RESTING STAGES OF *CORVOSPONGILLA* SP. (DEMOSPONGIAE, SPONGILLIDAE) FROM MESOPOTAMIA, IRAQ

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ABSTRACT

Discovery of freshwater sponges belonging to the genus *Corvospongilla* is recorded from one of the main tributaries of the River Tigris in Iraq. Water quality of the sponge habitat is characterised. Gemmules of two morphs are described by SEM. The gemmular role in survival and dispersal strategies is also discussed.

KEY WORDS

Freshwater sponges, River Diyala, sponge habitat, gemmular morphology, persistence, dispersal strategies.

INTRODUCTION

During the evolutionary history of gemmule-producing freshwater sponges of the suborder Spongillina Manconi & Pronzato, 2002 a notable structural diversification occurred in gemmules. Some traits appear to be extremely conservative and therefore valuable for phylogenetic relationships, whereas some others display a wide adaptive radiation (see MANCONI & PRONZATO, 2002).

Gemmular traits are diagnostic at the genus and species level and, usually, each species is characterised by a single gemmular morph with few exceptions within the family Spongillidae Gray, 1867. Only *Spongilla lacustris* L., 1759 and some species belonging to the genus *Corvospongilla* Annandale, 1911 produce two gemmular morphs (PENNEY & RACEK, 1968; MANCONI & DESQUEIROUX-FAUNDEZ, 1999; MANCONI & PRONZATO, 2002).

The genus *Corvospongilla* is characterised by a wide distributional range and a relatively high species richness comprising the following species: *C. becki* Poirrier, 1978, *C. boehmii* (Hilgendorf, 1883), *C. burmanica* (Kirkpatrick, 1908), *C. caunteri* Annandale, 1911, *C. lapidosa* (Annandale, 1908), *C. loricata* (Weltner, 1895), *C. micramphidiscoides* Weltner, 1913, *C. novaeterrae* (Potts, 1886), *C. scabrispiculis* Annandale, 1913, *C. sekti* Bonetto & Ezcurra de Drago, 1966, *C. sodenia* Brien, 1969, *C. thysi*

Brien, 1969, *C. ultima* (Annandale, 1910), *C. victoriae* Annandale, 1914, *C. volkmeri* (De Rosa-Barbosa, 1988), *C. zambesiana* (Kirkpatrick, 1906).

In most of these species only one gemmular morph, the free or the sessile one, was recorded. The coexistence of two gemmular morphs is however known in some species within the entire geographic range of the genus (HILGENDORF, 1883; POTTS, 1886, 1887; WELTNER, 1895, 1913; KIRKPATRICK, 1906, 1908; ANNANDALE, 1908, 1909, 1910, 1911a,b, 1912a,b, 1913, 1914, 1918; STEPHENS, 1919; BONETTO & EZCURRA DE DRAGO, 1966; BRIEN, 1968, 1969; VOLKMER-RIBEIRO *et al.,* 1975; POIRRIER, 1978; DE ROSA-BARBOSA, 1988; GUGEL, 1993; REISWIG & RICCIARDI, 1993).

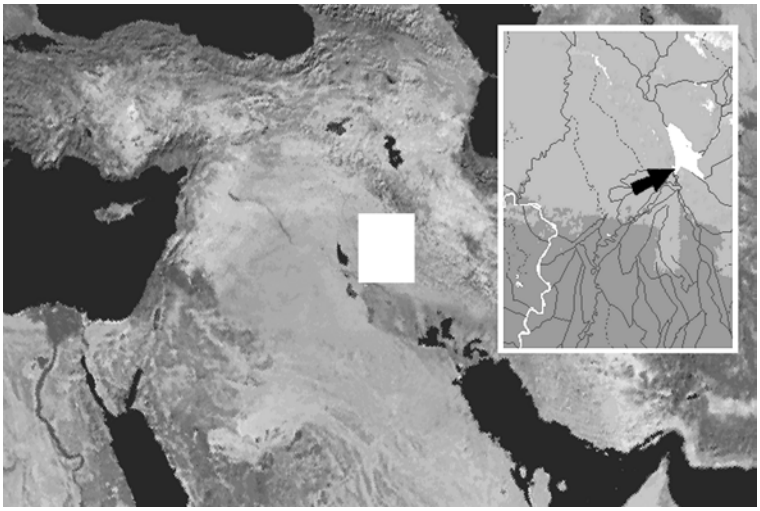

Fig. 1. *Corvospongilla* sp. Discovery area in NE Mesopotamia, Iraq is indicated by the white box. The collection locality a reservoir along the Diyala River is indicated by the black arrow within the enlarged box on the right.

This paper aims to describe two morphs of gemmules produced by a *Corvospongilla* species recently found in the SW Palaearctic region; this species from Iraq is probably new for science according to a taxonomic analysis presently in progress.

STUDY AREA AND HABITAT

Sponges were recorded in August 1997 in NE Mesopotamia, Iraq, in the framework of a biodiversity evaluation of the River Diyala catchment basin (SAADALLA, 1998) the most easterly of the main tributaries of the River Tigris (Fig. 1). Most of catchment's area of the River Diyala is in Iran, with an average slope of about 1.85m/km, until its confluence in Iraq with the River Tigris southern of Baghdad (AL- ANSARI, 1987).

The discovery occurred in the Himreen reservoir (34°7' N, 44°58' E) with a surface of 374 km^2 and maximum depth of 35 m; the dam is dated 1982 (AL- SAEDI, 1986). Sponges were found exposed to the air with a temperature of ca. 40° C during the summer low water level. Specimens were settled on the dam and rocks in the littoral area of the reservoir that is periodically subjected to dry up. According to SAADALLA (1998) water quality conditions in

1995-96 were the following: temperature 11 - 30° C, pH 7.9 - 8.6, light penetration 45 - 150 cm, turbidity 20 - 62 NTU, conductivity 394 - 828 μS/cm, hardness 198 - 251 mg/l $CaCO_3$, calcium concentration 38 - 77 mg/l, magnesium concentration 14 - 31 mg/l, salinity 0.25 - 0.53 °/∞, oxygen (% sat.) 106.3 - 91.6 %. Waters were classified in the range eutrophic-ipereutrophic.

MATERIAL AND METHODS

Two flourishing dry specimens with a conspicuous size of ca. 20 x 15 x 6 cm were used for the morphological analysis. The distribution and shape of gemmules was firstly studied in dissected sponge bodies, and cross sections of 20 gemmules were made by hand with a Wild M3 light microscope (LM). Entire gemmules and their sections were mounted on stubs, sputter coated with gold and investigated under a ZEISS DMS 962 scanning electron microscope (SEM).

RESULTS

Sponges with a massive cushion-like growth form were dry at the collection time. Abundant gemmules are present in the entire body of studied sponges from the superficial choanosome to the sponge basis at the level of the basal spongin plate. LM and SEM observations on gemmules revealed two morphs: sessile and free.

Sessile hemispherical gemmules are strictly adhering, singly or in groups, exclusively at the sponge basis, partly or totally embedded in the well developed basal spongin plate. Gemmules are enveloped, singly or in groups, by gemmular cages (882 - 1172 μm in diameter) made of dense assemblages of spicules and spongin (Figs 2A, B). The cage is clearly separated from the surface of the gemmular theca (Figs 2B, C). Spicules of the cage are large smooth strongyles with inflated tips, associated to several short slightly bent acanthostrongyles to form a mosaic-like wall (Fig. 2A). The foramen is lateral. The suboval gemmular theca (636 - 1000 μm in diameter) of almost compact spongin (36 - 45 μm thick) is supported in its inner part by acanthostrongyles (Figs 2C, D). The inner layer is made of sublayered compact spongin (Fig. 2D).

Free subspherical gemmules (Figs 2E-H) are scattered singly within the meshes of the entire choanosomal skeletal net, or they are grouped in cavernous areas of the skeleton. The foramen is apical (Fig. 2E). The gemmular theca (360 - 580 μm in diameter) bears an almost smooth surface (Figs 2E, H) with rare spiny oxeas. Cross sections show a trilayered gemmular theca (Fig. 2F) with a thin outer layer bearing rare acanthostrongyles tangentially arranged (Fig. 2H). The intermediate well developed pneumatic layer of chambered spongin (44 - 53 μm thick) is supported in its inner part, by acanthostrongyles more or less tangentially embedded (Fig. 2G). The inner layer is made of sublayered compact spongin.

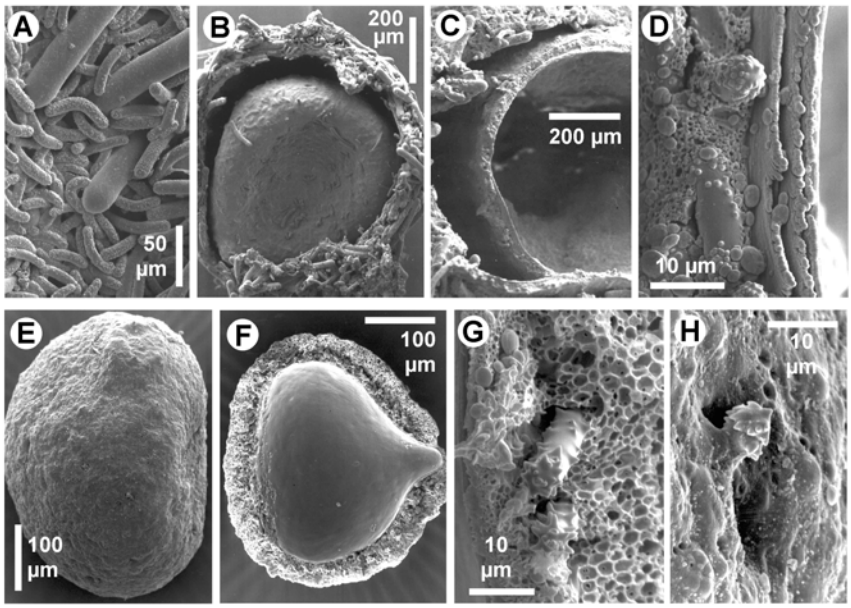

Fig. 2. Gemmules of *Corvospongilla* sp. from Iraq.
A-D Sessile gemmule. **A,** Surface of the gemmular cage with large smooth strongyles and short spiny strongyles in a mosaic-like arrangement. **B,** Gemmular cage around the gemmular theca. **C,** Section of gemmular cage and theca. **D,** Cross section of gemmular theca with spiny strongyles and the sublayered inner layer.
E-H Free gemmule. **E,** Gemmular theca. **F,** Cross section of gemmular theca with foraminal tube (on the right). **G,** Pneumatic layer with spiny strongyles-oxeas. **H,** Gemmular outer layer with rare spiny oxeas piercing the surface.

DISCUSSION AND CONCLUSIONS

The morphological analysis of gemmules found in *Corvospongilla* sp. from Mesopotamia highlights that the two gemmular morphs diverge in both architecture and distribution within the sponge body. From a functional point of view the two morphs appear to be able to play different roles in sponge survival.

The architecture of sessile gemmules and their localization at the sponge basis seems to favour processes of regeneration of the mother-sponge *in situ* supporting the population survival and persistence (Fig. 3). The dense spicular structure of both gemmular cage and theca, with the consequent great weight together with the absence of a pneumatic layer strongly support this functional role.

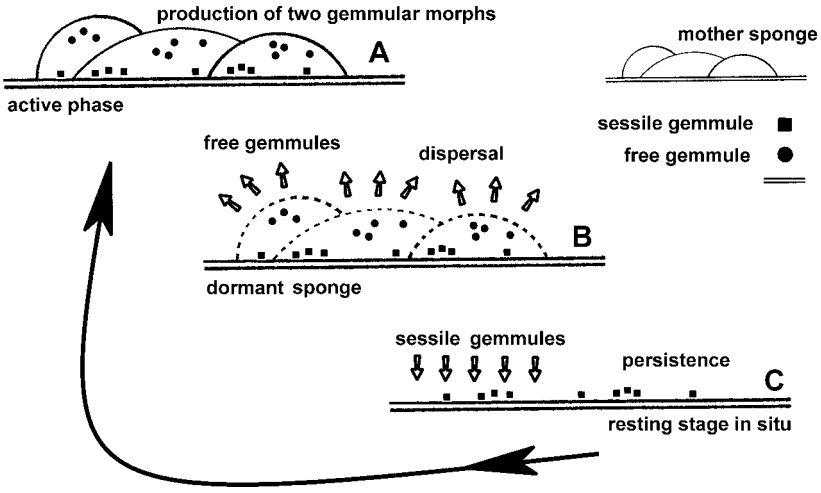

Fig. 3. Scheme of the processes of persistence and dispersal hypothetically performed by the two gemmular morphs of *Corvospongilla* sp. (**A**). Dispersal in different water bodies could be assured by low-weight floating free gemmules (**B**). Persistence of the mother-sponge *in situ* appears to be linked to regenerative processes due to sessile gemmules (**C**).

On the other hand the abundance and scattered distribution of free gemmules in the skeletal network, together with the well developed pneumatic layer and the light-weight, seem to confer to these asexual propagules the ability to float and disperse passively into other areas of the same hydrographical basin by means of water movement or into more distant water bodies by carriers (Fig. 3).

These two morphs of survival and dispersal bodies fit well the life strategies performed by cryptobiosis of gemmule-producing freshwater sponges (PRONZATO & MANCONI, 1994, 1995).

The here reported first find of *Corvospongilla* in the Asian area of the Western Palaearctic region reduces the disjunction in the geographic range of the genus (Fig. 4) (POTTS, 1887; GEE, 1931, 1932; ARNDT, 1936; PENNEY, 1960; PENNEY & RACEK, 1968; MANCONI & PRONZATO, 2002). The presumed ability of gemmules to successfully survive environmental injuries both *in situ* and along dispersal routes may account for the high species diversity and the wide geographic range of the genus *Corvospongilla* recorded untill now from the Afrotropical, Neotropical, Nearctic regions and the Indian subregion.

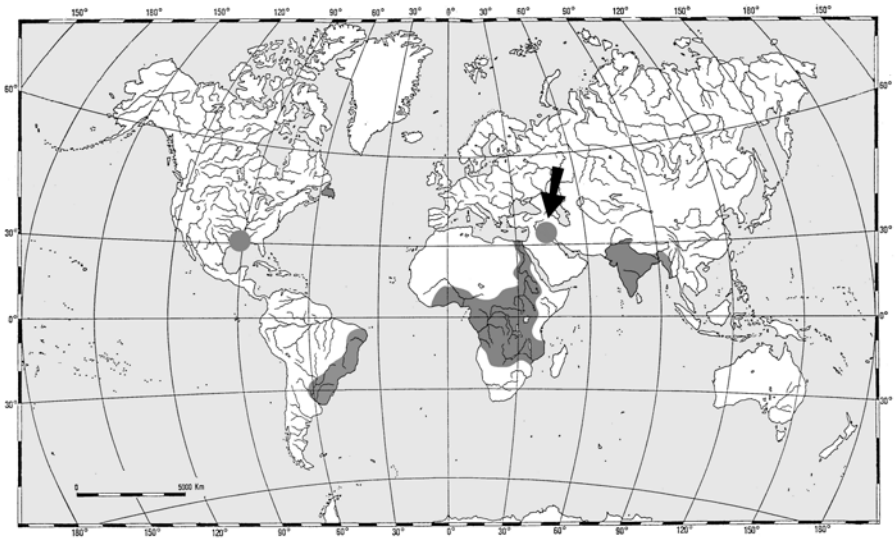

Fig. 4. Geographic range of the genus *Corvospongilla*. The arrow indicates the present new finding in Iraq. Spots represent findings in a single locality.

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REFERENCES

AL- ANSARI N.A., 1987 - Hemrin Reservoir, geological and hydrological investigation. *J. Water Resour.,* Spec. Publ. N. **2**, 195 pp.

AL- SAEDI H.A.M., 1986 - Irrigation and drainage projects in Diyala province, Geographic study. MSc. Thesis, Univ. of Baghdad, 250 pp.

ANNANDALE N., 1908 - Notes on freshwater sponges. VIII. Preliminary notice of a collection from western India with description of two new species. *Rec. Indian Mus.,* **2**: 25-28.

ANNANDALE N., 1909 - Beitrage zur Kenntnis der fauna von Sud-Afrika. Ergebnisse einer reise von Prof. Max Weber im Jahre 1894. IX. Freshwater sponges. *Zool. Jahrb. Abth. Syst.,* **27** (6): 559-568.

ANNANDALE N., 1910 - Notes on freshwater sponges. XII. Description of a new species from Cape Comorin. *Rec. Indian Mus.,* **5**: 31.

ANNANDALE N., 1911a - Notes on freshwater sponges. XIII. Specimens collected in the Poona District, Bombay Presidency, by S.P. Agharkar. *Rec. Indian Mus.,* **6**: 225-226.

ANNANDALE N., 1911b - Freshwater sponges, hydroids and polyzoa. The fauna of British India, including Ceylon and Burma. pp. 27-126, 241-245.

ANNANDALE N., 1912a - Notes on freshwater sponges. XIV. The generic position of *Spongilla ultima. Rec. Indian Mus.,* **7**: 99.

ANNANDALE N., 1912b - The freshwater sponges of the Malabar zone. *Rec. Indian Mus.,* **7**: 383-397.

ANNANDALE N., 1913 - Notes on freshwater sponges. XV. Sponges from shells of the genus *Aetheria*. *Rec. Indian Mus.,* **9**: 237-240.

ANNANDALE N., 1914 - Spongillidae. In W. Michaelsen (ed.), *Beitrage zur Kenntnis der Land und Susswasserfauna Deutsch Sudwestafrikas*. Vol. **2,** Hamburg: 235-249.

ANNANDALE N., 1918 - Zoological results of a tour in the Far East. II. Freshwater sponges from Japan, China, and the Malay Peninsula. *Mem. Asiatic Soc. Bengal,* **6**: 199-216.

ARNDT W. 1936 - Die von A. Monard in Angola gesammelten Süsswasserschwämme. Mit einem Uberblick über die Spongilliden-fauna Afrikas nach dem gegenwartingen stand unserer kentnisse. *Arq. Mus. Bocage,* **7**: 7-35.

BONETTO A.A., EZCURRA DE DRAGO I.D., 1966 - Nuevos aportes al conocimiento de las esponjas argentinas. *Physis,* **26**(71): 129-140.

BRIEN P., 1968 - Eponge nouvelle du Cameroun: *Potamolepis thysi* (n. sp.). *Rev. Zool. Bot. Afr.,* **78** (1-2): 113-122.

BRIEN P., 1969 - A propos de deux eponges du Cameroun du genre *Corvospongilla:* Embryogenese, Parenchymula, Gemmule. *Rev. Zool. Bot. Afr.,* **80**:121-156.

GEE N.G., 1931 - A contribution towards an alphabetical list of the known freshwater sponges. *Peking Nat. Hist. Bull.,* **5** (1): 31-52.

GEE N.G., 1932 - The known freshwater sponges. *Peking Nat. Hist. Bull.,* **6** (3): 25-51.

GUGEL J., 1993 - Sessile invertebrates from the Nile. *Zoology in the Middle East,* **8**: 103-120.

HILGENDORF F., 1883 - On two freshwater sponges (*Spongilla nitens*, Carter, and *S. bohmii*, sp. n.) collected by Dr. R. Bohm in the River Ugalla near Lake Tanganyika. *Ann. Mag. Nat. Hist.,* **12**: 120-123.

KIRKPATRICK R., 1906 - Report on the Porifera with notes on species from the Nile and Zambesi. Zoological results of the third Tanganyika expedition. *Proc. Zool. Soc. London,* **1**: 218-227.

KIRKPATRICK R., 1908 - Description of a new variety of *Spongilla loricata* Weltner. *Rec. Indian Mus.,* **2**: 97-99.

MANCONI R., DESQUEIROUX-FAUNDEZ R., 1999 - Freshwater sponges (Porifera, Spongillidae) from the Lake of Geneva, Switzerland. *Rev. Suisse Zool.,* **106** (3): 571-580.

MANCONI R., PRONZATO R., 2002 - Spongillina subord. nov.: Freshwater Sponges. In J.N.A. Hooper, R.W.M. van Soest (eds), *Systema Porifera. A Guide to the Classification of Sponges*. Kluwer Academic / Plenum Publishers, New York, Vol. **1**: 921-1019.

PENNEY J.T., 1960 - Distribution and bibliography (1892-1957) of the freshwater sponges. *Univ. South Carolina Publ. Ser. 3,* **3** (1): 1-111,1-97.

PENNEY J.T., RACEK, A.A. 1968 - Comprehensive revision of a world-wide collection of freshwater sponges (Porifera: Spongillidae). *US Natl. Mus. Bull.,* **272**: 1-184.

POIRRIER M.A., 1978 - *Corvospongilla becki* n. sp., a new freshwater sponge from Louisiana. *Trans. Am. Microsc. Soc.,* **97** (2): 240-243.

POTTS E., 1886 - Freshwater sponges from Newfoundland: a new species. *Proc. Acad. Nat. Sci. Philadelphia,* **38**: 227-230.

POTTS E., 1887 - Contribution toward a synopsis of the American forms of freshwater sponges with description of those named by other authors and from parts of the world. *Proc. Acad. Nat. Sci. Philadelphia,* **39**: 158-279.

PRONZATO R., MANCONI R., 1994 - Life history of *Ephydatia fluviatilis:* a model for adaptive strategies in discontinuous habitats. In R.W.M. van Soest, T.M.G. van Kempen, J.C. Braekman (eds), *Sponges in Time and Space*. Biology, Chemistry, Paleontology. Balkema, Rotterdam: 327-331.

PRONZATO R., MANCONI R., 1995 - Long-term dynamics of a freshwater sponge population. *Freshwater Biol.,* **33**: 485-495.

REISWIG H.M., RICCIARDI A., 1993 - Reexamination of *Corvospongilla novaeterrae* (Porifera, Spongillidae) an environmentally restricted freshwater sponge from eastern Canada. *Can. J. Zool.,* **71**: 1954-1962.

ROSA BARBOSA R. DE, 1988 - *Corvospongilla volkmeri* sp. n. e registro de *Corvospongilla seckti* Sonetto & Ezcurra De Drago, 1966 no Brasil (Porifera, Spongillidae). *Iheringia Ser. Zool.,* **67**: 109-122.

SAADALLA H.A.A., 1998 - Ecological study on the effect of Himreen Reservoir on the benthic and planktonic invertebrates of river Diyala. Ph.D. Thesis, University of Baghdad, 254 pp.

STEPHENS J., 1919 - Two new African freshwater sponges. *Ann. Mag. Nat. Hist.,* **3**: 95-97.

VOLKMER-RIBEIRO C., GROSSER K.M., DE ROSA BARBOSA R., PAULS S:M:, 1975 – Primeiro relato de ocorencia de espongilideos (Porifera) na Bacia do Guaiba, estado do Rio Grande do Sul. *Iheringia Ser. Zool.,* **46**: 33-49.

WELTNER W., 1895 - Spongillidenstudien III. Katalog und verbreitung der bekannten susswasserschwamme. *Arch. Naturgeschichte,* **61** (1): 114-144.

WELTNER W., 1913 - Süsswasserschwämme (Spongillidae) der Deutschen Zentralafrika-Expedition 1907-1908. *Wiss. Erg. Deutsch. Zentralafrika Exped. 1907-1908,* Vol. **4**, Klinkhardt & Biermann, Leipzig: 475-485.