

## **LIZARDIA CAPRICORNIA NEW STATUS (POLYCHAETA, HESIONIDAE), INCLUDING MORPHOLOGICAL DATA AND BIOGEOGRAPHIC NOTES**

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### **ABSTRACT**

In 2000, the uninominal taxon *capricornia* Pleijel & Rouse was established as part of a phylogenetic proposal for the taxon Hesionidae (Annelida, Polychaeta), reported from the Great Barrier Reef, Australia. In that article, Pleijel & Rouse affirmed that the species should not be recognized as any special species taxa; thus, the species must be named as a Least-Inclusive Taxonomic Unit (LITU); taxon names refer to monophyletic groups only. The International Code of Phylogenetic Nomenclature (PhyloCode) does not totally reject Linnean nomenclature, but interprets taxa as belonging to species lineages or to supraspecific taxa without ranks. In 2005, Pleijel & Rouse erected the taxon *Lizardia*, including the monotypic species *Lizardia hirschi* from the same locality of *capricornia* (Great Barrier Reef). According to the PhyloCode, and on the basis of morphological data and biogeographic notes, we determine that *capricornia* should be called *Lizardia capricornia* new status, constituting the sister taxon of the species *L. hirschi*, both being nested within the monophyletic taxon *Lizardia*.

### **KEYWORDS**

Great Barrier Reef. *Sinohesione*. South China Sea. Supraspecific taxa.

### **INTRODUCTION**

Pleijel & Rouse (2000a) do not favor distinguishing species from supraspecific taxa, and proposed that a phylogenetic system should simply aim to nest monophyletic clades, without ranks, from the most inclusive to the least inclusive taxa. They nevertheless suggested that it is useful to specify when a name refers to the smallest known clade which cannot be further divided, and introduced for this the new concept of the

Least Inclusive Taxonomic Unit (LITU). LITUs were to be italicized, with a lower-case initial letter. In this same year 2000, Pleijel & Rouse (2000b) erected the species *capricornia* Pleijel & Rouse, 2000b, based on the concept of the LITU. The taxon *capricornia* has the following apomorphic character: “penes homologous to those on segment 9”<sup>19</sup>. Later, Pleijel & Rouse (2005) described a new monotypic hesionid genus *Lizardia* Pleijel &

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Rouse, 2005, containing the species *Lizardia hirschi* Pleijel & Rouse, 2005.

In 2006, Salazar-Vallejo & Orensanz erected a new genus named *Pleijelius*, including a cladogram of hesionids. In this article, they affirmed that *capricornia* and *Lizardia* are the only two Gyptini with external sexual organs in segment 9. They also proposed that *capricornia* is the sister group to all hesionids. However, these authors did not include *L. hirschi* in the cladogram<sup>23</sup>. Based on morphological and molecular data, Ruta et al. (2007) proposed a new phylogeny of Hesionidae. These authors concluded that the phylogenetic relationships of *capricornia* and *L. hirschi* are poorly supported and problematic. Yet, both taxa carry many similar characteristics, including plesiomorphic characters combined with autapomorphic reproductive features, possibly indicating paedomorphosis or heterochrony<sup>22</sup>. Finally, Rizzo & Salazar-Vallejo (2014), elaborated a key of all hesionids, where *capricornia* and *Lizardia* were separated according with the morphology of the palpophores, “reduced” and “distinct”, respectively.<sup>21</sup>

Other supporters of the PhyloCode<sup>3,6,10</sup> prefer to recognize only two distinct ontological category concepts: species, that represent unitary evolutionary lineages, with no requirement of monophyly; and supraspecific taxa, that represent clades of various levels of inclusiveness and contain an ancestral species lineage and all of its descendant species lineages. Phylogeneticists agree that the requirement of the Linnean system to associate species names with taxa of generic rank causes nomenclatural instability<sup>3,25</sup>, so that either binominal nomenclature must be discontinued or, if maintained, the first epithet must represent only a forename, without a generic connotation.<sup>6,18</sup>

The PhyloCode aims to name taxa based on relationships of common ancestry and descent, according to the phylogenetic principles established by Hennig

(1966), and further developed by Wiley (1981), Amorim (2002), among others. This International Code does not totally reject Linnean nomenclature, but aims to interpret existing names in a phylogenetic context, accepting species and eliminating supraspecific categories<sup>2,6,13</sup>. Phylogenetic nomenclature uses explicit definitions that specify referents for taxon names in terms of clades and/or common ancestry. This is contrary to Linnean nomenclature, which is based on implicit definitions that specify taxonomic categories as referents for taxon names<sup>2,9,12,14</sup>. Taxonomy and nomenclature should represent distinct activities<sup>11</sup>. To enhance nomenclatural stability, taxa should be named intentionally, independently of taxonomic decisions regarding category inclusions as required by the Linnean system and the International Code of Zoological Nomenclature (ICZN)<sup>3,16</sup>. The PhyloCode does not prohibit the use of categories, but suggests that the relationships among taxa may be expressed without the use of categories. Species concepts are diverse. However, they may be unified if or when the fundamental idea of species representing an independent lineage segment evolving separately from other similar lineages is accepted. The remaining species definitions may be used as secondary evidences for defining different subcategories of this fundamental species category (for example, species that become reproductively isolated, monophyletic species, diagnosable species).<sup>10</sup>

During the First Meeting of the International Society for Phylogenetic Nomenclature (ISPN) (Paris, July 2004) it was proposed that the Linnean system can be adapted to the phylogenetic system. For the naming of species, one suggestion that gained favor established that the specific epithet (ICZN) be combined with author, publication date and, if necessary, page number of the original description, when more than one homonymous specific epi-

that occurs in the same paper<sup>5,7,8</sup>. Dayrat *et al.* (2008) now suggest that it is no longer necessary to change existing binominal species taxa named according to Linnean nomenclature into uninominal taxa; under phylogenetic nomenclature it is only necessary to abandon the generic connotation of the species forename. In this article, based

on morphological data and biogeographic notes, we propose that *capricornia* is the sister taxon of the species *Lizardia hirschi*, both being nested within the monophyletic taxon *Lizardia*. The taxon *capricornia* may be named *Lizardia capricornia* new status. These proposals are consistent with the recommendations of the PhyloCode.

## MATERIALS AND METHODS

All descriptive information was obtained from the literature, mainly Pleijel & Rouse (2000a, b, 2005). In addition to the basic works cited in the introduction, we

compared illustrations available in the primary literature. In this way, we could compare homologous structures throughout the clade.<sup>4</sup>

## RESULTS

### Systematics

Family HESIONIDAE Grube, 1850

Genus *Lizardia* Pleijel & Rouse, 2005

APOMORPHIES: Spermathecae on segments 10-12; oviducts opening on segment 11.

*Lizardia capricornia* new status

APOMORPHIES: Penes long and narrow, on the anterior face of the parapodia, located on segment 9.

DISTRIBUTION: Great Barrier Reef, Australia.

*Lizardia hirschi* Pleijel & Rouse, 2005

APOMORPHIES: Penes robust, located on pygidium.

DISTRIBUTION: Great Barrier Reef, Australia.

With the systematic analyses conducted herein, we establish a new status for taxon *capricornia*, as the sister taxon of the available species *L. hirschi*. Both taxa are contained within the clade *Lizardia*. In our phylogenetic system of *Lizardia*, we continue to use it as a forename for *L. hirschi*. We consider the use of this same forename for *capricornia*: *L. capricornia* new status. We contrast our phylogenetic system of *Lizardia* with a Linnean classification of the same data (Table 1). The main differences lie in information content, not in the formal structure of both classifications. In the phylogenetic system, all taxa are monophyletic. The forename *Lizardia*, already in use for the taxon *L. hirschi*, may be used for *capricornia*, and has no generic category connotations.

**Tabela 1** - Abridged Linnean versus Phylogenetic classification of *Lizardia* (Polychaeta, Hesionidae).

Linnean classification	Phylogenetic classification
Genus <i>Lizardia</i> Pleijel & Rouse, 2005	<i>Lizardia</i> Pleijel & Rouse, 2005
Species <i>L. capricornia</i> <b>new status</b>	<i>L. capricornia</i> <b>new status</b>
Species <i>L. hirschi</i> Pleijel & Rouse, 2005	<i>L. hirschi</i> Pleijel & Rouse, 2005

## DISCUSSION

**Morphological data** - The species *L. hirschi* is morphologically simi-

lar to the taxon *L. capricornia*, differing mainly by the position and shape of the

homologous external genital organs of the male (a pair of penes)<sup>20</sup>. Characters modified from Pleijel & Rouse (2000b, 2005) have been used. In *L. capricornia*, males carry a pair of external penes present in segment 9, extending up to segment 5, being long and narrow<sup>19</sup> (Fig. 2F). Meanwhile, in males of *L. hirschi* each penis forms a robust median projection inserted at the base of the pygidium, between the dorsal cirri of segment 20 and the anal cirri<sup>20</sup> (Fig. 2A, B). Furthermore, females of *L. hirschi* have spermathecae on segments 10-12, and share the oviduct openings on segment 11, while females of *L. capricornia* have spermathecae in segments 11-12 and oviduct openings on segment 11. These last characters serve to distinguish *Lizardia* from the remaining taxa of Hesioniidae. Other characters were compared between these two taxa. In *L. hirschi* the lateral antennae are of the same length as the palps<sup>20</sup> (Fig. 1B, C), while in *L. capricornia* these antennae are slightly longer than the palps; the inverted proboscis in *L. hirschi* reaches segment 7, while in *L. capricornia* the proboscis does not reach the median segments. Specimens that compose *L. hirschi* have median dorsal cirri on segment 17 and thereafter directed posteriorly in males. Regarding the notochaetae, in *L. hirschi* there is only one type of notochaeta, which has two rows of teeth; two types appear in *L. capricornia*: one with two rows of teeth, and the other one with the distal portion densely serrate. *L. hirschi* has noto and neuroaciculae on segments 2-3, while there are no aciculae on the first four segments of *L. capricornia*. In relation to the pygidium, males of *L. hirschi* have small, flask-shaped, and smooth cirri, similar in size and shape to the dorsal and ventral cirri of segment 20<sup>20</sup> (Fig. 2A, B), while *L. capricornia* bears long and narrow segmented cirri<sup>19</sup> (Fig. 2I).

This character was not observed in the females of *L. hirschi*.<sup>20</sup>

Despite the main differences commented above, these two taxa must be grouped into one clade, based on their sharing of several similar characters: the shape of the body, prostomium, and palps<sup>19</sup> (Fig. 2A-C),<sup>20</sup> (Fig. 1A-C); the absence of a facial tubercle and of lip glands; the shape and size of the median antenna<sup>19</sup> (Fig. 2C),<sup>20</sup> (Fig. 1B); the shape and quantity of papillae on the terminal ring of the proboscis<sup>20</sup> (Fig. 1D); the shape and disposition of the cirri and parapodial lobes; the shape of the ventral cirri beginning on segment 5; the shape of the neurochaetae; and the absence of the median projection on the pygidium<sup>19</sup> (Fig. 2I),<sup>20</sup> (Fig. 2A, B).

**Biogeographic notes** - Both *L. capricornia* and *L. hirschi* are errant polychaetes only reported on the reefs from Great Barrier Reef, located in east coast of Queensland (Australia)<sup>19,20</sup>, suggesting affinity of the genus with this habitat and type locality. The origin of these species may have occurred through sympatric speciation. The monospecific taxon *Sinohesione Westheide, Purschke & Mangerich, 1994*, has non-homologous external genital organs compared to the clade *Lizardia*<sup>19,20</sup>. Furthermore, the taxon *Sinohesione* has many differences in relation to clade *Lizardia*, e.g. position and size of median antenna, shape of the palps, and presence of median pygidial projection. Finally, both supraspecific taxa are located in different geographic regions; *Sinohesione* inhabits the South China Sea, while *Lizardia* occurs in North-east Australia (Great Barrier Reef) 19, 20, 24. During the Paleozoic Devonian (around 400 Myr ago), the South China region had separated from Gondwana (including Australia)<sup>17</sup>. This time interval possibly indicates the allopatric speciation between *Sinohesione* and *Lizardia*.

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## **LIZARDIA CAPRICORNIA NOVO STATUS (POLYCHAETA, HESIONIDAE), INCLUINDO DADOS MORFOLÓGICOS E NOTAS BIOGEOGRÁFICAS**

### RESUMO

Em 2000, o táxon uninomial *capricornia* Pleijel e Rouse foi estabelecido como parte de uma proposta filogenética para o táxon Hesionidae (Annelida, Polychaeta), reportado para a Grande Barreira de Corais, Austrália. Neste artigo, Pleijel e Rouse afirmaram que as espécies não deveriam ser reconhecidas como táxons especiais; então, as espécies devem ser nomeadas como uma Unidade Taxonômica Menos-Inclusiva (LITU); os nomes dos táxons referem-se a grupos monofiléticos apenas. No entanto, o Código Internacional de Nomenclatura Filogenética (PhyloCode) não rejeita totalmente a nomenclatura Lineana, mas interpreta táxons como pertencentes a linhagens de espécies ou a táxons supraespecíficos sem o uso de categorias. Em 2005, Pleijel e Rouse erigiram o táxon *Lizardia*, incluindo a espécie monotípica *Lizardia hirschi* da mesma localidade de *capricornia* (Grande Barreira de Corais). De acordo com o PhyloCode, e com base em dados morfológicos e notas biogeográficas, nós determinamos que *capricornia* deve ser chamada de *Lizardia capricornia* novo status, constituindo o táxon irmão da espécie *L. hirschi*, sendo ambos aninhados dentro do táxon monofilético *Lizardia*.

### PALAVRAS-CHAVE

Grande Barreira de Corais; Sinohesione; Mar do Sul da China; Táxons supraespecíficos.

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