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Nomenclatural revision of the squaliform taxa introduced by Daimeries (1888).

Jürgen Pollerspöck[1*], Nicolas Straube[2] & Thomas Reinecke[3]

1 Bavarian State Collection of Zoology, Münchhausenstr. 21, 81247 Munich, Germany
2 University Museum of Bergen, Department of Natural History, Realfagbygget Allégt. 41, 5007 Bergen, Norway
3 Independent researcher. Auf dem Aspei 33, 44801 Bochum, Germany
* juergen.pollerspoeck@shark-references.com

Abstract

In this study, we revise one genus-name and six species-names introduced by Daimeries in 1888 for fossil teeth of extinct squaliform sharks. Our revision shows that the names *Biforisodus major* and *Biforisodus minor* do not meet the required criteria for availability according to the International Code of Zoological Nomenclature (ICZN). For this reason, these names are considered nomina nuda, as there are no sufficient descriptions or illustrations available. *Acanthias crepini* Daimeries, 1888 did not meet the requirements of the Code and is therefore not available and should be discarded. In contrast, *Acanthias depauwi and Acanthias munsteri* are available based on a sufficient reference to earlier illustrations or a description. Furthermore, species authorship of *Squalus minor* is transferred to Leriche (1902). Our study highlights the importance of strict adherence to nomenclatural rules in paleontological research and clarifies the nomenclatural status of several nominal taxa. Our results underline the need for a continuous review of the taxonomic literature to ensure the correct usage of taxon-names when referring to the fossil record of sharks.

Introduction

In the middle of the 19th century, the monumental five-volume work by Jean Louis Rodolphe Agassiz (1833-1843) marked the beginning of the fundamental research and description of fossil fish species. The quality of the descriptions is no longer comparable to that of today's descriptions, but some taxa described by Agassiz in his work '*Recherches sur les poissons fossiles*', which was published in numerous installments between 1833 and 1843, are regarded available today. In the following years, the number of species descriptions increased in subsequent publications, for example, in Bassani (1877, 1878, 1886), Probst (1877, 1878, 1879, 1882), Jaekel (1889, 1890a, 1890b, 1894, 1898), Winkler (1873, 1874a, 1874b, 1875) and Daimeries (1888a, 1888b, 1888c). The abundance of newly introduced names, which do not fulfill the criteria of availability of the International Code of Zoological Nomenclature (ICZN, 1999, henceforth "the Code"), led to uncertainties about the availability of individual genus-names and species-names as well as doubts regarding their authorships (e.g., Brignon 2015, 2021, Pollerspöck & Shimada 2024).
Especially the large number of fossil shark teeth led to numerous species descriptions. The squaliform sharks described by Daimeries (1888c) in particular exemplify such a taxonomically insecure and confusing situation. Therefore, the aim of this study is the revision of the availability of names proposed by Daimeries (1888a-c) for squaliform taxa.

Historical overview

In 1888a Daimeries presented first results of an excursion to the Paleocene marine sediments (Orp Sand Member, Heers Formation, Selandian), near the village of Maret, municipality of Orp-le-Grand (Belgium). He reported on a large number of excavated fossil specimens, such as teeth, vertebrae and coprolites. He listed under running numbers 2 and 3 of his species list two newly introduced taxon names "2. *Biforisodus*

major, Nobis (*Notidanus orpiensis*, part. Wink.)" and "3. *Biforisodus minor*, Nobis (*Notidanus orpiensis*, part. Wink.)". The additions in brackets (*Notidanus orpiensis*, part. Wink.) refer to the species *Notidanus orpiensis* first described by Winkler (1874a). Winkler's type material came from the same locality, Orp-le-Grand, and he named this new species after this locality. Winkler, who described morphological features of this species in detail and illustrated a total of 5 specimens (figs. 13-17) (fig. 1), assigned all figured teeth to the species *Notidanus orpiensis*. Daimeries (1888a), on the other hand, came to the conclusion that there should exist two different species. He documented this with the two different species names (*B*. *minor* and *B. major*) of the newly established genus *Biforisodus*. In this publication, however, he neither referred to Winkler's specific illustrations when naming the two species, nor did he illustrate any specimens he excavated, nor did he describe the material he had found in this publication.
Daimeries has seemingly introduced different names for some identical species. To date, the Code has not been applied to determine which of Daimeries' species names have priority and to verify if authorship can be attributed to Daimeries in all cases.

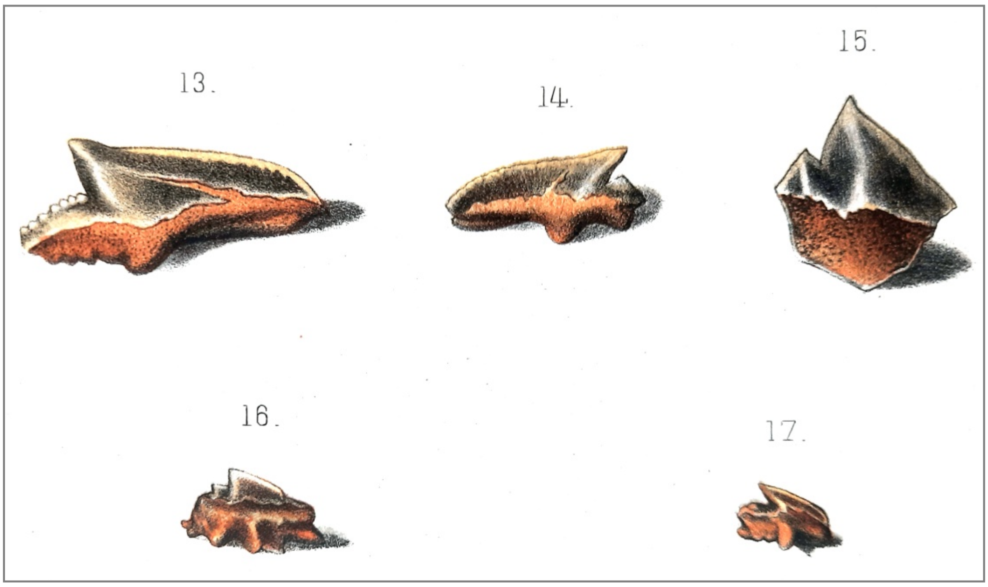

fig. 1.

Original illustration of *Notidanus orpiensis* (figs. 13-17) from Winkler (1874a).

Nomenclatural assessment of the genus and species names introduced in Winkler (1874a, *Notidanus orpiensis*) and Daimeries (1888a, *Biforisodus major* and *Biforisodus minor*)

Article 12 (Requirements) of the Code (ICZN 1999) defines the general conditions for names published before 1931. The following conditions must be fulfilled:

a) To be available, every new name must satisfy the provisions of Article 11 (ICZN 1999)
b) and must be accompanied by a description or a definition of the taxon that it denotes, or by an indication (Art. 12.1) (ICZN 1999).
c) The name or nomenclatural act must have been published, in the meaning of Article 8, after 1757 (Art. 11.1 Publication) (ICZN 1999)
d) The formal conditions according to Art. 11.2 (Mandatory use of Latin alphabet), 11.3 (Derivation), 11.4 (Consistent application of binominal nomenclature), 11.5 (Names to be used as valid when proposed), 11.8 (Genus-group names), 11.9 (Species-group names) must be fulfilled (ICZN 1999).

The name *Notidanus orpiensis* introduced by Winkler (1874a) fulfills all these requirements, as it has been published in an admissible paper, the species characteristics have been described in detail, a type series has been illustrated and the formal conditions of Art. 11.2-11.9 of the Code have been met. The illustrated specimens thus become syntypes (Art. 73.2) (ICZN 1999).
However, the names *Biforisodus major* and *Biforisodus minor*, introduced by Daimeries (1888a), do not meet all the necessary criteria to be considered available. While the publication satisfies the conditions outlined in Article 8 of the Code, it lacks a description of the new species as required by Article 12.1 (ICZN 1999). According to Article 12.1, either a description or a bibliographic reference to a previously published description or illustration to which the proposal of a new name is associated with (or a bibliographic reference to such illustration) must be provided. This is not the case here. Daimeries (1888a) neither described the species-specific characteristics, nor illustrated new specimens, nor did he refer to any previously published illustrations of the two newly introduced species names.
For this reason, the two names introduced by Daimeries (1888a) (*Biforisodus minor* and *Biforisodus major*) are nomina nuda (see glossary ICZN 1999: nomen nudum (pl. nomina nuda): "*A Latin term referring to a*

name that, if published before 1931, fails to conform to Article 12; or, if published after 1930, fails to conform to Article 13. A nomen nudum is not an available name, and therefore the same name may be made available later for the same or a different concept; in such a case it would take authorship and date [Arts. 50, 21] from that act of establishment, not from any earlier publication as a nomen nudum.").

Nomenclatural assessment of the genus and species names introduced by Daimeries (1888b, *Biforisodus major* and *Biforisodus minor*)

In the second part of the series 'Notes ichthyologiques (Systèmes Landénien et Heersien)' published by Daimeries (1888b), he again listed both of the aforementioned new species-names within revised species lists. Here, too, he added neither a description nor illustrations, we therefore conclude that the taxon names are nomina nuda, just as in Daimeries (1888a).
This is not affected by the note at the end of the work, in which he states that he will summarise his observations on the newly described species in later publications (Daimeries 1888b p. 46: „*Au fur et à mesure de l'avancement de nos études sur les poissons fossiles belges, nous publierons une série de notes résumant les observations nouvelles que chacune des espèces aura fournies*"). These announced descriptions were never published by Daimeries in the following years.

Nomenclatural assessment of the species names introduced by Daimeries (1888c, *Acanthias depauwi*, *Acanthias hennequini*, *Acanthias crepini* and *Acanthias munsteri*)

Daimeries (1888c) described four squaliform species in the third part of his series (Notes ichthyologiques - III.), namely

a) *Acanthias depauwi*: based on an unknown number of specimens and a single tooth illustrated by Rutot (1876) under the name *Notidanus* sp. (pl. 1, fig. 3) from the Oligocene,
b) *Acanthias hennequini:* described in Daimeries (1888c) as referring to *Biforisodus minor* Daimeries (1888a, b) and Winkler (in part, 1874a, figs. 16 and 17),
c) *Acanthias crepini:* described in Daimeries (1888c) as referring to *Biforisodus major* Daimeries (1888a, b) and Winkler (in part, 1874a, figs. 13–15),
d) *Acanthias munsteri:* a single tooth excavated at the Senonian coastal deposits at Orp-Jauche, Wallonia, Belgium.

Regarding point a)

Daimeries (1888c) classified the tooth illustrated by Rutot (1876) under the name *Notidanus* sp. (fig. 2) in the genus *Acanthias* Risso, 1827 (objective synonym of *Squalus* Linnaeus, 1758). In his description, he briefly discussed the differences between *Acanthias depauwi*, *A. hennequini*, and *A. munsteri*.
The publication by Daimeries (1888c) fulfills the requirements of Arts. 8 and 11 of the Code (ICZN 1999). The note on the differences from *A. hennequini* and *A. munsteri,* in combination with the description is sufficient to make the name *Acanthias depauwi* available.
In the synonymy list for the species *Acanthias depauwi*, Daimeries (1888c) refers to the tooth illustrated by Rutot (1876, pl. 1, fig. 3a, b) and designated as *Notidanus* sp. This tooth thereby becomes a syntype of the new species, along with the other specimens mentioned by Daimeries (1888c). In this context, the reference in the synonymy to the work of Winkler (1874) and the mention of the species name *Notidanus orpiensis* is unclear. This is because he cites no figures and restricts the stratigraphic distribution of *Acanthias depauwi* to the Oligocene (Tongrian). However, the teeth described by Winkler (1874) were found in sediments assigned to the Orp Sand Member of the Heers Formation, which belongs to the much older Selandian stage of the Paleocene. This may be a misprint.

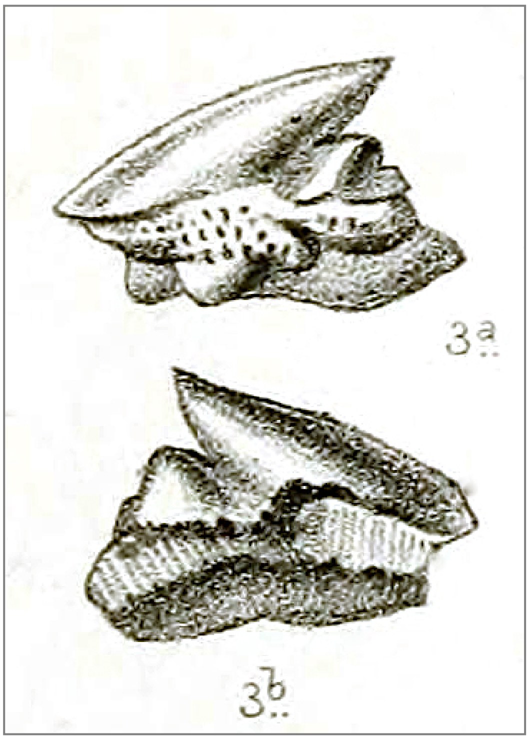

fig. 2 Original illustration of *Notidanus* sp. (pl. 1, fig. 3) from Rutot (1876).

Cappetta et al. (2016) commented on this species: "*A species of* Squalus*,* S. depauwi*, was described, but not illustrated and poorly defined by Daimeries (1888: p.102, as* Acanthias depauwi*) from the Rupelian of Belgium. Since at the moment only a single species of* Squalus *is known in the Rupelian, there is a high probability that the species of Daimeries is the same. In this case,* Squalus depauwi *is a senior synonym and would have priority on* S. alsaticus *described by Andreae in 1890. However, due to a widespread use of the Andreae's species and to avoid confusion, it seems us more reasonable to continue to retain the binomen* S. alsaticus *and not using* Squalus depauwi*.*"
The conclusion reached by Cappetta et al. (2016) that the original description of *Acanthias depauwi* was poorly defined and not illustrated is incorrect. The authors overlooked that Daimeries (1888c) explicitly referred to the illustration in Rutot (1876). Whether the species described by Daimeries (1888c) as *Acanthias depauwi* is identical to the species *Acanthias alsaticus* Andreae, 1890, as Cappetta et al. (2016) assumed, can only be assessed once the syntypes of *Acanthias depauwi* will have been found. Whether the syntypes still exist or have been lost could not be verified in the context of this study. Which of the two names then takes priority has to be decided on the basis of the rules of the Code (Art. 23).

<u>Regarding point b)</u>
In Daimeries (1888c), Daimeries introduced a new name (*Acanthias hennequini*) for the teeth he had previously referred to as *Biforisodus minor* (Daimeries, 1888a, b and Daimeries 1888c: synonymic list). He did not provide a reason or further explained why he discarded the genus and species name he had previously proposed. However, at the time of this work (Daimeries 1888c) he realised that similar teeth had already been described by a number of other authors („*Les auteurs qui ont décrit des poissons fossiles provenant des couches géologiques de notre pays et ceux qui en ont parlé ne citent aucune espèce de la famille des Spinacidae — ordre des Plagiostomes — sous-ordre des Selachiens. Cependant cette famille, dont Agassiz, Probst, Hasse, Noetling, etc., ont constaté la présence à l'étranger, depuis la craie jusqu'à l'époque actuelle, a eu en Belgique de nombreux représentants dans les mers sénonienne, maestrichtienne, heersienne, landenienne et tongrienne, qui ont successivement recouvert des parties de notre sol et dans les sédiments desquelles on retrouve leurs débris. Si nous consultons les figures données par MM. Winkler et Rutot, nous voyons que des dents du genre* Acanthias*, de la famille des Spinacidae, ont été décrites et figurées, mais indûment rapportées au genre* Notidanus *de la famille des Notidanae.*"

In his description of *Acanthias hennequini*, Daimeries (1888c) referred to the teeth illustrated by Winkler (1874a) under figures 16 and 17 and also mentioned that he acquired a dorsal finspine from Orp-le-Grand (Belgium) that approximately corresponds to the fin spines illustrated in Agassiz (1837) identified as *Spinax major* Agassiz, 1837 (Poissons fossiles, t. III, pl. 10b, fig. 8-14). Agassiz' material (1837) stems from the chalk deposits of Lewes (Sussex, southern England) and, according to Woodward (1889), is located in the British Museum (coll. No. 4041, 4080, 4084, 4085, 4103, collection M. Mantell) (fig. 3).

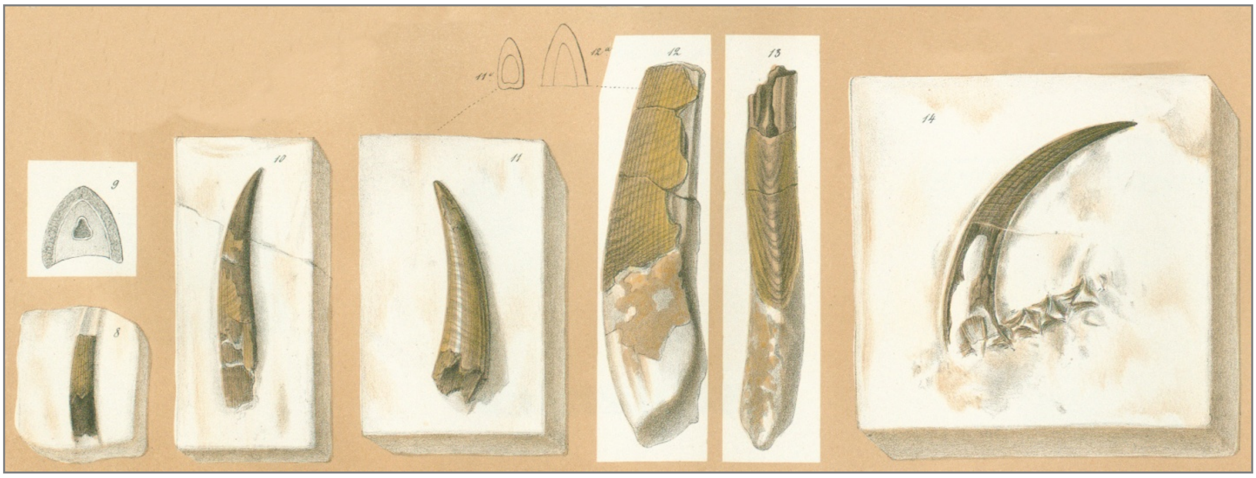

fig. 3. Original illustration of *Spinax major* (pl. 10b, figs. 8-14) from Agassiz (1837).

Therefore, the name *Acanthias hennequini* Daimeries 1888c fulfills the requirements of Art. 8 and 11 of the Code (ICZN 1999). The reference to the illustration in Winkler (1874a, figs. 16 and 17), supplemented by the notes on the similarities and differences to *A. depauwi*, *A. munsteri* and *A. crepini*, provides a sufficient description to make the name *A. hennequini* available. The two teeth illustrated by Winkler (1874a) and the specimens that Daimeries had at his disposal thus became syntypes of the species *Acanthias hennequini* Daimeries, 1888c.

Leriche (1902) revised the fauna described in Daimeries (1888a, b, c) and redescribed the species *Acanthias minor* Daimeries, 1888. Under the list of synonyms, Leriche (1902) listed the name *Biforisodus minor*, first introduced by Daimeries (1888a, b), with the note ("*nom seulement*" = just a name). Daimeries (1888a, b) also listed the name *Acanthias hennequini* and subsequently published it in Daimeries, 1888c. Leriche made no specific comments on the validity of this name. In the introduction to the systematic section, however, Leriche (1902) pointed out that Daimeries never provided detailed descriptions of the new species that he had published several times under different names lacking a suitable explanation („*Enfin, dans une série de notes, M. Daimeries (') a fait quelques additions aux listes des Poissons du Heersien et du Tuffeau de Lincent, et indiqué plusieui's formes nouvelles. Malheureusement, ces notes n'ont jamais été suivies du travail descriptif annoncé par l'auteur à différentes reprises*."). For this reason, we assume that Leriche (1902) interpreted the species-name *Acanthias hennequini* as unavailable and therefore chose the original species name "*A. minor*". However, as this species name as proposed by Daimeries (1888a, b) is to be regarded as a nomen nudum, and such species-names can be used again at any time, Leriche's (1902) name proposal is to be regarded as an independent nomenclatural act. As all other requirements are also met (Art. 8, 11 and 12 of the Code) (ICZN 1999), the species-name *A. minor* Leriche, 1902 is available. The series of types from Daimeries' collection illustrated by Leriche (1902) (pl. 1, figs. 9-16) are therefore syntypes (fig. 4).

As a result, the description by Leriche (1902) has defined a second name for the same type material. According to Art. 23 (Principle of Priority) of the Code (ICZN 1999), the oldest available name is recommended to be used as the valid name. In this case, that would be *Acanthias hennequini* Daimeries, 1888. However, this principle is restricted by Art. 23.9 (Reversal of precedence) of the Code (ICZN 1999). Accordingly, the younger synonym is to be used if the following conditions are cumulatively fulfilled:

a) the senior synonym or homonym has not been used as a valid name after 1899, and
b) the junior synonym or homonym has been used for a particular taxon, as its presumed valid name, in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of no less than 10 years. (ICZN 1999).

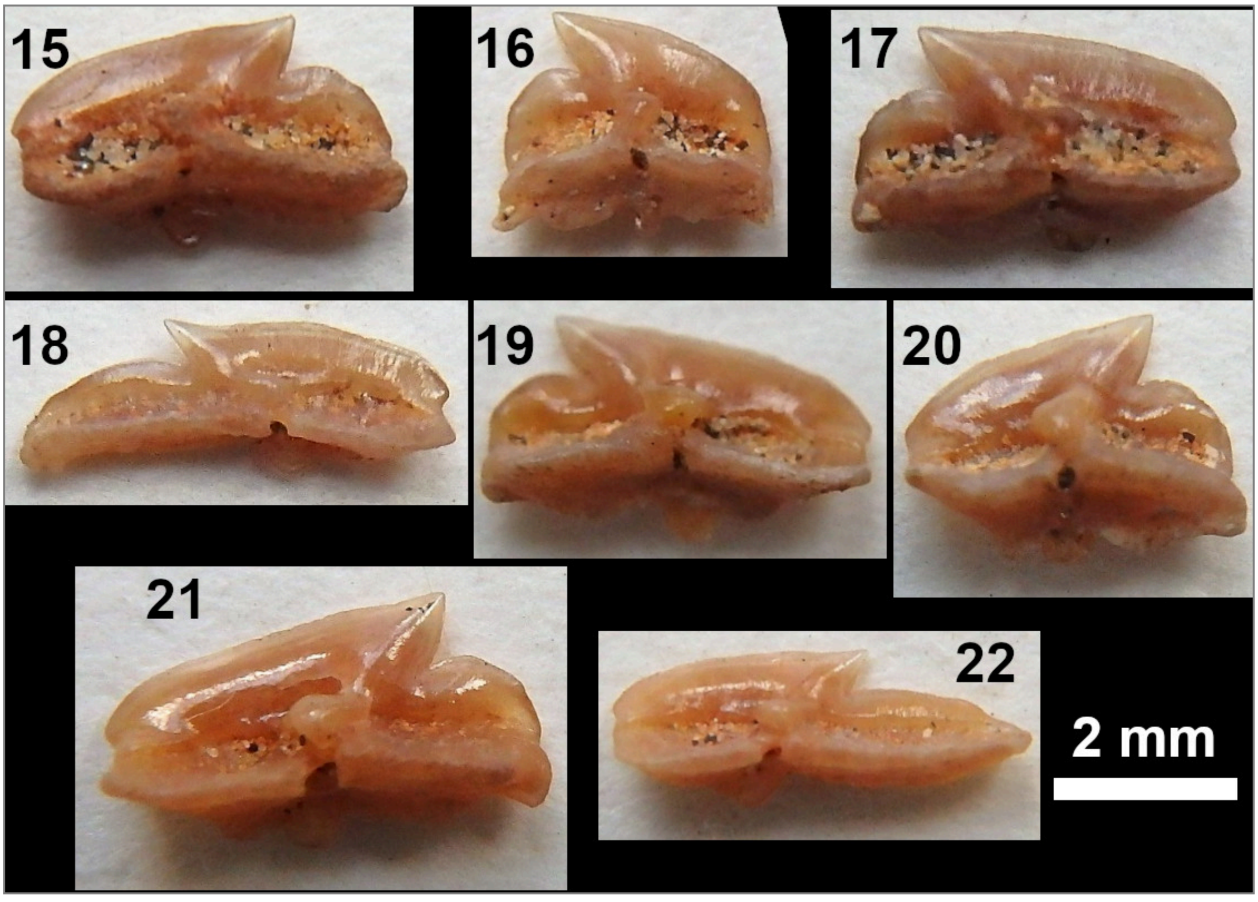

fig. 4. Syntypes of *Acanthias minor* from Leriche (1902), coll.no. IRSNB P 00015-00022, Institute of Natural Sciences, Brussels.

Regarding point c)

Daimeries (1888c) introduced the name *Acanthias crepini* for the teeth that he previously had named *Biforisodus major* (Daimeries, 1888a, b and Daimeries 1888c: synonymic list). Here, too, he referred to the teeth illustrated by Winkler (1874a, figs. 13, 14 and 15) and added a short description. In doing so, he disregarded the species name *A. orpiensis* introduced by Winkler (1874a), as he assigned new names to all the specimens illustrated by Winkler. This is not permissible. If it later turns out that an author has named and described two or more species under a single species name, the originally introduced name remains available (Art. 17.1 of the Code) (ICZN 1999). Consequently, Daimeries should only have introduced a single new name. The name *A. crepini* therefore does not fulfill the conditions of the Code and must be rejected (see glossary of the Code: "*rejected name: A name which, under the provisions of the Code, cannot be used as a valid name and which is set aside in favour of another name*".
Leriche (1902) was the first to recognise this and used the species-name *A. orpiensis* (Winkler, 1874a) as valid referring to the teeth illustrated by Winkler (1874a) (figs. 13-15).

Regarding point d)

Finally, Daimeries (1888c) introduced the new name *Acanthias munsteri* for a specimen collected at the chalk deposits of Folx-les-Caves (Orp-Jauche, Belgium). He neither added an illustration of this tooth nor did he describe the characteristics on which the new species is based upon. He just noted that it is a very small tooth and that it shows similarities with *Acanthias hennequini*, but is supposed to differ in the shape of the main cusp ("*Elle est fort petite, offre quelque ressemblance avec* A. Hennequini*, dont elle se différencie par la forme du cône principal, plus petit et plus droit*."). The name *A. munsteri* fulfils the requirements of Article 12.1 as it is accompanied by a description.

Conclusion:

As a result, it can be concluded that

- the names *Biforisodus major* and *Biforisodus minor* introduced by Daimeries (1888) are nomina nuda,
- *Acanthias depauwi* Daimeries, 1888 and *Acanthias munsteri* Daimeries, 1888 are available names,
- *Acanthias crepini* Daimeries, 1888 does not meet the requirements of the Code, is therefore not available and should be discarded, and
- *Acanthias minor* has priority over the species name *Acanthias hennequini* for reasons of stability (Art. 23.9.).

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Appendix 1

List of publications that use the species name *Squalus minor* as valid

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