Cryptic diversity of genus Leucosolenia (Porifera: Calcarea) in the White Sea

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Introduction. The Porifera represent one of the most diverse taxa of sessile invertebrates with over 9000 extant species. Calcareous sponges of the genus Leucosolenia are an emerging model object for evolutionary developmental biology studies. However, recent studies on the class Calcarea, and in particular on the subclass Calcaronea, indicates the presence of high cryptic diversity within most genera.

Currently Leucosolenia complicata is the only species mentioned for the White Sea and shows wide distribution range in North Atlantic from Greenland to Norway. Our study was aimed on the comprehensive analysis of Leucosolenia complicata identity in the White Sea using molecular, morphological, embryological and ecological data.

Material and methods. Material was collected during 2016-2018 summer seasons in environs of Pertsov White Sea Biological Station MSU (Russia) and of Station Biologique de Roscoff (France). External morphology, cytology, skeleton arrangement and spicule morphology were examined. Molecular study included analysis of Cregion of 285 rDNA and partial Histone $H 3$.


Skeleton: Oscular skeleton predominantly formed by both Tshaped tri- and tetractines, while in cormus tetractines rare. Lanceolate diactines form small osculum crown and cover tubes surface, extending outside by lance-shaped tip.

Spicule morphology:
a: triactines; b: lanceolate diactines c: tetractine


## Leucosolenia sp. 2

External morphology: cormus formed by creepy tubes; short oscular tubes possess prominent
spicular crown and lack lateral diverticula
 c: long trichoxeas; d: spined trichoxeas; e: details of spines

Mean measurements of triactines (in $\mu \mathrm{m}$ )

| Species | Unpair actine |  | Pair actines |  | Angle |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 70.5 | 6.5 | 82.8 | 6.6 |  |
| Leucosolenia sp. 2 | 80.7 | 5.4 | 94.9 | 5.8 | $131.1^{\circ}$ |
| Leucosolenia sp. 3 | 122.3 | 8.1 | 128.0 | 8.3 | $137.7^{\circ}$ |
| Leucosolenia complicata | 113.5 | 6.3 | 95.0 | 6.9 | $120.1^{\circ}$ |


| Species | Unpair actine |  | Pair actines |  | Apical |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Length | Width | Length | Width | Length | Width |
| Leucosolenia sp. 1 | 68.8 | 5.6 | 78.1 | 6.0 | 22.8 | 5.5 |
| Leucosolenia sp. 2 | 85.1 | 6.2 | 94.9 | 6.5 | 25.6 | 5.2 |
| Leucosolenia sp. 3 | 147.6 | 8.5 | 143.0 | 8.9 | 22.8 | 5.9 |
| Leucosolenia complicata | 109.3 | 6.7 | 93.2 | 6.8 | 23.8 | 5.4 |

Results and discussion. Molecular analysis of two cormus tubes, making them hispid. In addition its independent markers revealed eight monophyletic tri- and tetractines are thin, many of them are species-level lineages. Surprisingly, Leucosolenia abnormal. Tetractines are rare, presented only in complicata was found only in the North-East Atlantic, oscular rim. Leucosolenia sp. 3 is easily distinguished where it shows stable diagnostic morphological traits: by voluminous spherical cormus with one or several tri- and tetractines with unpaired actines commonly long oscular tubes, presence of lanceolate diactines longer than paired ones and the presence of both and T- or V-shaped tri- and tetractines, some of lanceolate diactines and small trichoxeas. In contrast, which are abnormal. In addition, we found peculiar in the White sea Leucosolenia diversity is represented type of mesohyl cells with specific inclusions, by a complex of three pseudo-cryptic species, which occurring in large number. differ in external features, cytology, skeleton Leucosolenia sp. 1 and Leucosolenia sp. 2 are most arrangement and spicule morphology. Leucosolenia common species in the White sea. In the upper sp. 1 is characterized by lanceolate diactines and T- intertidal zone they usually occurred sympatrically, shaped tri- and tetractines with unpaired actines while deeper waters are inhabited mostly by commonly shorter than paired ones. Leucosolenia sp. 2 Leucosolenia sp. 1. Leucosolenia sp. 3 is also found in possess smooth and spined trichoxeas, which form deep waters, but restricted to a single locality near prominent spicular crown around oscula and cover Krestovye islands, which have specific fauna.

