribbean	*Verongula gigantea*
Aplysina herdmani	Dendy, 1905	Gulf of Mannaar	*Aplysina?* incertae sedis
Aplysina higginsi	Lendenfeld, 1889	Australian seas	incertae sedis
Aplysina hirsuta	Hyatt,1875	Caribbean	incertae sedis
Aplysina inflata	Carter, 1882	Caribbean	incertae sedis
Aplysina laevis	Carter, 1885	South Australia	*Pseudoceratina purpurea*
Aplysina lendenfeldi	Bergquist, 1980	S Australia	incertae sedis
Aplysina compacta	Carter, 1881	Bahamas	*Aplysina archeri*
Aplysina meandrina	Lendenfeld, 1889	S Australia	incertae sedis
Aplysina minima	Hentschel, 1914	Antarctic	incertae sedis
Aplysina minuta	Lendenfeld, 1889	W Africa	incertae sedis
Aplysina mollis	Row,1911	Sudanese Red Sea	*Suberea mollis* incertae sedis
Aplysina mollis aruensis	Hentschel,1912	Indonesia	*Suberea mollis* incertae sedis
Aplysina ocracea	Alcolado,1984	Caribbean	*Aplysina ocracea*
Aplysina pergamentacea	Hechtel, 1983	Brazil	*Aplysina pergamentacea*
Aplysina praetexta	Hyatt, 1875	Caribbean	*Verongula pretexta* incerta sedis
Aplysina primitiva	Burton, 1959	Zanzíbar	*Dictyodenrilla*? (incertae sedis)
Aplysina procumbens	Lendenfeld, 1889	New Zealand	incertae sedis
Aplysina praetensa	Row,1911	Sudanese Red Sea	*Aplysina praetensa*
Aplysina reticulata	Lendenfeld, 1889	Indian Ocean	incertae sedis
Aplysina spengeli	Lendelfeld, 1899	Jamaica	*Aplysina fistularis*
Aplysina tenuissima	Hyatt,1875	Caribbean, Brazil	incertae sedis
Aplysinopsis massa	Szymanski, 1904	Mediterranean	*Aplysina?* (incertae sedis)

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TABLE 2 (continued)

Genus and species/subspecies	Author(s)	Distribution	Taxonomic status
Aplysinopsis tuberosa	Szymanski, 1904	Mediterranean	*Aplysina?* (incertae sedis)
Luffaria applicata	Duchassaing & Michelotti, 1864	Caribbean, Caribbean	incertae sedis
*Luffaria archeri**	Higgins, 1875	Caribbean, Brazil	*Aplysina archeri*
*Luffaria cauliformes**	Carter 1882	Caribbean, Brazil	*Aplysina cauliformis*
Luffaria cauliformis elongoreticulata	Carter, 1882	Caribbean,	incertae sedis
Luffaria cauliformis rufa	Carter, 1882	Caribbean	*Aplysina cauliformis*
Luffaria compressa	Carter, 1882	Caribbean	incertae sedis
Luffaria digitata	Carter, 1885	South Australia	*Aplysina*? (incertae sedis)
*Luffaria insulares**	Duchassaing & Michelotti, 1864	Caribbean	*Aplysina insularis*
Luffaria nuciformis	Duchassaing & Michelotti, 1864	Caribbean	*Aplysina lacunosa*
Luffaria picea	Duchassaing & Michelotti, 1864	Caribbean	*Aplysina?* (incertae sedis)
Luffaria sebae	Duchassaing & Michelotti, 1864	Caribbean	*Aplysina lacunosa*
Spongia cellulosa	Esper, 1794	Unknown	*Fasciospongia?*(incertae sedis)
Spongia fistularis	Pallas 1776	Caribbean, Brazil, Mexico	*Aplysina fistularis*
*Spongia fulva**	Pallas 1776	Caribbean, Brazil,	*Aplysina fulva*
*Spongia lacunosa**	Pallas 1776	Caribbean, Brazil,	*Aplysina lacunosa*
Spongia tubaeformis	Lamarck, 1814	Puerto Rico	*Aplysina fistularis*
Verongia cavernicola	Vacelet,1959	Mediterranean	*Aplysina cavernicola*
Verongia janusi	Boury-Esnault, 1973	Brazil	*Aplysina janusi*
Verongia pedunculata	Lévi, 1969	South Africa	*Suberea pedunculata*

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TABLE 2 (continued)

Genus and species/subspecies	Author(s)	Distribution	Taxonomic status
Verongia tenuissima	(Hyatt, 1875)	Brazil	*Aplysina archeri* after Lendelfeld 1889
Verongia thiona	de Laubenfels, 1930	California	*Aiolochroia?*(incertae sedis)

We also confirmed that the transfer by Maldonado and Young (1998) of *A. aztecus* (Gomez and Bakus) (Mexican Pacific) and *Verongia pedunculata* (Lévi) (South Africa) to the genus *Suberea* Bergquist, 1995 (Aplysinellidae) is justified. Species of *Suberea* are distinguished by a loose and poorly anastomosing fiber network rather than the much tighter and more regular and well interconnected fibroreticulum of *Aplysina* species. One of us compared the new species with the specimens recorded (but not described) as *Aplysina ecuadorensis* Desqueyroux-Faundez & Van Soest, 1997. The three samples are pedunculate branches and fragments of branches, and their general shape, outline, and fiber characteristics agree with *A. chiriquiensis* n.sp., thus extending the distribution from Panamá to the coasts of Ecuador.

Currently, three species: *A. gerardogreeni* Gómez and Bakus and *A. fistularis* (Pallas), and our new *A. chiriquiensis* have been described from the Eastern Pacific. *A. gerardogreeni* is easily distinguished from *A. chiriquiensis* by its distinct habit (massive amorphous to lobular, and non pedunculate), but its generic assignation remains to be validated after a close evaluation of its fiber skeleton. *A. fistularis* from Veracruz , Mexico (Green, 1977) is very similar in morphology to the specimens of *A. fistularis insularis* Duchassaing and Michelotti, 1864 (currently *A. insularis*) from the Caribbean.The affinity of this eastern pacific aplysinid with its caribbean counterparts must await a genetic comparison of specimens from both oceans.

It is evident that there are but two valid pedunculate aplysinid species, *A. bathyphila* Maldonado and Young from deep water in the Western Atlantic (Bahamas) and *A. chiriquiensis* found on shallow reefs in the Eastern Pacific. Generally, skeleton characteristics in *Aplysina* are well defined and distinctive allowing easy species assignment to this genus. On the other hand, high plasticity of morphological characters on the species level causes much confusion regarding proper taxonomic status (Table 2), such as distinguishing between environmentally-induced forms (ecophenotypes) and true species, possibly even hybrids. To this end, we are confident that because of morphological differences [globular versus ramose; oscula placement apical vs. lateral; pith diameter small (9–12 %) vs. large (10–70 %) and geographic separation (Atlantic vs. Pacific)] the tropical pedunculate *A. bathyphila* and *A. chiriquiensis* are distinct species. The wider distribution of these interesting and abundant species must be further investigated to better understand their relationships with other members of the genus.

Acknowledgements

We are grateful to the National Museum of Natural History and the Smithsonian Tropical Research Institute for sponsoring this work. This work was part of tenure by one of us (M.C.D.) as postdoctoral fellow of the Smithsonian Marine Science Network. The work was partially sponsored by the Smithsonian Tropical Research Institute, the AVINA Foundation, and the International Cooperative Biodiversity Groups. Specimens were collected during several cruises to study the Gulf of Chiriquí on board of the R/V Urraca, and we offer our appreciation of the assistance by the captain and crew. We thank Carlos Guevara for his support in the field.

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