REVISTA DE Biología Tropical

How false is *Nereis falsa* (Annelida, Phyllodocida, Nereididae)?

Sergio I. Salazar-Vallejo[1*], Patrick Gillet[2] & Victor Surugiu[3]

1. Estructura y Función del Bentos, Depto. Sistemática y Ecología Acuática, ECOSUR, Chetumal, México; savs551216@hotmail.com, ssalazar@ecosur.mx
2. Mer Molécules Santé, Département Biologie Environnement, Faculté des Sciences UCO, Angers, France; patrick.gillet@uco.fr
3. Faculty of Biology, Alexandru Ioan Cuza University of Iaşi, Iaşi, Romania; vsurugiu@uaic.ro

* Correspondence

Received 12-I-2017. Corrected 14-II-2017. Accepted 17-III-2017.

Abstract: There are many taxonomic problems in polychaete species names and solving confusing or inadequate taxonomic procedures is both time-demanding and extremely important. Our objective in this contribution was to analyse what is the current taxonomic situation for *Nereis falsa* de Quatrefages, 1866; it was based upon *Nereis pulsatoria?* Rathke, 1837 from the Black Sea, and it is currently regarded as having a very wide distribution. The species has been collected from different benthic substrates and even can be found on floating objects or marine turtles. *Nereis falsa* has been recorded from the Mediterranean Sea, the Eastern Atlantic along Africa, the Western Atlantic (Gulf of Mexico, Caribbean Sea, Brazil), and the Indian Ocean. However, despite the fact *N. falsa* was proposed as a species from the Black Sea, it has not yet been found there. How can we explain that a species is able to attain a very wide distribution and yet be missing from its type locality? After a careful study of previous publications and with our understanding of the systematics of nereidid polychaetes, we clarify the current situation by examining several related species and pointed out some nomenclatural issues. Our analysis indicates there is more than one species included under the same name, and in this contribution we propose some means to promote discussion and actions, and suggest some basic research for solving this issue. Rev. Biol. Trop. 65 (3): 847-857. Epub 2017 September 01.

Key words: taxonomy, cosmopolitan species, exotic species, pharynx areas, type localities.

In polychaete taxonomy, as in many other scientific areas, there are some very influential scientists; these scientists usually were extremely productive and their publications included several faunistic studies or revisions. At least among polychaete taxonomists, these efforts often made them believe cosmopolitan species were common in the group. This conclusion usually overlooked basic differences in mean water temperature, sediment type, water depth, and salinity, what has been regarded as the ecological horizon (Salazar-Vallejo, Carrera-Parra, González, & Salazar-González, 2014). Foremost among these scientists are Olga Hartman and Pierre Fauvel and despite their efforts, they did not always include the study of type material for their nomenclatural acts, such that their conclusions were mostly based upon publications. This was a difficult task because descriptions and illustrations, if any available together with the descriptions, were not standardized until recently, and at the same time, diagnostic features have been continually refined. The result of these comparisons of very heterogeneous precedent works is that there are many taxonomic problems in polychaete species names, and current taxonomists must devote some time for solving earlier confusion, or inadequate taxonomic procedures because this is a very relevant activity.

Our objective with this contribution was to analyse what is the situation for *Nereis falsa*

de Quatrefages, 1866. For this, we have made a careful study of previous publications and with our understanding of the systematics of nereidid polychaetes, we hope to clarify the current situation, to propose some means for promoting discussion and actions, and suggested some basic research for solving the issue.

For this purpose, all relevant publications were collected and the corresponding sections for *N. falsa* were translated and, whenever relevant, were fully quoted in order to show earlier ideas or conclusions. Documents available in our personal libraries or downloadable from Biodiversity Heritage Library, Internet Archive, and la Fédération Française des Sociétés de Sciences Naturelles were carefully studied.

Historical account

As a part of the Fauna Ibérica series, Núñez (2004) made an examination of the genus *Nereis* Linnaeus, 1758 in the Mediterranean region. He listed *N. pulsatoria* (Savigny, 1822) and *N. splendida* Grube, 1840, but *N. falsa* de Quatrefages, 1866 was not recognized. Characters for *N. pulsatoria* include antennae about as long as the palps, a smooth anterior peristomial margin which is not projected, and homogomph falcigers with short, slightly denticulated blades. Additionally, area VI has 4-10 paragnaths in two transverse series, and areas VII-VIII have paragnaths in 3-4 series. In *N. splendida* antennae are shorter than palps, peristomial anterior mid-dorsal margin projects anteriorly, pharyngeal area VI has 3 paragnaths in an inverted triangle **or** 4(-5) paragnaths in a rhombus, areas VII-VIII have paragnaths in several series, and the homogomph falcigers have long, markedly denticulated blades. This variation has been indicated before by Amoureux (1976: 340), although he was referring to *N. falsa*, and Gravina, Lezzi, Bonifazi, and Giangrande (2015: 159) illustrated the morph having 3 paragnaths in area VI for *N. falsa*.

It is interesting that for *N. splendida* two patterns are recognized for area VI despite the fact there is usually a very low variation in paragnath number in this area (González-Escalante & Salazar-Vallejo, 2003; Conde-Vela & Salazar-Vallejo, 2015). Further, Alós et al. (2004) listed the junior synonyms of *N. pulsatoria* as *N. zonata* Malmgren, 1867 described from Spitsbergen and *N. cylindrata* Ehlers, 1868 from the Adriatic Sea, whereas for *N. splendida* they included *N. falsa* de Quatrefages, 1866 originally described from the Black Sea and *N. parallelogramma* Claparède, 1868 from the Mediterranean Sea. How did we arrive to this point?

Rathke (1837) made a large report on the fauna of Crimea and its shores on the Black Sea, including mammals, amphibians, reptiles, fishes (8 new species), crustaceans (15 n. spp), worms (4 n. spp), and cnidarians (1 n. sp). In the section devoted to worms, Rathke (1837: 412-415, Pl. 7, Fig. 1, Fig. 4-8) made a thorough description of some of his nereidids from Balaklava Bay (44°30' N, 33°36' E) as *N. pulsatoria?* This was because he noted some differences from the description of *N. pulsatoria* (Savigny, 1822) such as body and eye pigmentation, and the size of the upper parapodial lobes, with dorsal cirri clearly longer than upper notopodial lobes in median and posterior chaetigers. However, the arrangement of paragnaths or fine details of the chaetal blades were not clarified or illustrated. Rathke compared his specimens with *N. pulsatoria* (Savigny, 1822: 33), and not after *Lycoris pulsatoria* Savigny *in* Lamarck (1818: 313) as listed in WoRMS (2016), because the latter is a *nomen nudum*.

For parapodial features, Savigny (1822: 33) indicated: "Cirres courts; le cirre supérieur n'atteint pas même le sommet de la branchie." [Transl.: Cirri short; the dorsal one does not reach branchial (upper notopodial ligules) tips]. Rathke also had at hand the series by Audouin and Milne-Edwards (1832: Pl. 13, Figs. 8-13, 1833: 216-217), who provided a description and high quality illustrations for *N. pulsatoria*, now regarded as a junior synonym of *N. zonata* Malmgren, 1867 in WoRMS.

Grube (1840: 73-74) studied Rathke's material and added some features to the earlier

description, especially regarding the chaetal blades and paragnath arrangement on the pharynx, but made no further comment about its identity. For chaetal blades, Grube (1840: 73) indicated: "diesen die Anhängsel der langen Borsten gesägt erschienen, indessen treten die Zähnehen erst bei einer bedeutenderen Vergrösserung hervor." [Transl.: the blades of the long chaetae are denticulate, but their number is only evident with a more powerful enlargement]. The paragnath pattern details are very difficult to understand, indeed. In the same contribution he described *N. cultrifera* (now in *Perinereis*), *N. imbecillis* (*incertae sedis fide* Fauvel, 1923: 362), and *N. splendida*. For the latter Grube (1840: 75-76) stated that the body was golden with dorsal transverse lines on each segment, the antennae were smaller than the palpophore, the longest tentacular cirri reach segment 3, and some chaetae had an additional tooth. Grube also indicated the pharyngeal paragnath patterns resembled those present in *N. pulsatoria* but the pharynx was not everted. This latter feature led Fauvel (1916: 81) to consider *N. splendida* as indeterminable.

de Quatrefages (1866: 505) proposed *N. falsa* for what Rathke had regarded as *N. pulsatoria?* However, it must be emphasized that he made no formal description or illustration for *N. falsa*, nor had he any specimens. Consequently, based upon Rathke's description and illustration, and in comparison with Savigny or Audouin and Milne-Edwards, de Quatrefages indicated that: "La tête est plus courte; les antennes latérales plus grosses …; les tentacules sont plus longs; l'anneau buccal égale en longuer les deux suivants … Aux pieds, les sois sont plus nombreuses et les languettes à peu près égales" [Transl.: The head is shorter; the antennae thicker …; the tentacular cirri longer; the peristomium as long as the following two segments … In parapodia, chaetae are more abundant and lobes almost equal (to each other)]. No type material exists because Rathke's collection was not preserved in the Kantiana University in Tartu (*olim* Dorpat), Estonia.

Some accounts include *Nereis clava* Leach *in* de Blainville, 1825 (p. 439), despite the fact that Hartman (1959: 256) regarded it as a nephtyid or indeterminable. It must be rejected from this discussion because de Blainville (1825: 439-440) compared it to what we now regard as *Nephtys ciliata* (Müller, 1778), Audouin and Milne-Edwards (1833: 257) regarded it as a junior synonym of *N. hombergi* Savigny *in* Lamarck, 1818, and de Quatrefages (1866: 434) confirmed its similarities with Nephtyidae.

Claparède (1868: 477, Pl. 9, Fig. 7, 10, Fig. 2) described *N.* (*Nereilepas*) *parallelogramma* by emphasizing that his species was "évidemment distincte de la *N. pulsatoria* Mont. (Sav.) avec laquelle M. Grube l'a confondue. La seule proportion des cirres suffirat déjà à la différencier, car ils dépassent notablement la languette supérieure chez notre espèce, tandis qu'ils sont plus courts qu'elle chez la *N. pulsatoria*" [Transl.: evidently distinct from *N. pulsatoria* Mont. (Sav.) with which it was confused by Mr. Grube. The cirri proportion will be enough to differentiate them, because they markedly surpass the dorsal lobe in our species, whereas they are shorter in *N. pulsatoria*]. In the following page, Claparède (1868: 478) referred to the paragnath pattern in the pharynx and explained the etymology: "L'article basilaire de la trompe est renflé sur le dos en deux éminences portant quelques paragnathes plus gros que ceux des autres groups. Ils sont en général au nombre de quatre, disposes en parallélogramme" [Transl. The basal pharynx ring is bulged dorsally into two projections larger than those present in other groups. They are generally four in number, arranged in a parallelogram].

Synonymy: Advances and Retreats

Grube (1873: 70, p. 15 in preprint) included many known nereidid species into several genera and groups and concluded that *Nereis*: "*parallelogramma* Clap., welche mit der von mir beschriebenen *N. splendida* zusammenfällt" [Transl.: *parallelogramma* Clap., coincides with the *N. splendida* described by me].

Von Marenzeller (1874: 466-470, Pl. 7, Fig. 3) first recorded *Hediste diversicolor* Müller, 1776 for the Mediterranean Sea with specimens from Muggia Bay, Gulf of Trieste, which had been found living in fresh water. He made an extensive description and in the footnotes (p. 469) he confirmed the previous synonymy by Grube, and concluded: "*N. falsa* Quatrefages, eine *N. pulsatoria* Audouin & Milne-Edwards, ja selbst eine *N. diversicolor* gewesen sein." [Transl.: *N. falsa* Quatrefages, a *N. pulsatoria* Audouin and Milne-Edwards, can be the same as *N. diversicolor*].

Bobretzky (1881: 192-193) indicated that by (Transl.) "recognizing that *Lycoris pulsatoria* Rathke is categorically different from a nereidid described under this name either by Savigny (1822: 33) or by Audouin and Milne-Edwards (t. XXVII, 1832: pl. XIII, fig. 8-13 and t. XXIX, 1833: 216), Quatrefages (1866) established for Black Sea specimens a distinct species, *N. falsa*. Marenzeller (1874) recently supposed *N. falsa* to be the same as *N. parallelogramma* Clprd., which Claparède (1868: 477 and 1870: 84) recognized as the same species as that identified by Grube (1840: 73), in comparison with the authentic specimens of Rathke, identified as *Nereis pulsatoria*. On this basis Marenzeller proposed to forget the name provided by Claparède to the above mentioned species and to replace it by the older one, *N. falsa*." Further, Bobretzky (1881), after a thorough study of *L. pulsatoria?* Rathke, synonymyzed it with *Hediste diversicolor*. This conclusion was followed by Hartman (1959: 259) as she regarded *N. falsa* as a junior synonym of *H. diversicolor*.

Fauvel (1923: 335-336), apparently overlooked Bobretzky (1881), and keyed-out *N. falsa* as closely allied to *N. pelagica* Linnaeus, 1758. He distinguished these two species by their chaetal blades: short, blunt, rather smooth in *N. pelagica*, while they are long, denticulate, with a distal tooth fused to blade's tip in *N. falsa*. Fauvel (1923: 337), then listed, under *N. falsa* his early ideas (Fauvel 1913: 63, 1916: 81) about junior synonyms: *N. splendida* Grube, 1840 (indeterminable), *N. parallelogramma* Claparède, 1868, *N. pervisceralis* Claparède, 1868, *N. lucipeta* Ehlers, 1908, and *N. splendida sensu* Ehlers, 1913. These species deserve some comments.

For *N. splendida,* Fauvel (1916: 83) noted that Grube (1873: 70, p. 15 in preprint) had regarded his species as a synonym of *N. parallelogramma,* and that "Il est fort possible qu'il s'agisse de la même espèce, mais la description de Grube, sans figures, bien qu'assez détaillée, ne precise pas suffisamment certains points pour que cette identité puisse être reconnue d'une façon indubitable." [Transl.: It is highly likely that it is the same species, but Grube's description, without figures, and despite its many details, does not sufficiently specify several points for regarding this identity without any doubt]. Actually, Grube (1873: 70) grouped *N. diversicolor*, *N. pelagica*, *N. parallelogramma* and his *N. splendida* due to the paragnath patterns of their pharynx: area VI with 4(-5) paragnaths in a group, and he indicated that his species was coincident with *N. parallelogramma*. This conclusion has been indicated by Claparède (1868: 478) but he referred to what Grube indicated for *N. pulsatoria*, not for *N. splendida*. Claparède did not deposit any of his specimens because he wanted other naturalists to study living organisms rather than preserved ones.

Including *N. pervisceralis* in the list of synonyms was incorrect, despite the small size of the specimens (1 cm), because Claparède (1868: 471, Pl. 12, Fig. 1) stated that its pharynx has a single series of paragnaths in areas VII-VIII, whereas *N. parallelogramma* has 2(-3) transverse series in areas VII-VIII, although they were not illustrated. There is often a great deal of size-dependent variation but this refers to the number of paragnaths per series, not to the number of series.

Ehlers (1908: 69, Pl. 8, Figs. 7-13) described *N. lucipeta* based upon some atokous and epitokous specimens collected in Southern Angola. It is very similar to Mediterranean epitokous specimens illustrated by Fauvel (1916, Pl. 5, Figs. 4-7), but there are some subtle differences in parapodial features in anterior chaetigers,

especially in the dorsal cirri. In Mediterranean specimens the dorsal cirri in chaetiger 7 are swollen along 2/3 of its length and it is twice longer than wide, whereas in *N. lucipeta* it is swollen along ¾ of its length and it is three times longer than wide. Further, in subsequent segments the dorsal cirri are barely longer than the upper notopodial ligules, whereas in *N. lucipeta* they are twice longer. Consequently, *N. lucipeta* must be regarded as a distinct species. The syntype series of *N. lucipeta* is in Berlin (ZMB 4440). A later record by Ehlers (1913: 496) as *N. splendida* from Simonstown, South Africa, must correspond to the atokous form of *N. lucipeta* and as such, could be the one characterized and illustrated by Day for South Africa (1962: 639, 1967: 317, Fig. 14.7k-o). This specimen might also be in Berlin, but it was not listed by Hartwich (1993) since it was not a species newly described by Ehlers. It is interesting to note that Ramsey (1914: 212) with some South African specimens, regarded *N. lucipeta* as a junior synonym of *N. pelagica,* and that Augener (1918: 184) listed *N. lucipeta* as a junior synonym of *N. callaoana* (Grube, 1857) and recorded this Eastern Pacific species from Togo and Namibia. These specimens must be studied to clarify this supposed affinity.

In fact, Day (1962: 639) followed Hartman (1959: 271) by pointing out another important issue: *N. splendida* Grube, 1840 is a junior homonym of *N. splendida* de Blainville, 1825. Audouin and Milne-Edwards (1833: 257) indicated that de Blainville introduced the name for *N. clava* (see above), and that it is a junior synonym of *N. hombergi*. Anyway, *N. splendida* Grube, 1840 must be replaced (ICZN, 1999: Ch. 12, Art. 60), as has been recently indicated by Gravina et al. (2015: 162).

Distribution

As indicated above, *N. falsa* was based upon *Nereis pulsatoria?* Rathke, 1837 from the Black Sea, and it is currently regarded as having a very wide distribution. This species has been frequently recorded from the Mediterranean Sea: in the harbour of Monaco (Fauvel, 1913) and included in the Fauna of France (Fauvel, 1923), in Alexandria, Egypt (Fauvel, 1937), in the Corsica Channel (Aliani & Meloni, 1999), in the Algeciras Bay (Sánchez-Moyano, García-Adiego, Estacio, & García-Gómez, 2001), in the National Park of Circeo in Italia (Andrea & Giancarlo, 2003), in the Bay of Izmir (Çinar et al., 2008), in Greece (Faulwetter, 2010), and in the region of Ceuta, Strait of Gibraltar (Guerra-García, Gonzáles-Vila, & García-Gómez, 2003). Several other records have been made for Western Africa: Morocco (Fauvel, 1936; Gillet, 1986, 1988), Western Sahara (Rullier & Amoureux, 1969), Mauritania (Gillet, 1990), Senegal (Fauvel, 1950; Sourie, 1954; Fauvel & Rullier, 1957, 1959) and Guinea (Amoureux, 1973).

According to WoRMS (2016), *N. falsa* has also been recorded for the Gulf of Mexico (Taylor, 1984; Salazar-Vallejo & Jiménez-Cueto, 1997; Felder & Camp, 2009), Caribbean Sea (de León-González, Solís-Weiss, & Ochoa-Rivera, 1999; Miloslavich et al., 2010) and Brazil (Amaral, Nallin, Steiner, Forroni, & Filho, 2013). The same species has been recorded for the Indian Ocean in Madagascar (Fauvel, 1919), and from Durban Bay, South Africa (Day & Morgans, 1956; Day, 1962, 1967). It is remarkable that despite the fact *N. falsa* was proposed for a species from the Black Sea, it has not been recorded there (Surugiu, 2005; Şahin & Çinar, 2012).

Biology and ecology

The reproduction and oogenesis of *N. falsa* were studied by Daas, Younsi, Daas-Maamcha, and Scaps (2010) and Daas, Younsi, Daas-Maamcha, Gillet, and Scaps (2011). In Algeria, sexual reproduction does not include epitoky, and spawning occurred in August/September. The lack of epitoky contradicts what was regarded as typical by Fauvel (1923), and provides additional indications that more than a single species is present in the Mediterranean.

There are a few data concerning their abundance in Algeria: mean density was 11.27 ind.m^{-2} with a minimum of 7.83 ind.m^{-2}

and a maximum of 14.50 ind.m^{-2} (Daas et al., 2011). Regarding their living substrate, *N. falsa* was found on chains by Fauvel (1913), rocks (Fauvel, 1937; Gillet, 1986, 1988), and hard substrates with red algae (Daas et al., 2010, 2011) but also found on soft substrates such as mud (Fauvel, 1937) and sand (Rullier & Amoureux, 1969). This species also lives on floating debris (Aliani & Molcard, 2003), and algae (Thiel & Guttov, 2005) or as an epibiont on the carapace of loggerhead turtles (Pfaller, Bjorndal, Reich, Williams, & Frick, 2006) and in mussel beds (Çinar et al., 2008). These latter findings could explain a large distribution and if all records really belong to the same biological species, there would be a low genetic variability.

Means for solution?

Despite the fact that *N. splendida* might have priority over *N. falsa*, because the former was not well defined, the type specimen originally deposited in Berlin is lost (Hartwich, 1993: 139), and there are no other specimens in Wroclaw (Wiktor, 1980), we must follow Fauvel and regard it as indeterminable. A recent proposal for reinstating *N. splendida* by Núñez (2004: 375) and Alós et al. (2004: 513), probably by strict priority, should not be followed due to the lack of type material, the incomplete original description, and because it is a junior homonym.

Nevertheless, as indicated by the above analysis, there are three distributional alternatives: 1) *N. falsa* is an euryhaline species that can be present in the Black Sea and other Mediterranean localities and elsewhere; 2) *N. falsa* is restricted to the Black Sea, its type locality, and it could be regarded as resembling *H. diversicolor*; or 3) Two species are involved under the same name with two combinations: 3a) None live in the Black Sea and the two are common in the Mediterranean and adjacent NE Atlantic; and 3b) Non NE-Atlantic records belong to other, perhaps undescribed, species.

The first two alternatives, involving *N. falsa* living in the Black Sea, must be rejected. As indicated above, recent studies on Black Sea polychaetes have failed to confirm the presence of *N. falsa* for the type locality, and despite ecological changes since its original description, a local extinction is unlikely. Further, at least von Marenzeller (1874) and Bobretzky (1881) regarded *N. falsa* as a junior synonym of *H. diversicolor* which would somehow support the second alternative. However, two different species currently regarded as *H. diversicolor* were recognized in the Baltic Sea (Audzijonyte, Ovcarenko, Bastrop, & Väinölä, 2008), and three different clades that can be regarded as different species were found in European seas, with a distinct form present in the Black Sea (Virgilio, Fauvelot Constantini, Abbiati, & Backeljau, 2009).

For the third option, and its combinations, it must be reminded that two paragnath patterns in area VI are included under *N. splendida* - one with 4-5 paragnaths in a diamond, and one with 3 paragnaths in an inverted triangle. The next question would be, because the species name *N. splendida* must be rejected, how should we call the species living outside the Black Sea, and apparently present throughout at least the Mediterranean Sea? Take *N. parallelogramma*, which despite the fact no type was deposited, it was described and illustrated in full detail and deserves to be reinstated.

A further issue is what should we call other species resembling *N. falsa* from other localities? Not an easy answer, either. Regional records should be addressed in each ocean basin and by clarifying the status of type materials and track the sequence of proposed names for each region.

Finally, we concluded that, since our study was based upon publications, not on specimens, we considered that there are four desirable future steps to fully solve the *N. falsa* problem, and all must be based on the study of topotype or type specimens:

1. Delineate *H. diversicolor* in the Baltic Sea after which other similar Mediterranean species can be delineated and described.

2. Find a Neapolitan specimen, or series of specimens, to clarify the variation in area VI (3 vs 4 paragnaths), and then proceed to redescribe them as *N. parallelogramma* Claparède, 1868 (area VI with 4 paragnaths), and propose a neotype.

3. Find out other specimens from the Black Sea, Sevastopol or nearby areas, and in Trieste or Naples for what was regarded by Grube as *N. splendida,* because its type locality was not indicated. If they consistently have area VI with 3 paragnaths, redescribe it as *N. falsa* and propose a neotype, because *N. splendida* is unavailable.

4. Other non-Mediterranean records of *N. falsa* deserve a similar approach; some regional species names must be reinstated, as *N. lucipeta* for South Africa, after making a redescription and probably including the proposal for a lectotype, or if different, then full descriptions will be needed for several specimens now included as records for *N. falsa*.

These steps will be relevant to avoid any future confusion and will certainly depend on collective efforts by several interested scientists. Hope this note will encourage our colleagues to move towards this direction.

ACKNOWLEDGMENTS

Biodiversity Heritage Library, Internet Archive, and la Fédération Française des Sociétés de Sciences Naturelles made available many difficult to find documents. Julia Dunaeva, from the Library of the Zoological Institute and Museum, Russian Academy of Sciences, Saint-Petersburg, provided a fine scan of Rathke's plates, and Tulio Villalobos one of Ehlers' plates. The careful reading and recommendations of an anonymous referee and of Daisy Cristina Arroyo Mora helped to improve this contribution.

RESUMEN

¿Qué tan falsa es *Nereis falsa* (Annelida, Phyllodocida, Nereididae)? Entre los nombres de especies de poliquetos hay muchos problemas taxonómicos y resolver los procedimientos taxonómicos confusos o inadecuados consume mucho tiempo y es muy importante. Nuestro objetivo en esta contribución es analizar cuál es la situación para *Nereis falsa* de Quatrefages, 1866; fue basada en *Nereis pulsatoria?* Rathke, 1837 del Mar Negro, y se considera como una especie de amplia distribución. La especie se ha recolectado en diferentes sustratos bénticos e incluso puede hallarse en objetos flotantes o sobre tortugas marinas. *Nereis falsa* se ha registrado del Mar Mediterráneo, en el Atlántico oriental a lo largo del África, en el Atlántico occidental (Golfo de México, Mar Caribe, Brasil), y en el Índico. Sin embargo, a pesar de haber sido propuesta para una especie del Mar Negro no se ha vuelto a encontrar en el mismo. ¿Cómo conjugar que una especie pueda alcanzar una vasta distribución y faltar en su localidad tipo? Después de un estudio cuidadoso de las publicaciones sobre el tema y con nuestra comprensión de la sistemática de los poliquetos neréididos, clarificamos la situación prevalente al examinar varias especies relacionadas e indicamos algunas cuestiones nomenclaturales. Nuestro análisis indica que hay más de una especie bajo el mismo nombre y en esta contribución, nos enfocamos al problema, proponemos algunas formas para promover la discusión y la acción, y sugerimos algunas actividades de investigación para resolver el problema.

Palabras clave: taxonomía, especies cosmopolitas, especies exóticas, áreas faríngeas, localidades tipo.

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